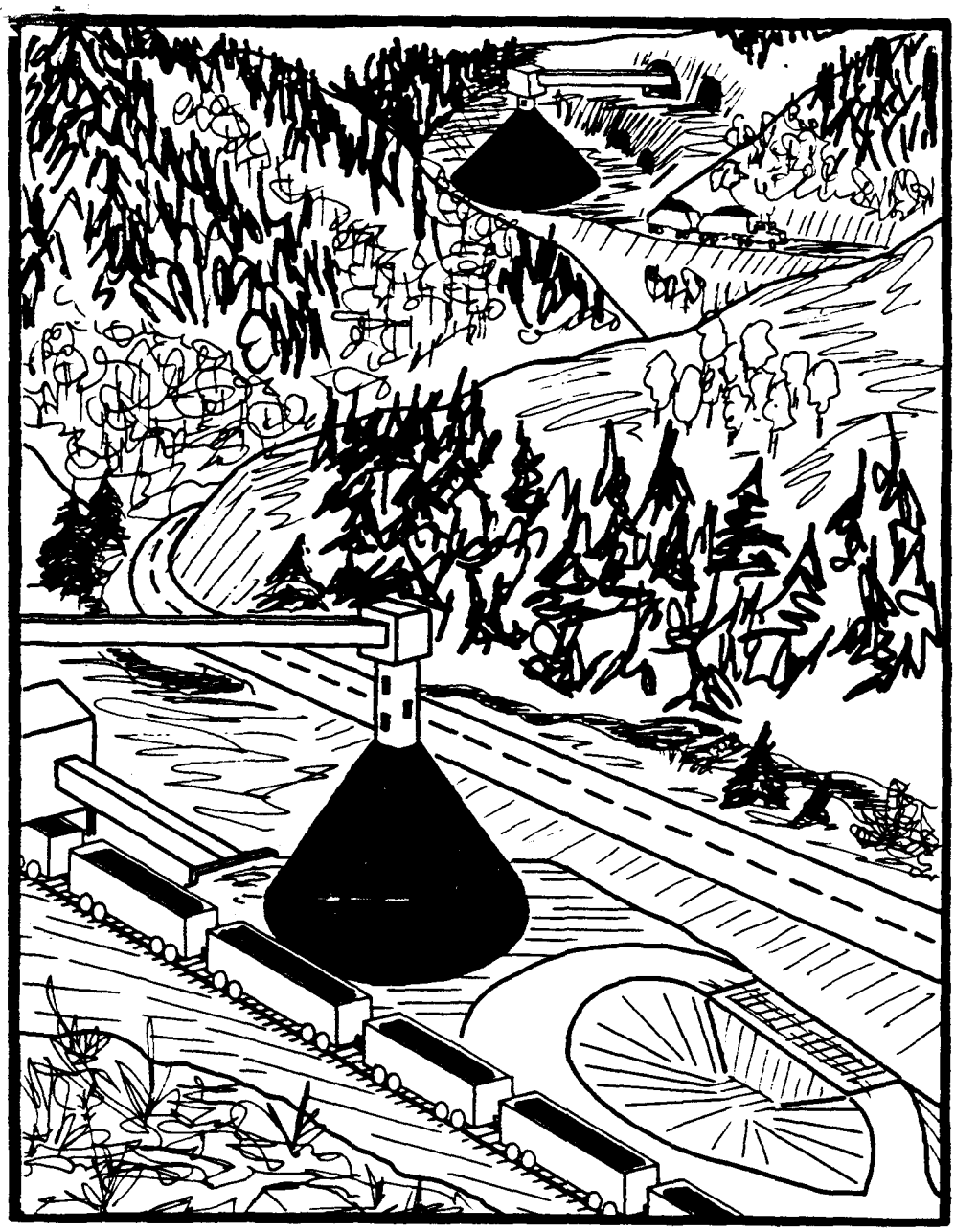

R614 RULES

5-YEAR MINE PERMIT RENEWAL APPLICATION

APPENDICES

VALLEY CAMP OF UTAH, INC.

SCOFIELD ROUTE, HELPER, UTAH 84526

United States
Department of
Agriculture

Soil
Conservation
Service

P. O. Box 11350
Salt Lake City, UT 84147

May 28, 1982

Valley Camp of Utah, Inc.
Scofield Route
Helper, UT 84526

Dear Sir:

In response to your request we have made an examination of the soil survey data available. On the basis of this information the soils in this area do not meet the requirements for prime farmland because no irrigation water is available and the growing season is too short.

Without irrigation water the moisture requirement for prime farmland cannot be met.

Sincerely,

Harold I. Brown, acting

GEORGE D. MCMILLAN
State Conservationist

The Soil Conservation Service
is an agency of the
Department of Agriculture

APPENDIX L

Geotechnical Investigation of Cut Slopes at the Belina Mine Complex and Haul Road Carbon County, Utah

Prepared for

Valley Camp of Utah, Inc.
Helper, Utah

Prepared by

Morrison-Knudsen Co., Inc.
Boise, Idaho

October, 1983

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1.0 INTRODUCTION

1.1 GENERAL: At the request of Valley Camp of Utah, Inc.(Valley Camp), a geotechnical investigation was initiated on September 13, 1983 at the Belina Mine located in Carbon County near Helper, Utah. The purpose of this investigation was to evaluate the stability of cut slopes in the mine facilities area and on the 1.4 mile long haul road leading to the mine from Eccles Canyon.

1.2 SCOPE OF WORK: The geotechnical investigation consisted of a drilling and sampling program, field reconnaissance and mapping, laboratory testing, and computer assisted slope stability analyses. This report presents the data obtained during the course of the investigation, as well as conclusions and recommendations formulated from that data base and other information furnished by Valley Camp.

2.0 FIELD INVESTIGATION

2.1 GENERAL: The field investigation was directed toward evaluating the stability of cut slopes steeper than 2 horizontal:1 vertical. At the mine facilities site, three major cut areas were investigated: the backslope above the upper coal stratum portals; the backslope above the office/changehouse; and, the cut slope near the coal loadout chute. Numerous cut slopes on the haul road were also examined and/or mapped which were steeper than 2H:1V.

2.2 BACKSLOPE DRILLING PROGRAM: Soil and rock samples were required to evaluate the stability of the backslope above the upper portals and the office/changehouse. To obtain these samples, four exploratory borings were drilled to depths ranging from 49 feet to 61 feet below existing grade at location shown on the Geotechnical Investigation Site Plan (Figure 1).

Drilling was performed using a CME-750 drill machine mounted on an all-terrain vehicle and equipped with 6.0 inch diameter continuous flight hollowstem auger and NX-size coring tools. Disturbed samples of soil and soft rock were obtained for laboratory testing and logging purposes using a Standard Penetration Test (SPT) sampler, which is driven into soil or soft rock by a 140 pound hammer with a free-fall of 18 inches. The number of blows required to drive the sampler one foot (known as the "N-Value") is a measure of the relative density of cohesionless soils and the consistency of cohesive materials. Relatively undisturbed soil and soft rock samples for laboratory testing were extracted using a 3-inch o.d. Dames and Moore sampler with inner-liner brass rings, which serve to protect the samples during shipment to the laboratory.

The hollowstem auger was used as casing for NX coring tools. A 10 foot long double tube core barrel with a split inner barrel and carbide or diamond bits was utilized to obtain rock samples for logging and laboratory testing. Water was used as a drilling medium. Excessive water loss into pervious rock strata was experienced at all boring locations. Additives such as bentonite, cellulose, nut shell and DE-7 polymer did not significantly reduce the water loss. Only in borings in the vicinity of a 12,000 gallon

water storage tank, automatically resupplied by pumped water, could sufficient quantities of siphoned water be obtained to allow continuous coring operations.

Soil and soft rock samples were immediately sealed in plastic bags, placed in airtight containers, and stored in special foam-padded aluminum boxes. Rock samples were placed in standard cardboard core boxes; samples selected for laboratory testing were wrapped in plastic, sealed, wrapped in paper, and stored in a padded box.

All borings were thoroughly backfilled with soil after groundwater readings were taken. In the spring, Valley Camp personnel should check the bore holes and refill them if necessary.

2.3 FILL PAD BORING: At the request of Valley Camp an exploratory boring was drilled on the existing earth fill pad to obtain soil samples for later testing, which will determine the suitability of the fill for reclamation purposes. Valley Camp provided burlap bags with plastic inner bags for sample collection at 2.5-foot intervals. Samples were identified for location and depth. It is our understanding that sample shipment and subsequent laboratory testing will be performed under the direction of Valley Camp. The location of this boring is shown in Figure 1. It was backfilled in the same manner as the four backslope borings.

2.4 BORING LOGS: Boring logs were prepared for the four backslope exploratory borings, and are included in the report as boring nos. 1 through 4 (Figures 2 through 5). The fill pad boring was logged and is contained herein as boring no. 5 (Figure 6). Locations and top ground elevations of the borings were determined by Valley Camp personnel and are referenced to Belina Mine survey data points.

The boring logs include: the depths and elevations of major changes in soil and rock stratigraphic units; classification and description of natural soils in accordance with the Unified Soil Classification System; locations of disturbed, undisturbed, and cored soil and(or) rock samples; core sample

data, including the percentage of total core recovered and the percentage of core greater than 4 inches in length (rock quality designation, RQD); pertinent drilling information; and, groundwater data.

2.5 COMPOSITE LOGS OF CUT SLOPES: Two cut slopes in the mine facilities area exposed subsurface stratigraphic rock units and the orientation of fractures within those rock units. These cut slopes were logged in the same manner as an exploratory boring would be logged. The depths were estimated and fracture orientations were inferred from the same stratigraphic unit at several locations in the cut slope.

The composite log for the cut slope behind the office/changehouse building is included in this report as "B-6" (Figure 7), and the log of the cut slope near the coal loadout chute is included as "B-7" (Figure 8).

2.6 DETAIL LINE MAPS: Two detail line maps or detailed mappings of fracture orientations along a measured straight line were made in the cut slope near the loadout chute. The purpose of this mapping was to determine the orientation of primary and secondary joint sets and the nature of any infillings. These detail line maps are shown in Figures 9 and 10. The locations mapped are identified on the Geotechnical Investigation Site Plan (Figure 1), as "D1" and "D2".

Fracture orientations were determined using a hand-held Brunton compass.

2.7 GENERAL RECONNAISSANCE OF MINE FACILITIES AREA: Cut slopes in the mine facilities area were visually examined for evidence of tension cracks related to past and(or) potential slope movements, erosion or ravelling problems, and abnormal vegetation growth above the cut slopes that may indicate slope creep. The results of this reconnaissance are included in site descriptions contained in Section 3.0 of this report, Geology and Site Conditions.

2.8 RECONNAISSANCE OF CUT SLOPES ON THE HAUL ROAD: Detailed descriptions of cut slopes on the haul road were prepared in the field. They are

presented in this report as Figures 11 through 13, which are organized as an odometer mileage log that begins at the beginning of the road in Eccles Canyon. Specific references to these cut slope descriptions are contained in other parts of this report.

Joint and other fracture orientations were measured by Brunton compass, and in most cases, the strikes and dips recorded are actually averages of readings taken on four or more different rock surfaces.

3.0 GEOLOGY AND SITE CONDITIONS

3.1 GEOLOGY OF THE AREA: It is not the purpose of this report to present detailed geologic data of the Belina Mine Complex. However, the following brief overview of the regional geology does provide data pertinent to the geotechnical investigation of the Belina Mine cut slopes.

The Belina Mine lies within the Wasatch Plateau Coal Field, in an area in which all of the coal mined lies within 400 feet of the base of the Blackhawk Formation of Upper Cretaceous geologic age. Other than several coal strata, the lithology is predominately composed of yellow and gray sandstones and siltstones with some interbedded shales.

Structurally the mine lies between two northward striking, vertical displacement faults, on the upthrown block of a horst-like geologic feature. The nearer of the two faults passes less than one-half mile to the west, which may have determined the gentle southwestward dip of stratigraphic rock units at and near the Belina Mine. According to Valley Camp personnel and the observations made for this investigation, the magnitude of the dip is about 4°. Undoubtedly, other less significant faulting has occurred that affects site-specific geology. The approximate location of a possible strike-slip fault passing through the area is indicated in Figure 1 of this report. Mining personnel have indicated that at least one fault with minor vertical displacement has been encountered underground.

Two coal strata are mined at Belina and outcrops of each stratum are located on the enclosed site plan (Figure 1). Separate sets of portals penetrate the two strata.

A generalized backslope lithologic section is presented in this report as Figure 14, which represents data obtained from the four backslope borings.

3.2 BACKSLOPE ABOVE THE UPPER PORTALS: Boring nos. 1 and 2 were drilled in an area in which some slide activity has been experienced. The boring logs indicate that 13.5 to 26.5 feet of colluvium and talus overlie competent bedrock strata, predominately composed of gray siltstones that exhibit

various degrees of differential weathering. Permeability of the bedrock strata is quite high up to the depths penetrated by the borings. However, 20 hours after drilling, a static groundwater level was measured at 12.5 feet below existing grade at the location of boring no. 1. This boring could not be continuously cored because of excessive water loss into the formations at many different depths. Therefore, it is believed that the water level reading is the result of a zone of seepage water, noted on the log at 12.5 feet, filling a hole that was finally sealed with a layer of drilling mud. The sealing occurred after the hollowstem auger was pulled (i.e., rotated up and down to clear the augers) from the bottom of the hole. It does not appear that the backslope above the upper portals has a static phreatic surface within the depths penetrated by boring nos. 1 and 2.

Several tension cracks, approximately one inch wide and 3 to 5 feet long, were observed in an area about 50 feet southwest of boring no. 1. A water seep was trickling from the slope, before drilling began, about 10 to 15 feet below boring no. 1. Evidence of some slope erosion from this seep could be seen. In the vicinity of boring no. 2 there is a distinct lack of tree growth and evidence of recent slide activity, including some erosional scour. No tension cracks or water seeps were noted. An overview of the area suggests that a fault may pass through the natural drainageway in the vicinity of boring no. 2. This conjecture is based only on surface characteristics, the unusual thickness of colluvium and talus in boring no. 2, and conversations with Valley Camp mining personnel. The exploration borings were not deep enough to confirm the fault presence. Vertical displacement of the fault should not be significant, based upon visual observation of the upper coal stratum outcrop.

In general, the backslope above the upper portals appears to be in a nearly natural condition. The slide area seems to be more the result of natural weathering processes on a daylighting fault zone than a condition caused by mining activities.

Sections A-A' and B-B' (Figures 15 and 16) present simplified geologic cross sections through boring nos. 1 and 2, respectively. The sections also show

sample locations and types, as well as the existing slope configurations above and below the borings.

3.3 BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Boring logs 3 and 4 indicate that about 11 feet of colluvium and(or) talus overlie predominately gray siltstones, shales, and sandstones. The bedrock strata are quite pervious, and in some instances a ten foot core run required about 1000 gallons of water to complete. In most cases, core runs were made with water loss of 75 to 100%.

Tension cracks, erosional scour, or seepage zones were not observed in the vicinity of boring nos. 3 and 4. Surface vegetation was lush, and numerous large trees indicated no evidence of slope creep. Except for the steep cut slope behind the office/changehouse, the backslope appears to be virtually natural.

The composite log of the cut slope behind the office/changehouse (Figure 7) shows a section of competent bedrock units. The strike of the slope is approximately parallel to the regional dip direction (to the southwest at 4°±), which is a favorable cut slope orientation. The same cut slope continues to the northeast, and at a point above the waste water treatment plant some potential for ravelling of the upper coal stratum may exist which could precipitate a minor, shallow slide of overlying colluvium. Some ravelling of the coal stratum above the office/changehouse may also occur.

Section C-C' (Figure 17) presents the generalized geologic section of this slope.

3.4 CUT SLOPE NEAR THE COAL LOADOUT CHUTE: The log of this nearly vertical cut slope is referred to herein as "B-7" (Figure 8). Detail line maps (Figures 9 and 10) present further data on fracture orientations. The sandstone exposed in this cut is massive and extremely competent. The overlying coal, however, has been cut quite steeply for about a 3-foot thickness. The coal ravels from this portion of the section even in a light wind. The gentler slope above the coal appears to be nearly natural to the

elevation of the existing tree line, although some evidence of erosional scour can be observed.

3.5 CUT SLOPES ON THE HAUL ROAD: The haul road from Eccles Canyon traverses the east side of the ridge on which the Belina Mine is located. The regional bedding plane dip direction to the southwest presents a favorable orientation for the haul road cuts. Neither cut slopes perpendicular to the dip direction nor cut slopes parallel to the dip directions, have downdip bedding planes daylighting into the slope faces.

Primary and secondary joint sets are prominent in many of the cut slope faces and dips of the joints are generally quite steep, steeper than the inclination of the cut slopes. The steep dip in itself often precludes the possibility of plane shear failure because unfavorable joint planes do not daylight in the slope face.

The primary joint set generally strikes north-south (±10°) and has an average dip of about 80° to the east. The secondary joint set generally strikes east-west (±10°) and has an average dip of 75° to the north.

The descriptions of cut slopes contained in this report (Figures 11 through 13) indicate only four relatively minor areas in which regular maintenance or remedial measures may be required to stabilize cut slopes. These areas will be further discussed in sections 5.0 and 6.0 of this report.

4.0 LABORATORY TESTING

A laboratory testing program was established to determine the engineering properties of soil masses and jointed and intact rock masses. Test results were utilized to properly classify material types and to provide strength parameters for use in slope stability analyses.

4.1 MOISTURE AND DENSITY DETERMINATION: Moisture and density determinations were performed on thirteen specimens. These data, found in Table 1, provide information relative to the degree of saturation, compressibility characteristics, and the mass weight of various stratigraphic soil and rock units. These data are required for slope stability analysis.

4.2 ATTERBERG LIMITS TEST DATA: To properly classify soils in accordance with the Unified Soil Classification System, the liquid and plastic limits (two of the Atterberg limits) of seven representative soil samples were determined. These data also provide indications of the susceptibility of the soils to volume changes with changes in moisture content. Some references (e.g. NAVFAC, DM-7, Department of the Navy, 1972) also correlate these data with the angle of internal friction, Ø, of a soil, and with certain consolidation characteristics.

Table 2 contains the results of these Atterberg limits tests.

4.3 UNCONFINED COMPRESSION TESTS: Nine specimens of soil and rock were tested in unconfined compression to determine the shear strength parameter, c (unit cohesion), of those materials when Ø (angle of friction) is assumed to be 0. This is a quick, relatively inexpensive test method for obtaining values of c.

Test results are shown in tabulated form in Table 3. The modulus of elasticity is included, which is a function of the stress-strain curve, dependent on the sample stress history, moisture content, density and other factors. These data are also used in slope stability analyses.

4.4 TRIAXIAL COMPRESSION TESTS: Three samples were subjected to lateral confining pressures before an axial load was applied. These triaxial tests (unconsolidated, undrained) require a high degree of specimen homogeneity before the data points may be combined to provide accurate values for both ϕ and c. In this case, the samples did not prove to be sufficiently homogeneous to provide such data, although ranges may be established for ϕ and c.

These test data are also found in Table 3.

4.5 DIRECT SHEAR TESTS: Three multi-stage direct shear tests were performed on jointed rock specimens to evaluate the shear strength parameters ϕ and c of the rock joints. In a rock slope stability analysis, these data provide parameters for a probable failure surface that would primarily follow existing joint patterns.

Test data are shown in Table 4, and more detailed direct shear test results are contained in Figures 18 through 20 of this report.

5.0 SLOPE STABILITY ANALYSIS

5.1 GENERAL: Recognized potential modes of slope instability consist of plane shear, wedge, circular, and toppling failures. Such failures are dependent upon many factors including the slope configuration, geologic discontinuities, and physical characteristics of the stratigraphic units.

Laboratory data and(or) stratigraphic information from exploratory borings, field reconnaissance, and field mapping were utilized to establish computer models or stereographic projections by which the stability of various cut slopes could be evaluated.

A computer program based on a limiting equilibrium analysis method (STABL, Siegel, 1977) was used to evaluate the two major Belina Mine slopes: the backslope above the upper portals, and the backslope above the office/changehouse. Stereographic projection techniques were used to evaluate the cut slope near the coal loadout chute and the major cuts along the haul road.

For the computer analysis the most important consideration is the selection of correct soil and rock shear strength parameters for each stratigraphic unit. For the backslopes, the worst-case unconfined compression test result of 8.5 psi was utilized for the colluvium/talus. A significant Ø angle was estimated to be 18° from NAVFAC, DM-7. This Ø value was used to calculate the value of c from the unconfined compressive strength test results. For the weathered siltstones, direct shear test results on jointed rock, along with unconfined compression tests of intact rock, were utilized to estimate the shear strength. Since rock joints were noticeably absent in the rock cores extracted in the drilling program, it was assumed that a potential failure surface would have to pass through some intact rock. Therefore, c was estimated to be a midrange value of 34.7 psi and Ø was estimated to be 38°. Groundwater and earthquake factors were not assumed to be significant factors in the analyses. Moist unit weights were used for both soil and rock.

5.2 ANALYSIS OF BACKSLOPE ABOVE UPPER PORTALS: The computer-generated geologic models of the A-A' and B-B' sections are included in this report as Figures 21 and 22. The most critical failure paths passed through the colluvium and(or) talus interface with the underlying bedrock surface. For section A-A', the corresponding factor of safety against slope instability was 1.4. For section B-B' the factor of safety was 1.15 at the steepest portion of the slope, just below boring no. 2. Failure surfaces extending into bedrock materials had very high factors of safety, in excess of 2.5.

5.3 ANALYSIS OF BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Figure 23 presents the computer-generated geologic model of the C-C' section. As in the analysis for the adjacent backslope described above, the most critical failure path passed through the colluvium and(or) talus interface with the bedrock. The lowest factor of safety obtained was 1.9.

5.4 ANALYSIS OF THE CUT SLOPE NEAR THE COAL LOADOUT CHUTE: Stereographic projections are long recognized methods of presenting kinematic tests for various modes of slope instability. Using the cut slope log "B-7" and detail line data, stereographic projections were prepared for potential shear plane, wedge and toppling failures (Figures 24 through 26). The massive sandstone in this cut is extremely competent and joint orientations generally appear to be favorable. Only that portion of the cut slope striking S25°W shows a slight potential for failure in a toppling mode. However, the adjacent portion of the cut confines this potential toppling section, causing the entire slope to be safe.

5.5 ANALYSIS OF THE HAUL ROAD CUT SLOPES: The potential failure plane described between odometer mileage readings 0.14 to 0.17 on Figure 11 does not pass the kinematic test for stability because the slope face is 3° steeper than the 65° dip of the secondary joint set. Relatively minor quantities of rock are found above the daylighting joint set.

The colluvium/talus described between odometer mileage readings 0.69 to 0.72 on Figure 12 indicates that the colluvium/talus is cut in the steepest portion of the slope to an angle of about 65°. The thickness of this

stratum is not known, but a stable slope configuration should be flatter, as evidenced by the results of the Belina Mine Complex backslope analysis.

The potential failure surface described at the 0.86 odometer reading on Figure 12 is located on a "nose", or peninsula-like rock feature. This type of rock mass is the most susceptible to natural weathering processes, and it is likely that the potential failure surface is a naturally occuring phenomenon than a result of "blast damage." In any case, the potential failure surface does not pass the kinematic test for stability.

At odometer reading 0.92 on Figure 12, highly fractured rock may be cut to a slope that is slightly steeper than long-term stability would dictate. There is no laboratory data available to substantiate this possibility.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS: Slope stability analyses have indicated that the cut slopes in the area of mine facilities are, in general, stable. The steeper portion of the backslope above the upper portals, represented by section B-B', is the only backslope that does not meet the required 1.3 minimum factor of safety established by the State of Utah for cut slopes steeper than 2 horizontal to 1 vertical. It should be reiterated that this so-called "unstable" condition may not be related to mining operations and may rather be associated with natural geologic discontinuities.

The vertical 3-foot high section of coal above the massive sandstone exposed in the cut slope by the coal loadout chute is too steep, and will probably ravel or weather to an angle of about 34°.

For the most part, the haul road cuts were found to be stable. Four haul road cut slopes described in section 5.5 appear to be too steep for long-term stability, although the cut slope at the 0.86 odometer reading may have had the potential failure surface develop long before the haul road was constructed.

6.2 GENERAL RECOMMENDATIONS

6.2.1 BACKSLOPE ABOVE THE UPPER PORTALS: In the vicinity of boring no. 2 (section B-B') the steep portion of the slope should be excavated to a flatter configuration, perhaps 23°, which is the slope angle of the more stable section A-A'.

Positive surface drainage must be directed away from the slope face, and the slope should be smoothed and revegetated. Seepage water should be controlled, possibly by gravel-lined diversion ditches.

In lieu of the above-mentioned remedial actions, seasonal maintenance of slope or slide debris should be anticipated.

6.2.2 BACKSLOPE ABOVE THE OFFICE/CHANGEHOUSE: Some ravelling may occur from the coal and siltstone strata, and maintenance provisions should be anticipated.

6.2.3 CUT SLOPE NEAR THE COAL LOADOUT CHUTE: The coal stratum above the massive sandstone should be flattened to a slope angle of about 34°. The gentler slope above the coal should be smoothed and revegetated to more properly control surface water runoff. A diversion ditch on the trail above the slope may further reduce the runoff erosion potential.

6.2.4 HAUL ROAD CUT SLOPES: Major cut slope failures on the haul road are not likely. More probably, natural weathering processes will remedy most of the stability problems over a period of years, during which time seasonal maintenance should be anticipated. However, flattening of the slopes identified in section 5.5 should alleviate much of the scheduled road maintenance. In any case, the identified slopes should be carefully observed with monthly regularity, and more often during the spring thaw period.

TABLES

Table 1

Moisture and Density Determinations

Boring No.	Depth (ft.)	Sample No.	Moisture (% of dry wt)	Wet Density (PCF)	Dry Density (PCF)
1	5.0-6.5	1-1*	18.7	146.6	123.5
1	11.5-11.8	1-3*	10.5	136.9	123.9
1	16.0-16.5	CORE	5.7	152.9	144.7
2	4.0-4.5	2-1	17.6	125.0	106.3
2	9.5-10.0	2-2	20.0	130.3	108.6
2	14.3-14.5	2-3	14.5	130.1	113.6
2	29.0-29.5	2-6	5.4	139.6	132.4
3	5.0-5.5	3-1	12.3	126.4	112.6
3	17.0-17.5	3-4	16.1	133.2	114.7
3	21.7-22.3	CORE	7.6	152.8	142.0
3	25.0-25.5	CORE	10.6	156.6	141.6
3	30.5-30.9	CORE	8.2	147.5	136.3
4	9.5-10.0	4-2	15.4	132.6	114.9

*Represents disturbed samples, and wet/dry density results may not be accurate.

Table 2

Atterberg Limits Test Data

Boring No.	Depth (ft.)	Sample No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity* Index (%)	Group Classi-fication
1	5.0-6.5	1-1	38	27	11	ML
2	4.0-4.5	2-1	28	19	9	CL
2	9.5-10.0	2-2	35	19	16	CL
2	14.3-14.5	2-3	35	20	15	CL
3	5.0-5.5	3-1	36	18	18	CL
3	17.0-17.5	3-3	31	19	12	CL
4	9.5-10.0	4-2	29	18	11	CL

*Liquid Limit - Plastic Limit = Plasticity Index

Table 3

Unconfined Compression Tests

Boring No.	Depth (ft.)	Lithology	Density (pcf)	Compressive Strength (psi)	Young's Modulus (psi)
1	16.0-16.5	SILTSTONE	152.9	68*	7.3×10^3
2	4.0-4.5	SANDY CLAY	125.0	8.5	-
2	9.5-10.0	SILTY CLAY	130.3	48	1.3×10^3
2	29.0-29.5	SILTSTONE	139.6	120	5.2×10^3
3	5.0-5.5	SILTY CLAY	126.4	42	2.2×10^3
3	17.0-17.5	SHALE	133.2	90[1]	1.5×10^3
3	21.7-22.3	SHALE	152.8	428[2]	2.3×10^4
3	25.0-25.5	SHALE	156.6	130[3]	2.2×10^3
3	30.5-30.9	SHALE	147.5	61	1.1×10^3
3	59.6-60.0	COAL	76.8	1,540	1.3×10^5
4	9.5-10.0	SANDY CLAY	132.6	37	8.1×10^2
4	57.0-57.5	SANDSTONE	159.2	20,640	-

*Failure across healed fracture

[1]Confining pressure of 20 psi (triaxial test - uu)

[2]Confining pressure of 50 psi (triaxial test - uu)

[3]Confining pressure of 80 psi (triaxial test - uu)

Table 4

Direct Shear Test Results*

Boring No.	Depth (ft.)	Lithology	Type of Joint	Friction Angle, Ø (degrees)	Unit Cohesion c (psi)
3	49.7-50.2	SILTSTONE	70°, OPEN	25.6°	28.3
4	20.5-21.0	SHALE	0°, OPEN	22.3°	30.7
4	37.5-38.0	SILTSTONE	77°, OPEN	38.0°	15.5

*Shear strength parameters for each sample were determined by multi-stage tests, using five different normal stresses.

F I G U R E S

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9139.6	0	CL	Silty Clay: dark brown; 15-20% fine sand; very wet; medium plasticity; medium stiff. Some organics. (Topsoil zone)			Location - N: 7,226.26 W: 10,102.57
9138.1	1.5	CL	Silty Clay: dark yellowish-brown; 20% fine sand; wet to very wet; medium plasticity; medium stiff.			(on slope above ventilation fan)
9136.1	3.5	CL	As above but mottled with dark grayish-brown and wet.			Hole cased to 13.5' with hollowstem auger.
9134.1	5.5	CL-CH & ML	Silty Clay: dark brownish-gray and dark gray; wet; medium to high plasticity; stiff. Some thin (1/8") coal seams, and zones of sandy silt.	SPT 1-1	3, 4, 7	N=11
9132.1	7.5	CH	Silty Clay: dark gray and gray; moist; high plasticity; very stiff.			
9130.1	9.5	CL	Silty and sandy clay: dark gray, yellowish brown, and brown; up to 25% fine sand; moist; low to medium plasticity; hard to very hard. Last 2-3" saturated from groundwater perched on sandstone stringer from 12.5 to 12.7'. (Weathered rock)	D&M 1-2	35, 38	
				SPT 1-3	23, 47	N=70 Groundwater @ 12.3' after 20 hours.
9126.1	13.5		Shale and Siltstone: silty and sandy clay; gray mottled with brownish-yellow; up to 25% fine sand; partings every 8"±; soft rock.	NX core Run #1		94% Recovery (diamond bit; bentonite and D7-E polymer)
9119.6	20					94% RQD (10 pieces)

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Figure 2

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in continuous flight auger	Standard Penetration Test		Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 3
w = Moisture Content, %	D = Dry Density, pcf	Penetration Resistance: N = Blows per foot	Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9119.6	20					
9113.3	20.3		As before (shale and siltstone)			56% Recovery (carbide bit; bentonite and D7-E; lost circulation at 21.5")
			Badly weathered sandstones and shales: brown and brownish yellow; very soft rock.	NX Core Run #2		0% RQD
						Added cellulose, nut shell and more bentonite to drilling water: began drilling w/ tricone bit at 23.9' lost circulation; continued drilling with hollowstem auger; tried tricone bit again at 29.0' and lost circulation immediately.
				D&M 1-4	72 in 3"	
9107.6	32					
9107.1	32.5		Zone of broken sandstone.			
		CL-ML	Shale and siltstone: silty clay; gray and dark gray; moist; low to medium plasticity; soft rock.			
				SPT 1-5	100	in 3" N=100+
9102.6	37					
9102.1	37.5		Possible sandstone			
		ML	Siltstone: sandy silt; dark brown and grayish brown; dry; slight plasticity; moderately soft rock.			
9099.6	40					

Figure 2a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test			Boring No. 1
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot			Date: 9-13-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9099.6	40		As before (siltstone) D&M	1-6	100	in 1"
9095.1	44.5		Sandstone (poor recovery with hollowstem auger); soft to moderately hard rock.			
9093.6	46		Siltstone, as before.			
9091.6	48		Sandstone: hard rock.			
9090.6	49		(Refusal of hollowstem auger with carbide teeth, using CME-750 rig)			

Figure 2b

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9230.1	0	CL	Silty Clay: very dark brown; 15-20% fine sand; moist; medium plasticity; medium stiff.			Location - N: 7,561.28 W: 10,196.59 (Active slide area)
9227.6	2.5	CL	Sandy Clay: dark yellowish brown; some pieces of weathered sandstone (¼" diameter).			
9226.6	3.5	CL	Sandy Clay: brownish yellow mottled with brownish gray; 20-25% fine sand; pieces of weathered sandstone; medium plasticity; soft to medium stiff.	D&M 2-1	5, 9, 10	(33% recovered)
9224.1	6	CL& CH	Silty Clay: gray and dark gray becoming dark brownish gray; some pieces of weathered sandstone; medium and high plasticity; very stiff to hard.	D&M 2-2	7, 13, 19	No groundwater 38 hours after drilling.
9218.8	11.3		Weathered sandstone			
9218.1	12	CL& CH	As before but more zones of weathered sandstone.	D&M 2-3	5, 6, 10	
9214.1	16		Weathered sandstone pieces.			
9213.1	17	CL, CH, &SM	Silty and sandy clay: brownish yellow; wet; 5-35% fine sand; low (sandy clay) & high (silty clay) plasticity; stiff. Zones of badly weathered sandstone (SM).	SPT 2-4	3, 11, 8	N=19
9210.1	20					

Figure 3

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 3
w = Moisture Content, % / D = Dry Density, pcf	Penetration Resistance: N = Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9210.1	20	CL, CH, &SM	As before (silty and sandy clay with badly weathered sandstone)			
9206.1	24		Siltstone or sandstone: moderately hard rock; possible talus (no samples).			
9204.6	25.5	CL, CH, SM	As before with thin seams of siltstone	SPT 2-5	9	
9203.6	26.5				10	
					50	in 5" N=60+
			Weathered siltstone: sandy silt; gray; moist; 15-20% fine sand; soft to moderately hard rock.			
				D&M 2-6	16	
					29	
					40	
9197.6	32.5		As above but moderately hard to hard rock (harder than above)			
9194.6	35.5	SM& ML	Badly weathered siltstone & sandstone: brownish yellow and yellowish gray; wet; very soft rock.			
				SPT 2-7	39	
					18	N=64
					46	
9191.1	39		Siltstone or sandstone: moderately hard rock (no recovery).			

Figure 3a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina MIne, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 2
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-14-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9190.1	40		As before.			
9189.6	40.5		Weathered siltstone: sandy silt; gray; moist; soft to moderately hard rock.	D&M 2-8	100 in 2"	Hollowstem auger used as casing at 44.0'; tried to hold water head with bentonite and cellulose to see if coring was possible; lost head of water within 30 seconds.
9182.1	48		Weathered siltstone: as above but mottled with yellowish brown and yellowish gray; somewhat harder.	SPT 2-9	50 in 2"	N=50+
			End of Boring	SPT 2-10	100 in 3.5"	N=100+
9175.8	54.3					

Figure 3b

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9129.3	0	CL	Silty Clay: dark brown to brown; 15 to 20% fine sand; moist; low to medium plasticity; organics upper 12".			Location - N: 7,786.38 W: 9,745.67 (on slope above changehouse)
9125.8	3.5	CL& CH w/ SM	Silty/sandy clay with sandstone: grayish brown; zones of hard weathered sand compose ≃ 20% of stratum; wet; medium and high plasticity; up to 30% fine sand in zones of sandy clay; very stiff to hard.	D&M 3-1	14 21 25	Hollowstem auger set as casing at 18.5'
9121.3	8	CL, SM &ML	Badly weathered siltstone&sandstone: sandy clay matrix with pieces of moderately soft rock; brownish yellow and brownish gray.	SPT 3-2	8 23 19	No groundwater data-hole plugged at 18' 24 hours after drilling. N=42
9118.8	10.5		Weathered siltstone: gray; moist; moderately soft rock.			
9117.3	12	CL	Silty Clay: brownish yellow; wet; low to medium plasticity; stiff. Zones of claystone ≃ 3-4" thick; hard.	SPT 3-3	7 11 19	N=30
9113.8	15.5	CL-CH	Weathered shale: brownish yellow becoming gray at 17.5'; moist; medium to high plasticity; very soft to soft rock.	D&M 3-4	25 29 23	in 2"
9109.3	20			NX Core Run#1		See following page for core data

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Figure 4

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9109.3	20					
9108.8	20.5	CL-CH	As before			
			Weathered shale: gray and brownish yellow; some interbedded sandstone strata ≃ 1-2" thick; partings at 2-3"; soft rock. Joints: 20.5', moderately smooth, open, 10° dip; 21.7-22.3', closed 90° dip; 23.1-23.2' moderately smooth; 30° dip.	Cont. NX Core Run #1		97% Recovery 12% RQD (1 piece) (Carbide bit; "unlimited" water supply by siphon from 12,000 gal. potable water storage tank; water did not recirculate
9105.3	24		Sandstone: brownish yellow; moderately hard rock. Joints: 24.2-24.4' moderately rough, open, 80° dip; 24.6-24.7' moderately smooth, 45&60°; 24.7'24.9', open, moderately smooth, 90° dip.			
9104.4	24.9					
9103.5	25.8		Weathered shale: gray and brownish yellow; moist; soft rock.	NX Core Run #2		52% Recovery 15% RQD (1 piece)
9101.3	28		Badly weathered sandstone & shale: brownish yellow and gray; partings every ½ to 2". Joints: 26.0', open, rough, 75° dip.			
			Lost sample: very soft rock.			
9099.3	30		Weathered shale, siltstone&sandstone: gray and brownish yellow; soft rock partings ½-3".	NX Core Run #3		78% Recovery 14% RQD (2 pieces)
9096.3	33		Sandstone: brownish yellow; hard; thin-bedded (1.5-3").			
9095.3	34		Weathered shale and siltstone: gray and brownish yellow; soft rock; partings ½ to 2". Joints: 39.2', closed, 90°.	NX Core Run #4		87% Recovery 0% RQD
				NX Core Run #5		80% Recovery 23% RQD (2 pieces)
9089.8	39.5		As below			

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Figure 4a

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 3
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler		Sheet 3 of 3
w = Moisture Content, % / D = Dry Density, pcf	Penetration Resistance: N = Blows per foot		Date: 9-15-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9089.3	40		Weathered shale: gray and brownish yellow; soft rock. Joints: 40.7 & 41.3', open, rough, 20° dip. Partings every 2 to 12".	Cont. NX Core Run #5		As before
				NX Core Run #6		100% Recovery 46% RQD (8 pieces)
9083.8	45.5		Siltstone: gray and brownish yellow; moist; moderately hard rock. Joints: 48.5', open, rough, 0°; 49.5-49.8', 3 pieces, rough, 70°; 50.0', open, moderately smooth, 20°. Partings every 2 to 7".			
9078.3	51		Very soft weathered shale			
9077.3	52		Coal: thin bedded, moderately soft. Partings every 1 to 3"; highly fractured from 55.5' to 56.5'.	NX Core Run #7		82% Recovery 0% RQD
9068.3	61		End of Boring			

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Figure 4b

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 4
Undisturbed Soil Sampler: 3-in. o.d. DBM sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-16-8

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9176.1	0	CL	Fill: silty and sandy clays; dark gray and dark grayish brown; medium stiff.			Location - N: 8,031.57 W: 9,605.70
9174.6	1.5	CL	Sandy Clay: dark brown to brown; 25-30% fine sand; moist; low plasticity; stiff.			(on jeep trail east of potable water tank)
9171.6	4.5	SM	Sandstone cobble: top 6" badly weathered.	SPT 4-1	32 45	N=50+
9169.6	6.5	CL	Silty Clay: brownish yellow; 15-20% fine sand; wet; medium plasticity; stiff.			No groundwater 24 hrs. after drilling
9168.1	8	SM	Silty Sand: brownish yellow; 40-45% nonplastic fines; moist; dense (badly weathered sandstone cobble).			
9167.1	9	CL, ML, &SM	Silty/sandy clay, sandy silt, and silty sand: hard soil colluvium with pieces of rock.	D&M 4-2	16 25 50	in 2"
9165.6	10.5	ML	Weathered siltstone cobble: brownish gray; moderately soft rock.			
9164.6	11.5		Weathered siltstone with some sandstone: gray mottled with brownish gray and brownish yellow; soft rock.			
			Weathered shale & sandstone: brownish yellow and gray w/ brownish red; highly fractured; moderately hard rock. Joints(all open): 17.5-17.7', moderately smooth, 80°; 18.3-18.4', moderately rough, 90°, 19.1-19.3', moderately smooth, 20°&90°; (4 pieces).	SPT 4-3	34 50	in 5" N=80+
9160.1	16			NX Core Run #1		89% Recovery 34% RQD (4 pieces between 19.5' & 25')
9156.6	19.5		As below			

Figure 5

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 4
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler		Sheet 2 of 3
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-16-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9156.1	20		Weathered shale: gray, brownish gray, very dark gray and very dark grayish brown; moist; medium and high plasticity; zones of siltstone; soft rock. 2" thick highly fractured sandstone at 20.8'. Partings every 2 to 9".	Cont. NX Core Run #1		As before
9151.9	24.2		Siltstone: gray; moderately hard rock.			
9151.1	25		Sandstone: brownish yellow, gray and yellowish red; thin shale seams (1/8"); highly fractured in part; parts moderately hard.	NX Core Run #2		96% Recovery 9% RQD (1 piece, below 27')
9149.7	26.4		Badly weathered shale & siltstone: gray mottled with brownish yellow; highly fractured in part; very soft rock. Partings every ½ to 3" (some coal in partings). Joint: 29.6-29.8', open, smooth, 90°.			
				NX Core Run #3		100% Recovery 39% RQD (8 pieces, between 33 & 38')
9143.9	32.2		Siltstone: yellowish gray mottled with brownish yellow; up to 35% fine sand; moderately hard rock. Partings every 2-8" with leaf fossils. Parting with slickensides at 34': variable dip of partings above 34', 20° dip below 34'.			
9138.1	38		Weathered siltstone: dark gray and gray mottled with brownish yellow; many multi-piece irregular joints; cont....			
9136.1	40					

Figure 5a

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MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County

Upper Portal Backslope

Boring Method: 6-in. continuous flight auger	Standard Penetration Test			Boring No. 4
Undisturbed Soil Sampler: 3-in.o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in.o.d. Split-barrel Sampler	Sheet 3 of 3
w=Moisture Content, % D=Dry Density, pcf	Penetration Resistance: N=Blows per foot			Date: 9-16-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9136.1	40		Weathered siltstone, cont.. soft rock with zones of very soft rock. Partings every ½ to 3". Joints: 39.5-39.6', open, irregular, moderately smooth, 70-90° dip, 4 pieces.			
9133.1	43		Siltstone: yellowish gray; moderately hard rock. Partings every 2 to 5".	NX Core Run #4		95% Recovery 32% RQD (7 pieces, between 43-44' & 45-50')
9132.1	44	ML				
9131.1	45		Badly weathered siltstone: yellowish brown; weathered to soil in part; very soft rock. Partings every ¼ to 2".			
			Weathered siltstone: yellowish brown and gray; badly fractured from 47.5 to 48.0 and 49.0-49.4'. Partings every 2-10".			
9126.7	49.4		Claystone: dark gray; hard rock.			
9124.4	51.7			NX Core Run #5		100% Recovery 50% RQD (5 pieces)
9124.3	51.8		Weathered clay parting			
			Siltstone: gray and brownish yellow; moderately hard rock becoming softer. Partings generally every 2-3".			
9120.4	55.7		Siltstone: brownish yellow; zones of fine sandstone, badly fractured from 59.5 to 60.0'. Partings every 2-12". Joint: 57.5-57.8', open, rough, 60°, 4 pieces.			
911.61	60		End of Boring			

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Figure 5b

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Boring to Sample Fill on Pad

Boring Method: 6-in. continuous flight auger	Standard Penetration Test	Boring No. 5
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall / 2-in. o.d. Split-barrel Sampler	Sheet 1 of 2
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot	Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8923.3	0	CL w/ coal	Fill: silty clay with coal; very dark grayish brown.	1		Location - N: 7526.24 W: 9092.96
8921.3	2	SM w/ CL	Fill: silty sand with silty clay; brownish yellow.	2		Purpose of hole was to obtain bag samples at 2.5' intervals for testing by Valley Camp to determine potential use of the fill for reclamation. Boring log is necessarily rough because of variations within the fill.
8917.3	6	CL	Fill: sandy clay; dark yellowish brown.	3		
8916.3	7	SM& CL	Fill: pieces of sandstone and sandy clay; brownish yellow.	4		No groundwater 24 hours after drilling.
8912.3	11	CL	Fill: silty clay; dark yellowish brown.	5		
				6		
8908.3	15	CL	Fill: silty and sandy clay with pieces of wood and roots; very dark grayish brown.	7		
				8		
8903.3	20					

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Figure 6

MORRISON KNUDSEN Mining Group

BORING LOG

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Boring to Sample Fill on Pad

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 5
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2
w = Moisture Content, % D = Dry Density, pcf	Penetration Resistance: N = Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8903.3	20		As before	9		
8901.3	22	CL w/ coal	Fill: silty clay with coal and coal tailings; very dark grayish brown.	10		
8897.3	26	CL	Fill: sandy clay; very dark grayish brown.	11		
				12		
8893.3	30					

Figure 6a

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MORRISON KNUDSEN Mining Group

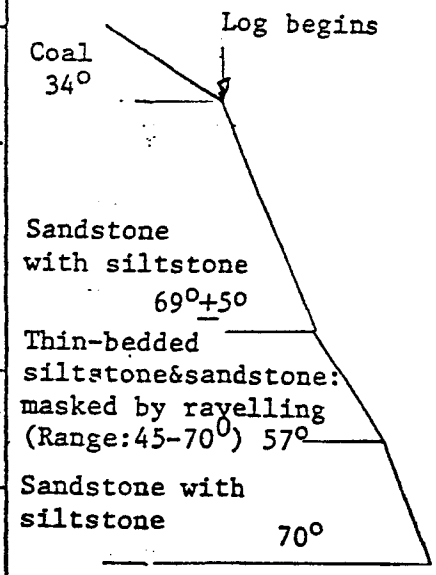
LOG OF CUT SLOPE

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
Behind Changehouse

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 6
Undisturbed Soil Sampler: 3-in.o.d. DBM sampler	140-lb. Hammer	30-in. Fall	2-in.o.d. Split-barrel Sampler	Sheet 1 of 2
w=Moisture Content, % / D=Dry Density, pcf	Penetration Resistance: N=Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9042*	0		Sandstone: hard; fractured in part.			Composite log of cut slope behind the changehouse, at the center of the building. Depths shown in log are estimated only, from the base of the coal stratum.
9040.5	1.5		Siltstone			
9039.5	2.5		Sandstone: hard; joints strike N80W with dip 70-90°N.			
9038	4		Siltstone			
9037.5	4.5		Sandstone: hard, as before.			
9036	6		Shale and siltstone: hard.			
9034.5	7.5		Sandstone: as before, but secondary joint system strikes N20E and dips 80°E.			
9033	9		Alternating zones of sandstone and siltstone.			
9030	12		Coal			
9029.5	12.5		Sandstone: hard, as before.			
9028.5	13.5		Siltstone: thin-bedded (½ to 2"); soft rock. Source of erosion, ravelling, and undercut.			
9025	17		Sandstone and siltstone: 1-6" thick bedding; joints strike N10E, dipping 85°E.			
9022	20					



Generalized section

*Elevation estimated from topographic map

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Figure 7

MORRISON KNUDSEN Mining Group

LOG OF CUT SLOPE

PROJECT

Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
Behind Changehouse

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 6
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer	30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 2 of 2
w = Moisture Content, %	D = Dry Density, pcf	Penetration Resistance: N = Blows per foot	Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
9022	20		Sandstone with some siltstone: massive in part (bedding 1-3" thick, and up to 24" thick); primary joints strike N10E, dipping 85°E; secondary joints strike E-W with dip 85°N. The 24" thick bedding is actually very tight thin-bedded sandstone.			
9016	26		Bottom of slope cut			

Figure 7a

601

MORRISON KNUDSEN Mining Group

LOG OF CUT SLOPE

PROJECT
Valley Camp of Utah, Inc.
Belina Mine, Carbon County
Composite Log of Cut Slope
East of Loadout Chute

Boring Method: 6-in. continuous flight auger	Standard Penetration Test		Boring No. 7
Undisturbed Soil Sampler: 3-in. o.d. D&M sampler	140-lb. Hammer / 30-in. Fall	2-in. o.d. Split-barrel Sampler	Sheet 1 of 1
w = Moisture Content, % / D = Dry Density, pcf	Penetration Resistance: N = Blows per foot		Date: 9-17-83

Elevation	Depth	Group Symbol	Description of Materials	Sample No.	Blows	Remarks
8949*	0		Coal: cut almost vertically, ravels in light wind.			Composite log of vertical cut slope (at the center of the cut) near the coal loadout chute. Depths shown in log are estimated only, from the top of the "vertical" section.
8947	2		Weathered shale: dark yellowish brown.			
8945.5	3.5		Sandstone: massive; hard rock; yellowish brown.			Log of cut was made at point D1 of the first detail line (see boring location plan).
8938	11					
8937.8	11.2		Bedding plane filled with weathered sandstone.			
			Sandstone: massive, as before.			
			Base of cut			
8924	25					

*Elevation estimated from topographic map

Figure 8

MORRISON-KNUDSEN W.O. NO. 1630-02 PAGE 1 OF

DATA SHEET FOR DETAIL LINE MAPPING

PROJECT Valley Camp BY B. Gale

LINE NO. D1 TREND S55°W PLUNGE 0° ELEV. 8929 LOCATION Belina DATE 9-17-83

LINE INTERCEPT (ft.)	ROCK TYPE	STRUCTURE TYPE	STRUCTURE STK	STRUCTURE DIP	GEOMETRY MD	GEOMETRY P	GEOMETRY LENGTH	GEOMETRY ± OVERLAP	GEOMETRY T_L	GEOMETRY T_U	GEOMETRY R	WIDTH ( )	FILLING	W	REMARKS
D1 (NE end)															
0		SJ	S60W	90		PL	5'		R	N	SM				
5		SJ	S25W	84E		PL	4'		N	R	SM	1.5"	Clay		
9	OVERLAIN BY	SJ	W	75N		WV	2"		R	N	RH				
11		SJ	S65W	80E		PL	14'		N	N	SM				
25		SJ	S	90		PL	3'		N	R	SM				
28		SJ	W	83N		PL	16'		N	N	SM	becoming RH			
39	MASSIVE SANDSTONE (OVERLAIN BY LOWER COAL STRATUM)	SJ	-	58E		--	--		R	R	--				
44		SJ	S15W	87W		PL	1'		N	R	SM				
45			BLAST DAMAGED JOINT												
45.5		SJ	S35W	86E		WV	1.5'		N	R	RH				
47			BLAST DAMAGED MASSIVE ROCK TO 62'												
62		SJ	S75W	54S		PL	2'		R	N	SM				
63			BLAST DAMAGED MASSIVE ROCK TO 83'												
83		SJ	S	84E		PL	2'		N	R	SM				
85			BLAST DAMAGED MASSIVE ROCK TO 90'												
90 (D1', SW End: at a point 14' NE of ℄ of loadout chute drive, perpendicular to ℄)															

ROCK TYPE ABBREVIATIONS	

STRUCTURE TYPE	
SJ	SINGLE JOINT
FT	FAULT
CT	CONTACT

GEOMETRY

MD = MINIMUM DIP

P = PLANARITY: PL, WV R = ROUGHNESS: SM, RH

T_L, T_U = TERMINATIONS

H	>20°	R	IN ROCK
L	<20°	N	NONE
		E	ENECHELON

WATER: D = DRY, W = WET, F = FLOWING

FILLING ABBREVIATIONS

N	NONE

Figure 9

DATA SHEET FOR DETAIL LINE MAPPING

PROJECT Valley Camp BY B. Gale

LINE NO. D2 TREND S25°W PLUNGE 0° ELEV. 8929 LOCATION Belina DATE 9-17-83

LINE INTERCEPT (ft.)	ROCK TYPE	STRUCTURE TYPE	STRUCTURE STK	STRUCTURE DIP	GEOMETRY MD	GEOMETRY P	GEOMETRY LENGTH	GEOMETRY ± OVERLAP	GEOMETRY T_L	GEOMETRY T_U	GEOMETRY R	WIDTH ( )	FILLING	W	REMARKS
D2 (N end)															
0	SANDSTONE, AS BEFORE ON D1	SJ	--	70N		PL	--		N	R	SM				
0		SJ	S25W	76W		PL	21'		N	N	SM				
21		SJ	N85E	73S		PL	--		N	R	SM	1.5"	Open		
21		SJ	S20W	80W		PL	7'		N	N	SM				
28		SJ	E	78S		WV	1'		N	R	SM	12"	Clay		
29		SJ	S15W	83E		PL	23'		N	R	SM				
51			BLAST DAMAGED FACE 2'LONG												
52		SJ	S15W	75E		PL	8'		N	R	SM				
60 (D2', S End; at a point 10' from D1 on the same slope)															

ROCK TYPE ABBREVIATIONS			

STRUCTURE TYPE			
SJ	SINGLE JOINT		
FT	FAULT		
CT	CONTACT		

GEOMETRY

MD = MINIMUM DIP

P = PLANARITY: PL, WV R = ROUGHNESS: SM, RH

T_L, T_U = TERMINATIONS

H	>20°	R	IN ROCK
L	<20°	N	NONE
		E	ENECHELON

WATER: D = DRY, W = WET, F = FLOWING

FILLING ABBREVIATIONS

N	NONE				

Figure10

Geotechnical Mileage Log of Cut Slopes

Valley Camp of Utah, Inc.
Belina Mine Haul Road
Section 19, R7E, T13S, Carbon County, Utah

Odometer Mileage	Description
0.0	Road begins on north side of Eccles Canyon.
0.14-0.17	*Evidence of movement along secondary joint set on 20-. high 68° cut slope. Secondary set strikes E-W with dip to N @ 65° (Primary N-S ± 10°, dip to E @ 75-90°) Strike of slope S53°E at this point. Bedding dips into slope (SW dip direction & 4° dip)
0.21	40' high cut (above slide area) with 65° slope angle. Upper portion has some overhanging rock, and cobble zone at top will produce some rockfall. Primary joints strike N-S ± 10°, dip to E 75-90° Secondary joints strike E-W ± 10°, dip to N 70-90° Bedding dips into slope
0.32	Same cut as above, but 30' high "nose" with weathered sandstone and siltstone cut at 45° to depth of 10', and competent sandstone cut to 60°. Primary joints of competent sandstone strike N10°W to N20°E, dip 72-78°E Secondary joints strike E-W ± 10°, dip N 60-65°. Bedding dips into slope
0.37	Center of 20' high 45-50° cut in competent sandstones.
0.42	10' high "nose" (with same joint sets as described below at mile 0.52) will weather/ravel to smoother slope.
0.44	Beginning of cut described at mile 0.52.
0.52	Center of 70°, 25' high (500' ± long) cut with 6' weathered rock on top of competent sandstone and siltstone. Parts of weathered rock section may be cut too steep, but natural weathering will remedy. Primary joints of sandstone strike N3°W, dip 84°E Secondary joints strike N80°W with dip 90° ± 5° Bedding dip is into the slope.

*Indicates areas that may require regular maintenance and (or) remedial work.

Figure 11

Geotechnical Mileage Log of Cut Slopes, cont.

Odometer Mileage	Description
0.57	Drainageway
0.61	65°, 12' high cut in competent rock with dip into the slope.
0.69-0.72	*25' high cut in possible colluvium/talus on 65° slope with concave face. May be a potential slide area: top of slope could be flattened but revegetation would be essential.
0.74	Major drainageway
0.86	*Possible blast damaged "nose" rock section. 15' high that may creep on an open, potential failure surface (which might continue beneath the road section) with a strike of $S60^{\circ}W$ and a dip of $42^{\circ}E$.
0.87	20' high cut in very competent sandstone. Strike of cut parallels primary joint set (N-S $\pm$ 5° with dip of $82^{\circ}E$). Secondary set strikes E-W with 90° dip.
0.92	*Possible fault? Rock is highly fractured in $40-45^{\circ}$, 20' high cut. Evidence of soil creep and erosion. Soil cover will continue moving (perhaps 3-4' thickness)
0.97	Heavy soil cover on slope described at mile 1.02, but some competent rock strata still visible. Cut is 48°.
1.02	20' high, 60° cut in rock composed of sandstones and siltstones with 1-8" thick bedding. Most of cut is perpendicular to SW dip direction.
1.06	Drainageway
1.07	15' high, 55° cut in competent rock.
1.12	15' cut with weathered rock (top 5') over competent rock with dip into the slope.
1.23	Some ravelling evident at beginning of slope described at mile 1.32.

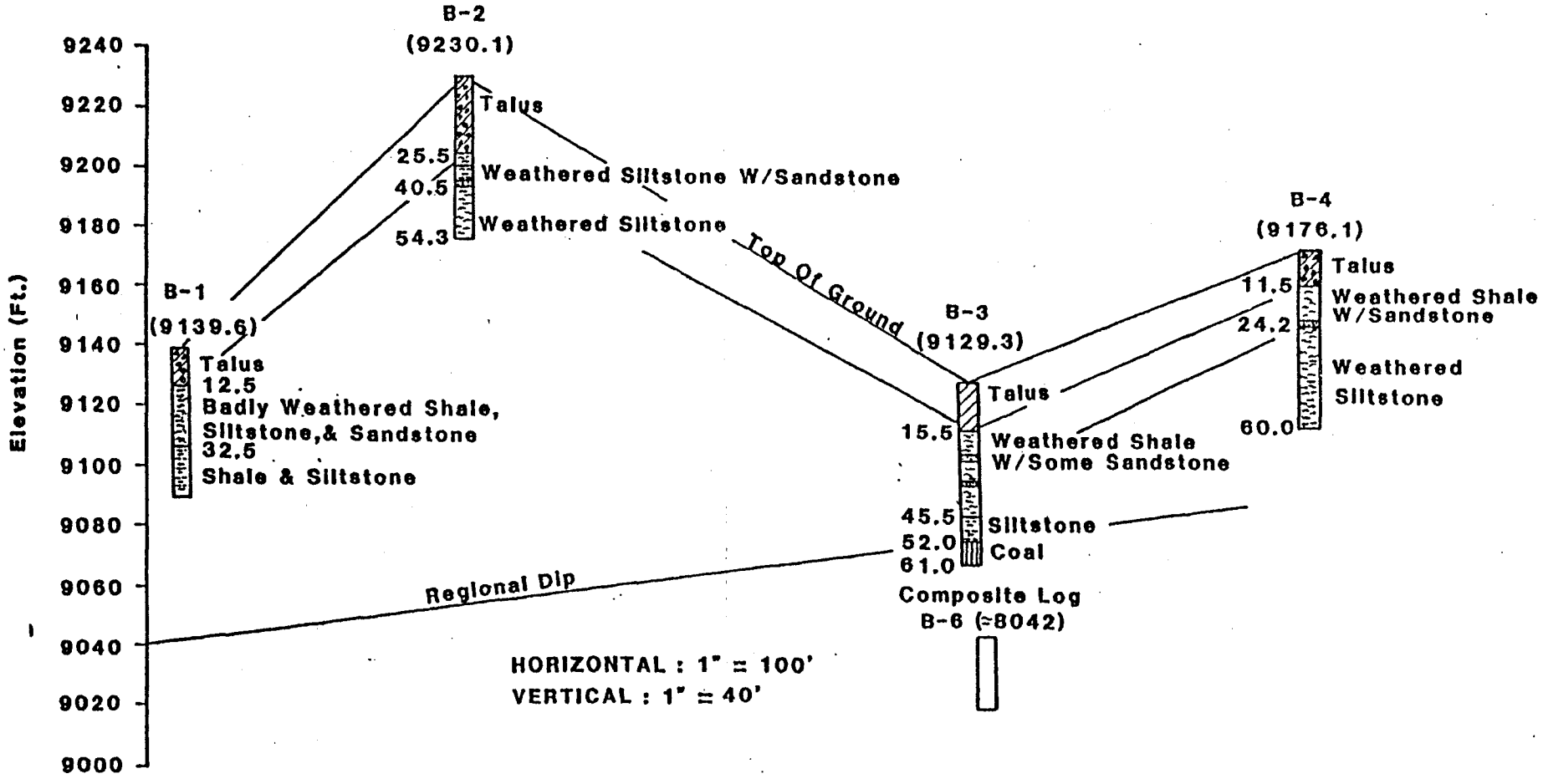
*Indicates areas that may require maintenance and (or) remedial work.

Figure 12

Geotechnical Mileage Log of Cut Slopes, cont.

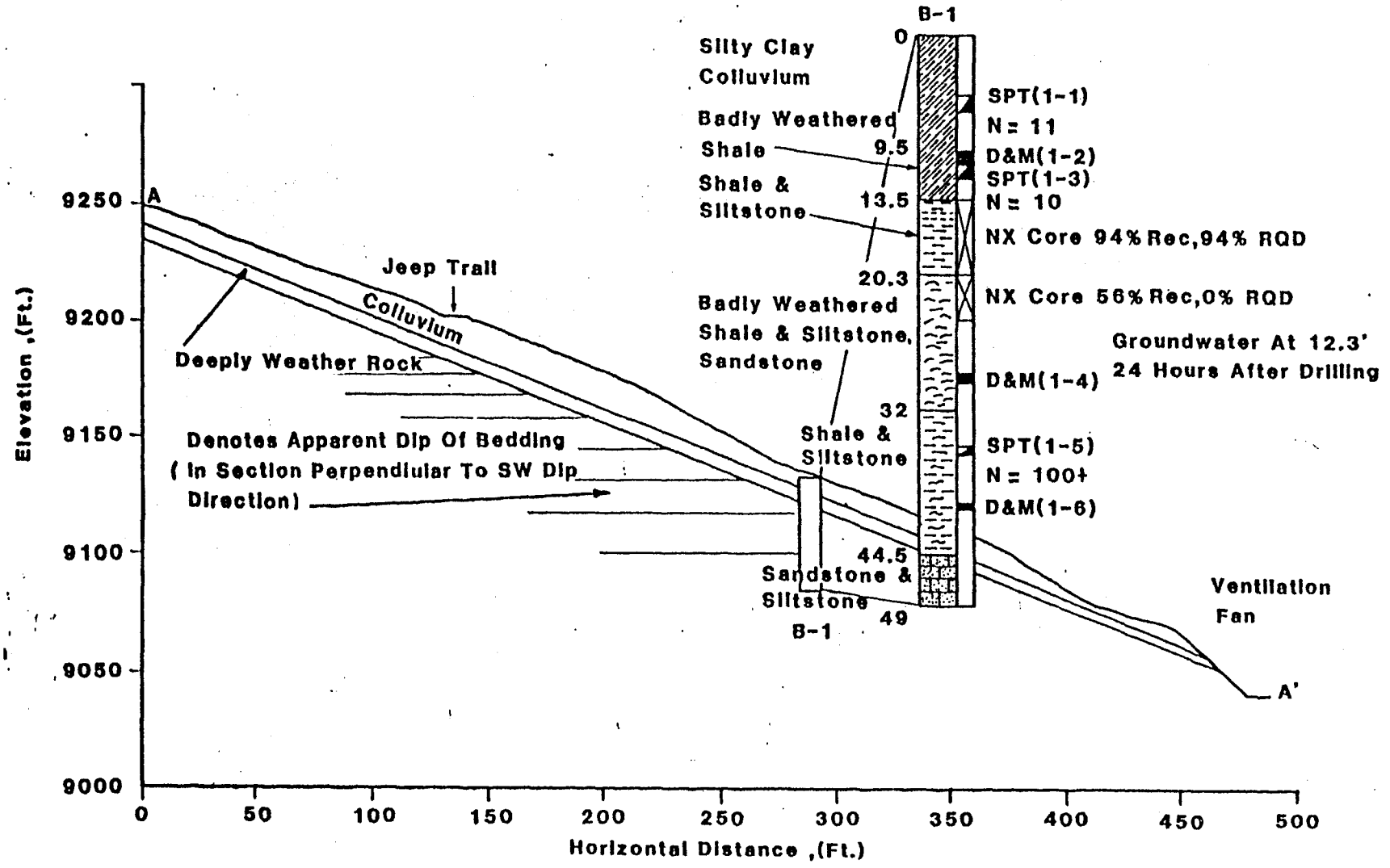
Odometer Mileage	Description
1.32	15' cut, 42° in weathered rock (top 6') and competent rock with dip into slope. Some ravelling will occur from the top of the cut. At mile 1.28, primary joint set strikes N10°E with dip of 85°E.
1.40	20' high cut, 35° in weathered rock, 55° in competent rock (sandstone/siltstone) with primary joint set striking parallel to the haul road (≈N-S) dipping at 85°E.
1.42	Fork in haul road leading to upper and lower portals of the Belina mine.

Figure 13



VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY
GENERALIZED BACKSLOPE SECTION

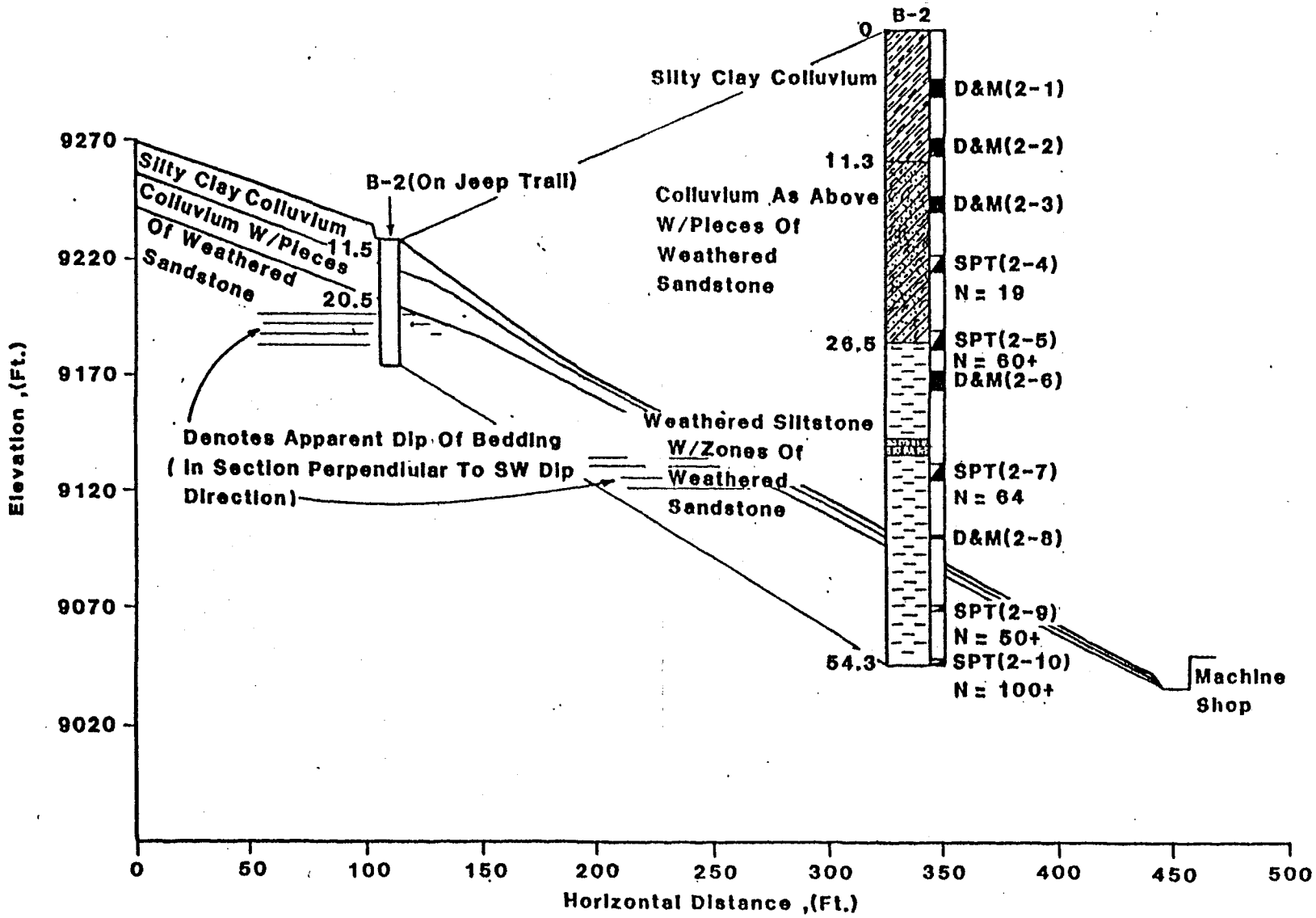
FIGURE 14



VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY

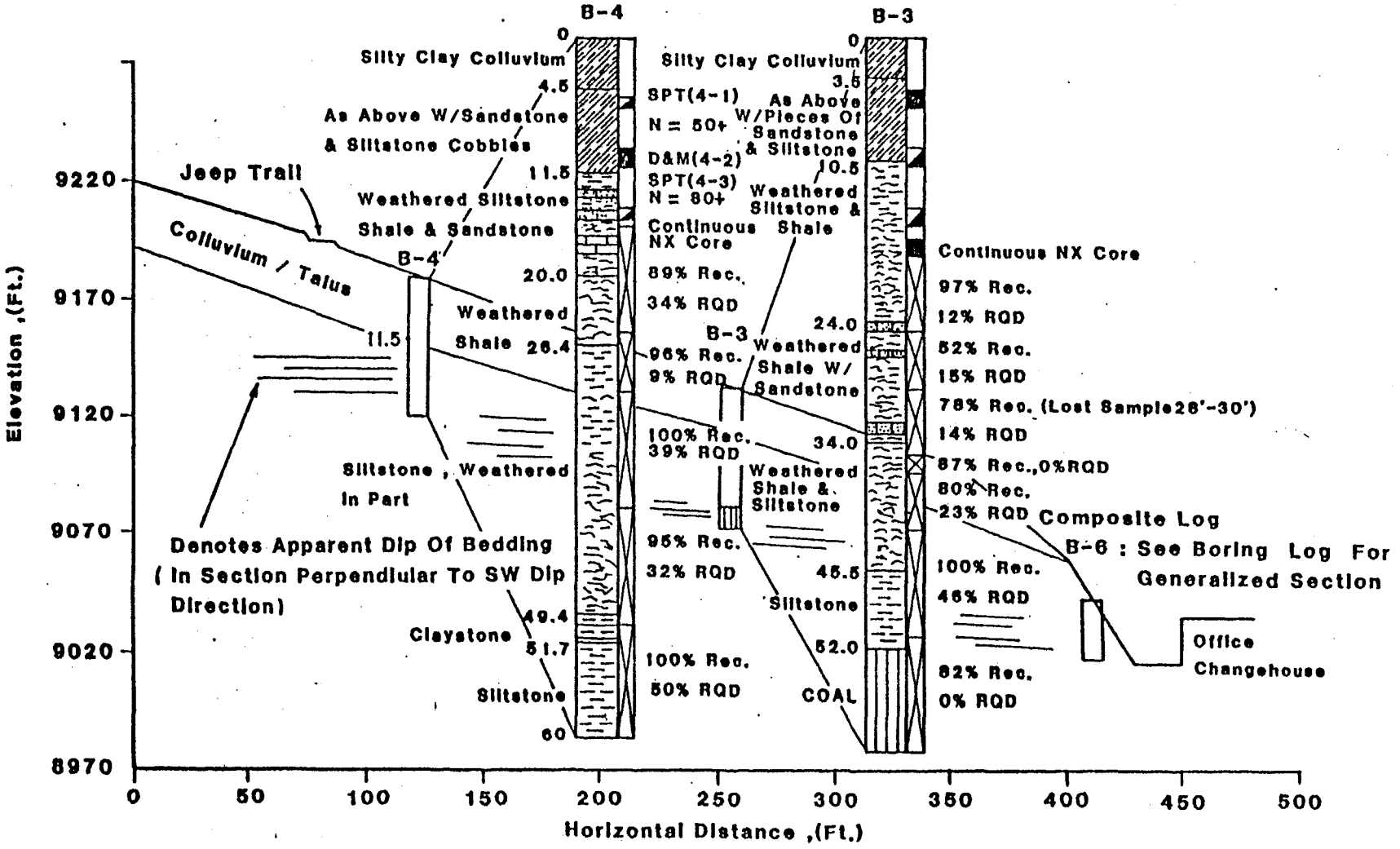
UPPER PORTAL BACKSLOPE SECTION A - A'

FIGURE 15



VALLEY CAMP OF UTAH , INC.
BELINA MINE , CARBON COUNTY
UPPER PORTAL BACKSLOPE SECTION B - B'
(ACTIVE SLIDE AREA)

FIGURE 16



VALLEY CAMP OF UTAH ; INC.
BELINA MINE , CARBON COUNTY
UPPER PORTAL BACKSLOPE SECTION C - C'

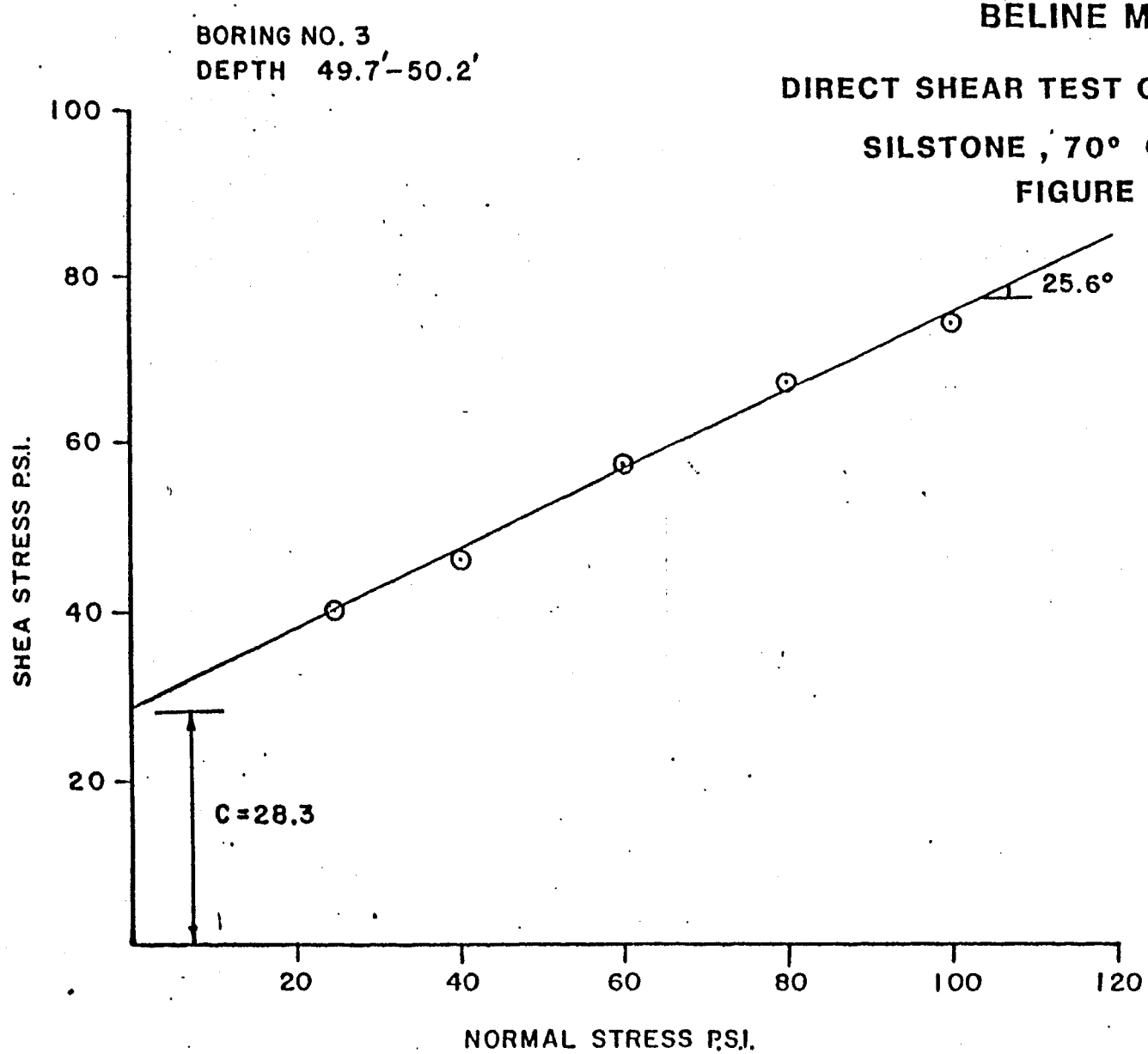
FIGURE 17

VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SILSTONE , 70° OPEN JOINT

FIGURE 18

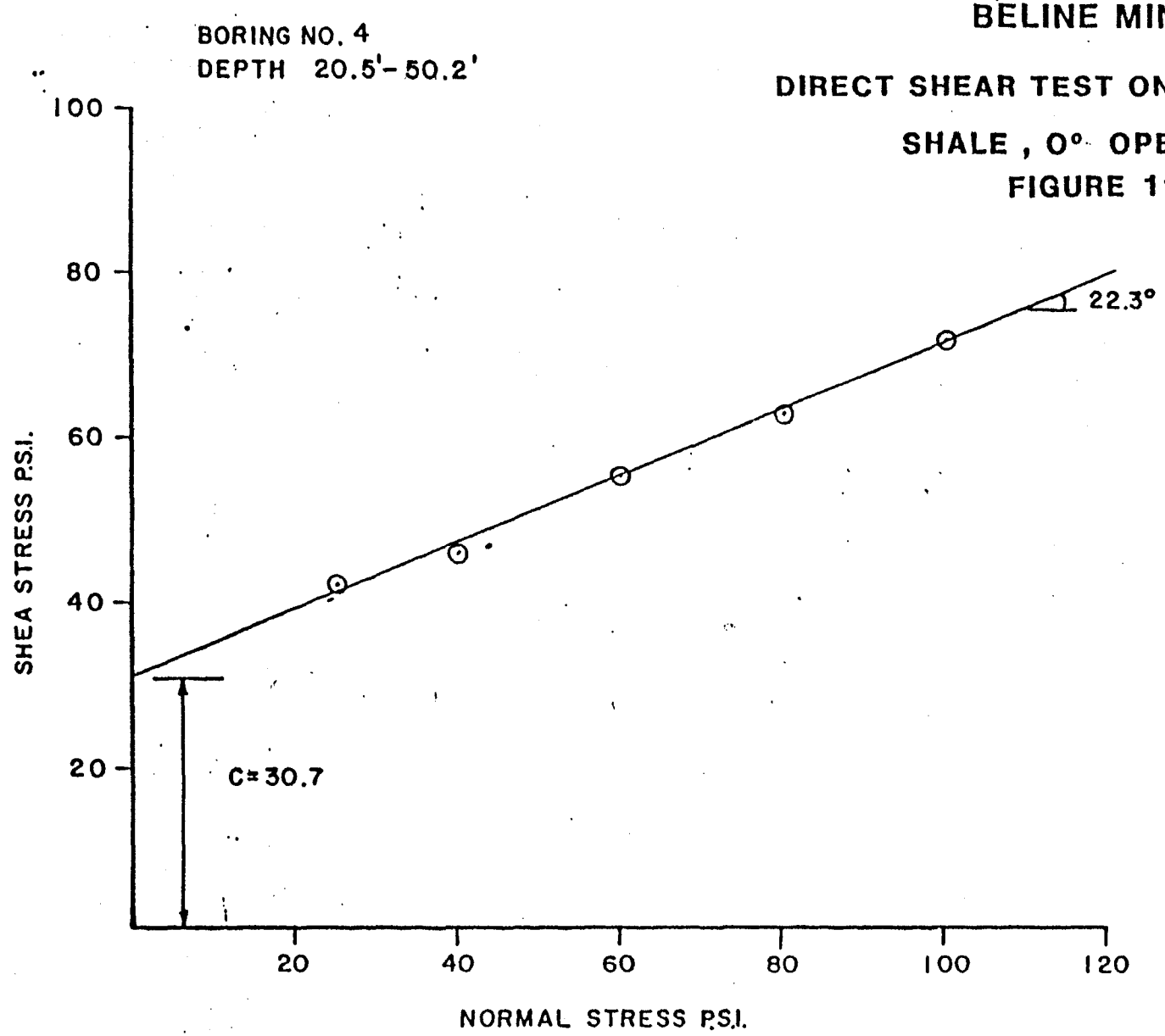


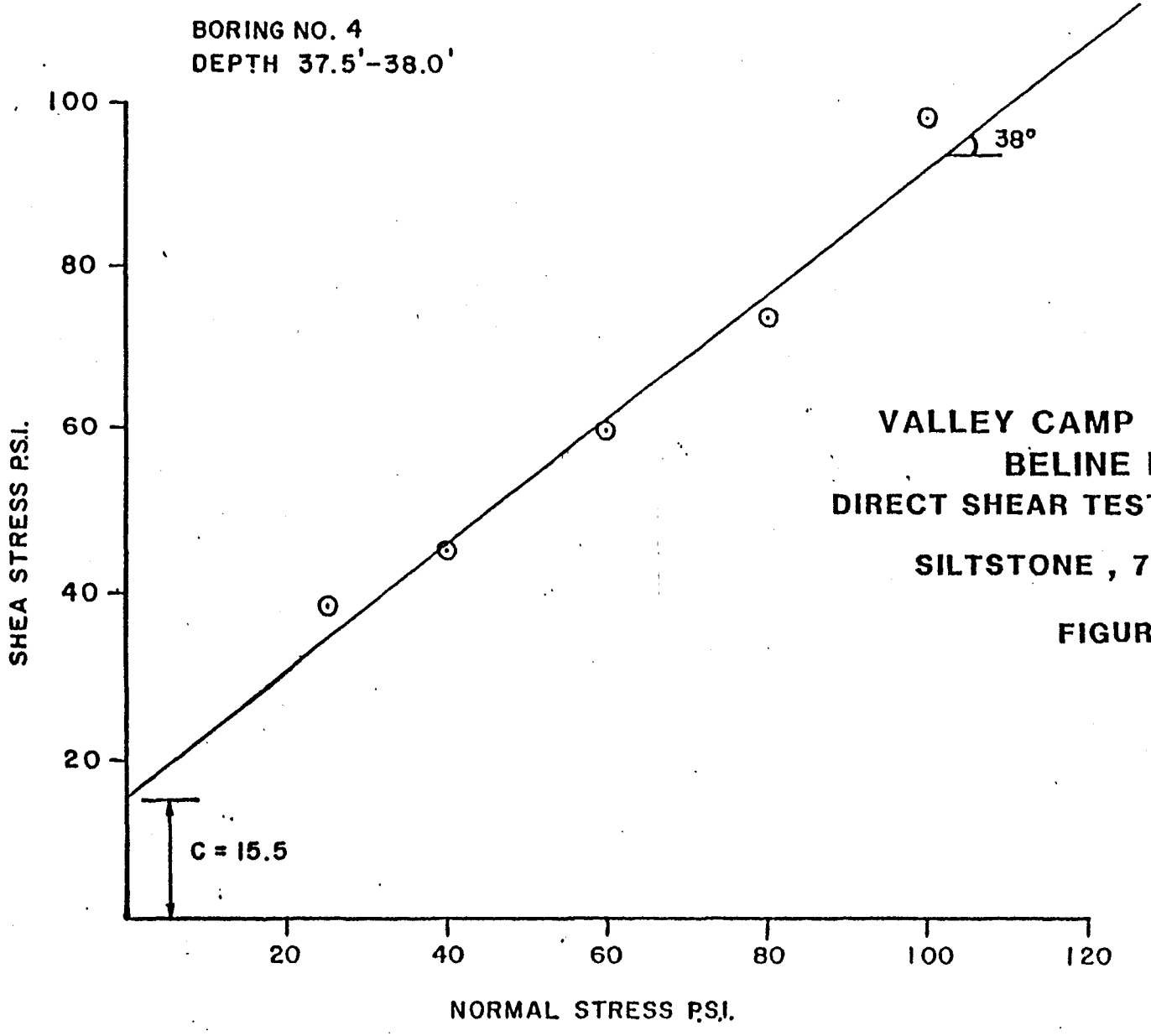
VALLEY CAMP OF UTAH , INC.
BELINE MINE

DIRECT SHEAR TEST ON DISCONTIUITY :

SHALE , 0° OPEN JOINT

FIGURE 19

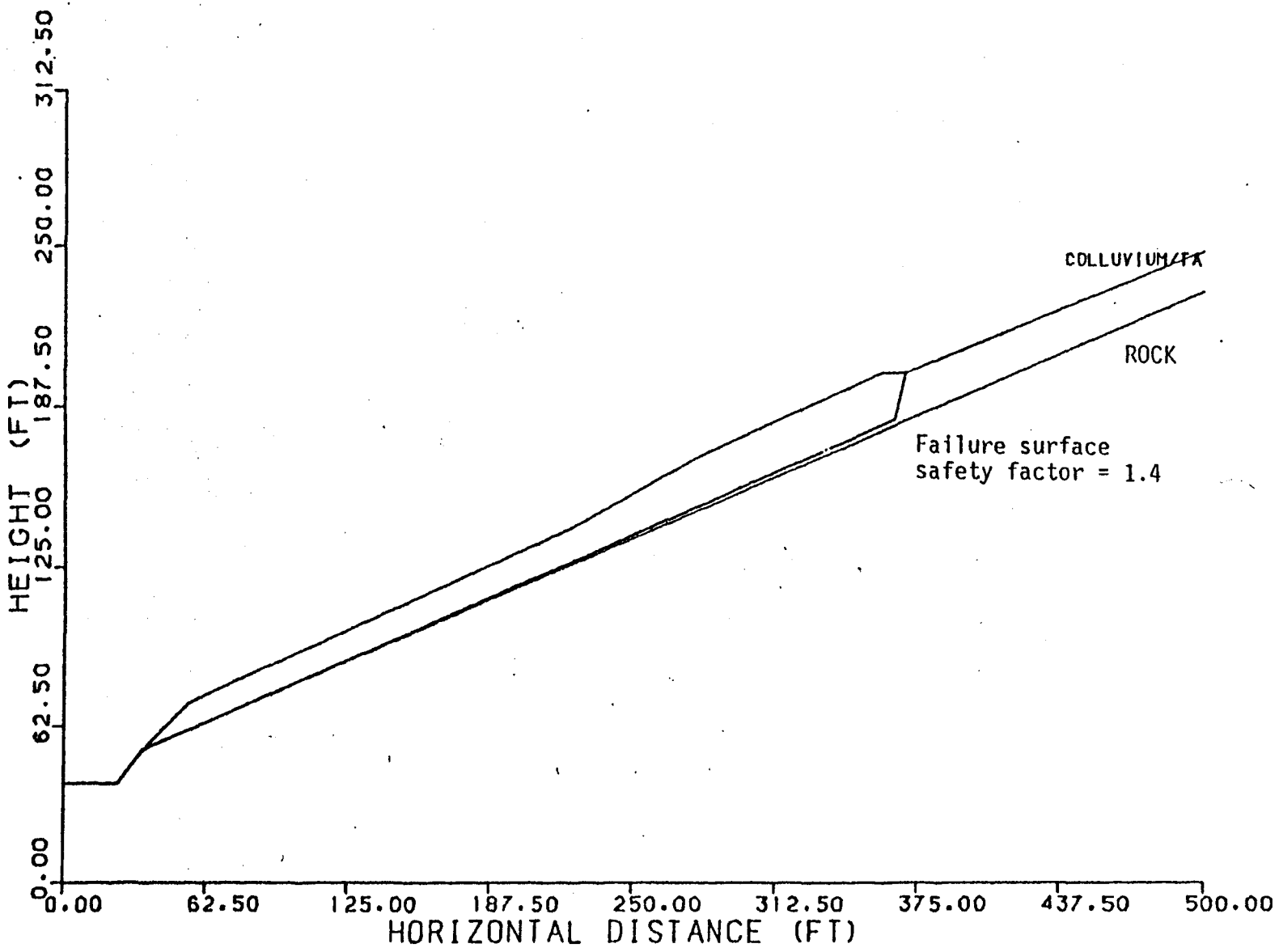




VALLEY CAMP OF UTAH , INC.
BELINE MINE
DIRECT SHEAR TEST ON DISCONTIUITY :

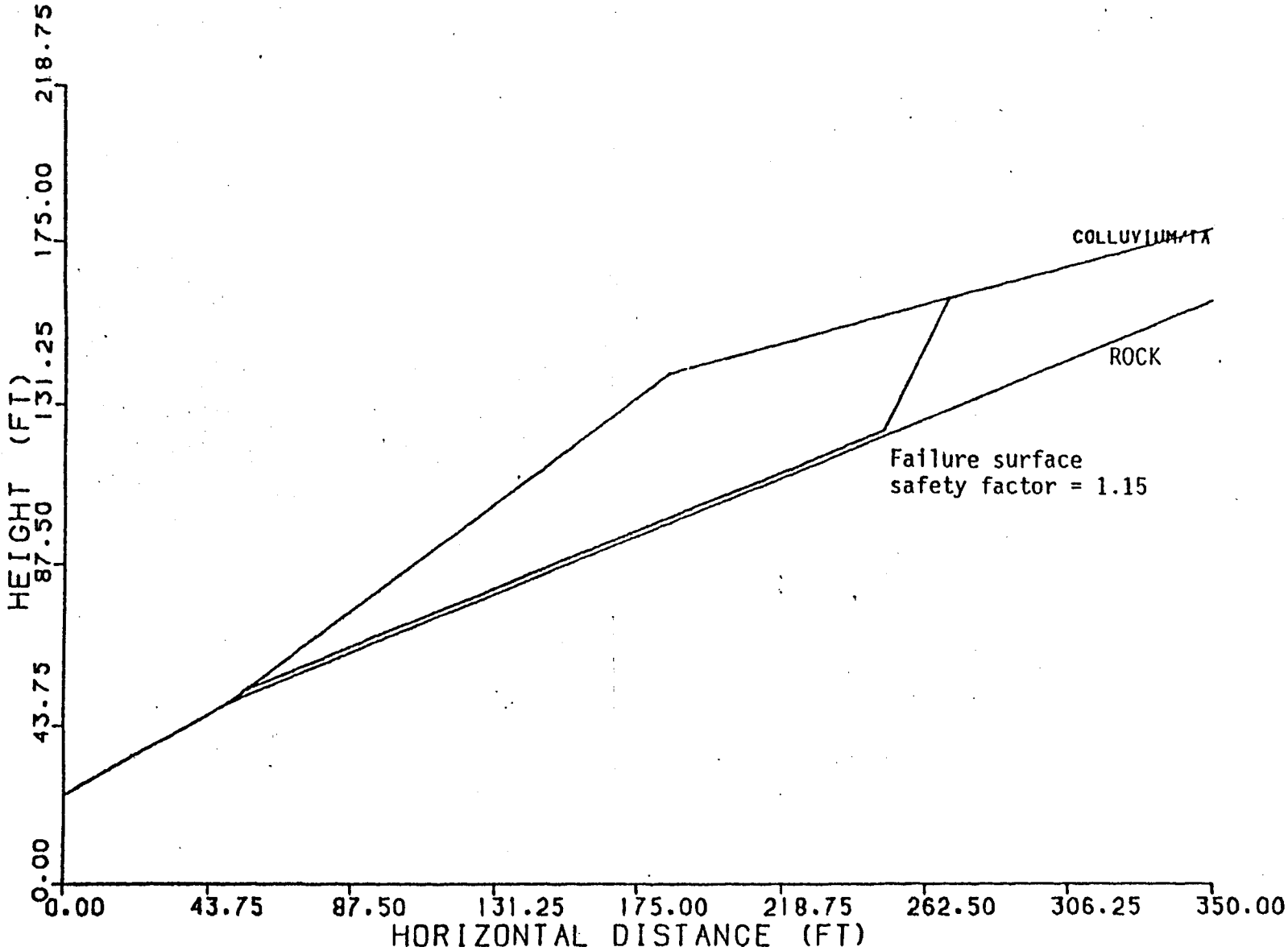
SILTSTONE , 77° OPEN JOINT

FIGURE 20



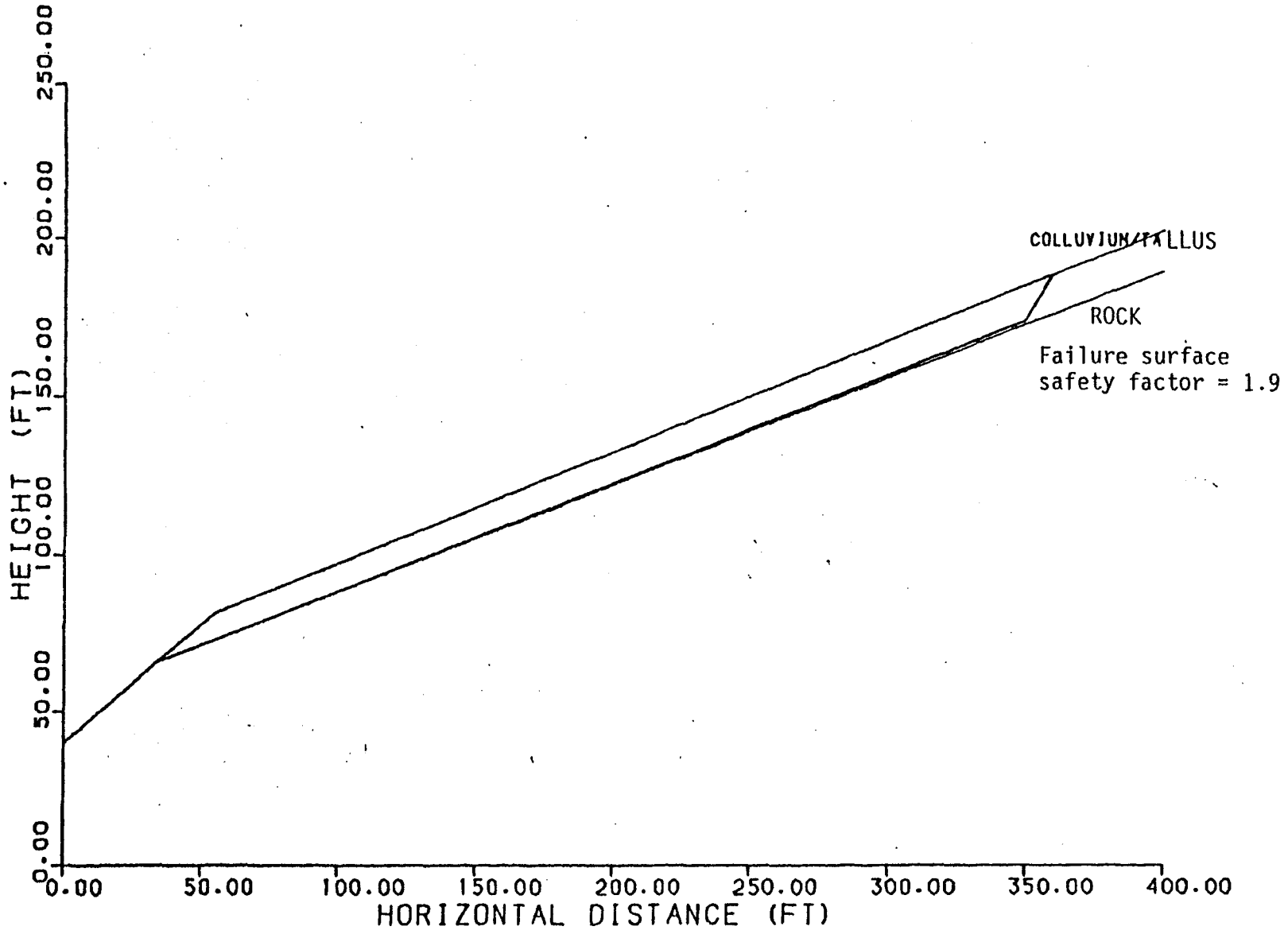
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section A-A

Figure 21



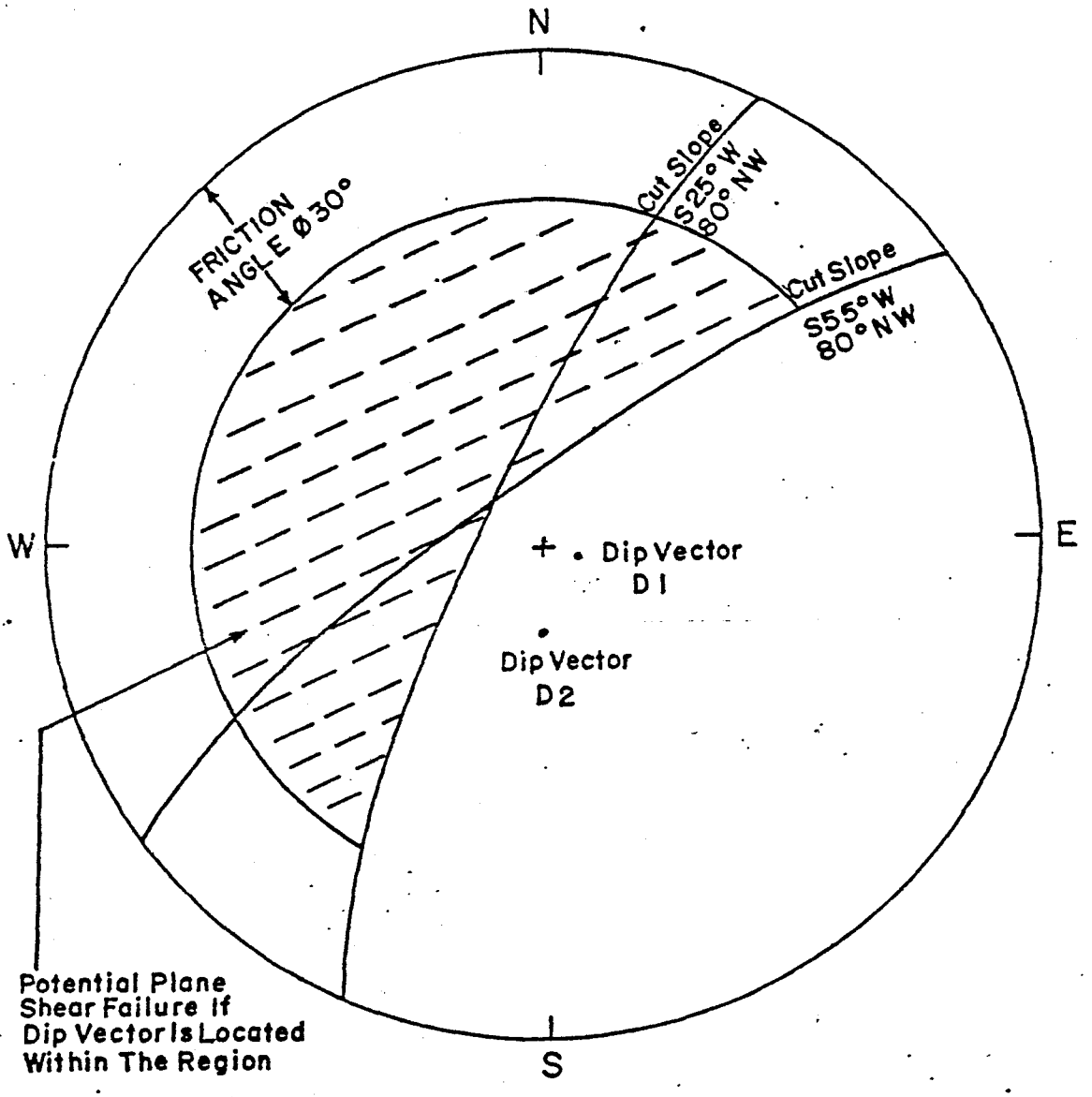
Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section B-B (most critical portion)

Figure 22



Valley Camp of Utah, Inc.
Belina Mine
Computer Generated Geologic
Model of Section C-C

Figure 23

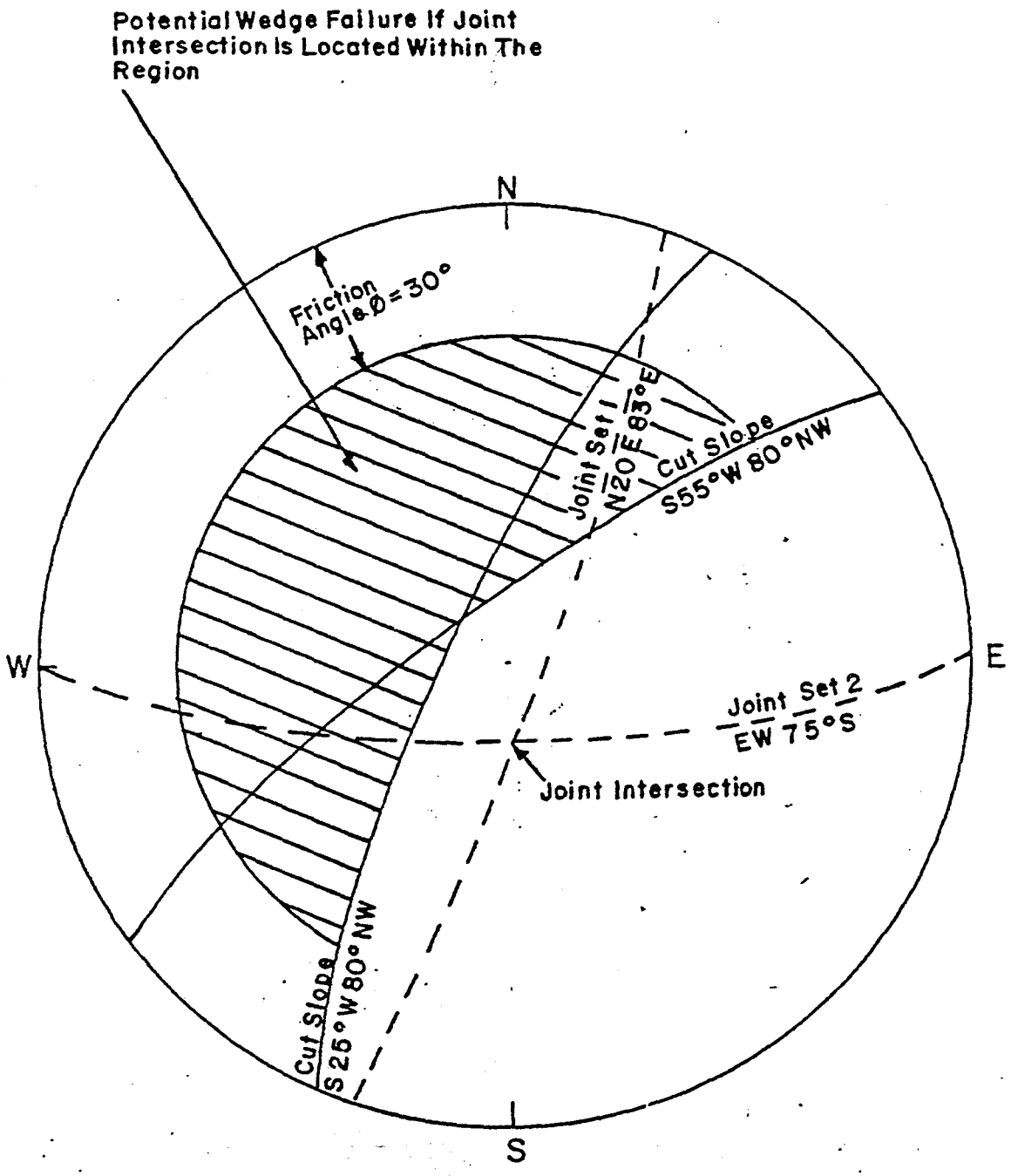


VALLEY CAMP OF UTAH , INC.

BELINA MINE

STEREOPLOT FOR PLANE SHEAR ANALYSIS FOR CUT SLOPE NEAR COAL LOADOUT CHUTE

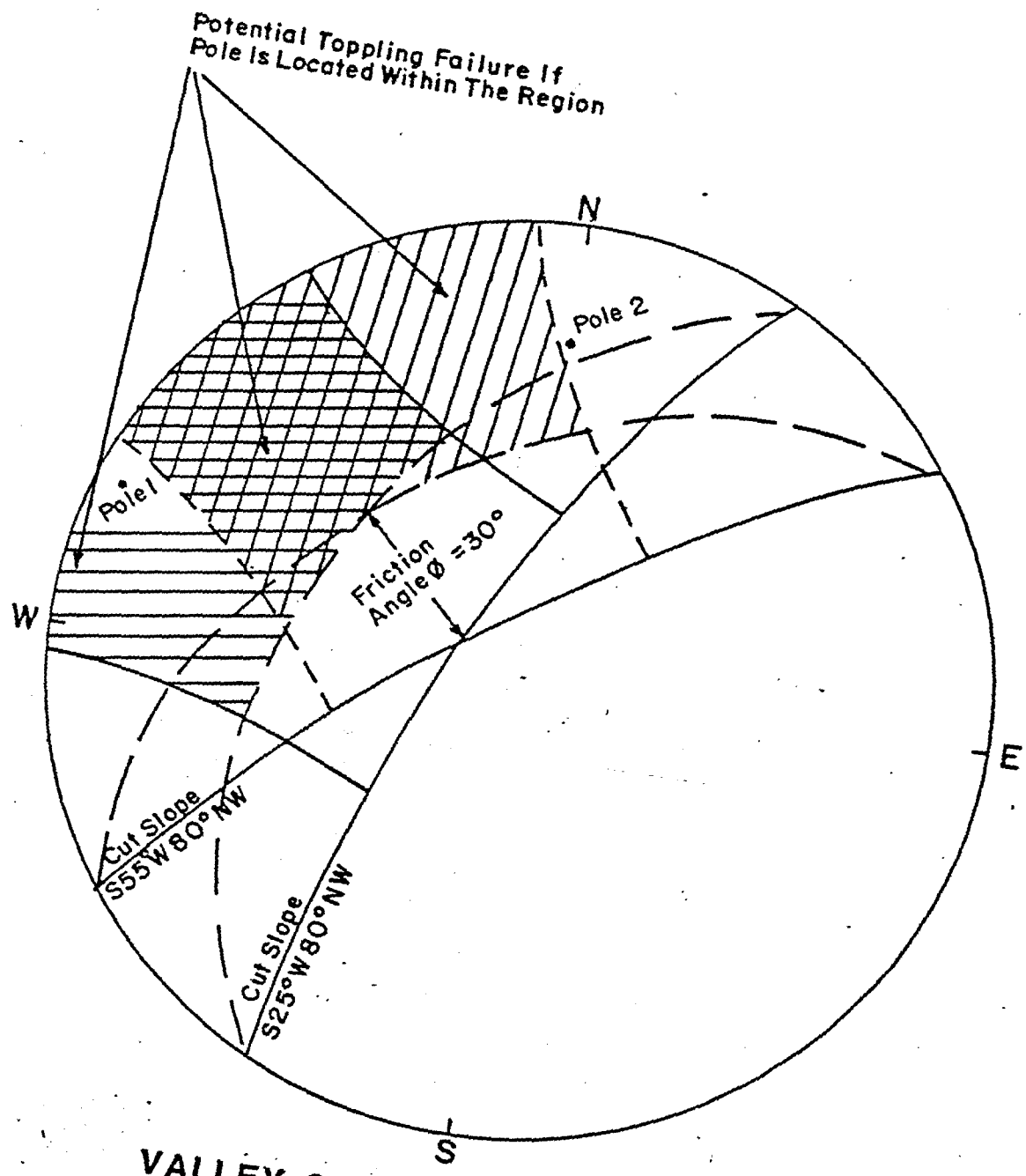
FIGURE 24



VALLEY CAMP OF UTAH , INC.
BELINA MINE

STEREOPLOT FOR WEDGE FAILURE ANALYSIS FOR CUT SLOPE NEAR COAL LOADOUT CHUTE

FIGURE 25



VALLEY CAMP OF UTAH , INC.
BELINA MINE
STEREOPLOT FOR POTENTIAL TOPPLING FAILURE FOR
CUT SLOPE NEAR COAL LOADOUT CHUTE

FIGURE 26

FORD CHEMICAL LABORATORY, INC.
Bacteriological and Chemical Analysis
40 West Louise Avenue
Salt Lake City, Utah 84115
Phone: 466-8761

RECEIVED
FEB 27 1990
DIVISION OF
OIL, GAS & MINING

METHODS OF ANALYSIS FOR
SOIL & OVERBURDEN SAMPLES

Parameter	Units	Method of Extraction & Analysis
Texture Analysis		
Sand	%	Sieve Analysis; USDA, 1952; #18
Silt	%	Hydrometer; USDA, 1952; #18
Clay	%	Hydrometer; USDA, 1952; #18
Total Combustible Solids	%	Dry Ash: ASTM D 3174
Total Noncombustible Solids	%	Dry Ash; ASTM D 3174
pH - Paste	Units	Saturated Paste; USDA, 1969; #60
Iron - Total Fe	ppm	AB DTPA 1
Manganese Mn	ppm	AB DTPA 1
Sulfur		
Phyritic Sulfur	%	ASTM D 2492; #26
Sulfate Sulfur	%	ASTM D 2492; #26
Organic Sulfur	%	ASTM D 2492; #26
Total Sulfur	%	ASTM D 3177; #26
Major Ions (Salinity-Alkalinity)		
Calcium as Ca	ppm	Saturated Paste Extract, USDA #60
Chloride as Cl^{-1}	ppm	Saturated Paste Extract, USDA #60
Fluoride as F^{-1}	ppm	Saturated Paste Extract, USDA #60
Magnesium as Mg	ppm	Saturated Paste Extract, USDA #60
Nitrogen: Nitrate as NO_3^{-1}	ppm	Saturated Paste Extract, USDA #60
Phosphate as PO_4^{-3}	ppm	AB-DTPA 1
Potassium as K	ppm	Saturated Paste Extract, USDA #60
Sodium as Na	ppm	Saturated Paste Extract, USDA #60
Sulfate as SO_4^{-2}	ppm	ASTM D 2492; #26
Conductivity	um/hos/cm	Saturated Paste Extract, USDA #60
Sodium Adsorption Ratio (SAR)		Saturated Paste Extract, USDA #60
Total Carbonate as CO_3^{-2}	%	Acid Titration, (23c), USDA #60
Toxic Heavy Metals		
Arsenic as As	ppm	AB DTPA 1
Barium as Ba	ppm	AB DTPA 1
Boron as B	ppm	Saturated Paste Extract, USDA #60
Cadmium as Cd	ppm	AB DTPA 1
Chromium as Cr	ppm	AB DTPA 1
Copper as Cu	ppm	AB DTPA 1
Lead as Pb	ppm	AB DTPA 1
Mercury as Hg	ppm	Acid Extract; U.S. EPA, 1979; 245.5
Molybdenum as Mo	ppm	AB DPTA 1
Nickel as Ni	ppm	AB DPTA 1
Selenium as Se	ppm	AB DPTA 1
Zinc as Zn	ppm	AB DPTA 1
Radioactive		
Gross Alpha	ppbU	USGS, 1977
Gross Beta	piC/kg	USGS, 1977

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006766

SAMPLE: SOIL SAMPLES FROM BELINA PAD #2 COLLECTED 9-23-83
RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.
1-Clay % USDA 18	10.50	19.50	30.80
Sand % USDA 18	20.00	50.00	37.70
1-Silt % USDA 18	69.50	30.50	31.50
Acid/Base Pot.Tons/1000 Tons	.38	.37	.36
oron Sol.ppm USDA 60	.058	.013	.112
Ca.Carbonate Tons/1000Tons	2.07	3.87	4.39
alcium Carbonate ppm USDA 60	2,700.00	3,870.00	4,390.00
Calcium Sol. Meq/l USDA 60	95.30	117.26	127.64
Conductivity mmhos/cm @ 25	.90	.75	.69
opper ppm AB DTPA 1	.200	.270	.300
Iron ppm AB DTPA 1	51.500	45.600	44.900
agnesium Sol. Meq/l USDA 60	21.41	15.65	17.28
Manganese ppm AB DTPA 1	4.900	8.600	9.300

All reports are submitted as the confidential property of clients. Authorization for publication of our reports, conclusions, or, extracts from or regarding them, is reserved pending our written approval as a mutual protection to clients, the public and ourselves.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 2

CERTIFICATE OF ANALYSIS
83-006766

	0 - 2 FT.	2 - 4 FT.	4 - 8 FT.
Moisture %	23.00	34.60	40.20
Molybdenum ppm AB DTPA 1	.008	.010	.009
Neut./Potential Tons/1000Tons	2.32	3.50	4.03
Nitrate NO3-N ppm USDA 60	2.40	4.60	5.10
Organic Material % (WB)	3.60	5.40	4.80
pH USDA 60	7.20	7.30	7.50
Phosphorus ppm AB DTPA 1	16.50	26.40	25.40
Potassium ppm USDA 60	110.00	86.00	79.00
Pyritic Sulfur % ASTM D2492	.0123	.0120	.0115
Saturation %	23.40	18.70	25.10
Selenium ppm AB DTPA 1	.025	.017	<.001
Sodium Absorption Ratio	.039	.062	.063
Sodium Sol.Meq/l USDA 60	.30	.51	.54
Zinc ppm AB DTPA 1	.950	1.850	1.990

FORD CHEMICAL LABORATORY, INC.

All reports are submitted as the confidential property of clients. Authorization for publication of our reports, conclusions, or, extracts from or regarding them, is reserved pending our written approval as a mutual protection to clients, the public and ourselves.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

CERTIFICATE OF ANALYSIS
83-006765

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.
Moisture %	19.80	22.50	36.40	33.20
Molybdenum ppm AB DTPA 1	.075	.036	.055	.028
Neut./Potential Tons/1000Tons	4.07	3.04	2.48	3.14
Nitrate NO3-N ppm USDA 60	3.30	4.20	5.40	6.70
Organic Material % (WB)	4.70	3.90	4.50	3.36
PH USDA 60	7.50	7.40	7.45	7.80
Phosphorus ppm AB DTPA 1	20.60	31.40	4.50	16.20
Potassium ppm USDA 60	114.00	95.00	81.00	110.00
Pyritic Sulfur % ASTM D2492	.0140	.0133	.0125	.0150
Saturation %	22.50	21.90	19.30	24.60
Selenium ppm AB DTPA 1	.015	.010	.006	.002
Sodium Absorption Ratio	.047	.064	.087	.100
Sodium Sol.Meq/l USDA 60	.42	.51	.72	.85
Zinc ppm AB DTPA 1	1.650	2.400	1.900	2.300

FORD CHEMICAL LABORATORY, INC.

All reports are submitted as the confidental property of clients. Authorization for publication of our reports, conclusions, or, extracts from or regarding them, is reserved pending our written approval as a mutual protection to clients, the public and ourselves.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. 1

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006765

SAMPLE: SOIL SAMPLES FROM BELINA PAD #1 COLLECTED 9-23-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. #30-83-10-007831.

	0 - 2 FT.	2 - 4 FT.	4 - 6 FT.	6 - 8 FT.
1-Clay % USDA 18	12.80	28.20	85.50	60.20
Sand % USDA 18	65.80	53.50	27.50	27.30
1-Silt % USDA 18	21.40	18.30	14.00	12.50
Acid/Base Pot.Tons/1000 Tons	.43	.41	.39	.46
Boron Sol.ppm USDA 60	.057	.119	.089	.008
Ca.Carbonate Tons/1000Tons	4.50	3.45	2.87	3.60
Calcium Carbonate ppm USDA 60	4,500.00	3,450.00	2,870.00	3,600.00
Calcium Sol. Meq/l USDA 60	130.73	108.78	117.26	122.00
Conductivity mmhos/cm @ 25	.80	.77	.85	.95
Copper ppm AB DTPA 1	.250	.100	.300	.050
Iron ppm AB DTPA 1	66.500	68.300	59.200	77.500
Magnesium Sol. Meq/l USDA 60	15.81	15.33	14.26	17.26
Manganese ppm AB DTPA 1	14.500	12.600	10.500	6.650

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
COFIELD ROUTE
HELPER, UTAH
84526

83-006763

AMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
I-Clay % USDA 18	54.50	38.60	51.90	22.50	48.90
-Sand % USDA 18	33.50	39.80	31.50	56.50	25.50
1-Silt % USDA 18	12.00	21.60	16.60	21.00	25.60
cid/Base Pot.Tons/1000 Tons	.39	.42	.34	.37	.57
ron Sol.ppm USDA 60	.258	.168	.241	.165	.117
Ca.Carbonate Tons/1000Tons	4.60	4.20	3.77	3.92	3.70
lcium Carbonate ppm USDA 60	4,600.00	4,200.00	3,770.00	3,920.00	3,700.00
Calcium Sol. Meq/l USDA 60	127.74	123.75	115.26	118.26	128.74
onductivity mmhos/cm @ 25	.75	.80	.84	.90	.78
pper ppm AB DTPA 1	.020	.090	.100	.150	.280
Iron ppm AB DTPA 1	56.500	54.200	63.500	74.100	58.900
gnesium Sol. Meq/l USDA 60	14.79	14.40	13.76	13.57	13.11
Manganese ppm AB DTPA 1	9.200	6.800	4.900	8.300	9.500

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LABORATORY, INC.
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40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	0 - 2.5	2.5 - 5	5 - 7.5	7.5 - 10	10 - 12.5
Moisture %	19.80	21.50	22.40	22.50	34.50
Molybdenum ppm AB DTPA 1	.166	.175	.116	.150	.13
Neut./Potential Tons/1000Tons	4.21	3.78	3.43	3.55	3.1
Nitrate NO3-N ppm USDA 60	2.10	4.60	1.80	2.50	1.9
Organic Material % (WB)	3.30	4.60	8.20	5.90	7.7
pH USDA 60	7.20	7.40	7.80	7.30	7.5
Phosphorus ppm AB DTPA 1	12.90	15.60	8.70	16.20	11.4
Potassium ppm USDA 60	112.00	95.00	86.00	69.00	72.0
Pyritic Sulfur % ASTM D2492	.0125	.0136	.0110	.0120	.010
Saturation %	24.50	21.80	24.60	23.80	31.5
Selenium ppm AB DTPA 1	.005	.001	.001	<.001	<.00
Sodium Absorption Ratio	.081	.062	.080	.096	.05
Sodium Sol.Meq/l USDA 60	.69	.52	.65	.78	.4
Zinc ppm AB DTPA 1	1.770	1.950	1.800	7.100	7.500

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Bacteriological and Chemical Analysis
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SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
Organic Material % (WB)	5.50	6.80	4.85	10.50	6.80
PH USDA 60	7.80	7.44	7.90	7.50	7.45
Phosphorus ppm AB DTPA 1	10.50	14.50	21.60	15.50	11.50
Potassium ppm USDA 60	105.00	120.00	119.00	88.00	79.00
Pyritic Sulfur % ASTM D2492	.0122	.0165	.0180	.0135	.0124
Saturation %	27.10	20.70	21.50	28.20	20.40
Selenium ppm AB DTPA 1	<.001	<.001	<.001	<.001	<.001
Sodium Absorption Ratio	.060	.050	.060	.064	.084
Sodium Sol.Meq/l USDA 60	.47	.38	.50	.52	.65
Zinc ppm AB DTPA 1	2.200	1.300	1.450	1.220	2.100

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
88-006763

	12.5 - 15	15 - 17.5	17.5 - 20	20 - 22.5	22.5 -25
1-Clay % USDA 18	15.30	14.00	20.00	24.20	31.50
1-Sand % USDA 18	60.20	54.50	33.50	24.50	58.60
1-Silt % USDA 18	24.50	31.50	46.50	51.30	9.90
Acid/Base Pot.Tons/1000 Tons	.38	.51	.56	.42	.38
Boron Sol.ppm USDA 60	.098	.258	.410	.165	.137
Ca.Carbonate Tons/1000Tons	3.49	2.96	4.13	3.59	3.15
Calcium Carbonate ppm USDA 60	3,490.00	2,960.00	4,130.00	3,590.00	3,150.00
Calcium Sol. Meq/l USDA 60	109.73	99.10	122.50	114.42	102.79
Conductivity mmhos/cm @ 25	.88	.92	.88	.76	.80
Copper ppm AB DTPA 1	.030	.050	.100	.240	.250
Iron ppm AB DTPA 1	66.900	71.400	75.200	61.500	59.500
Magnesium Sol. Meq/l USDA 60	10.52	13.57	15.24	13.68	14.42
Manganese ppm AB DTPA 1	11.600	9.500	8.500	6.750	8.500
Moisture %	18.50	23.50	21.50	24.60	20.50
Molybdenum ppm AB DTPA 1	.085	.025	.016	.025	.185
Neut./Potential Tons/1000Tons	3.11	2.45	3.57	3.17	2.77
Nitrate NO3-N ppm USDA 60	2.80	4.40	3.50	1.80	2.85

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

CERTIFICATE OF ANALYSIS
83-006764

	25 - 27.5	27.5 - 30
Moisture %	31.40	29.50
Molybdenum ppm AB DTPA 1	.118	.037
Neut./Potential Tons/1000Tons	3.65	3.62
Nitrate NO3-N ppm USDA 60	6.40	5.30
Organic Material % (WB)	4.85	4.91
PH USDA 60	7.35	7.40
Phosphorus ppm AB DTPA 1	30.70	29.20
Potassium ppm USDA 60	96.00	91.00
Pyritic Sulfur % ASTM D2492	.0119	.0110
Saturation %	25.10	19.70
Selenium ppm AB DTPA 1	<.001	<.001
Sodium Absorption Ratio	.056	.061
Sodium Sol.Meq/l USDA 60	.45	.50
Zinc ppm AB DTPA 1	1.700	1.800

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Test Hole No. B-5

DATE: 12/29/83

CERTIFICATE OF ANALYSIS

VALLEY CAMP OF UTAH
SCOFIELD ROUTE
HELPER, UTAH
84526

83-006764

SAMPLE: SOIL SAMPLES FROM BELINA PAD COLLECTED 9-15-83 RECEIVED 9-23-83 FOR ANALYSIS UNDER P.O. 30-83-10-007831.

	25 - 27.5	27.5 - 30
1-Clay % USDA 18	22.00	17.10
-Sand % USDA 18	49.50	53.50
1-Silt % USDA 18	28.50	29.40
Acid/Base Pot.Tons/1000 Tons	.37	.34
Boron Sol.ppm USDA 60	.066	.098
Ca.Carbonate Tons/1000Tons	4.02	3.96
Calcium Carbonate ppm USDA 60	4,025.00	3,960.00
Calcium Sol. Meq/l USDA 60	120.25	119.01
Conductivity mmhos/cm @ 25	.74	.75
Copper ppm AB DTPA 1	.420	.460
Iron ppm AB DTPA 1	45.500	43.800
Magnesium Sol. Meq/l USDA 60	14.58	15.24
Manganese ppm AB DTPA 1	11.200	10.850

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Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

MINE: UTAH NO. 2

ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC.

DATE: September 24, 1983

Lab No.	Hole No.	Depth Interval Ft.	pH	Cond. mmhos/ cm @ 25°C	Saturation %	Particle Size Sand %	Silt %	Clay %	Texture	Soluble Cations Ca	Mg Meq/l	Na	SAR (1)
22093	1	10 Ft. - 2 Ft.	7.3	0.79	34.3	50.4	38.9	10.7	Loam	5.29	1.71	1.22	0.65
22094	2	8 Ft. - 2 Ft.	7.4	1.08	30.5	59.5	30.7	9.8	Sandy Loam	7.75	2.35	1.32	0.59
22095	3	6 Ft. - 2 Ft.	5.5	0.31	32.2	44.0	42.5	13.5	Loam	1.81	0.41	0.97	0.92

Footnotes: (1) Sodium Adsorption Ratio

Valley Camp of Utah, Inc.
Belina Mine Site
Clear Creek, Utah 84526

MINE: UTAH NO. 2 ANALYSIS BY: INTER-MOUNTAIN LABORATORIES, INC. DATE: September 24, 1983

Lab No.	Hole No.	OM% (13)	K+ (14)	PO4 (15)	Fe ppm (2)	Zn ppm (3)	B ppm (4)	N ppm (5)	Mo ppm (6)	Cu ppm (7)	Mn ppm (8)	TS % (9)	AB (10)	NP (11)	ABP (12)
22093	1	1.9	123.	17.4	15.1	1.09	0.84	7.13	0.09	0.51	9.35	0.05	1.56	22.3	20.7
22094	2	2.5	69.	13.7	16.6	1.12	0.85	5.71	0.08	0.41	13.3	0.05	1.56	57.1	55.5
22095	3	4.5	68.	8.74	59.3	0.66	0.76	4.30	0.05	0.80	7.52	0.05	1.56	11.9	10.3

Footnotes:
(13) Organic Matter
(14) Potassium
(15) Phosphate as P
(2) Iron DTPA
(3) Zinc DTPA
(4) Boron
(5) Nitrate Nitrogen
(6) Ammonium Extractable Molybdenum
(7) Copper DTPA
(8) Manganese DTPA
(9) Total Sulfur Per Cent
(10) Acid Base
(11) Neutralization Potential
(12) Acid Base Potential in Tons Calcium Carbonate per 1000 Tons of Soil

RESULTS OF VEGETATION SAMPLING AND MONITORING FOR THE UTAH AND BELINA REVEGETATION TEST PLOTS

1989

Prepared by

MT. NEBO SCIENTIFIC RESEARCH & CONSULTING
Post Office Box 337
Springville, Utah 84663
(801) 489-6937

Prepared for

VALLEY CAMP OF UTAH, INC.
Scofield Route
Helper, Utah 84526

Report by
Patrick D. Collins, Ph.D.

Fieldwork: Patrick D. Collins
P. Dean Collins

October 1989

INTRODUCTION

Following are second year results from vegetation monitoring of test plots for Valley Camp of Utah. The plots are located near Scofield, Utah. Quantitative data were also submitted in 1988 for the test plots.

The test plots were constructed in 1987 to test revegetation potential of available soil material on the mine area. The test plot design was developed by the State of Utah, Division of Oil, Gas & Mining (DOGM) and Valley Camp of Utah, Inc. Plot construction (layout and earthmoving work) was accomplished by (or under the direction of) Valley Camp of Utah. Seed, fertilizer and hydromulch by the specified design was applied by Mt. Nebo Scientific in October of 1987.

Two main areas were used as sites for the vegetation test plots. These areas were called the Utah Site and the Belina Site. The Utah Site is located south of the truck load-out pad and east of the railroad tracks on an old coal storage area. The Belina Site is on the slope south of the sediment pond.

Monitoring was initiated by sampling the vegetation on the two sites by Mt. Nebo Scientific in August of 1988 and 1989. An additional site that had been previously implemented by a different contractor was sampled and submitted to Valley Camp Co. and DOGM for comparisons in 1988. Results of the quantitative sampling are summarized in this report.

METHODS

Quantitative and qualitative data were taken on each of the two sites. Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. A randomized block design was implemented to insure adequate representation of the entire plot. On the Utah site, three 12.5 meter transects were regularly placed on the plot to adequately cover the entire plot. Twenty sample points were then placed every 1.5 meters along these transects. A one meter buffer strip was placed around the entire plot where sample points were avoided to limit sample bias. There was only one treatment to be monitored on this plot.

The Belina Site, however, had four different treatments to be sampled. Therefore, a total of four areas or "subplots" were sampled. The subplots were labeled on the data summary tables by directional locations and treatments and are listed below:

1) NE Subplot, Light Soil A, Fertilized
2) NW Subplot, Light Soil A, Unfertilized
3) SE Subplot, Gray Soil B, Fertilized
4) SW Subplot, Gray Soil B, Unfertilized

Three transects were also placed on each of the subplots listed above. Eight sample locations were regularly placed on each treatment with a total of 40 samples for all treatments. A one meter buffer strip was also placed around each of the treatments where quadrat placement was avoided.

Cover estimates were made using ocular methods with meter square quadrats. Species cover, total cover, composition and relative

frequency were also assessed from the quadrats. Also recorded on data sheets were estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Sampling adequacy for cover on the Utah Site was achieved using formulas from Snedocor and Cochran (1980), insuring that 80% of the samples were within 10% of the true mean of the test plots. Sample number of the Belina Site was determined by L. Kunzler (DOGM). All sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired.

Plant species nomenclature follows Welsh et al. (A Utah Flora. 1987. Great Basin Naturalist Memoir No. 9). Sample design and methodologies were approved by a representative of the State of Utah, DOGM (L. Kunzler, Reclamation Biologist). Mr. Kunzler was present on site upon initiation of the test plot sampling in 1988.

RESULTS

Summary Tables

All results of the vegetation sampling for 1989 are shown on the summary tables (Tables 1 - 10). Included in these tables are:

1) percent cover and standard deviations (total living cover, mulch & litter, bare ground, & rock),
2) composition (% shrubs, forbs, & grasses),
3) cover and frequency by species,
4) sample sizes.

Nomenclature

Because the author decided to use the most recent nomenclature for plant species for the summary tables, and because some of the species on the original seed mix list have been changed, a list is provided below showing the old and new scientific names.

Old Name (on seed mix lists)	New Name (Welsh 1987)
Shrubs	
Amelanchier alnifolia	Amelanchier alnifolia
Artemisia tridentata var. vaseyana	Artemisia tridentata vaseyana
Chrysothamnus nauseosus albicaulis	C. nauseosus albicaulis
Rosa woodsii	Rosa woodsii
Sambucus coerulea	Sambucus coerulea
Symphoricarpos oreophilus	Symphoricarpos oreophilus
Forbs	
Achillea millefolium	Achillea millefolium
Artemisia ludoviciana	Artemisia ludoviciana
Linum lewisii	Linum perenne ssp. lewisii
Hedysarum boreale	Hedysarum boreale
Medicago sativa	Medicago sativa
Melilotus officinalis	Melilotus officinalis
Penstemon strictus	Penstemon strictus
Grasses	
Agropyron dasystachyum	Elymus lanceolatus
Agropyron smithii	Elymus smithii
Bromus marginatus	Bromus carinatus
Poa canbyi	Poa canbyi
Poa pratensis	Poa pratensis

The test plots will continue to be monitored according to the schedule accepted by the State of Utah, DOGM.

TABLE 1: 1989 SAMPLING RESULTS - BELINA PLOT
(NE Subplot, Light Soil A, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	29.50	15.61	8
Mulch & Litter	11.63	6.87	8
Bareground	13.75	9.27	8
Rock	45.13	16.67	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	1.91	3.51	8
Forbs	5.08	6.55	8
Grasses	93.02	9.63	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 2: **1989 SAMPLING RESULTS - BELINA PLOT**
(NE Subplot, Light Soil A, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	0.13	0.33	8	12.50
Picea pungens	0.13	0.33	8	12.50
FORBS				
Circium sp.	0.75	1.64	8	25.00
Linum lewsii	0.38	0.48	8	37.50
Urtica dioica	0.13	0.33	8	12.50
GRASSES				
Bromus carinatus	6.50	5.15	8	62.50
Dactylus glomeratus	3.38	4.15	8	50.00
Elymus lanceolatus	13.88	9.91	8	87.50
Elymus smithii	2.13	2.32	8	50.00
Elymus spicatus	0.25	0.66	8	12.50
Poa pratensis	1.88	4.96	8	12.50

TABLE 3: 1989 SAMPLING RESULTS - BELINA PLOT
(NW Subplot, Light Soil A, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	31.25	5.99	8
Mulch & Litter	14.38	7.68	8
Bareground	12.50	2.50	8
Rock	41.88	8.99	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	--
Forbs	7.08	13.58	8
Grasses	92.92	13.58	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 4: **1989 SAMPLING RESULTS - BELINA PLOT**
(NW Subplot, Light Soil A, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
Circium sp.	0.25	0.66	8	12.50
Epilobium halleanum	0.63	1.65	8	12.50
Fragaria vesca	0.63	1.65	8	12.50
Urtica dioica	0.13	0.33	8	12.50
GRASSES				
Bromus carinatus	3.75	4.15	8	50.00
Dactylis glomerata	4.75	3.60	8	75.00
Elymus lanceolatus	15.50	8.99	8	100.00
Elymus smithii	1.25	2.17	8	25.00
Elymus spicatus	3.75	4.84	8	37.50
Elymus trachycaulus	0.63	1.65	8	12.50

TABLE 5: 1989 SAMPLING RESULTS - BELINA PLOT
(SE Subplot, Gray Soil B, Fertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	35.63	11.84	8
Mulch & Litter	8.13	3.48	8
Bareground	28.13	3.48	8
Rock	28.13	7.47	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	15.42	22.00	8
Grasses	84.58	22.00	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 6: **1989 SAMPLING RESULTS - BELINA PLOT**
(SE Subplot, Gray Soil B, Fertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	8	--
FORBS				
Epilobium halleanum	0.38	0.70	8	25.00
Hedysarum boreale	1.13	1.76	8	37.50
Machaeranthera canescens	0.63	1.65	8	12.50
Penstemon strictus	1.63	3.31	8	25.00
GRASSES				
Bromus carinatus	6.88	10.83	8	50.00
Dactylis glomerata	1.63	3.31	8	25.00
Elymus lanceolatus	8.75	8.91	8	62.50
Elymus smithii	9.63	5.57	8	87.50
Elymus spicatus	1.25	2.17	8	25.00
Poa pratensis	3.75	4.84	8	37.50

TABLE 7: 1989 SAMPLING RESULTS - BELINA PLOT
(SW Subplot, Gray Soil B, Unfertilized)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	30.00	14.36	8
Mulch & Litter	5.00	0.00	8
Bareground	35.00	12.75	8
Rock	30.00	12.50	8

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	--	--	8
Forbs	11.61	11.70	8
Grasses	88.39	11.70	8

*Sample size was determined by Division of Oil, Gas & Mining (see METHODS).

TABLE 8: **1989 SAMPLING RESULTS - BELINA PLOT**
(SW Subplot, Gray Soil B, Unfertilized)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS	--	--	--	--
FORBS				
Epilobium halleanum	0.63	1.65	8	12.50
Penstemon strictus	1.88	2.42	8	37.50
Urtica dioica	0.38	0.99	8	12.50
GRASSES				
Bromus carinatus	5.38	3.67	8	75.00
Dactylis glomerata	3.38	4.15	8	50.00
Elymus lanceolatus	7.13	5.16	8	75.00
Elymus smithii	7.50	11.18	8	62.50
Elymus spicatus	1.88	2.42	8	37.50
Poa pratensis	1.88	4.96	8	12.50

TABLE 9: 1989 SAMPLING RESULTS - UTAH PLOT
(Single plot design)

Total cover and composition for the revegetation test plots of Valley Camp of Utah. The table shows means, standard deviations and sample sizes.

COVER

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Total Living Cover	33.20	9.14	20
Mulch & Litter	6.95	5.48	20
Bareground	50.50	17.69	20
Rock	9.35	9.91	20

COMPOSITION

	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE *
Shrubs	2.94	4.14	20
Forbs	59.57	14.92	20
Grasses	37.50	14.09	20

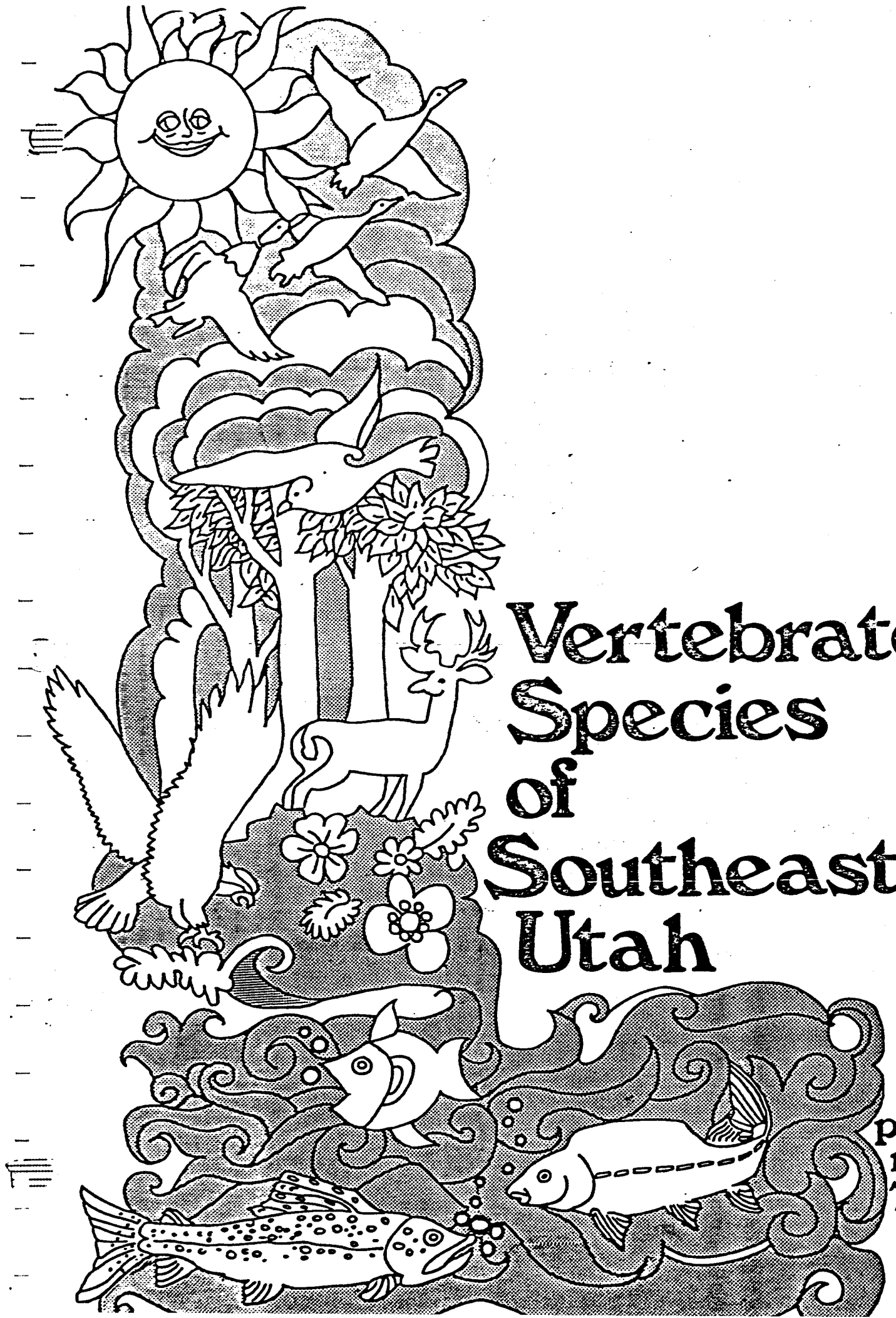
* Sample size insures 80% accuracy within 10% of the true mean.

TABLE 10: **1989 SAMPLING RESULTS - UTAH PLOT**
(Single Plot Design)

Mean percent cover, standard deviation, sample size and relative frequency by species for the revegetation test plots of Valley Camp of Utah.

COVER BY SPECIES

SPECIES	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZE	RELATIVE FREQUENCY
SHRUBS				
Artemisia tridentata	1.15	1.62	20	40.00
FORBS				
Artemisia ludoviciana	2.25	3.81	20	35.00
Chaenactis douglasii	0.30	1.10	20	10.00
Circium sp.	1.75	2.98	20	30.00
Eriogonum sp.	0.45	0.80	20	30.00
Gayophytum ramosissimum	0.10	0.44	20	5.00
Lappula occidentalis	1.00	2.00	20	35.00
Linum perenne ssp. lewisii	1.00	1.26	20	50.00
Melilotus officinalis	7.20	4.83	20	95.00
Penstemon strictus	0.10	0.44	20	5.00
Polygonum aviculare	0.60	0.86	20	35.00
Rumex cripus	0.30	0.56	20	25.00
Salsola iberica	2.15	2.20	20	60.00
Verbascum thapsus	2.20	2.16	20	55.00
GRASSES				
Bromus carinatus	1.65	2.15	20	40.00
Elymus lanceolatus	7.70	3.89	20	95.00
Elymus smithii	3.30	3.35	20	60.00



Vertebrate Species of Southeastern Utah

publ. no. 78-16

SPECIES LIST OF VERTEBRATE WILDLIFE

THAT INHABIT SOUTHEASTERN UTAH

Compiled by

Larry B. Dalton
C. Brent Farnsworth
Randall B. Smith
R. Craig Wallace
Roger B. Wilson
Samuel C. Winegardner

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UTAH STATE DIVISION OF WILDLIFE RESOURCES

Douglas F. Day, Director

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Agencies and individuals that have contributed information on species distribution within the southeastern region are acknowledged. Bureau of Land Management and U.S. Forest Service biologists provided information concerning local sightings and distribution of wildlife species. Species lists obtained from Arches and Canyonlands National parks were also helpful. Within the Utah Division of Wildlife Resources, local conservation officers and wildlife biologists provided valuable information on species within their districts or areas of experience. Thanks go to other Division personnel who assisted with review of this document.

The status and population trend for individual species is a product of the experience of the authors and others who have professional experience with the wildlife resource in southeastern Utah.

Larry B. Dalton
C. Brent Farnsworth
Randall B. Smith
R. Craig Wallace
Roger B. Wilson
Samuel C. Winegardner

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SPECIES LIST OF VERTEBRATE WILDLIFE THAT INHABIT SOUTHEASTERN UTAH

Utah is believed to be inhabited by 734 species of vertebrate wildlife. Four hundred forty-five of these species are protected: 2 amphibians, 2 reptiles, 26 mammals, 58 fish and 357 birds. One hundred of the protected species are game species: 10 species of big game; 20, fish; 10, furbearers; 43, migratory game birds; 5, small game mammals; and 12, upland, small game birds. Table 1 provides a comparison of inhabitation by game species between Utah Division of Wildlife Resource's five regions.

Southeastern Utah is inhabited by 466 species of vertebrate wildlife in six biogeographic areas (Table 2). Three hundred forty-three of these species are protected: 2 amphibians, 26 mammals, 38 fish and 277 birds. Seventy-nine of the protected species that inhabit southeastern Utah are game species: 9 species of big game; 13, game fish; 9, furbearers, 35, migratory game birds; 4, small game mammals; and 9, upland, small game birds.

Southeastern Utah has been divided into six biogeographic areas. Each area allows an overlap of wildlife species that inhabit contiguous low and high elevation areas. This procedure was utilized to reduce any controversy that would normally arise from a "sharp line" drawn on a map.

A- Wasatch Plateau extending east from Skyline Drive to Highway 10 and bounded on the north by Highway 6 and on the south by Interstate 70.

B- West Tavaputs Plateau including all drainages into the Price River drainage from Soldier's Summit east along Reservation Ridge and including the drainages into Argyle, Nine Mile and Minnie Maud creeks; bounded on the east by the Green River and south and west by Highway 6.

C- East Tavaputs Plateau bounded on the east by the Colorado-Utah state line; on the south by Interstate 70; on the west by the Green River and on the north by Uintah-Ouray Indian Reservation and the Uintah-Grand county line.

D- San Rafael Swell and San Rafael Desert bounded by Highway 6 on the north; Highway 10 on the west; the Green River on the east and the Emery-Wayne county line on the south.

E- Henry Mountains and Burr Desert bounded on the north by Emery-Wayne county line; the Green and Colorado rivers on the east; Lake Powell on the south and Capitol Reef National Park and the Waterpocket Fold on the west.

F- Mountains and deserts of Grand and San Juan counties south of Interstate Highway 70 and north of the San Juan River bounded on the east by the Utah-Colorado border and on the west by the Green and Colorado rivers and Lake Powell.

Each species is listed by common name followed by the generic and specific nomenclature. The status for each species was determined by the authors after evaluation and consultation from several sources. The listing for mammals was developed from Sparks (1974), Burt and Grossenheider (1976) and Durrant (1952). The primary sources consulted in compiling the bird list were Behle and Perry (1975) and Hayward et al. (1976) although, Peterson (1969), Robbins et al. (1966) and Udvardy and Rayfield (1977) were also used.

Holden (1973), Bailey et al. (1970), Eddy (1969) and Sigler and Miller (1963) were consulted for preparation of the list of fishes.

The status of reptiles and amphibians was determined through discussion with local herpetologists. The phylogenetic listing is after Stebbins (1966). Tanner (1975) was consulted for species inhabiting Utah.

The following code letters are given for each species to describe its status.

K Status unknown - It is believed that these species are present, but little is known of their population dynamics.
C Common - These species are widespread and abundant.
U Uncommon - These species are widespread, but not abundant.
R Rare - These species are seldom identified during any one year.
O Occasional - These species are periodically identified during a long term period--10-50 years.
A Accidental - Distribution for these species does not normally include this area. Sightings are as far between as 50 to 100 years.
E Endangered - These species are endangered with extinction or extirpation from wildland in Utah.
T Threatened - These species are threatened with becoming endangered in Utah.
L Limited - These species are common but restricted to a particular use area or habitat type in Utah.
X Extirpated - These species have disappeared from wildland habitats in Utah.
P Protected - These species are protected by state or federal laws in Utah.
N Nonprotected - These species are not protected by any laws in Utah.

The following terminology is used to describe the seasonal status for avian species.

Transient - These species pass through southeastern Utah twice a year during their migratory travels.

Resident - These species occur yearlong in southeastern Utah.

Summer Resident - These species breed in southeastern Utah and migrate elsewhere for the winter.

Winter Resident - These species breed elsewhere but winter in southeastern Utah.

Note, the species marked with an asteric (*) are of high interest to the State and those marked with an exclamation mark(!) have potential to inhabit the environs of the project area.

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Fishes -- 38 species in southeastern Utah				
Family Clupeidae				
Threadfin Shad (Dorosoma petenense)	E,F	L-P	Stable	Lake-pelagic areas
Family Salmonidae				
* Cutthroat Trout (Salmo clarki)	A,B,D,F	C-P	Stable	Lakes-rocky shores, deep pelagic water; river-pools, riffles, and overhanging banks
* Rainbow Trout (Salmo gairdneri)	A,B,E,F,	C-P	Stable	Lake-littoral and pelagic areas rivers-pools, riffles, overhanging banks
* Brown Trout (Salmo trutta)	A,B,E,F	C-P	Stable	Lake-pelagic and littoral areas rivers-pools, riffles, and overhanging banks
* Brook Trout (Salvelinus fontinalis)	A,F	L-P	Stable	Lake-pelagic and littoral areas
Family Esocidae				
* Northern Pike (Esox lucius)	E,F	L-P	Unknown	Lake-littoral areas with submerged trees and brush
Family Cyprinidae				
Longfin Dace (Agosia chrysogaster)	E,F	K-P	Unknown	Unknown
Carp (Cyprinus carpio)	A,B,C,D,E,F	C-P	Stable	Lakes-littoral areas; quiet water areas in rivers, ponds, sloughs, creeks, and irrigation ditches
Utah Chub (Gila atraria)	A,B	L-P	Abundant	Irrigation ditches, ponds, sloughs, creeks, rivers, and lakes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Leatherside Chub (Gila copei)	A,E	C-P	Stable	Pool and riffle areas
* Humpback Chub (Gila cypha)	B	E-P	Decreasing	Eddies and backwaters
* Bonytail Chub Gila elegans)	B,C,F	E-P	Decreasing	Main channels of large rivers
Roundtail Chub (Gila robusta)	B,C,D,E,F	C-P	Stable	Riffles and stagnant backwaters
Red Shiner (Notropis lutrensis)	B,C,D,E,F	C-P	Increasing	Riffles, pools, backwaters, and eddies
San Shiner (Notropis stramineus)	F	C-P	Increasing	Riffles, pools, backwaters, and eddies
Fathead Minnow (Pimephales promelas)	B,C,D,E,F	C-P	Stable	Pools and backwaters
* Colorado Squawfish (Ptychocheilus lucius)	B,C,D,E,F	E-P	Decreasing	Slow waters, eddies, backwaters, and large pools
* Longnose Dace (Rhinichtys cataractae)	A	U-P	Unknown	Pools and riffles
! Speckled Dace (Rhinichtys osculus)	A,B,C,D,E,F	C-P	Stable	Pools and riffles
Redside Shiner (Richardsonius balteatus)	A,B,D	C-P	Stable	Lakes, creeks and rivers
Family Catostomidae				
White Sucker (Catostomus commersoni)	E,F	U-P	Unknown	Unknown
Bluehead Sucker (Catostomus discobolus)	A,B,C,D,E,F	C-P	Stable	Pools, riffles and lakes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Flannelmouth Sucker (Catostomus latipinnis)	B,C,D,E,F	C-P	Stable	Pools and riffles
! Mountain Sucker (Catostomus platyrhynchus)	A	L-P	Stable	Pools and riffles
* Humpback Sucker (Xyrauchen texanus)	B,C,D,E,F	T-P	Decreasing	Large rivers with strong currents
Family Ictaluridae				
* Black Bullhead (Ictalurus melas)	B,C,D,E,F	C-P	Stable	Pools, quiet water and lakes
* Yellow Bullhead (Ictalurus natalis)	E,F	R-P	Stable	Quiet water areas and lakes
* Channel Catfish (Ictalurus punctatus)	B,C,D,E,F	C-P	Stable	Pools, riffles, quiet water areas and lakes
Family Cyprinodontidae				
Plains Killifish (Fundulus kansae)	F	R-P	Stable	Quiet water areas
Family Poeciliidae				
Mosquito fish (Gambusia affinis)	F	R-P	Stable	Quiet water areas
Family Cottidae				
* Mottled Sculpin (Cottus bairdi)	A	C-P	Stable	Rocky riffles and pool areas
Family Percichtyidae				
* Striped Bass (Morone saxatilis)	E,F	C-P	Increasing	Lake-pelagic areas
Family Centrarchidae				
Green Sunfish (Lepomis cyanellus)	B,C,D,E,F	C-P	Stable	Quiet backwaters and lakes
* Bluegill (Lepomis macrochirus)	E,F	C-P	Stable	Lakes-littoral areas with rocky shores and submerged brush

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Largemouth Bass (*Micropterus salmoides*)	A,B,C,D,E,F	C-P	Stable	Rivers-quiet water areas; lakes-littoral rocky areas, with submerged brush
* Black Crappie (*Pomoxis nigromaculatus*)	E,F	C-P	Stable	Lake-littoral zone around submerged brush and trees, and pelagic areas
Family Percidae				
* Perch (*Perca flavescens*)	F	U-P	Unknown	Unknown
* Walleye (*Stizostedion vitreum*)	E,F	C-P	Stable	Lake-deep water around rocky bottoms
Amphibians -- 11 species in southeastern Utah				
Family Ambystomatidae				
! * Tiger Salamander (*Ambystoma tigrinum*)	A,B,C,D,E,F	C-P	Unknown	Quiet water of ponds, reservoirs, lakes, temporary rain pools and streams from arid sagebrush plains to rolling grasslands, mountain meadows and forests
Family Pelobatidae				
! Great Basin Spadefoot Toad (*Scaphiopus intermontanus*)	A,B,C,D,E,F	C-N	Unknown	Sagebrush flats, pinion-juniper woodlands to high elevations in spruce-fir communities

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Western Spadefoot Toad (*Scaphiopus hammondi*)	F	K-N	Unknown	Washes, alkali flats, foothills, mountain valleys, in open vegetation and shortgrass, where soil is sandy and/or gravelly
Family Bufonidae				
/ Western Toad (*Bufo boreas*)	A	K-N	Unknown	Desert streams, springs, grasslands, woodlands, and mountain meadows
Red Spotted Toad (*Bufo punctatus*)	D,E,F,	C-N	Unknown	Open grassland and rocky canyons
/ Woodhouse's Toad (*Bufo woodhousei*)	A,B,C,D,E,F	C-N	Unknown	Grassland, sagebrush flats, woods, desert streams, valleys, flood plains, farms, and city backyards
Great Plains Toad (*Bufo cognatus*)	C,D,E,F,	C-N	Unknown	Prairies, deserts, quiet water of streams, grasslands and sagebrush plains
Family Hylidae				
/ Chorus Frog (*Pseudacris triseriata*)	A,B,C,D,F	C-N	Unknown	Grassy pools, lakes, and marshes of prairies or mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Canyon Tree Frog (Hyla arenicolor)	E,F	L-N	Unknown	Intermittant or permanent streams with rocky pools in canyons with cottonwoods or other trees
Family Ranidae				
* Bullfrog (Rana catesbeiana)	F	L-P	Unknown	Colorado River-usually quiet water where there is thick growth of aquatic vegetation
! Leopard Frog (Rana pipiens)	A,B,C,D,E,F	C-N	Unknown	Springs, creeks, rivers, ponds, canals, reservoirs and wet meadows
Reptiles -- 36 species in southeastern Utah				
Family Iguanidae				
* Chuckwalla (Sauromalus obesus)	E,F	L-N	Unknown	Rocky hillsides
Collared Lizard (Crotaphytus collaris)	A,B,C,D,E,F	C-N	Unknown	Canyons, rocky gullies, mountain slopes and boulder strewn alluvial fans where vegetation is sparse
Leopard Lizard (Crotaphytus wislizenii)	A,B,C,D,E,F	C-N	Unknown	Arid and semi-arid plains with bunchgrass, sagebrush or other low desert shrub communities; avoids dense vegetation
Lesser Earless Lizard (Holbrookia maculata)	F	K-N	Unknown	Washes, sandy stream banks and sand dunes on shortgrass prairie and farmlands

ecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
/ Eastern Fence Lizard (Sceloporus undulatus)	A,B,C,D,E,F	C-N	Unknown	Forest, woodlands, prairie, brushy flatlands, sand dunes, rocky hillsides and farmlands
Desert Spiny Lizard (Sceloporus magister)	D,E,F	C-N	Unknown	Shadscale deserts, pinion-juniper woodland, willows and cottonwoods.
/ Sagebrush Lizard (Sceloporus graciosus)	A,B,C,D,E,F	C-N	Unknown	Variety of habitat types; sagebrush, pinion-juniper, low desert shrub and rocklands
/ Tree Lizard (Urosaurus ornatus)	A,B,C,D,E,F	C-N	Unknown	Trees and rocks
/ Side-blotched Lizard (Uta stansburiana)	A,B,C,D,E,F	C-N	Unknown	Inhabits a variety of habitat types; sandy washes with scattered rocks and low growing shrubs
Desert Horned Lizard (Phrynosoma platyrhinos)	E	K-N	Unknown	Along washes at the edge of dunes in saltbrush and sagebrush areas
/ Short-horned Lizard (Phrynosoma douglassi)	A,B,C,D,E,F	C-N	Unknown	Desert grassland, sagebrush, pinion-juniper, pine-spruce and spruce-fir associations, extending from desert shrub to mountain habitats

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Xantusiidae				
* Utah Night Lizard (Xantusia vigilis)	E,F	L-N	Unknown	Dead clumps of yucca plants and woodrat middens
Family Teiidae				
Plateau Whiptail (Cnemidophorus velox)	F	K-N	Unknown	Mountains in pinion-juniper woodland and lower edges of ponderosa pine forests
Western Whiptail (Cnemidophorus tigris)	A,B,C,D,E,F	C-N	Unknown	Desert shrub communities where plants are sparse and there are open areas for running
Family Scincidae				
Many-lined Skink (Eumeces multivirgatus)	E,F	K-N	Unknown	Shortgrass prairie that extends into the mountains; often vacant lots, city dumps and backyards
Western Skink (Eumeces skiltonianus)	C	K-N	Unknown	Grasslands, woodlands and forests in rocky habitat near streams with abundant cover
Family Boidae				
Rubber Boa (Charina bottae)	A	C-N	Unknown	Grasslands, woodlands, and forests with rotting logs; often found under rocks and under the bark of fallen or standing dead trees

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Colubridae				
Smooth Green Snake (*Opheodrys vernalis*)	F	K-N	Unknown	Damp grassy environment
! Striped Whipsnake (*Masticophis taeniatus*)	A,B,C,D,E,F	C-N	Unknown	Brushlands, grasslands, sagebrush flats, pinion-juniper woodlands and open pine forests
Coachwhip (*Masticophis flagellum*)	E,F	K-N	Unknown	Utilizes a variety of habitats but avoids dense vegetation; rodent burrows, rocks and branches are used
! Racer (*Coluber constrictor*)	A,B,C,D,E,F	C-N	Unknown	Meadows, sparse brush and forest openings with semi-arid and moist areas; grassy places near rocks and logs are preferred
Corn Snake (*Elaphe guttata*)	F	K-N	Unknown	Stream and river bottoms, rocky wooded hillsides, coniferous forests, and farmland with rodent burrows, rocks and logs
! Ringneck Snake (*Diadophis punctatus*)	A	K-N	Unknown	Moist habitats usually in the mountains or along stream and river bottoms

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Gopher Snake (*Pituophis melanoleucus*)	A,B,C,D,E,F	C-N	Unknown	Lowlands to high mountains including desert, coniferous forest and farmland types; grassland and open brushland are prescribed
! * Milk Snake (*Lampropeltis triangulum*)	A,B,C,F	K-N	Unknown	Variety of habitats from lowlands to mountains; rotten logs and stumps are preferred
Common Kingsnake (*Lampropeltis getulus*)	E,F	K-N	Unknown	Variety of habitats from lowlands to mountains with rock outcrops and clumps of vegetation under rotting logs or rocks
! * Sonora Mountain Kingsnake (*Lampropeltis pyromelana*)	A	K-N	Unknown	Mountains, pinion-juniper woodlands, mountain brush, coniferous forests with rocks, logs and dense clumps of vegetation
Long-nosed Snake (*Rhinocheilus lecontei*)	F	K-N	Unknown	Prairies, brushland and irrigated parts of deserts
! Western Terrestrial Garter Snake (*Thamnophis elegans*)	A,B,C,D,E,F	C-N	Unknown	Variety of terrestrial and aquatic habitats from lowlands to mountains
! Common Garter Snake (*Thamnophis sirtalis*)	A,F	K-N	Unknown	Variety of habitats, usually near water

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-necked Garter Snake (*Thamnophis cyrtopsis*)	F	K-N	Unknown	Desert and grasslands
Western Black-headed Snake (*Tantilla planiceps*)	E,F	K-N	Unknown	Grasslands, woodlands and deserts; often found under rocks and logs
! Night Snake (*Hypsiglena torquata*)	A,B,C,D,E,F	C-N	Unknown	Plains, sagebrush flats, desert and woodlands; often found under rocks and surface litter
Family Crotalidae				
Hopi Rattlesnake (*Crotalus viridis nuntius*)	E	U-N	Unknown	Prefers rock piles and rodent burrows on grasslands, brushlands, woodlands and forests; avoids sparsely vegetated deserts
Prairie Rattlesnake (*Crotalus viridis viridis*)	F	U-N	Unknown	Prefers rock piles and rodent burrows on grasslands, woodlands and forests; avoids sparsely vegetated deserts
! Midget Faded Rattlesnake (*Crotalus viridis concolor*)	A,B,C,D,E,F	C-N	Unknown	Prefers rock piles and rodent burrows on grasslands, brushlands, woodlands and forests; avoids sparsely vegetated deserts

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Birds -- 278 species in southeastern Utah				
Order Gaviiformes				
Family Gaviidae				
Common Loon (Gavia immer)	A,B,C,D,E,F	U-P transient and winter resident	Stable	Lakes of coniferous forests, open lakes, reservoirs and bays
Order Podicipediformes				
Family Podicipedidae				
Horned Grebe (Podiceps auritus) *	A,B,C,D,E,F	R-P transient and summer resident	Stable	Lakes, ponds and reservoirs
Eared Grebe (Podiceps nigricollis)	A,B,C,D,E,F	C-P summer resident	Stable	Lakes, bays and reservoirs
* Western Grebe (Aechmophorus occidentalis)	A,B,C,D,E,F	C-P summer resident	Stable	Sloughs, bays and reservoirs and lakes with emergent vegetation for nesting
Pied-billed Grebe (Podilymbus podiceps)	A,B,C,D,E,F	C-P summer resident	Stable	Ponds, lakes, streams and marshes
Order Pelecaniformes				
Family Pelecanidae				
* White Pelican (Pelecanus erythrorhynchos)	A,B,C,D,E,F	L-P transient and summer resident	Stable	Larger shallow bodies of water and large rivers
Family Phalacrocoracidae				
* Double-crested Cormorant (Phalacrocorax auritus)	A,B,C,D,E,F	U-P summer resident	Stable	Bays, lakes and rivers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Ciconiiformes				
Family Ardeidae				
!*Great Blue Heron (Ardea herodias)	A,B,C,D,E,F	C-P resident	Stable	Marshes, shallow reservoirs, rivers, streams, shores and irrigation ditches
Green Heron (Butorides striatus)	B,E,F	R-P transient	Unknown	Marshes, wooded streams, rivers, small ponds and lake margins
Cattle Egret (Bubulcus ibis)	E,F	O-P transient	Unknown	Marshes, lake margins, and irrigated lands
! Snowy Egret (Egretta thula)	A,B,C,D,E,F	C-P summer resident	Stable	Marshes, ponds, lake margins and irrigated land
Black-crowned Night Heron (Nycticorax nycticorax)	A,B,C,D,E,F	C-P summer resident	Stable	Marshes, lake margins and shores
Least Bittern (Ixobrychus exilis)	D,E,F	U-P transient	Unknown	Densely vegetated marshes
American Bittern (Botaurus lentinginosus)	A,B,C,D,E,F	U-P summer resident	Stable	Densely vegetated marshe
Family Ciconiidae				
Wood Stork (Mycteria americana)	D,E,F	O-P transient	Unknown	Marshes, ponds and lake margins
Family Threskiornithidae				
*White-faced Ibis (Plegadis chihi)	A,B,C,D,E,F	C-P summer resident	Increasing	Marshes and irrigated land

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Anseriformes				
Family Anatidae				
* Whistling Swan (Olor columbianus)	A,B,C,D,E,F	O-P winter resident C-P transient	Stable	Lakes, large rivers and fields
* Trumpeter Swan (Olor buccinator)	B,C,D,E,F	R-P transient	Unknown	Lakes and large rivers
* Canada Goose (Branta canadensis)	A,B,C,D,E,F	C-P resident and transient	Increasing	Lakes, bays, marshes, rivers and grainfields
*White-fronted Goose (Anser albifrons)	A,B,C,D,E,F	R-P transient	Stable	Marshes, fields, lakes and bays
*Snow Goose (Chen caerulescens)	A,B,C,D,E,F	U-P transient	Stable	Marshes, grainfields, reservoir, ponds and bays
* Ross' Goose (Chen rossii)	A,B,C,D,E,F	O-P transient	Stable	Marshes, grainfields, prairies, ponds and bays
! * Mallard (Anas platyrhynchos)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, irrigated land, grainfields, ponds, rive lakes, bays and reservoi extending from lowlands mountains
! *Gadwall (Anas strepera)	A,B,C,D,E,F	C-P resident and transient	Stable	Lakes, ponds, rivers and marshes
! * Pintail (Anas acuta)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, grainfields, ponds, lakes and reservoirs

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Green-winged Teal (Anas crecca)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, lakes, ponds, rivers and bays
*Blue-winged Teal (Anas discors)	A,B,C,D,E,F	U-P resident and transient	Stable	Ponds and marshes
*Cinnamon Teal (Anas cyanoptera)	A,B,C,D,E,F	C-P resident and transient	Stable	Stock ponds, rivers, marshes and lakes
*American Widgeon (Anas americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, irrigated land, ponds, lakes and bays
* Northern Shoveler (Anas clypeata)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, ponds and sloughs
*Wood Duck (Aix sponsa)	A,B,C,D,E,F	R-P transient	Stable	Wooded rivers and ponds
*Redhead (Aythya americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes with some deep water, lakes and reservoirs
*Ring-necked Duck (Aythya collaris)	A,B,C,D,E,F	U-P transient	Stable	Coniferous lakes, wooded ponds, marshes and reservoirs
*Canvasback (Aythya valisineria)	A,B,C,D,E,F	C-P transient R-P summer resident	Stable	Marshes, lakes and reservoirs

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Greater Scaup (Aythya marila)	A,B,C,D,E,F	U-P transient	Stable	Lakes, rivers and ponds
*Lesser Scaup (Aythya affinis)	A,B,C,D,E,F	C-P transient	Stable	Marshes, ponds and lakes
*Common Goldeneye (Bucephala clangula)	A,B,C,D,E,F	U-P transient	Stable	Lakes and rivers
*Bufflehead (Bucephala albeola)	A,B,C,D,E,F	U-P transient	Stable	Lakes, ponds and rivers
*White-winged Scoter (Melanitta deglandi)	D	O-P transient	Stable	Large lakes and reservoirs. Recorded occurrence at Desert Lake WMA
*Ruddy Duck (Oxyura jamaicensis)	A,B,C,D,E,F	C-P resident and transient	Stable	Marshes, ponds, rivers and reservoirs
*Hooded Merganser (Mergus cucullatus)	A,B,C,D,E,F	R-P transient	Stable	Wooded lakes, ponds, rivers and reservoirs
*Common Merganser (Mergus merganser)	A,B,C,D,E,F	C-P transient U-P winter resident	Stable	Wooded lakes and rivers in summer; in winter, open rivers, lakes and ponds
*Red-breasted Merganser (Mergus serrator)	A,B,C,D,E,F	C-P transient	Stable	Lakes, reservoirs and rivers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Falconiformes				
Family Cathartidae				
!*Turkey Vulture (Cathartes aura)	A,B,C,D,E,F	C-P summer resident	Stable	Usually seen in sky or perched on dead trees, posts, carrion or on groun
California Condor (Gymnogyps californianus)	A,B,C,D,E,F	X-P	Extirpated	Usually seen in sky or perched on dead trees, posts, carrion or on groun
Family Accipitridae				
!*Goshawk (Accipiter gentilis)	A,B,C,D,E,F	U-P resident	Stable	Mountain woodlands
! *Sharp-shinned Hawk (Accipiter striatus)	A,B,C,D,E,F	U-P resident and transient	Stable	Forests, thickets, scrubbak, desert riparian, mountain woodlands and aspen
!*Cooper's Hawk (Accipiter cooperii)	A,B,C,D,E,F	C-P summer resident and transient R-P winter resident	Stable	Broken woodlands, dry wooded canyons, riparian areas, pinion-juniper and conifers
!*Red-tailed Hawk (Buteo jamaicensis)	A,B,C,D,E,F	C-P resident	Stable	Open country, woodlands, mountains and deserts
*Red-shouldered Hawk (Buteo lineatus)	C,F	A-P transient	Unknown	Broken woodlands, primarily along lowland rivers and often close to cultivated fields
!* Swainson's Hawk (Buteo swainsoni)	A,B,C,D,E,F	U-P summer resident	Stable	Dry plains and rangeland with hills; open forest or alpine meadows with sparse trees

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Rough-legged Hawk (Buteo lagopus)	A,B,C,D,E,F	C-P winter resident	Stable	Open country, woodlands, deserts and marshes
* Ferruginous Hawk (Buteo regalis)	A,B,C,D,E,F	U-P summer resident R-P winter resident	Stable	Open desert; infrequentl marshes and farmlands are utilized
! * Golden Eagle (Aquila chrysaetos)	A,B,C,D,E,F	C-P resident	Stable	Open mountains, foot-hills, canyons and deser
*Bald Eagle (Haliaeetus leucocephalus)	A,B,C,D,E,F	E-P winter resident	Increasing	Lakes, rivers and marshe surrounded by open country with available perching sites
! *Marsh Hawk (Circus cyaneus)	A,B,C,D,E,F	C-P resident	Stable	Marshes, fields and prairies
Family Pandionidae				
*Osprey (Pandion haliaetus)	A,B,C,D,E,F	U-P transient	Stable	Rivers, lakes and large bodies of water
Family Falconidae				
! *Prairie Falcon (Falco mexicanus)	A,B,C,D,E,F	C-P resident	Stable	Canyons, open habitat in mountains, plains and deserts
*Peregrine Falcon (Falco peregrinus)	A,B,C,D,E,F	E-P resident	Unknown	Canyons, high cliffs, rivers, marshlands and deserts
*Merlin (Falco columbarius)	A,B,C,D,E,F	C-P winter resident	Unknown	Open country and foot-hills; often associated with flocking passerine:

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! * American Kestrel (Falco sparverius)	A,B,C,D,E,F	C-P summer resident U-P winter resident	Stable	Open country, prairies, deserts, wooded streams, farmland and cities
Order Galliformes				
Family Tetraonidae				
! * Blue Grouse (Dendragapus obscurus)	A,B,C,D,E,F	C-P resident	Stable	Coniferous forests, aspen, mountain brush, open slash and burns
! * Ruffed Grouse (Bonasa umbellus)	A,B	C-P resident	Stable	Aspen and coniferous forests near stream courses
! *Sage Grouse (Centrocercus urophasianus)	A,B,C,F	C-P resident	Stable	Sagebrush plains associated with pasture lands; sagebrush parks associated with wet meadows
Family Phasianidae				
* California Quail (Lophortyx californicus)	A,B,D,E,F	C-P resident	Stable	Mountain brush, woodland edges and farmlands near river bottoms
* Gambels Quail (Lophortyx gambelii)	D,E,F	C-P resident	Stable	Desert thickets, usually near water
* Chukar (Alectoris chukar)	A,B,C,D,E,F	C-P resident	Stable	Rocky, grassy or brushy slopes in arid mountains and canyons
* Ring-necked Pheasant (Phasianus colchicus)	A,B,C,D,E,F	C-P resident	Decreasing	Irrigated cropland, pastureland, wetlands and desert wa

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* White-winged Pheasant (Phasianus colchicus)	E,F	L-P resident	Decreasing	Irrigated cropland, pastureland and wetland: near Hanksville and Bluff, Utah
Family Meleagrididae				
* Merriam's Turkey (Meleagris gallapavo)	F	L-P resident	Stable	Mountainous regions with Ponderosa pine, mixed conifer and aspen woodlands or mountain brush
Order Gruiformes				
Family Gruidae				
* Sandhill Crane (Grus canadensis)	A,B,C,D,E,F	R-P transient	Stable	In winter, prairies grainfields and marshes in summer, mountain meadows and marshes
Family Rallidae				
* Virginia Rail (Rallus limicola)	A,B,C,D,E,F	C-P resident	Stable	Marshes
* Sora Rail (Porzana carolina)	A,B,C,D,E,F	U-P resident	Stable	Marshes and wet meadows
* Common Gallinule (Gallinula chloropus)	A,D	R-P transient	Unknown	Marshes, wet meadows, lakes with bulrush or cattails and sedges
* American Coot (Fulica americana)	A,B,C,D,E,F	C-P resident and transient	Stable	Ponds, lakes, marshes, and agricultural lands adjacent to wetland habitats.
Order Charadriiformes				
Family Charadriidae				
Semipalmated Plover (Charadrius semipalmatus)	A,B,C,D,E,F	U-P transient	Stable	Shores of marshes, reservoirs and mudflats

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Snowy Plover (Charadrius alexandrinus)	A,B,C,D,E,F	U-P transient	Stable	Alkali and sand flats
! Killdeer (Charadrius vociferus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Fields and pastures, lawns, riverbanks, irrigated land, shores, plowed fields, alkali flats and gravel roads
! Mountain Plover (Charadrius montanus)	A,B,C,F	R-P transient	Stable	Semi-arid grasslands, plains and plateaus
American Golden Plover (Pluvialis dominica)	A,B,C,D,E,F	U-P transient	Stable	Prairies, mudflats and shores
Black-bellied Plover (Pluvialis squatarola)	A,B,C,D,E,F	C-P transient	Stable	Mudflats, open marshes and shores
Family Scolopacidae				
* Common Snipe (Capella gallinago)	A,B,C,D,E,F	C-P resident	Stable	Marshes, irrigation ditches, stream sides, and wet meadows
* Long-billed Curlew (Numenius americanus)	A,B,C,D,E,F	U-P summer resident and transient	Declining	Meadows, pastures and wetlands
* Willet (Catoptrophorus semipalmatus)	A,B,C,D,E,F	U-P summer resident and transient	Stable	Marshes, wet meadows and muddy shores
! Spotted Sandpiper (Tringa macularia)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Pebbly lake shores, ponds and stream sides

Species	Biogeograph. Area Inhabited	Status	Population Trend	Habitat Use Area
1 Solitary Sandpiper (Tringa solitaria)	A,B,C,D,E,F	U-P transient	Stable	Stream sides, ponds and marshes
1 Greater Yellowlegs (Tringa melanoleuca)	A,B,C,D,E,F	U-P transient	Stable	Open marshes, mudflats, streams and ponds
Lesser Yellowlegs (Tringa flavipes)	A,B,C,D,E,F	C-P transient	Stable	Marshes, mudflats, shores and pond edges
Pectoral Sandpiper (Calidris melanotos)	A,B,C,D,E,F	U-P transient	Stable	Prairie pools and marshy shores
Baird's Sandpiper (Calidris bairdii)	A,B,C,D,E,F	U-P transient	Stable	Rainpools, pond margins mudflats and shores
Least Sandpiper (Calidris minutilla)	A,B,C,D,E,F	C-P transient	Stable	Grassy marshes, rain-pools, shores and alkal mudflats
Western Sandpiper (Calidris mauri)	A,B,C,D,E,F	C-P transient	Stable	Shores, beaches, mud-flats and open marshes
Sanderling (Calidris alba)	A,B,C,D,E,F	U-P transient	Stable	Lake shores
Short-billed Dowitcher (Limnodromus griseus)	A,B,C,D,E,F	U-P summer resident and transient	Stable	Mudflats, open marshes and ponds
Long-billed Dowitcher (Limnodromous scolopaceus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Mudflats, shallow pools and wetlands

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Marbled Godwit (Limosa fedoa)	A,B,C,D,E,F	C-P transient	Stable	Grasslands and meadows near lakes and shallow lake margins
Family Recurvirostridae				
American Avocet (Recurvirostra americana)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, mudflats, alkaline lakes, shallow ponds and sloughs
Black-necked Stilt (Himantopus mexicanus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Grassy marshes, alkali mudflats, pools and shallow lakes
Family Phalaropodidae				
Wilson's Phalarope (Phalaropus tricolor)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Shallow lakes, marshes, pools, shores and mudflats
Northern Phalarope (Phalaropus lobatus)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Lakes and ponds
Family Laridae				
Glaucous Gull (Larus hyperboreus)	D	R-P transient	Stable	Recorded using marshlands at Desert Lake WMA
Herring Gull (Larus argentatus)	A,B,C,D,E,F	U-P transient	Stable	Lakes, farmlands and dumps
California Gull (Larus californicus)	A,B,C,D,E,F	C-P summer resident	Stable	Lakes, rivers, farmlands and dumps
Ring-billed Gull (Larus delawarensis)	A,B,C,D,E,F	C-P winter resident	Stable	Lakes, rivers, refuse dumps, fields and cities

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Franklin's Gull (Larus pipixcan)	A,B,C,D,E,F	C-P summer resident	Stable	Prairies, marshes, lakes and plowed fields
! Bonaparte's Gull (Larus philidelphia)	A,B,C,D,E,F	U-P transient	Stable	Rivers, lakes and open marshes
Forsters Tern (Sterna forsteri)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, lakes and reservoirs
Common Tern (Sterna hirundo)	A,B,C,D,E,F	U-P transient	Stable	Lakes and reservoirs
Black Tern (Chlidonias niger)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Marshes, lakes and reservoirs
Caspian Tern (Hydroprogne caspia)	A,B,C,D,E,F	U-P transient	Stable	Large lakes and reservoirs
Order Columbiformes				
Family Columbidae				
! * Band-tailed pigeon (Columba fasciata)	A,E,F	U-P summer resident and transient	Stable	Forests, canyons and foothills near mountain brush (acorns) and agricultural lands
Rock Dove (Columba lavia)	A,B,C,D,E,F	C-N resident	Stable	Cities, farms and cliffs
! * Mourning Dove (Zenaida macroura)	A,B,C,D,E,F	C-P summer resident and transient	Stable	Farmlands, towns, open woods, grassland and deserts
White-winged Dove (Zenaidura asiatica)	E,F	A-P summer resident and transient	Unknown	Open woods and river bottoms

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Cuculiformes				
Family Cuculidae				
! * Yellow-billed Cuckoo (Coccyzus americanus)	A,B,C,D,E,F	K-P summer resident	Unknown	River thickets and willows
Order Strigiformes				
Family Tytonidae				
! * Barn Owl (Tyto alba)	A,B,C,D,E,F	K-P resident	Unknown	Woodlands, fields, farms, towns, canyons, cliffs and dirt banks
Family Strigidae				
! * Screech Owl (Otus asio)	A,B,C,D,E,F	U-P resident	Stable	Riparian communities and wooded canyons
! * Flammulated Owl (Otus flammeolus)	A,B,C,D,E,F	K-P summer resident	Unknown	Open pine and fir forests in mountains
! * Great Horned Owl (Bubo virginianus)	A,B,C,D,E,F	C-P resident	Stable	Ubiquitous
! * Pygmy Owl (Glaucidium gnoma)	A,B,C,D,E,F	K-P resident	Unknown	Wooded canyons in open coniferous, mixed woodlands and pinion-juniper forests
* Burrowing Owl (Speotyto cunicularia)	A,B,C,D,E,F	L-P resident	Declining	Open grassland, prairies, dikes, desert, farms and prairie dog colonies

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Spotted Owl (Strix occidentalis)	C,E	K-P Unknown	Unknown	Wooded canyons with narrow side canyons in the desert
* Long-eared Owl (Asio otus)	A,B,C,D,E,F	C-P resident	Stable	River woodlands, pinion-juniper forests, willow thickets and Russian olive trees
* Short-eared Owl (Asio flammeus),	A,B,C,D,E,F	C-P resident	Stable	Marshes, prairies, irrigated land and open country with short vegetation
* Saw-whet Owl (Aegolius acadicus)	A,B,C,D,E,F	K-P resident	Stable	Forest, conifers and groves
Order Caprimulgiformes				
Family Caprimulgidae				
Common Nighthawk (Chordeiles minor)	A,B,C,D,E,F	C-P summer resident	Stable	Treeless plains to mountains with open pine woods; often seen in fli over country side or tov
Lesser Nighthawk (Chordeiles acutipennis)	E	R-P summer resident	Unknown	Arid open scrub, dry grasslands, pastures and desert washes
Poor-will (Phalaenoptilus nuttallii)	A,B,C,D,E,F	C-P summer resident	Stable	Arid uplands with open pinion-juniper and spars brush; riparian areas ar roadsides

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Apodiformes				
Family Apodidae				
/*Black Swift (Cypseloides niger)	A,B,C,D,E,F	U-P summer resident	Unknown	Open areas in mountain country
White-throated Swift (Aeronautes saxatalis)	A,B,C,D,F	C-P summer resident	Unknown	Open areas; wide ranging and breeds mainly in dry mountain canyons
Family Trochilidae				
/ Black-chinned Hummingbird (Archilochus alexandri)	A,B,C,D,E,F	C-P summer resident	Unknown	Semi-arid country near water; semi-wooded canyons and slopes, mountain brush and riparian woodlands
/ Broad-tailed Hummingbird (Selasphorus platycercus)	A,B,C,D,E,F	C-P summer resident	Unknown	Ubiquitous
/ Rufous Hummingbird (Selasphorus rufus)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	Forest edges, thickets in coniferous and deciduous forests, mountain brush and alpine meadows
/ Calliope Hummingbird (Stellula calliope)	A,B,C,D,E,F	C-P summer resident	Unknown	High mountains, canyons and forest openings
/ Rivoli's Hummingbird (Eugenes fulgens)	E,F	U-P summer resident	Unknown	High mountain forest openings, pine-oak forests and canyons

Species	Geographic Area Inhabited	Status	Population Trend	Habitat Use Area
Order Caraciiformes				
Family Alcedinidae				
! * Belted Kingfisher (Megaceryle alcyon)	A,B,C,D,E,F	U-P resident	Stable	Rivers, ponds and lakes
Order Piciformes				
Family Picidae				
! Common Flicker (Colaptes auratus)	A,B,C,D,E,F	C-P resident	Stable	Deciduous or mixed woodlands, open forest, farms towns, canyons and semi-open country
* Pileated Woodpecker (Dryocopus pileatus)	F	R-P resident	Unknown	Mature coniferous and mixed forests with many snags
Red-headed Woodpecker (Melanerpes erythrocephalus)	B	R-P resident	Unknown	Groves, farm country, riparian areas, towns and scattered trees
! Yellow-bellied Sapsucker (Sphyrapicus varius)	A,B,C,D,E,F	C-P resident	Unknown	In summer woodlands and aspen groves; in winter orchards and other trees
* Williamson's Sapsucker (Sphyrapicus thyroideus)	F	U-P summer resident	Unknown	Higher coniferous forests and burns
* Lewis Woodpecker (Asyndesmus lewis)	F	K-P summer resident and transient	Unknown	Scattered or logged forests, burns, cottonwood groves and ponderosa pine
! Hairy Woodpecker (Dendrocopos villosus)	A,B,C,D,E,F	C-P resident	Unknown	Mountain forests, woodlands and river groves

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Downy Woodpecker (Dendrocopos pubescens)	A,B,C,D,E,F	C-P resident	Unknown	Broken or mixed forest, willows, poplars, riparian woodlands, orchards and shade trees
! Northern Three-toed Woodpecker (Picoides tridactylus)	A,B,C,E,F	U-P resident	Unknown	Coniferous forests
Order Passeriformes				
Family Tyrannidae				
Western Kingbird (Tyrannus verticalis)	A,B,C,D,E,F	C-P summer resident	Stable	Open country with scattered trees, farms and roadsides
! Cassin's Kingbird (Tyrannus vociferans)	A,B,C,D,E,F	U-P summer resident	Unknown	Semi-open high country, scattered trees, pine-oak mountains and ranch groves
Eastern Kingbird (Tyrannus tyrannus)	A,B,C,D,E,F	C-P summer resident	Unknown	Wood edges, parklands, riparian areas, farms, shelter belts, orchards and roadsides
Ash-throated Flycatcher (Myiarchus cinerascens)	A,B,C,D,E,F	C-P summer resident	Stable	Semi-arid country, deserts, brush, pinion-juniper and open woods
Black Phoebe (Sayornis nigricans)	F	C-P resident	Unknown	Streamside woodlands, farmyards and towns with cliffs near water
Says Phoebe (Sayornis saya)	A,B,C,D,E,F	C-P resident	Unknown	Open arid country, deserts, bushy plains, prairie farms, canyon mouths and bu

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Willow (Traill's) Flycatcher (Empidonax traillii)	A,B,C,D,E,F	C-P summer resident	Unknown	Breeds in willow thickets in low valleys, along canyons or in high mountain meadows
! Hammond's Flycatcher (Empidonax hammondii)	A,B,C,E,F	U-P summer resident	Unknown	High coniferous forests
! Dusky Flycatcher (Empidonax oberholseri)	A,B,C,D,E,F	C-P summer resident	Unknown	Breeds in mountain brush with a scattering of trees
Gray Flycatcher (Empidonax wrightii)	A,B,C,D,E,F	K-P summer resident	Unknown	Breeds in sagebrush and pinion-juniper woodlands
! Western Flycatcher (Empidonax difficilis)	A,B,C,D,E,F	C-P summer resident	Unknown	Moist woods, mixed or coniferous forests, canyons, groves; must have water and shade
! Western Wood Peewee (Contipus sordidulus)	A,B,C,D,E,F	C-P summer resident	Unknown	Woodlands, pine-oak forests, open conifers and river groves
! Olive-sided Flycatcher (Contopus borealis)	A,B,C,D,E,F	U-P summer resident	Unknown	Coniferous forests, burns and clearings; in migration habitats used are varied; usually seen on tip of dead tree or branch

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Alaudidae				
! Horned Lark (Eremophila alpestris)	A,B,C,D,E,F	C-P resident	Unknown	Plains, desert, prairies, fields, sparse sagebrush flats, dirt roads, shores, alpine meadows, alkali flats and areas of sparse vegetation
Family Hirundinidae				
! Violet-green Swallow (Tachycineta thalasssina)	A,B,C,D,E,F	C-P summer resident	Unknown	Widespread when foraging; when nesting, open forests foothill woods, mountains, canyons, cliffs and towns
! Tree Swallow (Iridoprocne bicolor)	A,B,C,D,E,F	C-P summer resident	Unknown	Open country near water, marshes, mountain meadows, streams, lakes and wires; when nesting requires dead trees and snags, preferabl: near water
! Bank Swallow (Riparia riparia)	A,B,C,D,E,F	C-P summer resident	Unknown	Usually near water; over fields, marshes, streams and lakes
! Rough-winged Swallow (Stelgidopteryx ruficollis)	A,B,C,D,E,F	C-P summer resident	Unknown	Near streams, lakes and washes
! Barn Swallow (Hirundo rustica)	A,B,C,D,E,F	C-P summer resident	Unknown	Open or semi-wooded country, farms, ranches, fields, marshes and lakes; usually near man's habitation

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Cliff Swallow (Petrochelidon pyrrhonota)	A,B,C,D,E,F	C-P summer resident	Unknown	Open to semi-wooded country, neat farms, cliffs, canyons, rivers or lakes
! * Purple Martin (Progne subis)	A,B,C,E,F	U-P summer resident	Unknown	Open forests of aspen and conifers
Family Corvidae				
! Steller's Jay (Cyanocitta stelleri)	A,B,C,D,E,F	C-P resident	Unknown	Conifers and pine-oak forests
! Gray Jay (Perisorius canadensis)	A,B,C,E,F	R-P resident	Unknown	Coniferous forests
Scrub Jay (Aphelocoma coerulescens)	A,B,C,D,E,F	C-P resident	Unknown	Foothills, oaks, mountain brush, river woods and pinion-juniper woodlands
! Black-billed Magpie (Pica pica)	A,B,C,D,E,F	C-P resident	Unknown	Foothills, ranches, sage-brush, river thickets, shelterbelts and prairie brush
! Common Raven (Corvus corax)	A,B,C,D,E,F	C-P resident	Unknown	Mountains, deserts, canyons and cliffs
! Common Crow (Corvus brachyrhynchos)	A,B,C,D,E,F	O-P transient	Unknown	Deciduous, mixed and open coniferous woodlands farmlands and river grove
Pinion Jay (Gymnorhinus cyanocephala)	A,B,C,D,E,F	C-P resident	Unknown	Pinion-juniper woodlands, but ranges into sagebrush
! Clark's Nutcracker (Nucifraga columbiana)	A,B,C,E,F	C-P resident	Unknown	High mountains in conifer: near tree line

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Paridae				
! Black-capped Chickadee (Parus atricapillus)	A,B,C,D,E,F	C-P resident	Unknown	In summer aspen-conifer, mixed woodlands and forest edges; in winter woodlands along valley streams and tree rows
! Mountain Chickadee (Parus gambeli)	A,B,C,D,E,F	C-P resident	Unknown	In summer mountain forests and conifers; in winter riparian woodlands at lower elevations
Plain Titmouse (Parus inornatus)	A,B,C,D,E,F	C-P resident	Unknown	Pinion-juniper woodlands
Bushtit (Psaltriparus minimus)	A,B,C,D,E,F	C-P resident	Unknown	Oak woodlands, mountain brush, broad-leafed and mixed woods and pinion-juniper forest
Family Sittidae				
! White-breasted Nuthatch (Sitta carolinensis)	A,B,C,D,E,F	C-P resident	Unknown	Coniferous forests, pinion-juniper woodlands, oak brush, and riparian woodlands
! Red-breasted Nuthatch (Sitta canadensis)	A,B,C,E,F	C-P resident	Unknown	Coniferous forests
! Pygmy Nuthatch (Sitta pusilla)	A,B,C,D,E,F	C-P resident	Unknown	Ponderosa pines and Douglas fir

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use A
Family Certidae				
/ Brown Creeper (Certhia familiaris)	A,B,C,E,F	C-P resident	Unknown	In summer mature montane mixed and coniferous forests; lower elevations in winter
Family Cinclidae				
/ Dipper (Cinclus mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Fast-flowing streams in or near mountains; lower levels in winter
Family Troglodytidae				
/ House Wren (Troglodytes aedon)	A,B,C,D,E,F	C-P summer resident	Unknown	Woodlands of mountains and valleys
Rock Wren (Salpinctes obsoletus)	A,B,C,D,E,F	C-P resident	Unknown	Desert to high mountain areas with talus slopes and cliffs
Canyon Wren (Catherpes mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Rocky cliffs, crevices, and rock slides
Bewick's Wren (Thryomanes bewickii)	A,B,C,D,E,F	C-P resident	Unknown	Under brush and pinion-juniper woodlands
Long-billed Marsh Wren (Cistothorus palustris)	A,B,C,D,E,F	L-P resident	Unknown	Cattail marshes
Family Mimidae				
Mockingbird (Mimus polyglottos)	A,B,C,D,E,F	U-P transient and summer resident	Unknown	Towns, farms, ranches, roadsides, brush and desert streamsides
/ Gray Catbird (Dumetella carolinensis)	A,B,C,D,E,F	U-P summer resident	Unknown	Undergrowth, brush or thickets along valley streams

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Brown Thrasher (Toxostoma rufum)	D,E,F	R-P resident	Unknown	Brushy places and thorny thickets
Bendire's Thrasher (Toxostoma bendirei)	F	R-P resident	Unknown	Desert scrub and farmlands
! Sage Thrasher (Oreoscoptes montanus)	A,B,C,D,E,F	C-P resident	Unknown	Sagebrush, rabbit-brush, brushy slopes and mesas
Family Muscicapidae				
! American Robin (Turdus migratorius)	A,B,C,D,E,F	C-P resident	Unknown	In summer towns, lawns, farmland, open forests, streamsides and any woode habitat; in winter berry-bearing trees
Varied Thrush (Ixoreus naevius)	E,F	O-P winter resident	Unknown	Deciduous and coniferous forests usually near wate
! Hermit Thrush (Catharus guttatus)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	In summer mixed woodlands and open coniferous fores in winter woods, thickets and parks
! Swainson's Thrush (Catharus ustulatus)	A,B,D	C-P summer resident	Unknown	Willow thickets, river woodlands, aspens, forest undergrowth and conifers
! Veery (Catharus fuscescens)	A,B	U-P summer resident	Unknown	Streamside woodlands

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! * Western Bluebird (Sialia mexicana)	A,B,C,D,E,F	U-P summer resident	Unknown	Scattered trees, open conifers, forests and farms
! * Mountain Bluebird (Sialia currucoides)	A,B,C,D,E,F	C-P resident	Unknown	In summer open areas where mountain meadows and pastures are interspersed with loose stands or single coniferous trees; in winter lower elevations, often open areas with available perching sites
! Townsend's Solitaire (Myadestes townsendi)	A,B,C,D,E,F	C-P resident	Unknown	In summer open coniferous forests in the mountains; in winter canyons, brushy slopes and junipers
Family Sylviidae				
! Blue-gray Gnatcatcher (Polioptila caerulea)	A,B,C,D,E,F	C-P summer resident	Unknown	Open mixed woods, streamside thickets, mountain brush and pinion-juniper woodlands
! Golden-crowned Kinglet (Regulus satrapa)	A,B,C,D,E,F	U-P resident	Unknown	In summer coniferous forests; in winter pinion-juniper and brush in lower elevations
! Ruby-crowned Kinglet (Regulus calendula)	A,B,C,D,E,F	C-P resident	Unknown	In summer coniferous forests; in winter other woodlands and thickets

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Motacillidae				
Water Pipet (Anthus spinoletta)	A,B,C,D,E,F	C-P resident	Unknown	In summer alpine zone; in migration and winter plains, bare fields, shores and irrigated field
Family Bombycillidae				
Bohemian Waxwing (Bombycilla garrulus)	A,B,C,D,E,F	U-P winter resident	Unknown	Widespread and feeds on berries
Cedar Waxwing (Bombycilla cedrorum)	A,B,C,D,E,F	C-P winter resident	Unknown	Open woodlands, Russian olive and other fruiting trees or orchards
Family Laniidae				
Northern Shrike (Lanius excubitor)	A,B,C,D,E,F	U-P winter resident	Unknown	Semi-open country or open country with look-out posts
Loggerhead Shrike (Lanius ludovicianus)	A,B,C,D,E,F	C-P resident	Unknown	Deserts and other open country with lookout posts, wires, scattered trees and low scrub
Family Sturnidae				
Starling (Stuirnus vulgaris)	A,B,C,D,E,F	C-P resident	Unknown	Cities, fields, orchards and woodlands
Family Vireonidae				
Gray Vireo (Vireo vicinior)	D,E,F	U-P summer resident	Unknown	Brushy mountain slopes, scrub oak and junipers
Solitary Vireo (Vireo solitarius)	A,B,C,D,E,F	U-P summer resident	Unknown	Streamside woodlands, pinion-juniper and Ponderosa pine forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Warbling Vireo (Vireo gilvus)	A,B,C,D,E,F	C-P summer resident	Unknown	Deciduous and mixed aspen woodlands near mountain and valley streams
Family Parulidae				
! Orange-crowned Warbler (Vermivora celata)	A,B,C,D,E,F	C-P summer resident and transient	Unknown	Brushy woodland clearings, hillsides, aspens and mountain brush; in migration streamside woodlands
! Nashville Warbler (Vermivora ruficapilla)	A,B,C,D,E,F	U-P transient	Unknown	Open mixed woods with undergrowth and at forest edges
Virginia's Warbler (Vermivora virginiae)	A,B,C,D,E,F	C-P summer resident	Unknown	Oak canyons, brushy slopes and pinion-juniper brushland
Lucy's Warbler (Vermivora luciae)	E,F	U-P summer resident	Unknown	Along desert streams in willows and cottonwoods
! Yellow Warbler (Dendroica petechia)	A,B,C,D,E,F	C-P summer resident	Unknown	Willows, aspens, streamside trees and shrubs or town shade trees
* Grace's Warbler (Dendroica graciae)	E,F	U-P summer resident	Unknown	Ponderosa pine-oakbrush communities of the mountains
! Magnolia Warbler (Dendroica magnolia)	A,B,C,D,E,F	U-P transient	Unknown	Coniferous forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Hermit Warbler (*Dendroica occidentalis*)	E,F	U-P summer resident and transient	Unknown	Coniferous forests; in migration other trees
Yellow-rumped Warbler (*Dendroica coronata*)	A,B,C,D,E,F	C-P summer resident	Unknown	In summer coniferous and mixed forests; in winter varied woods, river thickets, brush and gardens
Black-throated Gray Warbler (*Dendroica nigrescens*)	A,B,C,D,E,F	C-P summer resident	Unknown	In summer dry oak slopes, pinion-juniper woodlands, open mixed woods; in migration varied trees and brush
Townsend's Warbler (*Dendroica townsendi*)	A,B,C,D,E,F	U-P transient	Unknown	Coniferous forests
Northern Waterthrush (*Seiurus noveboracensis*)	B,C,D,E,F	U-P transient	Unknown	Swampy or wet woods, streamsides and lake-shores; in migration thickets
MacGillivray's Warbler (*Oporornis tolmiei*)	A,B,C,D,E,F	C-P summer resident	Unknown	Low dense undergrowth and shady, damp thickets
Yellowthroat (*Geothylpis trichas*)	A,B,C,D,E,F	L-P summer resident	Unknown	Cattail and bulrush marshes, willow thickets and streamsides
Yellow-breasted Chat (*Icteria virens*)	A,B,C,D,E,F	C-P summer resident	Unknown	Dense brush along water courses, willow thickets and [illegible]st canyons

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Wilson's Warbler (Wilsonia pusilla)	A,B,C,D,E,F	C-P summer resident	Unknown	Deciduous shrubbery or thickets, streamside growth, willows and fir thickets in the mountains
! American Redstart (Setophaga ruticilla)	A,B,C	U-P transient	Unknown	Open secondary deciduous woodlands and riparian woodlands
Family Ploceidae				
House Sparrow (Passer domesticus)	A,B,C,D,E,F	C-P resident	Unknown	Cities, farms and houses
Family Icteridae				
! Western Meadowlark (Sturnella neglecta)	A,B,C,D,E,F	C-P resident	Unknown	Open fields, meadows and plains
Yellow-headed Blackbird (Xanthocephalus xanthocephalus)	A,B,C,D,E,F	C-P summer resident	Unknown	Marshes with cattail and bulrushes; forages in fields and open country
Red-winged Blackbird (Agelaius phoeniceus)	A,B,C,D,E,F	C-P resident	Unknown	Breeds in marshes with emergent aquatic vegetation, forages in cultivated land and at the edge of water
Northern Oriole (Icterus galbula)	A,B,C,D,E,F	C-P summer resident	Unknown	Open woodlands, cottonwoods or other shade trees and riparian areas

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Scotts Oriole (Icterus parisorum)	C,D,E,F	U-P summer resident	Unknown	Pinion-juniper woodlands of desert mountains. oak slopes and cottonwood trees in canyons
Rusty Blackbird (Euphagus carolinus)	A	O-P transient	Unknown	Wooded marshes and riparian woodlands
Brewer's Blackbird (Euphagus cyanocephalus)	A,B,C,D,E,F	C-P resident	Unknown	Varied open country, lakeshores, irrigated pastures, feed lots, parks and cities
! Common Grackle (Quiscalus quiscula)	A,B,D	A-P transient	Unknown	Farms, fields, streamsides and wet woodlands
Brown-headed Cowbird (Molothrus ater)	A,B,C,D,E,F	C-P resident	Unknown	Farms, fields, barnyards wood edges and riparian woodlands
Family Thraupidae				
! Western Tanager (Piranga ludoviciana)	A,B,C,D,E,F	C-P summer resident	Unknown	Open coniferous, aspen or mixed forests; widespread in migration
Family Embarizidae				
Rose-breasted Grosbeak (Pheucticus ludovicianus)	F	O-P summer resident	Unknown	Broadleaf riparian areas and aspens
Black-headed Grosbeak (Pheucticus melanocephalus)	A,B,C,D,E,F	C-P summer resident	Unknown	Edges of second growth deciduous woods, pinion, riparian areas, orchards and parks

Species	Biogeographic Area Inhabit	Status	Population Trend	Habitat Use Area
Blue Grosbeak (Guiraca caerulea)	B,C,D,E,F	C-P summer resident	Unknown	Brushy and weedy places, willows and river thicke and other riparian areas
Lapland Longspur (Calcarius lapponicus)	A,B,C,D,E,F	R-P winter resident	Unknown	Fields, grasslands, saline flats, desert shrub; often seen with horned larks
Indigo Bunting (Passerina cyanea)	A,B,D	R-P summer resident	Unknown	Brush, farm lands and streamsides
Lazuli Bunting (Passerina amoena)	A,B,C,D,E,F	C-P summer resident	Unknown	Mountain brush, stream-side shrubs and farmland tree rows
Green-tailed Towhee (Chlorura chlorura)	A,B,C,D,E,F	C-P summer resident	Unknown	Low mountain brush, greasewood and pinion-juniper woodlands
Rufous-sided Towhee (Pipilo erythrophthalmus)	A,B,C,D,E,F	C-P resident	Unknown	Mountain brush, forest edges and city shrubs
Lark Bunting (Calamospiza melanocorys)	A,B,C,D,E,F	O-P transient	Unknown	Plains, prairies, desert shrub and sagebrush
Savannah Sparrow (Passercules sandwichensis)	A,B,C,D,E,F	C-P summer resident	Unknown	Grasslands, fields, saltgrass meadows and open country
* Grasshopper Sparrow (Ammodramus savannarum)	A,B,C,D,E,F	R-P transient	Unknown	Dry grasslands
LeConte's Sparrow (Ammospiza leconteii)	F	A-P transient	Unknown	Tall grass, weedy meadows and marshes

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Vesper Sparrow (*Pooecetes gramineus*)	A,B,C,D,E,F	C-P summer resident	Unknown	Alfalfa and grain fields, meadows, sagebrush and desert shrub
Lark Sparrow (*Chondestes grammacus*)	A,B,C,D,E,F	C-P summer resident	Unknown	Open country in sagebrush and desert shrub with available perch sites
Sage Sparrow (*Amphispiza belli*)	A,B,C,D,E,F	U-P summer resident	Unknown	Sagebrush, greasewood and other desert shrubs
Dark-eyed Junco (*Junco hyemalis*)	A,B,C,D,E,F	C-P resident	Unknown	In summer openings and edges of coniferous and mixed woodlands; in winte greasewood and undergrowt
Gray-headed Junco (*Junco caniceps*)	A,B,C,D,E,F	C-P summer resident	Unknown	Coniferous, mixed forests and mountain brush
Tree Sparrow (*Spizella arborea*)	A,B,C,D,E,F	U-P winter resident	Unknown	Willow thickets and brushy areas
Chipping Sparrow (*Spizella passerina*)	A,B,C,D,E,F	C-P summer resident	Unknown	Mountain coniferous and deciduous woodlands, valley woodlands, farms, orchards, parks and brushlands
Brewer's Sparrow (*Spizella breweri*)	A,B,C,D,E,F	C-P summer resident	Unknown	Sagebrush, greasewood and other desert shrubs or brushy areas
Harris Sparrow (*Zonotrichia querula*)	A,B,C,D,E,F	U-P winter resident	Unknown	Brushy edges of open woodlands, Russian olives and willows

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use
! White-crowned Sparrow (Zonotrichia leucophrys)	A,B,C,D,E,F	C-P resident	Unknown	In summer forest edges and clearings, low brush and mountain thickets; in winter widespread in the valleys, along fence rows, willows, brushy areas, corn and greasewood
White-throated Sparrow (Zonotricia albicollis)	E,F	R-P winter resident	Unknown	Coniferous and mixed woodlands, woodland undergrowth thickets and brush
Golden-crowned Sparrow (Zonotrichia atricapilla)	E,F	R-P winter resident	Unknown	Mountain brush and brushy areas in the lower valleys
Swamp Sparrow (Zonotrichia georgiana)	F	U-P winter resident.	Unknown	Marshes; in migration weedy fields
! Fox Sparrow (Zonotrichia iliaca)	A,B,C	K-P summer resident and transient	Unknown	Valley and mountain woodlands and brushy areas usually near water
! Lincoln's Sparrow (Zonotrichia lincolnii)	A,B,C	U-P summer resident R-P winter resident	Unknown	In summer willow thickets, brushy bogs; in winter lowland thickets, tall weeds and bushes
Song Sparrow (Zonotrichia melodia)	A,B,C,D,E,F	C-P resident	Unknown	Woodland edges, grasslands, cattail marshes, thickets and brushy fence rows

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-throated Sparrow (Amphispiza bilineata)	A,B,C,D,E,F	U-P summer resident	Unknown	Pinion-juniper, mountain brush and sagebrush
Family Fringillidae				
Evening Grosbeak (Coccothraustes vespertinus)	A,B,C,D,E,F	C-P winter resident	Unknown	Boxelders, Russian olive trees and fruiting shrubs
Cassin's Finch (Carpodacus cassinii)	A,B,C,D,E,F	C-P summer resident U-P winter resident	Unknown	In summer, open conifer forests of high mountains in winter valleys
House Finch (Carpodacus mexicanus)	A,B,C,D,E,F	C-P resident	Unknown	Varied habitats; towns, ranches, open woods, mountain scrub, canyons, deserts and riparian area
Pine Grosbeak (Pinicola enucleator)	A,B,C,E,F	U-P resident	Unknown	In summer coniferous forests; in winter mixed woods and fruiting trees
Rosy Finch (Leucosticte arctoa)	A,B,C,D,E,F	C-P resident	Unknown	In summer alpine tundra, meadows and snowfields; winters in lowlands
Pine Siskin (Carduelis pinus)	A,B,C,D,E,F	C-P resident	Unknown	Coniferous forests, along edges of second growth deciduous forests; in migration seen in large flocks in the lower valle

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
American Goldfinch (Carduelis tristis)	A,B,C,D,E,F	C-P resident	Unknown	Riparian woodlands, willows, cottonwoods, orchards, roadsides and sunflowers
! Lesser Goldfinch (Carduelis psaltria)	A,B,C,D,E,F	C-P resident	Unknown	Open brushy country, open woods, wooded streams and gardens
! Red Crossbill (Loxia curvirostra)	A,B,C,E,F	U-P summer resident	Unknown	Coniferous forests
Mammals -- 103 species in southeastern Utah				
Order Insectivora				
Family Soricidae				
*Dwarf Shrew (Sorex nanus)	B,C,D,E,F	R-N	Unknown	Open grass-covered areas which may have scattered brush, marshes, coniferous forests and openings in woods
! North Water Shrew (Sorex palustris)	A,B,C,E,F	C-N	Unknown	Along nearly all permanent streams in mountainous areas
! Merriam Shrew (Sorex merriami)	A,B,C,D,E,F	U-N	Unknown	Arid sagebrush or grassland areas, mountain mahogany, coniferous forests, aspen and cottonwoods
! Vagrant Shrew (Sorex vagrans)	A,B,C,F	C-N	Unknown	Marshes, bogs, wet meadows and along streams in forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Masked Shrew (Sorex cinereus)	A,B,D,E	C-N	Unknown	Moist sites in forests, open country and brushlan
! Dusky Shrew (Sorex obscurus)	A,B,C,F	C-N	Unknown	Marshes, coniferous forests and dry hillsides
* Gray (Desert) Shrew (Notiosorex crawfordi)	E,F	R-N	Unknown	Arid alluvial fans, brushy slopes, sagebrush and other low desert shrub communities
Order Chiroptera				
Family Vespertilionidae				
! Little Brown Myotis (Myotis lucifugus)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels, hollow trees or buildings usually near water
Fringed Myotis (Myotis thysanodes)	A,B,C,D,E,F	U-N	Unknown	Caves, old buildings, roc crevices, pinion-juniper and desert shrub
! Long-eared Myotis (Myotis evotis)	A,B,C,D,E,F	C-N	Unknown	Coniferous forests in hig mountains, around buildin or trees and occasionally caves
! Long-legged Myotis (Myotis volans)	A,B,C,D,E,F	C-N	Unknown	Buildings, small pockets, crevices in rock ledges and trees

Species	Biogrl. Area Inhabited	Status	Population Trend	Habitat Use A
Yuma Myotis (Myotis yumanensis)	A,B,C,D,E,F	U-N	Unknown	Caves, tunnels and buildings in arid areas
California Myotis (Myotis californicus)	A,B,C,D,E,F	C-N	Unknown	Mine tunnels, hollow trees, loose rocks, buildings, bridges; chiefly a crevice dweller (up to 6,000 feet in elevation)
! Small-footed Myotis (Myotis leibii)	A,B,C,D,E,F	U-N	Unknown	Caves, mine tunnels, crevices in rocks and in buildings
! Silver-haired Bat (Lasionycteris noctivagans)	A,B,C,D,E,F	C-N	Unknown	Forest areas, occasionall in caves or buildings
Western Pipistrelle (Pipistrellus hesperus)	A,B,C,D,E,F	C-N	Unknown	Caves, under loose rocks, crevices, in cliffs, buildings; arid areas nea water courses
! Big Brown Bat (Eptesicus fuscus)	A,B,C,D,E,F	C-N	Unknown	Caves, tunnels, crevices, hollow trees, buildings and wooded areas
! * Red Bat (Lasiurus borealis)	A,B,C,D,E,F	U-N	Unknown	Wooded areas; roosts in trees and occasionally enters caves
! Hoary Bat (Lasiurus cinereus)	A,B,C,D,E,F	U-N	Unknown	Wooded areas
! * Western Big-eared Bat (Plecotus townsendii)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels and buildings utilized for roosting; inhabits arid western desert shrub, pinion-juniper and pine forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Mexican Big-eared Bat (*Plectus phyllotis*)	F	R-N	Unknown	Caves in pine-oak forests between 5,000 to 8,500 feet elevation
*Spotted Bat (*Euderma maculata*)	Unknown	K-N	Unknown	Arid country; it occasionally enters buildings and caves
Pallid Bat (*Antrozous pallidus*)	A,B,C,D,E,F	C-N	Unknown	Caves, mine tunnels, crevices in rocks, buildings and trees are utilized for roosts; inhabits scattered desert shrub and pine-oak forests below 6,500 feet elevation
Family Molossidae				
Mexican Free-tailed Bat (*Tadarida brasiliensis*)	A,B,C,D,E,F	C-N	Unknown	Caves and buildings are utilized for roosts; inhabits lower and upper Sonoran Life Zones
Order Lagomorpha				
Family Ochotonidae				
Pika (*Ochontona princeps*)	A,B,C,E,F	C-N	Unknown	Talus slopes and rock-slides above 8,000 feet elevation
Family Leporidae				
! White-tailed Jackrabbit (*Lepus townsendii*)	A,B,C,D	C-N	Stable	Open, grassy or sage-brush areas at medium elevation
! *Snowshoe Hare (*Lepus americanus*)	A,B,C	C-P	Cyclic	Coniferous forests and aspen, riparian and brush types near conifers

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Black-tailed Jackrabbit (*Lepus californicus*)	A,B,C,D,E,F	C-N	Stable	Open grassland, sagebrush and desert shrub areas at low to medium elevations
*Mountain Cottontail (*Sylvilagus nuttallii*)	A,B,C,E,F	C-P	Stable	Thickets, sagebrush, loose rocks, cliffs and forests
*Desert Cottontail (*Sylvilagus audubonii*)	A,B,C,D,E,F	C-P	Stable	Open plains, foothills and low valleys with grass, sagebrush or scattered pinion-juniper
Order Rodentia				
Family Sciuridae				
Zuni Prairie Dog (*Cynomys gunnisoni*)	F	C-N	Stable	Mountain valleys, 5,000-12,000 feet elevation; open to slightly brushy country with scattered pinion-juniper
White-tailed Prairie Dog (*Cynomys leucurus*)	A,B,C,D,E,F	C-N	Stable	Valleys and flatlands where vegetation is sparse
*Abert Squirrel (*Sciurus aberti*)	F	L-P	Stable	Ponderosa pines
Red Squirrel (*Tamiasciurus hudsonicus*)	A,B,C,F	C-N	Stable	Coniferous forests in the mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Spotted Ground Squirrel (Spermophilus spilosoma)	F	L-N	Unknown	Open forests, scattered brush and grassy areas with sandy soil is preferred
Rock Squirrel (Spermophilus variegatus)	A,B,C,D,E,F	C-N	Stable	Rocky canyons with boulder strewn slopes, riparian woodlands, and ditchbanks
Uintah Ground Squirrel (Spermophilus armatus)	A,B	C-N	Stable	Meadows and edges of fields near green vegetation up to 8,000 feet elevation
Golden-mantled Ground Squirrel (Spermophilus lateralis)	A,B,C	C-N	Stable	Mountain brush, open pine and spruce-fir forests to above timberline
Whitetail Antelope Squirrel (Ammospermophilus leucurus)	A,B,C,D,E,F	C-N	Stable	Arid areas of low desert and foothills with sparse vegetation
Yellow-billied Marmot (Marmota flaviventris)	A,B,C,E,F	C-N	Stable	Rocky sites or talus slopes along valleys or in foothills 5,000 to 9,000 feet elevation
*Northern Flying Squirrel (Glaucomys sabrinus)	A,B,C,F	C-N	Unknown	Coniferous and mixed forests in high mountains

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Least Chipmunk (Eutamius minimus)	A,B,C,D,E,F	C-N	Stable	Variety of habitat types including sagebrush, desert shrub, mountain bush, coniferous and mixed forest areas
Colorado Chipmunk (Eutamius quadrivittatus)	C,E,F	C-N	Stable	Coniferous forests, mountain brush areas, rocky slopes and ridges
Uintah Chipmunk (Eutamius umbrinus)	A,B,D,E,F	C-N	Stable	Coniferous forest and mountain brush areas up to timberline with rocky slopes
Cliff Chipmunk (Eutamius dorsalis)	A,B,C,D,E	U-N	Stable	Pinion-juniper slopes, riparian woodlands with rocky areas
Family Geomyidae				
Northern Pocket Gopher (Thomomys talpoides)	A,B,C,D,E,F	C-N	Unknown	Grassy prairies, alpine meadows, brush areas, open pine forests; generally restricted to the mountains
Valley or Botta Pocket Gopher (Thomomys bottae)	A,B,C,D,E,F	C-N	Unknown	Valleys and mountain meadows; prefers loam soil but may be found in sandy or rocky situations

pecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Ord Kangaroo Rat (Dipodomys ordii)	A,B,C,D,E,F	C-N	Unknown	Desert shrub, pinion-juniper and tamarisk communities; sandy soils preferred but found on hard soils
Baird Pocket Mouse (Perognathus flavus)	F	C-N	Unknown	Prefers short grass areas with sandy or rocky soils
Great Basin Pocket Mouse (Perognathus parvus)	A,D	C-N	Unknown	Sagebrush or greasewood and other desert shrub communities and pinion-juniper
Apache Pocket Mouse (Perognathus apache)	C,D,F	C-N	Unknown	Sparse brushlands and scattered pinion-juniper, usually 5,000-7,200 feet elevation
Family Castoridae				
* Beaver (Castor canadensis)	A,B,C,D,E,F	C-P	Increasing	Streams, lakes and irrigation systems with poplars, birch or willows on the bank
Family Cricetidae				
Western Harvest Mouse (Reithrodontomys megalotis)	A,B,C,D,E,F	C-N	Unknown	Grasslands, open desert, wetlands, irrigated farmland of dense vegetation near water
Canyon Mouse (Peromyscus crinitus)	A,B,C,D,E,F	C-N	Unknown	Rocky canyons and slopes with mountain brush

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Deer Mouse (Peromyscus manicalatus)	A,B,C,D,E,F	C-N	Unknown	All dry-land habitat and irrigated farmland within its range
Brush Mouse (Peromyscus boylei)	A,B,C,D,E,F	C-N	Unknown	Brushy areas of arid and semi-arid regions; prefers rocky sites
Pinion Mouse (Peromyscus truei)	A,B,C,D,E,F	C-N	Unknown	Rocky terrain in pinion-juniper areas
Northern Grasshopper Mouse (Onychomys leucogaster)	C,F	U-N	Unknown	Open country of grass, sagebrush or greasewood and sandy or gravelly soil
*White-throated Wood Rat (Neotoma albigula)	F	C-N	Unknown	Brushland with rocky cliffs and shallow caves
Desert Wood Rat (Neotoma lepida)	A,B,C,D,E	C-N	Unknown	Desert floors and rocky slopes with low desert vegetation or arid mountain brush
*Mexican Wood Rat (Neotoma mexicana)	F	C-N	Unknown	Rocks, cliffs and mountains
Bushy-tailed Wood Rat (Neotoma cinerea)	A,B,C,D,E,F	C-N	Unknown	High mountains with rimrock, rock slides and pines
Muskrat (Ondatra zibethicus)	A,B,C,D,E,F	C-N	Stable	Marshes, edge of ponds, lakes, streams and irrigation canals

ecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
! Meadow Vole (Microtus pennsylvanious)	A,D	C-N	Unknown	Moist areas with dense growth of grasses
! Mountain Vole (Microtus montanus)	A,B,D,E	C-N	Unknown	Dense vegetation in sagebrush-grass communities
! Richardson's Vole (Microtus richardsoni)	A	C-N	Unknown	Creekbanks and marshes in mountains to above timberline
! Longtail Vole (Microtus longicaudus)	A,B,C,D,E,F	C-N	Unknown	In summer streambanks, mountain meadows with dry sites; in winter brushy areas
Sagebrush Vole (Lagurus curtatus)	C,F	C-N	Unknown	Scattered sagebrush with loose soil and arid conditions
Family Muridae				
Black Rat (Rattus rattus)	A,B,C,D,E,F	C-N	Unknown	Buildings and dumps
Norway Rat (Rattus norvegicus)	A,B,C,D,E,F	C-N	Unknown	Burrows along building foundations and beneath rubbish piles
! House Mouse (Mus musculus)	A,B,C,D,E,F	C-N	Unknown	Buildings and occasionally in fields

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
Family Zapodidae				
Western Jumping Mouse (*Zapus princeps*)	A	C-N	Unknown	Low meadows near streams with lush growth of grasses and forbs; found in various land habitats
Family Erethizontidae				
! Porcupine (*Erethizon dorsatum*)	A,B,C,D,E,F	C-N	Stable	Forested areas, occasionally away from trees if brush is available
Order Carnivora				
Family Canidae				
! Coyote (*Canis latrans*)	A,B,C,D,E,F	C-N	Stable	Ubiquitous
* Red Fox (*Vulpes fulva*)	A,B,C,D,E,F	C-N	Stable	Forest and open country preferred
* Kit Fox (*Vulpes macrotis*)	A,B,C,D,E,F	U-N	Stable	Open level, sandy ground preferred with low desert vegetation
! Gray Fox (*Urocyan cinereoargenteus*)	A,B,C,D,E,F	C-N	Stable	Brush and open forests

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Gray Wolf (Canis lupus)	A,B,C,D,E,F	X-P	Extirpated	Wilderness forests
Family Ursidae				
*Black Bear (Ursus americanus)	A,B,C,E,F	C-P	Increasing	Mountainous areas
*Grizzly Bear (Ursus horribilis)	A,B,C,E,F	X-P	Extirpated	Remote mountainous regions
Family Procyonidae				
Ring-tailed Cat (Bassariscus astutus)	A,B,C,D,E,F	C-N	Stable	Near water on slopes with mountain brush, rocky ridges and cliffs
*Raccoon (Procyon lotor)	A,B,C,D,E,F	O-N	Increasing	Along streams, lake borders and near wooded areas or rock cliffs
Family Mustelidae				
*Short-tailed Weasel (Mustela erminea)	A,B,C,F	R-P	Stable	Brushy or wooded areas not far from water
*Long-tailed Weasel (Mustela frenata)	A,B,C,D,E,F	C-P	Stable	All land habitat types near water
*Mink (Mustela vison)	A,B,C,F	L-P	Unknown	Along streams and lakes
*Wolverine (Gulo luscus)	A,B	X-P	Extirpated	Remote mountain regions
*Black-footed Ferret (Mustela nigripes)	A,B,C,D,F	E-P	Unknown	Prairie dog towns
*Marten (Martes caurina)	A,B,C,F	R-P	Unknown	Coniferous forests at high elevations

ecies	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
*Badger (Taxidea taxus)	A,B,C,D,E,F	C-P	Stable	Open grasslands, deserts and high mountain forests where prey is available
*Striped Skunk (Mephitis mephitis)	A,B,C,D,E,F	C-P	Increasing	Semi-open country of prairie, brushlands or mixed woodlands within two miles of water
*Spotted Skunk (Spilogale gracilis)	A,B,C,D,E,F	C-P	Stable	Prairies or grasslands with brushy or sparsely wooded areas along streams with boulders
*River Otter (Lutra canadensis)	A,B,C,D,E,F	R-P	Unknowr	Along streams and lake borders
Family Felidae				
*Bobcat (Lynx rufus)	A,B,C,D,E,F	C-P	Declining	Rimrock and mountain brush areas
*Canada Lynx (Lynx canadensis)	A,B,C,E,F	X-P	Extirpated	Forested areas in the mountains
*Cougar (Felis concolor)	A,B,C,D,E,F	C-P	Stable	Rugged mountains with forests, cliffs and ledges
Order Artiodactyla				
Family Cervidae				
*Mule Deer (Odocoileus hemionus)	A,B,C,D,E,F	C-P	Increasing	Coniferous forests, desert shrub, mountain brush, grassland with shrubs and other habitats where browse species are present

Species	Biogeographic Area Inhabited	Status	Population Trend	Habitat Use Area
* Moose (Alces alces)	A	L-P	Increasing	Mountainous areas, forests, mountain brush and willow bottoms
* Rocky Mountain Elk (Cervus canadensis)	A,B,C,E,F	C-P	Increasing	Semi-open forests, mountain meadows (in summer), foothills, plains and valleys
Family Antilocapridae				
* Pronghorn Antelope (Antilocapra americana)	B,C,D,E,F	L-P	Stable	Open prairies and sagebrush or desert shrub plains
Family Bovidae				
*Desert Bighorn Sheep (Ovis canadensis nelsoni)	D,E,F	L-P	Increasing	Precipitous terrain on mountain and canyon slopes and rims with sparse growth of trees
* Rocky Mountain Bighorn Sheep (Ovis canadensis canadensis)	B,C	L-P	Increasing	Precipitous terrain on mountain and canyon slopes and rims with sparse growth of trees
* Bison (Bison bison)	E	L-P	Stable	Desert shrub plains of the Burr Desert and mountain brush forest habitats associated with steep mountain slopes of the Henry Mountains

The 11 List of Game Species and Regions of Inhabitation Within Utah.

Game Species of Utah	REGION				
	Southeastern	Southern	Central	Northeastern	Northern
10 BIG GAME SPECIES					
Bison	x	x			
Black Bear	x	x	x	x	x
Cougar	x	x	x	x	x
Desert Bighorn Sheep	x	x			
Elk	x	x	x	x	x
Moose	x		x	x	x
Mountain Bighorn Sheep	x		x	x	x
Mountain Goat			x		
Mule Deer	x	x	x	x	x
Pronghorn Antelope	x	x	x	x	x
Subtotal	9	7	8	7	7
20 GAME FISH SPECIES					
Arctic Grayling		x		x	x
Black Bullhead	x	x	x	x	x
Black Crappie	x	x	x	x	x
Bluegill	x	x	x	x	x
Bonneville Cisco					x
Brook Trout	x	x	x	x	x
Brown Trout	x	x	x	x	x
Channel Catfish	x	x	x	x	x
Cutthroat Trout	x	x	x	x	x
Golden Trout			x	x	
Kokanee Salmon				x	x
Lake Trout		x	x	x	x
Largemouth Bass	x	x	x	x	x
Mountain Whitefish			x	x	x
Northern Pike	x	x			
Perch	x	x	x	x	x
Rainbow & Albino Trout	x	x	x	x	x
Smallmouth Bass			x	x	x
Striped Bass	x	x			
Walleye	x	x	x	x	x
White Bass		x	x		
Subtotal	13	16	16	17	17

Game Species of Utah	REGION				
	Southeastern	Southern	Central	Northeastern	Northern
9 FURBEARER SPECIES					
Badger	x	x	x	x	x
Beaver	x	x	x	x	x
Long-tailed Weasel	x	x	x	x	x
Marten	x	x	x	x	x
Mink	x	x	x	x	x
River Otter	x			x	x
Short-tailed weasel	x	x	x	x	x
Spotted Skunk	x	x	x	x	x
Striped Skunk	x	x	x	x	x
Subtotal	9	8	8	9	9
43 MIGRATORY GAME BIRD SPECIES					
American Widgeon	x	x	x	x	x
Band-tailed Pigeon	x	x	x		
Barrows Goldeneye	x	x	x	x	x
Black Brant		x			x
Black Duck		x	x		x
Blue-winged Teal	x	x	x	x	x
Bufflehead	x	x	x	x	x
Canada Goose	x	x	x	x	x
Canvasback	x	x	x	x	x
Cinnamon Teal	x	x	x	x	x
American Coot	x	x	x	x	x
Common Gallinule	x	x	x		x
Common Goldeneye	x	x	x	x	x
Common Merganser	x	x	x	x	x
Common Snipe	x	x	x	x	x
European Widgeon			x		x
Fulvous Tree Duck		x			x
Gadwall	x	x	x	x	x
Greater Scaup	x	x	x	x	x
Green-winged Teal	x	x	x	x	x
Harlequin Duck					x

Game Species of Utah	REGION Southeastern	Southern	Central	Northeastern	Northern
Hooded Merganser	x	x	x	x	x
Lesser Scaup	x	x	x	x	x
Mallard	x	x	x	x	x
Mourning Dove	x	x	x	x	x
Old Squaw		x	x		x
Pintail	x	x	x	x	x
Red-breasted Merganser	x	x	x	x	x
Redhead	x	x	x	x	x
Ring-necked Duck	x	x	x	x	x
Ross Goose	x	x			x
Ruddy Duck	x	x	x	x	x
Sandhill Crane	x	x	x	x	x
Shoveler	x	x	x	x	x
Snow Goose	x	x	x	x	x
Sora Rail	x	x	x	x	x
Surf Scoter			x		x
Trumpeter Swan		x	x		x
Virginia Rail	x	x	x	x	x
Whistling Swan	x	x	x	x	x
White-fronted Goose	x	x	x	x	x
White-winged Scoter	x	x	x		x
Wood Duck	x	x	x	x	x
Subtotal	35	40	39	31	42

5 SMALL GAME-MAMMAL SPECIES

Abert Squirrel	x				
Desert Cottontail	x	x	x	x	
Mountain cottontail	x	x	x	x	x
Pigmy Cottontail		x	x		x
Snowshoe Hare	x	x	x	x	x
Subtotal	4	4	4	3	3

Game Species of Utah	REGION Southeastern	Southern	Central	Northeastern	Northern
12 SMALL GAME-UPLAND BIRD SPECIES					
Blue Grouse	x	x	x	x	x
California Quail	x	x	x	x	x
Chukar	x	x	x	x	x
Gambels Quail	x	x			
Hungarian Partridge			x		x
Merriam's Turkey	x	x			
Ring-necked Pheasant	x	x	x	x	x
Ruffed Grouse	x	x	x	x	x
Sage Grouse	x	x	x	x	x
Sharp-tailed Grouse					x
White-tailed Ptarmigan				x	x
White-winged Pheasant	x	x			
Subtotal	9	9	7	7	9
100 Total Game Species in Utah	78	83	81	73	86

Table 2. Classification of the 466 species of vertebrate wildlife that inhabit six biogeographic areas within Southeastern Utah.

	Biogeographic Areas[1]					
	A	B	C	D	E	F
FISH	14	20	15	15	24	31
Protected-Threatened	(0)	(1)	(1)	(1)	(1)	(1)
Protected-Endangered	(0)	(3)	(2)	(1)	(1)	(2)
Protected-Nongame	(10)	(11)	(9)	(10)	(12)	(16)
Protected-Game	(4)	(5)	(3)	(3)	(10)	(12)
AMPHIBIANS	6	5	6	7	7	10
Protected-Nongame	(1)	(1)	(1)	(1)	(1)	(2)
Unprotected-Nongame	(5)	(4)	(5)	(6)	(6)	(8)
REPTILES	18	14	15	14	21	28
Unprotected-Nongame	(18)	(14)	(15)	(14)	(21)	(28)
BIRDS	242	244	242	235	251	262
Protected-Extirpated	(1)	(1)	(1)	(1)	(1)	(1)
Protected-Threatened	(0)	(0)	(0)	(0)	(0)	(0)
Protected-Endangered	(2)	(2)	(2)	(2)	(2)	(2)
Protected-Nongame	(199)	(202)	(202)	(193)	(208)	(217)
Protected-Game	(39)	(38)	(36)	(38)	(39)	(41)
Unprotected-Nongame	(1)	(1)	(1)	(1)	(1)	(1)
MAMMALS	84	80	80	65	66	90
Protected-Threatened	(0)	(0)	(0)	(0)	(0)	(0)
Protected-Endangered	(1)	(1)	(1)	(1)	(0)	(1)
Protected-Extirpated	(2)	(2)	(2)	(0)	(2)	(2)
Protected-Game	(18)	(19)	(19)	(12)	(16)	(19)
Unprotected-Extirpated	(0)	(0)	(0)	(0)	(0)	(0)
Unprotected-Nongame	(63)	(58)	(58)	(52)	(53)	(62)
Total Protected Species	277	286	279	263	293	317
TOTAL:	364	363	358	336	369	421

[1] Biogeographic areas of southeastern Utah
A- Wasatch Plateau east of Skyline Drive
B- West Tavaputs Plateau
C- East Tavaputs Plateau
D- San Rafael Swell and Desert
E- Henry Mountains and Burr Desert
F- Mountains and Deserts south of I-70 in Grand and San Juan counties

VERTEBRATE SPECIES OF WILDLIFE HAVING HIGH INTEREST TO THE STATE OF UTAH

Class of Animal	Number of species		
	Statewide[1]	SER[2]	Valley Camp of Utah
Fish	33	20	2
Amphbians	3	2	1
Reptiles	10	4	2
Birds	104	95	23
Mammals	61	40	13
TOTAL	211	161	51

1. Utah Division of Wildlife Resources as the state of Utah's wildlife authority recognizes 211 species of vertebrate wildlife that inhabit the state as being of high interest. High interest wildlife represent all game species and all species having significant economic importance from either a comsumptive or nonconsumptive perspective or special asthetic, scientific or educational values. This list includes all federally listed threatened or endangered species of wildlife.
2. Evaluation of data presented in Utah Division of Wildlife Resources publication No.78-16, " Species List of Vertebrate Wildlife That Inhabit Southeastern Utah" shows that 161 of the 211 species of the states high interest wildlife inhabit the Southeastern Region (SER) of the state on occasion or during different seasons of the year.

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Appropriations No. 01-59-09
Archives Approval No. 7900014

Scott M. Matheson
Governor

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

Alvin E. Rickers, 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
August 17, 1981

RECEIVED
AUG 21 1981
By

Trevor G. Whiteside
Valley Camp of Utah, Inc.
Scofield Route
Helper, UT 84526

RE: Air Quality Approval Order for Increase of Coal Production

Dear Mr. Whiteside:

On April 30, 1981, the Executive Secretary published a notice of intent to approve your increase in coal production from 1.2×10^6 tons/year to 2.25×10^6 tons/year. The 30-day public comment period expired on May 30, 1981 and no comments were received.

This air quality approval order authorizes the increase in production as proposed in your notice of intent dated March 26, 1981 with the following conditions:

1. The conveyor hood sections shall be securely positioned when transporting coal and be maintained in good operating condition.

2. The conveyor head chutes, reclaim tunnel feeder chutes and vibrator feeder discharge chutes shall be totally enclosed and maintained in good operating condition.

3. The conveyor skirtboards shall be properly positioned when transporting coal and be replaced as needed.

4. Stacker tube dust flaps shall be replaced as needed.

5. The 2.2 miles of haul road shared with other companies shall be paved no later than September 1, 1982. In the interim, the road shall be chemically stabilized to minimize fugitive emissions. A record/log of all treatments including date, amount and location shall be kept and made available to the Executive Secretary upon request.

6. The unpaved sections of haul roads not covered in condition #5 shall be chemically stabilized as necessary with dust suppressive material. A record/log of all treatments including date, amount and location shall be kept and made available to the Executive Secretary upon request.

7. All conveyor transfer points shall be equipped with water sprays.

8. The opacity of the crushing plant baghouse shall not exceed 20%. The baghouse shall be maintained in good operating condition.

9. No visible emissions, except from internal combustion engines, shall exceed 20% opacity as per Section 4.1.2, Utah Air Conservation Regulations (UACR). Visible emissions from diesel engines shall not exceed 20% opacity except for starting motion no farther than 100 yards or for stationary operation not exceeding three minutes in any hour according to Section 4.1.4, UACR.

10. All surge bins for loading of trucks or railroad cars shall be equipped with a telescoping chute to minimize the fall distance of the coal.

11. Total annual production of coal from the two mines and crushing plant throughput shall not exceed 2.25×10^6 tons without prior approval from the Executive Secretary according to Section 3.1, UACR.

12. The Executive Secretary shall be notified when monthly production reaches full capacity as a compliance inspection is required.

You are considered a minor source for purposes of the PSD regulations and will not require a permit from EPA/Region VIII. However, for State purposes you are a major source.

According to Section 3.9, UACR, a fee for the cost associated with processing this permit is required to be paid to the State of Utah upon receipt of this approval order. The final costs are attached.

Sincerely,

Brent C. Bradford
Executive Secretary
Utah Air Conservation Committee

DR:jw
cc: Southeastern District Health Dept.
EPA Region VIII (D. Kircher)
enclosure

Copy to Mary Ann

SCOTT M. MATHESON
GOVERNOR

STATE OF UTAH
DEPARTMENT OF COMMUNITY AND
ECONOMIC DEVELOPMENT

Division of
State History
(UTAH STATE HISTORICAL SOCIETY)

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

[illegible] OF
OIL, GAS & [illegible]NING

January 7, 1981

James W. Smith
Division of Oil, Gas and Mining
Department of Natural Resources
1588 West North Temple
Salt Lake City, Utah 84116

RE: Skyline Mine - Coastal State's Energy Company, Carbon County, Utah

Dear Mr. Smith:

The staff of the Utah State Historic Preservation Officer has received your letter of October 24, 1980. The staff, having reviewed the submitted report by Archeological Environmental Research Corporation, entitled "Archeological Surface Evaluations in the Skyline Project in Carbon and Emery Counties," has determined that the report is adequate to determine mitigation of impacts of the proposed operations on historic and cultural resources. Because of the limited number of resources and the described no adverse effect upon them in the Skyline Mine project, it is felt that this report could satisfactorily be submitted as part of a mining program as outlined by the Memorandum of Agreement between the Division of State History and the Division of Oil, Gas and Mining.

The Preservation Office is aware of the December 22, 1980 letter submitted to Coastal States Energy by the Office of Surface Mining concerning the adequacy of the report for submission. Our office agrees that there are many technical errors in the report. However, since the cultural resources are not eligible and there is no adverse effect, the mine plan should be approved.

The Office of Surface Mining has pointed out some serious problems with this report and others. The Preservation Office of Utah would like to suggest to Oil Gas & Mining and the Office of Surface Mining that a meeting be set up to determine some specific guidelines that can be dealt with on a systems basis rather than individual cases.

State History Board: Milton C. Abrams, Chairman • Thurton H. Luke • Ted J. Warner • Elizabeth Montague • Thomas G. Alexander
Dee G. Dayton • Walter K. Hinton • Helen Z. Papadopolos • David S. Morison • Elizabeth Griffith • William D. Owens

Should you need assistance or clarification, please call or write James L. Dykman, Cultural Resource Advisor, or Wilson G. Martin, Preservation Development Coordinator, Utah State Historical Society, Preservation Development, 300 Rio Grande, Salt Lake City, Utah 84101.

Sincerely,

Melvin T. Smith

Melvin T. Smith
Director and
State Historic Preservation Officer

JLD:jr:C942CB

cc: Office of Surface Mining, Attn: Bill Killiam, Brooks Towers, 1020 15th Street, Denver, Colorado 80202

INTENSIVE ARCHEOLOGICAL SURFACE EVALUATIONS IN THE PROPOSED WHISKEY CREEK CANYON-PLEASANT VALLEY PROJECT IN CARBON COUNTY, UTAH

Mine Plan Applicant:
Valley Camp of Utah, Inc.
(Coal Mine and General Service Facilities
Relative to Belina #1 and #2 and Utah #12 Mines)

F. R. Hauck, Ph.D., Principal Investigator

Report Prepared by:
F. R. Hauck, and D. G. Weder
ARCHEOLOGICAL-ENVIRONMENTAL
RESEARCH CORPORATION

PAPER NO. 21
September, 1980

Salt Lake City, Utah

ABSTRACT

In the summer of 1980, the Archeological-Environmental Research Corporation conducted an intensive cultural resource evaluation for Valley Camp Coal Company of Utah in the Pleasant Valley-Eccles Canyon locality south of Scofield, Utah. The survey consisted of a corridor evaluation extending from the proposed mine facilities in Whiskey Canyon to the Utah No. 2 Mine location.

A total of seven historic cultural resource sites is situated within, or adjacent to, the project area. These sites include four mine portal service areas, one sawmill site, and two cabin foundations. One of the seven sites is considered to meet the minimal criteria of eligibility under 36 CFR 60.6.

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Chapter I - INTRODUCTION

A. General Data on the Project

In the spring of 1980, the Archeological-Environmental Research Corporation (AERC) of Salt Lake City was contacted by Vaughn Hansen Associates, a Salt Lake City consulting firm, on behalf of Valley Camp of Utah, Inc. and contracted to perform an intensive cultural resource evaluation of mine portal areas, transportation corridors and service areas relative to the development of mine facilities in the Whiskey Canyon-Eccles Canyon-Pleasant Valley locality of Carbon County, Utah. Mine permits involved in this locality include Belina #1 and #2 and Utah #2. Vaughn Hansen Associates (VH) in conjunction with Valley Camp of Utah, Inc., desirous of preparing a mine plan application for submission to federal and state authorities, requested that cultural resource evaluations be conducted within the potential subsidence zone which would comply with pertinent government legislation, i.e., Executive Order 11593 "Protection and Enhancement of Cultural Environment" (Federal Register, Vol. 36, No. 95, May 15, 1971), and "The Archeological and Historical Data Conservation Act of 1974", which is an amendment of "The Reservoir Salvage Act of 1960" (74 Stat. 220). For additional information, please refer to the mine plan application prepared by Vaughn Hansen Associates.

AERC's field evaluations within this project area commenced in the summer of 1975 when F. R. Hauck began conducting proposed drill location evaluations for Valley Camp but in association with Sanders Associates, a consulting firm with offices in Kaysville, Utah. AERC's consulting for Sanders Associates (see report for June 13, July 17, October 13, November 28, 1975 and July 17 and August 23, 1976) featured

specific evaluations made within the general Scofield locality although no evaluations were actually conducted within the present project area.

Beginning in September, 1978, AERC began consulting for Coastal States Energy Company upon the Skyline Project which is situated on the west and adjacent to the Valley Camp project area (see Figure 1). Reports on AERC investigations in the Coastal States project area were furnished as CSEC-78-1 (10/2/78), CSEC-79-2 (7/23/79), CSEC-79-3 (8/10/79), CSEC-79-5 (9/18/79). In 1979, AERC conducted an intensive surface evaluation of the floor of Eccles Canyon extending from the mouth of that canyon on the west into the National Forest lands (see CSEC-79-2). That survey includes the entire floor of Eccles Canyon which will be included in the present mine plan permit application. During these preliminary cultural resource evaluations, only three cultural resource sites were recorded in the general locality. These sites included two historic campsites, AERC 270U/1 and 2, and one historic mine portal, service area, AERC 270N/1. All three sites are situated in Eccles Canyon; however, only the first two sites, 270U/1 and 2, need be considered in this report. Site 270N/1 is adjacent to the National Forest boundary up the canyon from the Valley Camp project area. No other cultural resources in the Eccles Canyon-Whiskey Creek locality had been recorded prior to AERC's surface evaluations being reported in this document.

From July 22-25, 1980, AERC personnel conducted intensive evaluations of the Whiskey Creek corridor and an extension of the Eccles Canyon corridor running north from the mouth of Eccles Canyon along the west bench of Pleasant Creek to the existing service area at the mouth of Green Canyon. Some four historic sites were recorded during this recent survey. Thus, a total of six historic cultural resource sites are situated within the Valley Camp mine plan permit area.

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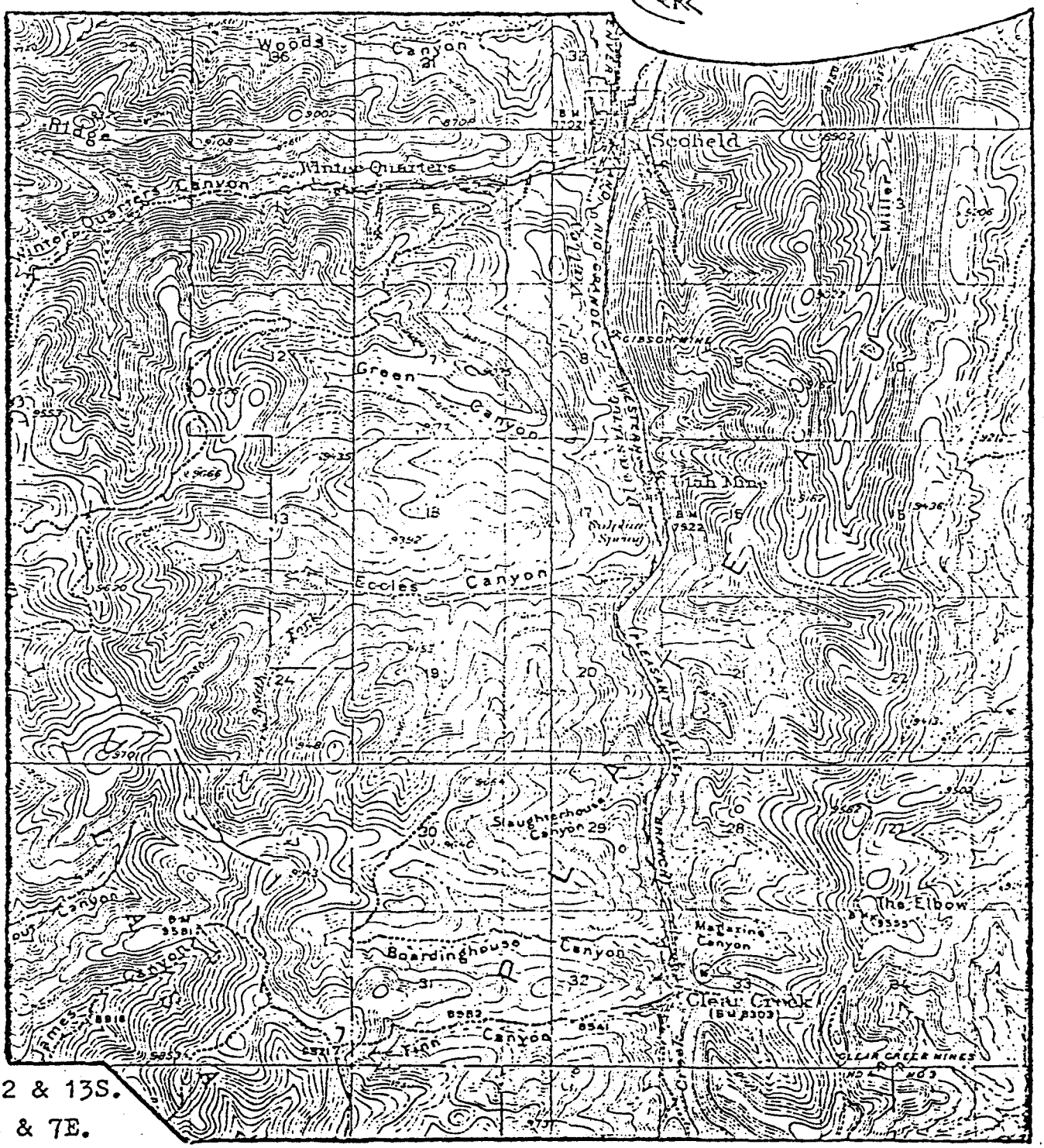

T. 12 & 13S.

R. 6 & 7E.

Meridian: Salt Lake B. & M.

Quad:

Project: VH-80-1

Series: Central Utah

Date: 9-17-80

Figure 1

GENERAL MAP
OF THE PROJECT AREA
IN THE
SCOFIELD LOCALITY
OF CARBON COUNTY, UTAH

Scofield, Utah
15 Minute USGS

Legend:

N

1 0 1 2 M.

0 1 2K.

Scale

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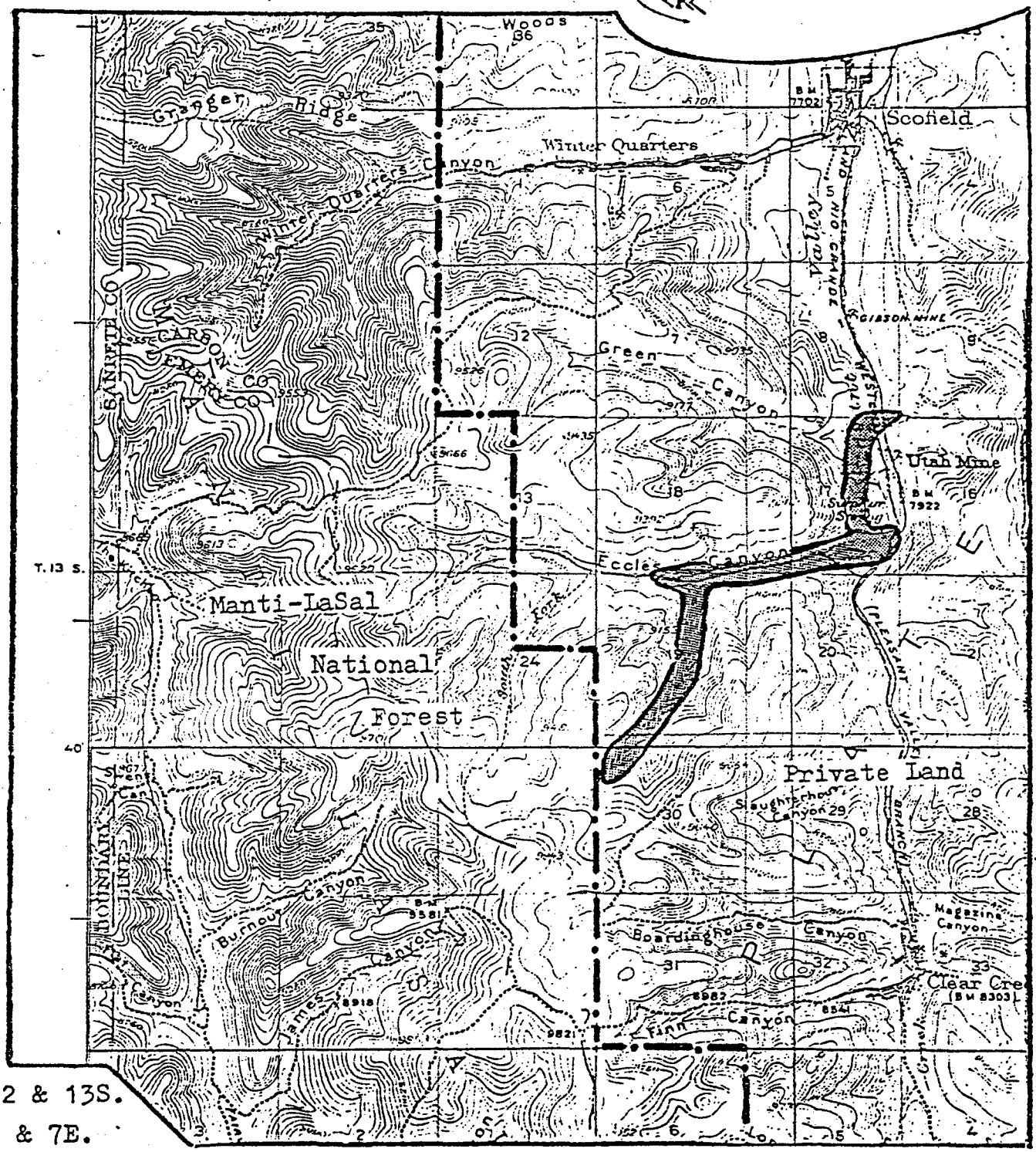

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Meridian: Salt Lake B. & M.

Quad: Scofield, Utah 15 Minute USGS

Project: VH-80-1

Series: Central Utah

Date: 9-17-80

Figure 2

SURVEY AREA AND LAND OWNERSHIP IN THE PROJECT AREA

Legend:

Survey Corridor

N

1 0 1 2 M.

0 1 2K.

Scale

Recommendations concerning site significance and mitigational techniques relative to those six sites are provided in this report.

All surveyed areas relative to the present mine plan permit are situated on privately owned lands and no federal antiquities permits have been procured to conduct the 1980 research.

The resource inventory area for the 1980 research involves about three miles of transmission corridor of 60 meters in width extending from the northwest quarter of Section 30 in Whiskey Creek north through the center of Section 19 into the bottom of Eccles Canyon and then east through Section 18 into Pleasant Valley and north in Section 17 to Section 8 and then east to the Utah No. 2 Mine location in the northeast quarter of Section 17, Township 13 South, Range 7 East, Salt Lake Base and Meridian. At special request from Valley Camp, AERC personnel also examined the Nicolitus Mine, the Green Canyon sawmill site and the Gibson Mine, all located in Pleasant Valley but outside the transmission corridor. This project area is situated about two miles south of Scofield, Utah, with the eastern corridor paralleling Utah State Highway No. 96 in Pleasant Valley. The Scofield, Utah, U.S.G.S. 15 Minute topographic map shows the project area.

All field notes and site data are filed at AERC headquarters in Bountiful, Utah. Site reports are being submitted to all relevant state and federal agencies as an appendix to this report. Artifacts collected during the survey are being curated at the Museum of Peoples and Cultures at Brigham Young University in Provo, Utah.

B. Environment and Locality

The project locality is situated in several narrow canyons which drain northwards into Scofield Reservoir via

Eccles Canyon Creek and Pleasant Valley Creek. The general elevation of the project area ranges between about 7750 feet at the Gibson Mine to about 9200 feet at the head of Whiskey Canyon.

The high elevations in the project area have a strong effect on the local climate. The precipitation amounts to about 30 inches annually, but most of this precipitation falls in the form of snow since the May to September precipitation is only eight inches (Utah Water and Power Board). Elevation and exposure also determine the freeze free growing period which is as low as 20 days per year at the highest elevation, but not greater than 60 days at the lowest elevations.

The surface geology of the project locality is relatively simple. The majority of the canyon's lower surfaces consists of an exposure of the Cretaceous age Star Point Sandstone, a formation of marine, deltaic and beach deposits of interbedded sandstone and shales. Above the Star Point is exposed the Black Hawk Group, a Cretaceous age deposit which consists of sandstone, mudstone, shale and coal.

The high elevation places the project locality within the Montane floral ecozone, but topographic factors create a mosaic of different plant communities. In the Montane ecozone, the following arboreal species are typically present in the project area (Johnson 1970):

Common Arboreal Species	
Limber pine	*Pinus flexilis*
Engelmann spruce	*Picea engelmannii*
Blue spruce	*Picea pungens*
Subalpine fir	*Abies lasiocarpa*
White fir	*Abies concolor*
Douglas fir	*Pseudotsuga menziesii*
Rocky Mountain juniper	*Juniperus scopulorum*

Common juniper	Juniperus communis
Mountain mahogany	Cercocarpus ledifolius
Aspen	Populus tremuloides
Serviceberry	Amelanchier spp.

Due to topographic factors, the east-facing side and bottom of Whiskey Canyon are predominately aspen whereas the west-facing side is a mixture of evergreen species.

The floral community along the Pleasant Valley Creek bottom include mixtures of willow Salix spp., sagebrush Artemisia tridentata, rabbit brush Chrysothamnus nauseosus and grasslands grading into mountain shrub communities.

The project locality is situated in the Northern High Plateau Subcenter of the Middle Rocky Mountain Faunal area and is characterized by a wide variety of species. The mammal species known to exist in the general project area according to Durrant (1952) include the following:

Order Insectivora	
Shrews	Sorex spp.
Order Lagomorpha	
Pika	Ochotona princeps
White-tailed jack rabbit	Lepus townsendii
Snowshoe rabbit	Lepus americanus
Cottontail rabbit	Sylvilagus nuttallii
Order Chiroptera	
	Myotis spp.
Silvery-haired bat	Lasionycteris spp.
Big brown bat	Eptesicus spp.
Red bat	Lasiurus spp.
Long-eared bat	Corynorhinus spp.
Big free-tailed bat	Tadarida spp.
Order Rodentia	
Squirrels	Citellus spp.
Chipmunks	Eutamius spp.

Northern pocket gopher	Thomomys talpoides
Beaver	Castor canadensis
Western harvest mouse	Reithrodontomys megalotis
Mouse	Peromyscus
Meadow mouse	Microtus spp.
Wood rat	Neotama cinerea
Big jumping mouse	Zapus princeps
Porcupine	Erethizon dorsatum
Marmot	Marmota flaviventer
Order Carnivora	
Coyote	Canis latrans
Wolf (formerly in area)	Canis lupus
Red fox	Vulpes fulva
Gray fox	Urocyon cinereoargenteus
Grizzly bear (formerly in area)	Ursus horribilis
Black bear	Ursus americanus
Ring-tailed cat	Bassaricus astutus
Ermine	Mustela erminea
Long-tailed weasel	Mustela frenata
Marten	Martes caurina
Badger	Taxidea taxus
Striped skunk	Mephitis mephitis
Spotted skunk	Spilogale gracilis
Canada lynx	Lynx canadensis
Bobcat	Lynx rufus
Mountain lion	Felis concolor
Order Artiodactyla	
Elk	Cervus canadensis
Mule deer	Odocoileus hemionus
Mountain sheep (formerly in area)	Ovis canadensis

The montane ecozone also supports a wide variety of avian species, some of which are summer migrants. Some of these species, according to Hayward et al (1976) include the following:

Local Avian Species

Coniferous Niche		
Red-breasted nuthatch	Sitta canadensis	(summer)
Golden-crowned kinglet	Regulus satrapa	
Ruby-crowned kinglet	Regulus calendua	
Yellow-rumped warbler	Dendroica coronata	(summer)
Western tanager	Piranga ludoviciana	(summer)
Aspen Niche (Hole nesting)		
Tree swallow	Tachycineata bicolor	
Violet green swallow	Tachycineata thalassina	(summer)
House wren	Troglodytes aedon	(summer)
Black-capped chickadee	Parus atricapillus	
Yellow-bellied sapsucker	Sphyrapicus varius	
Downy woodpecker	Picoides pubescens	
Common flicker	Colaptes auratus	
Chipping sparrow	Spizella passerina	(summer)
Cassin's finch	Carpodacus cassinii	(summer)
Black-headed grosbeak	Pheucticus melanocephalus	(summer)
Western wood pewee	Contopus sordidulus	(summer)
Mountain bluebird	Sialia currucoides	(summer)
Hermit thrush	Catharus gultatus	
Predators		
Goshawk	Accipiter gentilis	
Cooper's hawk	Accipiter cooperii	
Red-tailed hawk	Buteo jamaicensis	
Golden eagle	Aquila chrysaetos	
Great horned owl	Bubo virginianus	

Those species which migrate into the area from out of the state are indicated as summer residents. The other species are present during the entire year but generally migrate to somewhat lower elevations during the winter months.

C. Prehistory and History of the Region

The variety of human cultures which have inhabited the project region can be examined from several perspectives. The temporal continuum extending over a range of 12,000 years involves such diverse groups as the early prehistoric big game hunters, the archaic hunter-gatherers, the semi-horticultural Fremont, the Shoshonean bands, the early historic explorers and fur trappers, the Mormon colonists, the coal and cattle barons, the final influx of farmers, small town settlers, and merchants. Man's social and technological variations mirror the complexity of economic means used to exploit the necessary resources of his changing ecological system.

The Prehistoric Period

The prehistoric period within the project region can be subdivided into four main temporal phases: Paleo Indian, Archaic, Fremont and Shoshonean.

PALEO INDIAN PHASE

The Paleo Indian phase began at approximately 12,000 B.P. and terminated by about 7000 B.P., and is generally divided into three subphases which are known as the Llano, Folsom and Plano cultures (Jennings 1974:81).

The Llano culture was characterized by the hunting of mammoth during a time period between 12,000 B.P. and 10,000 B.P. Since the Llano culture has been defined primarily from the excavation of mammoth kill sites, very little is known about the overall subsistence activities of this culture.

Evidence of the Llano culture has been found over a widespread area in the Intermountain West and Southwest.

The Clovis point, a large, lanceolate, fluted spear point, is the only artifact which can be used confidently to infer the presence of the Llano hunters. Clovis points, in association with mammoth remains, have been found in New Mexico, Oklahoma, Colorado, Arizona and Wyoming.

Based on these sites, which are characterized by mammoth-Clovis point association, the core area of the Llano culture is limited to eastern Colorado, most of New Mexico and eastern Arizona. However, the Clovis point by itself has a much larger distribution. Clovis points, or very similar fluted points, have been found throughout the entire United States.

Within the project region of Utah, no characteristic Llano sites have been found, although several isolated Clovis points and one fluted point site have been reported. An isolated Clovis point was reported from Sevier County, Utah (Tripp 1966). Gunnerson (1956) performed a test excavation on a small rockshelter in Emery County (42Em8) from which a local collector had obtained a Clovis point. The test excavation did not, however, recover any additional Clovis points. An unusual fluted point very closely resembling the Cumberland fluted points commonly found east of the Mississippi River was found by an amateur collector in the San Rafael Swell and reported by Hauck in 1979 (42Em677).

The Folsom culture (ca. 11,000 B.P. to 9000 B.P.) immediately followed the Llano culture, but several differences in subsistence and artifacts allow a clear distinction to be drawn. Although the primary evidence of the Folsom culture is also from kill sites, the fauna hunted and the projectile points used are different from the Llano culture. The Folsom point is a lanceolate, fluted and usually eared projectile point generally smaller and thinner than the Clovis point. In addition, the Folsom point is associated at kill sites with the extinct Bison antiquus.

Folsom kill sites occur predominantly within the same region as the Llano core area but isolated Folsom points are not as widely distributed as Clovis points. Isolated Folsom points are almost entirely limited to the High Plains immediately east of the Rocky Mountains. A total of 11 Folsom points has been found in Utah but only one of these, found by an amateur collector somewhere in the San Rafael Swell, is known from the project region (Tripp 1967).

The Plano subphase of the Paleo Indian phase extends from ca. 9000 B.P. to 7000 B.P. The Plano culture, like the Llano and Folsom cultures before it, was economically partially dependent on large game, bison in particular. However, the Plano culture is characterized by a great diversity of projectile point types. Plano culture projectile points are typically lanceolate, precisely flaked and non-fluted.

A new hunting technique also became widespread during the Plano subphase, the jump-kill. The jump-kill hunting technique entailed the driving of a herd of bison over the edge of a cliff or arroyo in order to injure or kill the bison.

Evidence of Plano culture inhabitation is predominately limited to the High Plains east of the Rocky Mountains. The presence of Plano culture hunters in Utah is not widely acknowledged.

The presence of Paleo Indian cultures within Utah was minimal even during the Llano subphase and tended to decrease with time. The slight Paleo Indian utilization of Utah can possibly be tied to the relative scarcity of the large game species in Utah compared to the Great Plains east of the Rocky Mountains than on the eastern side and, as a result, the large herbivorous animals utilized by the Paleo Indian cultures were present on the Great Plains in considerably greater numbers.

ARCHAIC PHASE

Because of the relatively arid conditions of Utah and the Great Basin, large mammal hunting was not a viable subsistence technique in that area. The Great Basin and adjacent Colorado Plateau of eastern Utah were occupied at an early date by Indian groups who were engaged in a subsistence pattern dependent on smaller game animals and the gathering of wild plant foods.

The utilization of caves and rockshelters by Archaic cultures in Utah has resulted in good temporal sequences for the entire Archaic phase. Radiocarbon dates from Danger Cave (Jennings 1957) verify human inhabitation of the Great Basin as early as 10,000 B.P., but the artifacts retrieved from the lowest levels of Danger Cave are not diagnostic of any recognized culture group.

In addition to Danger Cave, Hogup Cave (Aikens 1970) in the Great Basin, Sudden Shelter (Jennings, Schroedl, Holmer 1980) in the southern Wasatch Mountains and Cowboy Cave (Jennings et al n.d.) in southeastern Utah, have all supplied important data pertinent to the development of a cultural sequence for the Archaic inhabitants of Utah. The Archaic has been divided into three phases based on changes in projectile point types.

The Early Archaic Period begins at approximately 8500 B.P. and continues until about 6000 B.P. Subsistence during this period was based on generalized gathering and hunting techniques. A large variety of plant, animal and insect resources was utilized. Hunting was primarily limited to deer and mountain sheep although antelope and bison were also utilized. The trapping of rabbits and small rodents was also an important source of protein.

The prevalent utilization of caves and rockshelters as habitations in conjunction with the aridity of the area has resulted in conditions suited to the preservation of normally perishable materials. Due to the excellent preservation, it

is known that the spear thrower (atlatl) was the implement used for hunting. The atlatl was used with a two or three component shaft and stone dart point throughout the Archaic phase. The Early Archaic Period was characterized by four types of dart points, the Pinto, Humboldt, Elko and the Northern Side Notch (Holmer 1978). During this time period, the Elko point type had a limited areal extent confined primarily to the northeastern Great Basin and the northern Colorado Plateau. The Pinto and Humboldt points, generally found in close association in archeological contexts, had the same distribution as the Elko points, but are also found in sites in southern and central Idaho at this time period. The Northern Side notch point had a very wide distribution during the Early Archaic period encompassing the northern Great Basin, Columbia Plateau, Northern Colorado Plateau and Great Plains.

The Middle Archaic Period began about 6000 B.P. and ended about 4500 B.P. Subsistence techniques and the utilization of caves were the same as during the Early Archaic but dart point styles changed and also diversified. Dart points such as the Rocker Side-notched, Sudden Side-notched, McKean Lanceolate and San Rafael Side-notched were characteristic of this period (Holmer 1978). The Elko point continued to be used during this period in the same areas as it had been during the Early Archaic period. Although the Rocker Side-notched and Sudden Side-notched points were limited in their distribution to central Utah, the McKean Lanceolate and San Rafael Side-notched styles had wider distributions including the Great Plains at this time. Another point style made its appearance during the Middle Archaic, the Gypsum point (Holmer 1978). This point style was very common in the southern Great Basin and northern Colorado Plateau and continued to be utilized through the end of the Late Archaic period.

The Late Archaic period began about 4500 B.P. and ended at roughly 1700 B.P. Subsistence techniques were essentially unchanged from the earlier Archaic periods and the utilization of the Elko and Gypsum points styles was continued although the latter style is generally limited in its occurrence to the southern half of Utah. At the end of the Late Archaic period, two new technological developments occurred which mark a significant change in prehistoric subsistence patterns: the introduction of corn and the bow and arrow.

Evidence of corn horticulture in the latter part of the Late Archaic period has been found at several locations: Cowboy Cave (Jennings et al in preparation), Cottonwood Cave in western Colorado (Hurst 1948) and Clyde's Cavern in central Utah (Winter 1973, Winter and Wylie 1974). At all three locations, corn caches were found which dated generally between 1600 B.P. and 2000 B.P. The very late portion of the Late Archaic period also witnessed the advent of the bow and arrow. At Cowboy Cave (Jennings et al n.d.b), Rose Springs arrowheads were recovered from the uppermost level and were dated about 1700 B.P.

The entire Archaic phase is characterized by a gathering and hunting subsistence mode and a sequence of dart point styles which have been defined through the analysis of excavated cave and rockshelter sites. Transient habitation of these caves during the annual migratory round is the most widely accepted interpretation of the Archaic subsistence pattern.

The atlatl was the universal Archaic hunting implement until the very last centuries of the Late Archaic period. However, the advent of the bow and arrow around 1700 B.P. does not seem to have eliminated the utilization of the atlatl during the late Archaic. Gypsum dart points continued to be manufactured even after the appearance of Rose Spring arrowheads at Cowboy Cave (Holmer in Jennings et al n.d.).

addition, Anasazi tradewares are considerably more prevalent in the Fremont culture sites than in the Sevier culture sites.

The unnamed plains-derived culture of northern and northeastern Utah existed from about 1300 to 650 B.P. (Madsen and Lindsay 1977). This culture was dependent upon hunting of bison and the collecting of wild plants. The dwellings are normally shallow basin structures without any clear evidence of the type of superstructure utilized. Unlike the coiled pottery of the Sevier, Fremont and Anasazi cultures, the unnamed culture produced pottery by the paddle and anvil techniques. It is important to note that there is a considerable spatial overlap of the unnamed culture and the Fremont culture traits in the northern portion of the latter's distribution. There is insufficient data at the present to determine whether the spatial trait overlap is due to alternate occupation, simultaneous occupation by the two cultures or a combination of these two possibilities.

Hunting activities among the Sevier, Fremont and unnamed cultures are evident from the many varieties of small arrowheads which have been recovered from excavations. Small stemmed corner notched (Rose Spring) arrow points are present in the earlier phases of all three cultures, but after about 1100 B.P., numerous regional variants developed. Side notch arrow point styles (Bear River Side-notched and Uinta Side-notched) were common in the northern part of Utah while Parowan Basal-notched and Bull Creek arrow point styles were common in the southwestern and south central portions of Utah respectively. The Bull Creek points are of particular interest because they are found in high frequencies at both Kayenta Anasazi sites in southern Utah and Fremont sites along the east side of the Wasatch Mountains (Coombs Village, Bull Creek sites, Snake Rock Village, Old Woman and Poplar Knob) and probably indicate the reciprocal exchange of males for matrimonial purposes (Holmer and Weder 1980).

Dart points, the Elko series and Gypsum, in particular, are also found in association with Fremont sites. This association has been used by Schroedl (1976) to verify the indigenous development of the Fremont culture from Archaic antecedents. Dart points, during the Archaic, were used as both projectile points and knives (Weder in Jennings et al n.d.) but their function in the Fremont context has not yet been evaluated.

In reference to Utah, the Mesa Verde and Kayenta variants of the Anasazi culture are of particular importance. The San Juan Anasazi culture was centered around the Four Corners area where Colorado, New Mexico, Arizona and Utah meet. The Kayenta Anasazi inhabited the extreme southern periphery of Utah from the San Juan River west to central Utah. As has already been noted, Kayenta influence is particularly evident in a narrow band of sites running from Coombs Village northwards past the Henry Mountains to the Snake Rock Village site adjacent to Interstate 70 on the east side of the Wasatch Plateau.

SHOSHONEAN PHASE

The Shoshonean populations, who were the sole inhabitants of Utah at the time of Euro-American contact, have been in the northeastern Great Basin region since approximately 650 B.P. Their origin has been the subject of considerable controversy, however. Several hypotheses have been expressed.

One hypothesis maintains that the Shoshoneans came from the southwest of the Great Basin at about the time of the dispersal of the Sevier, Fremont and Anasazi agriculturalists (Madsen 1975b and Lamb 1958). Gunnerson's hypothesis (1962) states that the Fremont, Sevier and Virgin cultures were Shoshonean peoples who had taken up horticultural and ceramic techniques diffused from the Anasazi but later reverted to an Archaic subsistence style after a climatic change which made agricultural subsistence techniques unproductive.

Regardless of which hypothesis is correct, Shoshonean groups (Ute, Paiute, Shoshone and Bannock) were inhabiting the Great Basin into eastern Utah at ca. A.D. 1300 roughly coincident with the disappearance of the Fremont and Sevier cultures.

The Shoshonean subsistence pattern was quite similar to the Archaic adaptation. Small familial bands were engaged in a gathering and hunting subsistence utilizing a wide variety of nondomesticated plant, mammal, and insect species.

Very little archeological evidence is available for this time period. Two characteristic artifact types can generally be associated with the Shoshonean occupation of Utah. The bow and arrow was utilized for hunting and a type of arrowhead, the Desert Side Notch point, has been correlated with the Shoshonean occupation (Holmer and Weder 1980). The Shoshoneans also utilized ceramics to a small degree. Shoshonean ceramics are easily distinguished from Sevier, Fremont and Anasazi wares by the former's relative crudeness. Shoshonean ceramics are typically thick walled, have large temper particles, are poorly smoothed, exhibit little decoration and have been fired in an uncontrolled or oxidizing atmosphere.

The Protohistoric Period

The prehistoric Shoshonean occupation of the Intermountain West continued up to and through the period of Euro-American contact. The Indian groups inhabiting the area of eastern Utah within which the project locality is situated came to be called the Utes.

PRECONTACT

The Utes are a group belonging to the Shoshonean (Uto-Aztecan) linguistic family of which there are three branches: Ute-Chemehuevi, Shoshoni and Mono-Paviotso. The Ute-Chemehuevi branch includes those groups which came to be

known as the Utes, Southern Paiutes and Chemehuevi. Although there is little archeological evidence, the Utes probably were characterized by a social organization and subsistence mode quite similar to all of the other aboriginal groups in the Great Basin and Colorado Plateau. The Utes were pedestrian gatherers and hunters who utilized a relatively large area of western Colorado and eastern Utah (Steward 1974).

The Utes were grouped into loosely organized bands consisting of extended families. Leadership was present only for subsistence task groups. The Utes could be reliably distinguished from the other contemporary aboriginal groups only in terms of linguistic differences.

Group territoriality was developed only in a statistical sense. A particular Ute band might consider a certain area as a home, but the seasonal round of each band was highly variable from year to year. The area with which any band was most familiar was not exlusively utilized by that band. Intermarriage among the various Ute bands tended to maintain linguistic unity but blur the definition of territorial homeland for any particular band. Except for those Utes who were utilizing the aquatic resources around Utah Lake, local populations were small and mobile (Steward 1974).

EARLY CONTACT

The presence of the Spanish colony at Santa Fe by 1598 resulted in the first contact between the Utes and Euro-American groups. The relationship which developed between the Utes and the Spaniards was consistently friendly and resulted in the spread of the horse among the Ute bands. When the Utes obtained the horse, a change in their subsistence occurred. The equestrian Ute was able to travel more widely and more effectively and concentrate on bison hunting (O'Neill 1973).

The utility of the horse was strongly mitigated by environmental factors, however. The maintenance of a large

horse herd required substantial supplies of grass which generally limited the advantage of the horse to those areas where grass was plentiful such as western Colorado, the Uintah Basin and along the western slopes of the Wasatch Mountains. The supply of grass also determined the distribution of the bison. The horse was, therefore, not equally valuable to all of the Ute bands. The bands in Colorado were able to support their horses whereas those bands in Utah, eastern Utah in particular, were unable to utilized the horse effectively and were more likely to eat a horse than ride it.

Considerable trading activity with the Utes was occurring during the 17th and 18th Centuries. Of particular importance was slave trade (O'Neill 1973). The Utes were able to conduct slave raids on neighboring tribes (especially the Navajo) because of their equestrian status. They then exchanged their slaves for horses and other Spanish goods. Whether the slaves were exchanged with traders travelling into Ute territory or were driven by the Utes to Spanish settlements is unknown because of the lack of documented evidence. Until the 1770s, there was little official Spanish interest in the territory of the Utes. However, at that time, King Charles III of Spain decided that an exploration of the areas north of Santa Fe would be beneficial to Spanish control. His developing interest was a reaction to the growing influence and explorations by the British and French in the West. Charles III felt that it was important to ensure control of trade by the Spaniards since he considered the British and French traders as a threat to Spanish rule (O'Neill 1973).

The first documented Spanish exploration of the area north of Santa Fe was the Dominguez-Escalante Expedition of 1776-1777. This expedition was also the first officially

sponsored exploration, the purpose of which was to find a route between Santa Fe and the Spanish settlements in California. Although the expedition was unsuccessful in reaching its goal, it did extensively explore the territory occupied by the Utes who, in all recorded instances, welcomed the Spaniards.

A trail was eventually established between Santa Fe and California which came to be known as the Spanish Trail. The origins of the Spanish Trail are obscure; however, this trail was probably utilized in prehistoric times as evidenced by its association with archeological sites.

LATE CONTACT

Beginning in the early 1800s, the fur trade became active in Utah. The Arze-Garcia expedition traded for furs with the Utes at Utah Lake in 1813 and soon thereafter trappers began to actively exploit the area. Etienne Provost was a member of the Choteau-DeMun exploration of 1815 to 1817 and subsequently founded his own trapping company which operated primarily within Ute territory. He was subsequently killed by the Utes near the site of the city which now bears his name, Provo (O'Neill 1973).

During this time, more detailed information on the Shoshonean peoples of the area was recorded. In particular, specific Ute bands are mentioned with reference to their respective territories. Within the project region, the Weeminuche band conducted its yearly rounds (O'Neill 1973).

The Adams-Onis treaty of 1819, which gave Mexico its independence, resulted in an influx of Americans to Santa Fe. Most of the Americans came to engage in trapping. The newly arrived trappers caused a considerable increase in traffic along the Spanish Trail and an increase in competition for the available fur resources. This competition was not welcomed by the Utes, who were no longer consistently friendly with the Euro-Americans.

Although there were a large number of independent trappers operating in Utah, their activities have not been well documented. Antoine Robidoux was an important trapper who by 1824 was operating primarily in the Uintah Mountains. William Ashley and Peter Skene Ogden were trapping in the northern Ute territory during the summer of 1824 and, at about the same time, Jedediah Smith was exploring eastern Ute territories to evaluate their trapping potential (O'Neill 1973).

The growing traffic along the Spanish Trail had an important effect on the local Ute bands. Wakara, a Tumpanuwache leader, became quite powerful in the 1820s by conducting horse raids in southern California and returning to Utah by way of the Spanish Trail (Lyman and Denver 1970). He enhanced his power and wealth by exacting tribute from travelers along the trail and by the trading of stolen horses and Pahvant and Paiute slaves (O'Neill 1973). In addition, Wakara and his band actively engaged in fur trapping.

By the late 1830s, there was considerable competition for the fur resources of Utah and western Colorado. Robidoux established a permanent fort and trading center in 1837 near Whiterocks in the Uintah Basin to capitalize on the beaver-laden streams of the Uintah Mountains.

The prosperity of the fur trade was not destined to last very long, however. The fierce competition over trapping areas led to widespread disruptive conflicts and, most importantly, the demand for furs used to make the beaver skin hats which were fashionable in Europe and the eastern United States declined rapidly about 1840 as the fashions changed. Fort Robidoux was burned in 1844 by the Utes who apparently blamed the trappers for the declining value of their furs (O'Neill 1973; Lyman and Denver 1970).

The decline of the fur trade had a serious impact on the Ute bands of Utah. The entire economic base of the

Utes began to disintegrate after 1840. The trading activities with Santa Fe began to dwindle with the decline in the horse and slave trade. The termination of Mexican control of the area in 1846 and the subsequent loss of contact for slave trade into Mexico (Lyman and Denver 1970) were very disruptive to the relationships existing between Utah and Santa Fe.

During the declining years of the fur trade, the largest invasion of Ute territory occurred. Beginning in 1847, Mormon pioneers began to move into Utah and rapidly swelled their numbers through immigration. At first, there was little conflict with the Utes because the major Mormon settlement, Salt Lake City, was on the periphery of the Ute territory and the earliest Mormon expansion was to the north. In 1849, Fort Utah (later to become the town of Provo) was founded near Utah Lake on the traditional campsite of the Tumpanuwache band. Since the Tumpanuwache band, still under the leadersip of Wakara, had been forced to revert to their earlier mode of subsistence due to the decline of the fur trade, their utilization of the resources around Utah Lake became of vital importance. The conflicting interests in the Utah Lake vicinity escalated into a series of raids and counterraids during the 1850s which became known as the Walker War. In the end, the Utes were forced to leave the valley and moved east across the Wasatch Mountains (O'Neill 1973).

The next few years were difficult for the Utes, who were being gradually forced to split up into small bands and resume a subsistence mode similar to the precontact period. Some of the bands, however, chose to raid Mormon settlements and farms to obtain cattle so that they could avoid starvation. These raids became more prevalent during the 1860s. Raids were conducted on the Mormon settlers west of the Wasatch and the Utes returned to the unsettled areas east of the Wasatch with the stolen cattle (O'Neill 1973).

Although several bands were responsible for these raids, one man by the name of Black Hawk became the focus of the blame for all the raiding.

The areas east of the Wasatch Mountains remained under Ute domination for several years. A Mormon attempt to colonize at Moab was undertaken in 1855 but the Mormon settlers were harassed by the Utes and forced to return to Salt Lake City. It was not until 1877, by which time the Utes had been removed to the Uintah Reservation, that Mormon colonists were able to safely settle east of the Wasatch Mountains (O'Neill 1973).

The Historic Period

The history of the east-central coal areas of Utah begins with the exploration and colonization efforts of the Spanish during the last quarter of the 18th Century. East-central Utah was first explored and mapped by the Dominguez-Escalante Expedition of the 1776-1777 in its efforts to establish a line of communication between the Spanish settlements of New Mexico and Monterey, California (Miller 1968).

Though the Dominguez-Escalante Expedition failed to achieve this end, subsequent attempts from the New Mexico settlements and the travelings of Spanish and American fur trappers, traders and frontiersmen resulted in a connecting route known as the Old Spanish Trail (Miller 1968:Map 20). Along this route, which came up from Santa Fé through the San Juan country, across the Colorado River at Moab, over the Green River at the present site of Green River, across the San Rafael Desert into Castle Valley, then south through Salina Canyon to southwestern Utah and southern California, passed thousands of horses and numerous trading, trapping and Indian slave trade expeditions (Miller 1968).

By the 1830s, the trail was well established, portions of its route being followed in 1853 by explorer, John C. Fremont and government surveyor, John W. Gunnison, who reported several sets of well-worn tracks near Green River where Interstate 70 presently runs. Other sections of the trail still remain near the Big Hole Wash in Emery County. The primary route of the Old Spanish Trail, plus divergent trails to Utah Lake, Fort Robidoux and Fort Kit Carson, brought the first extended contact into the project area (Miller 1968: Map 20).

Though forts and trading posts were scattered sparsely through southern and central Utah, the first attempts at organized settlement were undertaken by the Mormon Church. In 1855, the Elk Mountain Mission passed southward through Castle Valley to the area of Moab intending to establish a permanent settlement, but Indian hostility forced a quick retreat. The combination of hostile Indians, the desolate appearance of the region, the hardships involved in securing sufficient water for irrigation and doubts about the quality of the soil caused further attempts at colonization of the eastern area of what was then Sanpete County to be dropped for over 20 years (McElprang et al 1949:16).

At a priesthood meeting at Mt. Pleasant on September 22, 1877, encouragement was given to settle Castle Valley; soon after 75 men from Sanpete Stake were called with Christian G. Larsen as leader. Very few responded, however, because of the aforementioned reasons. Orange Seely was subsequently given the responsibility of superintending the founding of settlements and another call for colonizers was issued by the Church in the fall of 1878. Some of the earliest settlers of the area who dwelt in dugouts in hills or washes until log houses could be erected were Elias and John Cox, Ben Jones, William Avery and Anthony Humbel. By the fall of 1878, the crops were sufficient and the situation stable

enough for the families of these men to join them, a sure sign of an intent to remain (McElprang et al 1949).

Work progressed on the agricultural settlements of Castle Valley and roads were built through the Wasatch Mountains to the more stable areas of western Sanpete County. Additionally, in the fall of 1878, the "Star-Mail Route" was opened between Salina and Ouray, Colorado; it followed the paths of the Old Spanish Trail and the "Gunnison" Trail of years before (McElprang et al 1949:19-21). In just three years the towns of Castle Dale, Wilsonville, Ferron, Green-river (Blake), Huntington, Lawrence, Molen and Orangewill had been established and the Legislative Assembly in February, 1880, created Emery Coutny, which embraced all of present-day Carbon, Emery and Grand Counties (Lever 1898:593).

Though the project region was settled for its agricultural and grazing possibilities, it was the area that inspired active settlement and set the mining-dominated industrial base that central and eastern Utah retains to the present.

The first recorded discovery of coal in eastern Utah was by the Gunnison Expedition of 1853 (Powell 1976:13) when they located deposits of coal approximately three miles east of present-day Emery. The isolated location of the Gunnison find, coupled with the hope that the deposits already discovered at Coalville and Wales would prove sufficient for the territory's needs, caused Gunnison's discovery to be forgotten. The subsequent failure of the efforts at Wales to produce good coking coal, and the Union Pacific Railroad's monopolization and price-fixing on the deposits at Coalville, caused a re-evaluation of the potential coal producing areas east of the Sanpete settlements (Powell 1976:13).

As a result, the first effort to exploit the newly found eastern coal deposits was undertaken in 1875 at Connellsville in the upper reaches of Huntington Canyon. The

Fairview Coal Mining and Coke Company was organized by men from New York, Salt Lake City and Fairview. Eleven coke ovens were constructed and the coke was hauled by wagon into Springville. The expense involved with the hauling and the questionable quality of the coke produced caused the failure and abandonment of Connellsville by 1878 after only three years of operation (Powell 1976:13).

The next development of coal resources was begun in the Pleasant Valley area, also in 1875. The Pleasant Valley Coal Company, headed by Milan O. Packard, constructed a wagon road from Springville up Spanish Fork Canyon to Pleasant Valley coal lands in 1876; 1877 saw the opening of the Number 1 Mine in Winter Quarters Canyon (Powell 1976:14). A narrow gauge rail line was completed from Springville through Spanish Fork Canyon in October of 1879 by the Pleasant Valley Railroad Company as the haul to Springville by the wagon road occupied four days in good weather while in winter the road was impassable. This Pleasant Valley area proved to be extremely productive. The first three large scale mines in eastern Utah were established in this area when the Mud Creek Mine was reopened in 1882 followed by the 1884 opening of the Union Pacific Mine at Scofield just east of Winter Quarters (Powell 1976:15).

From the earliest times, the railroads sought to control the supply of coal in the territory, e.g., the Coalville resources and Union Pacific Railroad's control over that source. During the early 1880s, the Denver and Rio Grande Railroad was extending its lines from Colorado through Utah. Though originally graded through Castle Valley and Salina Canyon, the route of the railroad was altered, going through Price and Spanish Fork Canyon and thus taking in the rich coal areas of what was to become Carbon County (McElprang et al 1949:22).

Further expressing its interest in eastern Utah coal, the Denver and Rio Grande Western (Denver and Rio Grande's Utah

holdings) purchased the independently owned Pleasant Valley Railroad Company and Pleasant Valley Coal Company in 1882. Shortly thereafter, Union Pacific Railroad Company (UPRR) penetrated the Pleasant Valley area in order to protect its threatened monopoly on Utah coal (Powell 1976:16). The UPRR formed the Utah Central Coal Company in 1882 and opened the Union Pacific Mine near Scofield in 1884. With the Denver and Rio Grande's Pleasant Valley Coal development (1882), the establishment of Utah Fuel Company in 1887 and the creation of Utah Central Coal of Union Pacific, the railroad companies almost totally dominated the ownership and production of the Utah mines until the early 1900s (Reynolds et al 1948:195).

In 1888, a mine was opened at Castle Gate on the Price River near the mouth of Price Canyon. In about 1899, a new mine began operations at Sunnyside just 24 miles east of present-day Price at the base of the Book Cliffs. The Sunnyside Number 2 Mine also began its production in 1899 with the coal obtained there, and also at Castle Gate, being utilized for coking purposes (Powell 1976:17-18).

In 1906, the first of the coal operations which would remain free from railroad control began production at Kenilworth, three miles east of Helper. This enterprise was financially backed by James Wade and F. A. Sweet and was called the Independent Coal and Coke Company because of its unique ownership status. Sweet, one of Utah's most prominent coal authorities, also opened a mine on the middle fork of Miller Creek in 1908 and named the camp Hiawatha (Reynolds et al 1948:213). This locality at the foot of Gentry Mountain, about 18 miles southeast of Price, was the scene of further coal mining development in 1911 when Black Hawk mine was opened by Brown and Eccles. Just a few miles to the south in northern Emery County, a small wagon mine was purchased by the Castle Valley Fuel Company and the town, Mohrland, named from the initials of the company's four major figures--Mays, Orem, Heiner

and Rice--was begun. Mr. W. H. Wattis undertook the last development in this area in 1916 at Wattis, several miles north of Hiawatha on the flank of Castle Valley Mountain.

The decade from 1911-1920 saw an increase in activity in the coal regions of east-central Utah with many new mines being opened in hitherto undeveloped areas within the Utah coal producing regions. In 1911, Frank Cameron prospected the region around Panther Canyon on the Price River, and in 1914, the first coal was shipped out by the Utah Fuel Company which had leased the properties to Cameron for development. Cameron also developed and opened a small camp at the base of Castle Rock, about five miles northwest of Helper. Located directly on the main line of the Denver and Rio Grande Western Railroad, the camp's name was changed many times as was its ownership. Originally known as Bear Canyon, it soon was called Cameron, for its developer, then Rolapp, and finally, Royal (Reynolds et al 1948:244).

In 1912, Jesse Knight, one of the most prominent men in Utah mining history, bought 1600 acres of coal land west of Helper to provide coal for his smelting operations in the Tintic District. His mine, at what eventually became known as Spring Canyon, began production in 1913 and was the first of many mines in the Spring Canyon District, one of the most prolific coal producing areas in eastern Utah. Soon after the establishment of Storrs (Spring Canyon), F. A. Sweet opened another mine in Spring Canyon at Standardville, so called because it was considered to be the standard for the development of future mining camps. The year 1914 saw the opening of the Latuda Mine and camp by Liberty Fuel Company while mines were opened in 1916 at Peerless and Rains. The last mining development undertaken in the Spring Canyon District was Mutual Coal Company's Mutual and Little Standard operations, begun in 1921 and 1925, respectively.

The final major coal producing area to be opened in east-central Utah was the Gordon Creek District. This region had first been prospected in 1908, but was really brought to prominence in 1920 by A. E. Gibson, the superintendent of the Spring Canyon Mine. Mines were developed in this area up until 1925 by Consumers Mutual Coal Company, National Coal Company and Sweet Coal Company. The operations of all three companies ceased by 1950 (Carr 1972:81).

After the development of the Gordon Creek area, further work on the coal regions was undertaken in areas that had been opened previously. In 1922, Columbia Steel Company opened a mine at Columbia near the location of Sunnyside in order to further exploit the excellent coking coal obtainable from that region. One very late development of the same coal veins that supported the Columbia operation was initiated in Horse Canyon in 1942 by the United States government to aid steel production at its Geneva plant (Reynolds et al 1948:252). Both mine and steel plant were taken over by U.S. Steel after WWII and continue in operation to the present.

Most of the mines in east-central Utah continued production through the heavy demand years of WWI and the years of prosperity that followed but a combination of overdevelopment, the increased use of other natural fuels, rising costs associated with expensive underground haulage and the Depression of the late 1920s and early 1930s caused several camps to be abandoned. Among the first mines to succumb were the long exploited Pleasant Valley mines. Winter Quarters, near Scofield, was closed down in 1928 while Scofield and Clearcreek experienced reductions of operations during the early 1920s and 1930s, respectively. Rains was also forced to cut back on operations in 1930. Despite these setbacks, as of

1929, there were 22 coal mines operating in Carbon, Emery and Grand counties, the production of these mines providing 98% of the state's output (Sutton 1949:852).

Economic and production difficulties continued to plague Utah's coal industry during the decade of the 1930s, forcing the closure of the Mutual and Mohrland mines in 1938. World War II brought a temporary respite to the general downward trend with many mines achieving their highest production levels during the war years and immediately thereafter.

The decade of the 1950s signalled the end for a great number of the eastern Utah coal mining operations as the adaptation of coal for new uses was insufficient to keep pace with this fuel's replacement in many of its traditional roles. The increasing use of natural gas for heating homes and heavy industry use and the railroad's switch to diesel power were among the developments which severely hurt the coal industry. This bleak picture has drastically changed with the advent of America's "energy shortage", and new technologies for coal use in the future have caused an upswing in coal production in east-central Utah. Mines which were closed, or kept running with skeleton crews, have begun to increase operations during the last decade and the possibility of a new sustained burst of coal mining activity definitely exists (Alexander 1963:244-247).

D. Previous Investigations in the Region

Archeological research in the Castle Valley locality began with the Claflin Emerson Expedition. In 1929, Noel Morss and Henry Roberts conducted explorations and limited test excavations under the auspices of this expedition along the Fremont River and as far north as the Muddy River in Emery County. Morss' work resulted in the original definition of the

Fremont cultural entity (Morss 1931, Gunnerson 1969). Morss' description of Fremont sites north of the Colorado River was an important contribution to the understanding of the prehistoric horticultural adaptation in the American Southwest.

With the exception of Reagan's description of the large petroglyph panel in Buckhorn Draw (Reagan 1935), there were no archeological investigations in the Castle Valley region for the next 15 years. Between 1952 and 1957, the University of Utah conducted a series of surveys in order to better define the nature of the Fremont occupation in Utah. A large number of Fremont sites was located along the east side of the Wasatch Plateau and several of the sites were subjected to limited test excavations, including 42Em5, the Emery Site (42Em47) and Snake Rock Village (42Sv5). Each of these three sites were Fremont habitations (Gunnerson 1957). In addition to these Fremont sites, Gunnerson also tested a shallow rock shelter on Silverhorn Wash (42Em8) as a result of a local collector's report that a fluted projectile point resembling the Clovis style had been found eroding from the shelter deposits. Little additional information was obtained by the excavation, however (Gunnerson 1956).

In the 1970s, there was a significant upsurge in archeological activity in the Castle Valley region. In 1970, three sites endangered by vandalism were excavated by the University of Utah. These sites, Windy Ridge Village (42Em73), Crescent Ridge (42Em74) and Power Pole Knoll (42Em75) all proved to be Fremont habitation sites (Madsen 1975a) dating between about 980 B.P. and 1260 B.P.

During the following year, the University of Utah conducted excavations at Clyde's Cavern (42Em177). Clyde's cavern was a locus of summer plant gathering activities during the Late Archaic period, but the majority of the cultural deposits was shown to be the result of summer maize cultivation and wild plant harvesting activities during the subsequent Fremont period (Wylie 1972, Winter and Wylie 1974).

The next site to be excavated in the study area was Joe's Valley Alcove (42Em693). During the summer of 1974, the United States Forest Service excavated this site which had cultural strata, dated by both radiocarbon and typological means, from the Early Archaic, Late Archaic and Fremont Periods (E. DeBloois, personal communication). That same summer, a University of Utah field school excavated the Innocents Ridge site, which proved to be yet another Fremont habitation locus (Schroedl and Hogan 1975).

During the early fall of 1975, the Antiquities Section, Division of State History (Utah) conducted an excavation of a small rockshelter as a part of the cultural resource mitigation program for Consolidation Coal Company of Denver, Colorado. This site, known as Pint Size Shelter (42Em625), had two main cultural strata, one dated to the Late Archaic and the other dated to the early Fremont Period. Both of these occupations were evidently the result of wild plant procurement activities (Lindsay and Lund 1976).

Other Fremont habitation sites, located farther to the south, have been excavated. These sites include Snake Rock Village (Aikens 1967), Old Woman and Poplar Knob (Taylor 1957) and the Old Road Site and Ivie Ridge Site (Wilson and Smith 1976). These five sites were all Fremont period habitations although Kayenta and Mesa Verde Anasazi ceramics were recovered at low frequencies indicating that there was contact with other cultural groups located further south.

In addition to these Fremont sites, a deeply stratified rockshelter (Sudden Shelter, 42Sv6) was found to contain occupational strata spanning the entire Archaic Period, ca. 8000 B.P. to 3000 B.P. (Jennings et al 1980). The original site report indicated that Fremont diagnostics were present on the site when it was originally documented, but these artifacts were no longer present when the excavations were begun. The

Sudden Shelter site is of particular importance to the local prehistory and the prehistory of the eastern Great Basin and northern Colorado Plateau because of its numerous well-defined occupational strata which has allowed a fine-grain correlation between certain diagnostic projectile point types and the temporal phases of the Archaic period.

A test excavation of two heavily vandalized rockshelter sites (42Em959 and 42Em960) in Cottonwood Canyon conducted by AERC in 1979 seem to mirror the results of the excavations at the nearby Joe's Valley Alcove. Radiocarbon analyses have not yet been completed, but projectile point correlations indicate that these two sites were occupied during the Early Archaic period, Late Archaic and, most heavily, during the Fremont period (Weder and Hauck, n.d.).

Since 1970, the level of survey intensity has increased drastically. The various cultural resource inventories conducted during the 1970s have generally been the result of natural resource development programs and are too numerous to summarize in the present context. Summaries of these inventories performed before 1978 can be found in Sargent (1977) and Hauck (1979). The combined inventory results as of 1977 indicate that the majority of the culturally identifiable sites in the general area are Fremont although Archaic sites are also well represented. Protohistoric Numic sites are present but rare (Hauck 1979a:110).

E. Research Design

AERC's research design which has been developed to aid in project planning and resource evaluation for the east slopes of the Wasatch Mountain Range in central Utah include the following factors:

1. The determination of presence or absence of a continual sequence of Paleo-Indian, Archaic,

Fremont and Shoshonean utilization of the project area and the local manifestations of these cultural phases when present;

2. the determination of presence or absence of cultural materials which demonstrate the prehistoric utilization of drainages as access routes across the mountain range;

3. the determination of whether any specific ecozone contained a preponderance of prehistoric cultural resource sites, thus demonstrating any diversity of preference for different ecozones;

4. the determination of which types of prehistoric cultural activity were conducted in the project area based upon patterns in artifact associations or predominance of particular types of sites;

5. the determination of presence or absence of early historic Euro-American habitation, trapping, trade or travel within the project area; and

6. the determination, on a regional level, of whether the sites in the project area contained any remains, demonstrating local interaction between the San Rafael and Sevier variants of the Fremont Culture.

Since all research conducted in the Eccles Canyon locality has been oriented to identifying, recording and analyzing the historic and prehistoric remains within the project locality, only marginal artifact collection and subsurface testing has been carried out. No floral, faunal, radiocarbon, pollen or flotation specimens have been obtained for laboratory analyses. Collections have involved only the retrieval of diagnostic historic artifacts from the vicinity of the Utah Mine.

Chapter II - METHODOLOGY

A. Field Research

During late July, 1980, an intensive cultural resource inventory of a transmission corridor was conducted by AERC for Valley Camp of Utah and the Vaughn Hansen Associates consulting firm of Salt Lake City, Utah. This corridor is associated with the Pleasant Valley-Whiskey Creek project area located near Scofield, Utah.

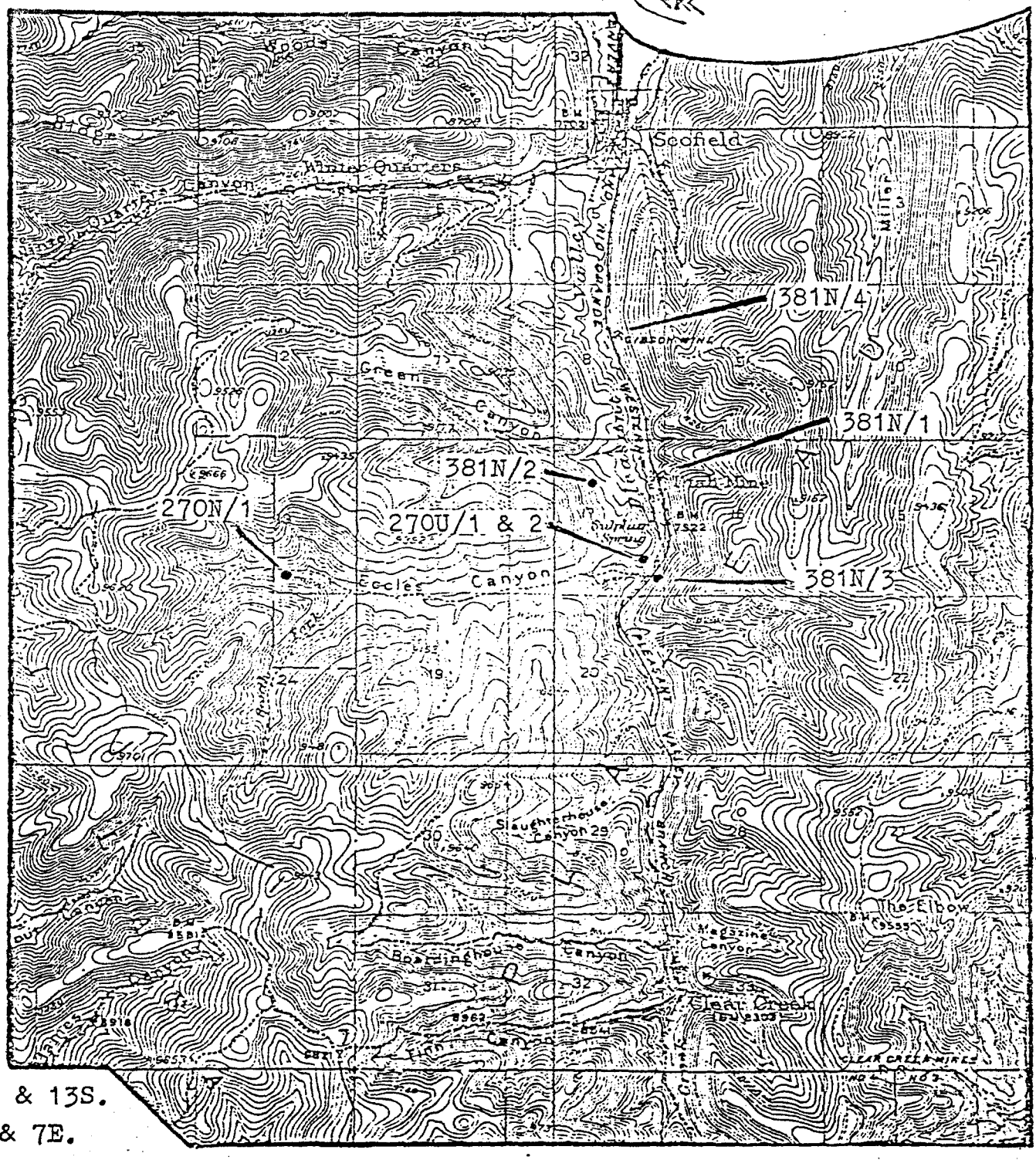
V. Garth Norman, a staff archeologist with AERC, was in charge of the field crew which included Monika Williams and Bunny Melendez. F. R. Hauck, president of AERC was principal investigator.

The survey area lies between the 7750 and 9200 foot elevations ASL within several narrow canyons where surface disturbance relative to transportation corridor development is planned. Location of the potential construction zones and the survey area is shown on Figure 3.

The purpose of the survey was twofold. An intensive evaluation of the Whiskey Canyon and Pleasant Valley corridor segments was conducted to assess the presence and significance of cultural resource sites which could be adversely affected by the development. These two corridors are linked by the eastern segment of the Eccles Canyon corridor which was evaluated by AERC in 1979 under contract to Coastal States Energy Company relative to that company's Skyline Project Mine Plan Permit application.

The second part of the survey was a surface examination and recording of three historic sites, all situated in Pleasant Valley. Although two sites, the Nicolitus Mine portals (AERC 381N/3), and the Gibson Mine (AERC 381 N/4), were evaluated by the AERC crew, they do not lie within the transmission corridor and no project-related adverse affect is planned for these sites.

ARCHEOLOGICAL-ENVIRONMENTAL RESEARCH CORPORATION



T. 12 & 13S.

R. 6 & 7E.

Meridian: Salt Lake B. & M.

Quad: Scofield, Utah

15 Minute USGS

Project: VH-80-1

Series: Central Utah

Date: 9-17-80

Figure 3

HISTORIC SITES IN THE PROJECT AREA

Legend:

Archeological Site or Historic Site •

1 0 1 2 M.

0 2K.

Scale

Their evaluation was considered important in providing a complete statement on the presence of important cultural resources situated adjacent to the present project permit area.

All inventoried surfaces in Whiskey Canyon, Eccles Canyon and on the west bank of Pleasant Valley were examined by team members performing parallel transects with personnel spacing ranging between 15 and 25 meters. In this manner, a three mile long corridor of about 60 meters width was intensively evaluated. Shorter intervals and zigzag transects were utilized on specific locations judged to be of high site potential.

A total of four historic sites has been recorded in the corridor zone. These sites (AERC 270U/1 and 2) include two historic cabin foundations situated at the mouth of Eccles Canyon which were recorded by AERC in 1979 (see report for CSEC-79-2 dated 7/23/79). Site AERC 381N/1 is the historic Utah No. 1 Mine site which is situated at the northern end of the corridor zone. The Green Canyon Sawmill site (AERC 381N/2) is located near the mouth of Green Canyon.

Three other historic sites are situated in the general area but lie outside the construction corridor zone. These sites include the Eccles Canyon Coal Mine (AERC 270N/1) which is situated in the southeast quarter of Section 13, Township 13 South, Range 6 East; the Gibson Mine (AERC 381N/4) which is situated in the northeast quarter of Section 8, Township 13 South, Range 7 East; and the Nicolitus Mine portals (AERC 381N/3) which are situated in Pleasant Valley in the southeast quarter of Section 17, Township 13 South, Range 7 East. One mine portal on the Nicolitus site is situated on the west bank of Pleasant Creek and, therefore, lies within the corridor zone. The remainder of this

site is situated on the east slope of Pleasant Valley and is outside the potential construction zone.

All cultural resource sites were recorded, evaluated, photographed, sketched and their locations marked on a Scofield, Utah, 15 Minute U.S.G.S. topographic map. Site reports will be provided to all relevant agencies as an appendix to this report.

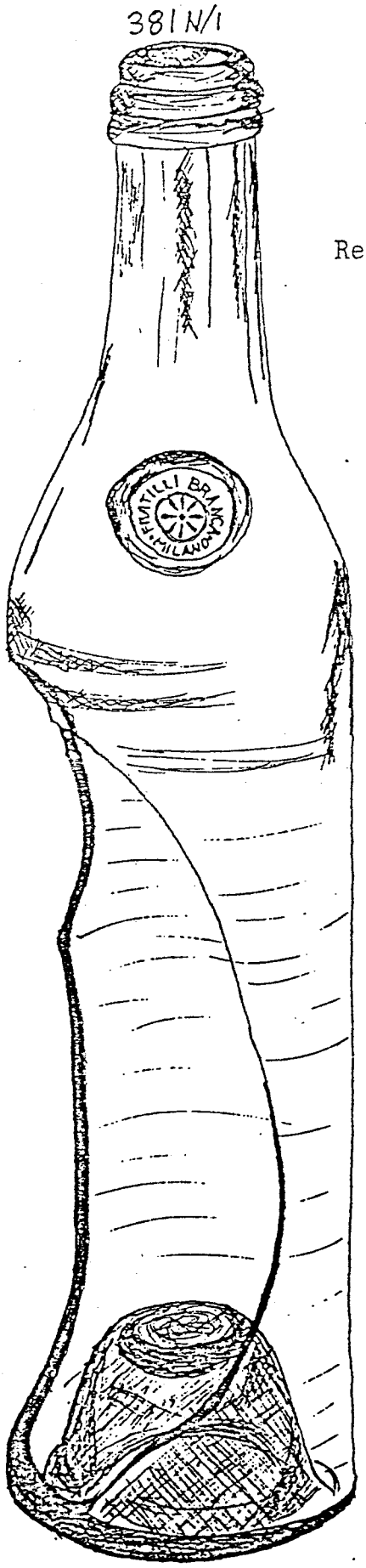
B. Laboratory Research

Laboratory analysis of artifacts was minimal since historic artifacts were minimally collected from only one site (381N/1). No other artifact or ecofact collections were made during the survey or during the 1979 survey when the Eccles Canyon segment of the corridor was evaluated.

C. Artifact Inventory and Analysis

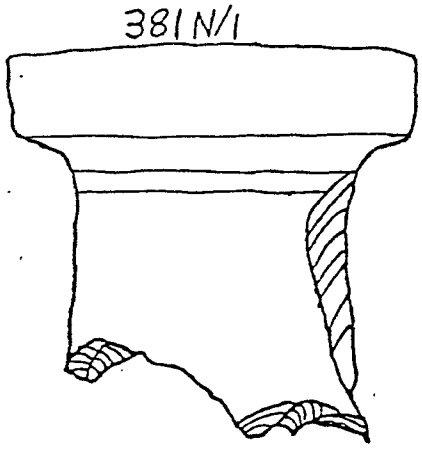
The following historic artifacts were collected at the Utah No. 1 Mine site (AERC 381N/1):

1. One green wine bottle manufactured in Milan, Italy, by the Fratilli Branca Company. This bottle was manufactured using a three piece mold, a technique used in the United States between 1809 and 1885 A.D. The striations on the body of the bottle indicate a turn mold was used for that portion. Twin molds were in use in the United States between 1880 and 1900 A.D. These factors indicate that this bottle was probably constructed between 1880 and 1915 (c.f. Vienneau 1973:45-46).
2. Two pieces of a historic ceramic were collected in which the trademark show D. MEAKIN Ltd., -----, (E)ngland.



Reduced by 30%

Figure 4



Actual Size

3. One fragment of a purple, square bottle was collected which carries the trademark --POLEON, Olive Oil.

4. One blue glass insulator was collected which shows the trademark -ingray-42.

5. One brass, portable gas lantern top was collected which has the trademark --OY'S DROPPER, Pat. 5.26.14, 1916.

6. One brown bottle rim was collected.

7. One steel spoon was collected.

8. One square bottle fragment was collected. This fragment contains the trademark --FIC SYRUP CO., __FIC, (PR)ODUCTS (INC.), --(O)R.

9. One wooden mount for an insulator was collected.

Sketches of the wine bottle and the brown bottle rim are shown on Figure 4.

Chapter III - CULTURAL RESOURCE DESCRIPTIONS

A. Site Analyses

A total of seven historic cultural resource sites is situated in the general project area. Five of these sites are either in the potential construction corridor (AERC 270U/1 and 2) or are partially within the corridor (AERC 381N/1, 2, and 3). These five endangered sites are indicated on Table 1.

Based upon the definitions of cultural resource significance (see Chapter IV), none of the seven historic sites listed in Table 1 are considered eligible for nomination to the National Register of Historic Places (NRHP) based upon an archeological evaluation. The significance of these sites is provided on Table 2. Site 381N/1, the Utah No. 1 Mine is a potential candidate for nomination to the NRHP, based upon the available historic information on the Mine. This site has been given a CRRS:S-2 rating (see Chapter IV). The other three sites are not considered as having NRHP potential. The Nicolitus Mine has been rated a CRRS:S-3 while the two cabin foundations were originally rated at the equivalent of CRRS:S-4. Should additional historic data upon these four sites provide information indicating that any site has a greater cultural value than presently assigned, the site rating will be adjusted accordingly.

Site locations are shown on Figure 3. This map can be coordinated with Figure 2 to demonstrate the spatial relationship of these sites to the corridor zone. Additional information on these sites is provided in the site reports which are being provided to all relevant government agencies as an appendix to this report.

Table 1

Cultural Resource Site Summary

AERC Site No.	Permanent Site No.	Site Type	Culture	Land Ownership
270N/1	----	Mine	Euro-American	Private
270U/1*	----	Cabin, Stone foundation	Euro-American	Private
270U/2*	----	Cabin, Stone foundation	Euro-American	Private
381N/1	----	Mine	Euro-American	Private
381N/2	----	Saw mill, corral	Euro-American	Private
381N/3	----	Mine	Euro-American	Private
381N/4	----	Mine	Euro-American	Private

*Sites situated in the corridor zone which could be directly affected by transportation corridor development.

B. Comparative Resource Analysis

Of the five sites situated in the transmission corridor zone, and therefore susceptible to adverse affect during the construction period, site 381N/1, the Utah No. 1 Mine, is the most important. The Utah No. 1 Mine was originally begun between 1875 and 1880 when it was known as the Mud Creek Mine. This mine "opened on the Castlegate 'A' coal bed. The south of the mine is at tipple height above the railroad, and in 1923 the coal, which was then being mined for railroad use, was dumped from the mine cars without screening into railroad cars. This mine was idle for many years after it was opened and the workings are less extensive than those of the other old mines of the district" (Spieker 1931:96). Extensive surface modification in the site area conducted during the past 100 years has altered much of the historic nature of the site. Some historic foundation rubble and depressions are presently discernable as are limited trash and rubble accumulations situated between the railroad track and the paved highway.

The Green Canyon Sawmill site (AERC 381N/2) includes a cement foundation and wooden rails for the log track. A corral and an abandoned roadbed are associated with this site which lies behind the Valley Camp of Utah offices.

The Nicolitus Mine site (381N/3) includes two portals situated on both the east and west slopes of Pleasant Valley. This site is situated at the mouth of Eccles Canyon and is visible from the highway. The mine portals were opened in the early 1920s by John Nicolitus and were worked for about five years. Joe Williams obtained the lease from Nicolitus and worked the portals in 1931 and 1932 but without success. Williams subsequently sold the lease to John Stone for $1100,

who unsuccessfully solicited John Staley and Joe Podbevsek to reopen the mine. The mine was never again worked because the veins were too thin to be profitable. No coal was ever sold from the mine (personal interviews conducted with Tom Biggs and John Staley in Scofield on August 29, 1980 by V. Garth Norman).

Sites AERC 270U/1 and 2 include two historic cabin foundations situated on the north ridge at the mouth of Eccles Canyon. These sites were originally recorded in 1979 by AERC while consulting for Coastal States Energy Company (CSEC-79-2). Both sites are limited, consisting of stone alignments and minimal construction materials. No trash area was discernible. Both sites may have been temporary campsites utilized during the construction of the west portal of the Nicolitus Mine (381N/3).

No prehistoric cultural resource sites or isolated artifacts have been observed or recorded in the general project locality.

Chapter IV - EVALUATIONS AND RECOMMENDATIONS

A. Resource Significance Evaluations:

An evaluation of site significance for the four sites situated within the mine plan permit area is presented in Table 2. Here the site quality indicators are presented with a statement on site condition. The field assessment of significance utilizing the CRRS system is provided in the fourth column. The CRRS system is best explained by quoting from the BLM definition sheet:

> Cultural Resource Rating System
>
> The following criteria are established as guidelines. The Bureau recognizes that the assignment of a particular rating is a professional judgment; however, the rationale of these judgments will be explicitly documented as part of the evaluation process.
>
> Assign an evaluation rating (S1, S2, S3, S4) to each site according to the following guidelines and record on the BLM form 6400-3:
>
> S1. S1 sites are those sites which are worthy of preservation in situ. In general, they are sites in relatively good condition with integrity (both internal and external); and are unique or representative; and/or have associations with important events or personages; and/or have yielded, or have a clear potential for yielding, highly significant scientific or educational information.
>
> S2. S2 sites are those sites which contain important scientific or educational data but yet are not worthy of preservation in situ. They are generally not particularly unique, representative, nor do they have important associations. Many contemporary sites may be S2 sites because, although they cannot be clearly and immediately assessed as such, they may become highly significant when evaluated from a future historical perspective.
>
> S3. S3 sites are those sites whose main worth are their potential for contributing data in regards to solving larger problems, such as reconstruction of

Table 2

Site Significance

Site	Quality	Condition	CRRS Value Rating
270N/1	a, g	Poor	3
270U/1*	----	Poor	4
270U/2*	----	Poor	4
381N/1 (First mine in area)	a, c, g, h	Poor	2
381N/2 (Saw mill for 381N/1)	g, h	Poor	3
381N/3	g	Poor	3
381N/4	g	Poor	3

*Sites situated in the corridor zone which could be directly affected by transporation corridor development.

AERC Quality indicators are:

a) size or layout is unique;
b) quantity and/or quality of artifacts is unique;
c) indication of depth;
d) environmental location is unique;
e) existence of unique artifacts, architecture, art or structure;
f) condition is excellent for preservation of materials or data;
g) site contains specific cultural data revelant to temporal and spatial identifications;
h) site is scene of an important event; and
i) site is associated with an important person.

paleo-environments and human use patterns. These kinds of sites generally show little concentration of artifacts, few features, no important associations, and little or no uniqueness or representativeness.

S4. S4 sites are those sites which have minimal information retrieval possibilities, or which have no integrity, uniqueness, representativeness, or no important associations.

No sites were accorded CRRS:S-1 significance.

Only one site is rated as CRRS:S-2 while one site is of CRRS:S-3 value. The remaining two sites have been given a CRRS:S-4 rating.

The site (AERC 381N/1) has been given an S-2 value based on the potential for additional information through archeological excavation. Should future research on any one of these sites provide new data relative to significance, the CRRS rating will be appropriately upgraded.

B. National Register Criteria of Eligibility:

Application of the National Register Criteria of Eligibility, defined under 36 CFR 60.6, to each of the four sites that are situated in the mine plan permit area provides the following information:

a) None of the four sites is associated with events that have made a significant contribution to the broad patterns of our history; or

b) none of the four sites is associated with the lives of persons significant in our past; or

c) none of the four sites embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction; and,

d) site 381N/1 could yield information of value to the history of the region. Extensive surface modification of this site, however, precludes the Utah mine from consideration as an important and

intact historic site. Any information of value to the history of the region would have to be obtained through oral history research and through archeological excavation. This site should, therefore, be considered as meeting the standards of criteria "d" of 36 CFR 60.6. The other three sites (270U/1, 2, and 381N/3) are not eligible under the criteria outlined above.

C. Discussion of Impact Potential on Cultural Resource Sites

Direct impact, i.e., project-related disturbance of the four cultural resource sites located adjacent to the potential disturbance zone could result during surface modification for road and conveyor belt line development. The cabin foundations (270U/1 and 2), the Utah No. 1 Mine site (381N/1), and the sawmill site (381N/2) can be easily avoided during the construction period. The endangered west portal of the Nicolitus Mine (381N/3) is of marginal historic value and disturbance could occur without causing a loss of valuable information or historic materials.

Indirect impact of these four sites through vandalism can be considered a minimal threat to their historic value. Any valuable or useful lumber or construction materials which provide an identity to these sites has already been removed, discarded or destroyed on site.

Table 3 provides a summary of the basic adverse affect potential for all seven historic sites situated in the general project area.

Table 3

Cultural Resource Impact Potential

Site	CRRS Status	Direct Impact	Indirect Impact	Impact Agent	Figure Reference
270N/1	3	No	No	-----	2
270U/1*	4	Not probable	Possible	Vandalism	2
270U/2*	4	Not probable	Possible	Vandalism	2
381N/1	2	Not probable	No	Coal Mine Development	2
381N/2	3	No	Possible	Vandalism	2
381N/3	3	Not probable	Possible	Transmission Corridor Development & Vandalism	2
381N/4	3	No	No	Vandalism	2

*sites situated in the corridor zone

D. Recommendations

AERC recommends that whenever possible, site avoidance procedures be implemented as a means of preserving the historic resources of the general area (see Table 3). Should total destruction of any one of these sites become necessary, a complete photographic documentation of the site should be conducted prior to disturbance.

AERC would also recommend that an archeologist be present to monitor the disturbance of any large trash areas or midden accumulations since such localities could contain historically diagnostic artifacts.

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Valley Camp of Utah

Belina Haul Road Reclamation Plan

January 1987

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

BELINA HAUL ROAD RECLAMATION PLAN

Prepared For

Valley Camp of Utah, Inc.
Helper, Utah

Prepared By

Morrison-Knudsen Engineers, Inc.
Boise, Idaho

January, 1987

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ENGINEERING CERTIFICATION

I, J. Carl Dille, have reviewed Section 2 and 3 and the following Tables, Figures and Exhibits in the Belina Haul Road Reclamation Plan.

REGISTERED PROFESSIONAL ENGINEER
No. 5538
J. CARL DILLE
STATE OF UTAH

J. Carl Dille, P.E.

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FIGURE 4-3 Unstable Fill - Final Contour Surface

LIST OF EXHIBITS

EXHIBIT 3-1 Watershed Map

SECTION 1.0 - INTRODUCTION

1.1 General

The following reclamation plan is for Valley Camp of Utah's Belina Haul Road which supports their coal mining operation located on Whiskey Creek in Carbon County, Central Utah.

The haul road is constructed on a cut/fill bench having a total road width of thirty-four feet with very steep natural slopes above and below the road. These two facts create several unique problems when considering reclamation of the road.

This reclamation plan addresses the removal of the road surface materials and associated structures and the recontouring of the area to facilitate the return of the disturbed lands to its pre-mining land use of limited rangeland and wildlife habitat.

1.2 Objectives

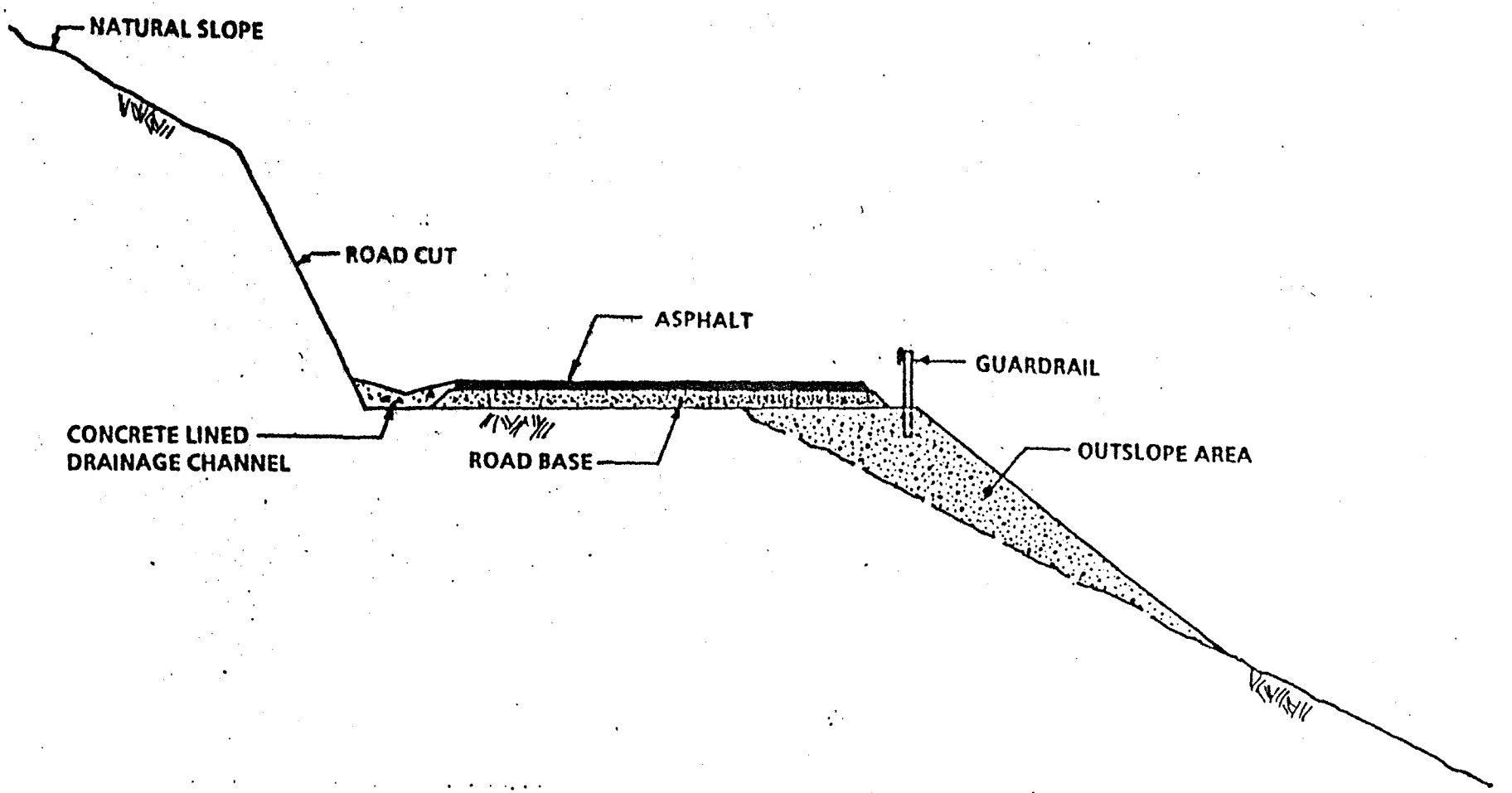
The objectives of this reclamation plan are to eliminate the permanent road surface and support structures and return the disturbed land to a condition capable of supporting the pre-mine land use of limited rangeland and wildlife habitat. These objectives will be obtained by recontouring the road surface to re-establish a drainage pattern comparable to pre-mining conditions; by replacing the soil medium and re-establishing an effective permanent vegetation cover.

The affective area consists of a strip of land approximately 100 feet wide and 1.5 miles long. Although the right-of-way (ROW) is approximately 100 feet wide, this reclamation plan will only address the road surface (34 feet wide); the outslope areas having

questionable slope stability and the area to be re-disturbed to re-establish the natural drainages. Figure 1-1 is a typical cross section illustrating the construction of the Belina Haul Road. Approximately ten acres will require recontouring and/or reclamation activities. The majority of the road outslope areas are considered stable as final reclamation, as discussed in Section 2.0, and therefore will not be disturbed. Determination of slope stability is discussed in detail in Section 2.0. The results of a limited geotechnical evaluation concerning the road outslopes and drainage fills are shown in Table 2.1. Only the potentially unstable slopes and their corresponding station location are shown on this table. These station locations were determined from plan and profile sheets showing the general road location and grade. Survey station locations were shown on the map beginning at the mine portal going towards the Eccles Canyon intersection and ending at Station 83+52.

Reclamation activities will be conducted in a manner that will minimize the potential adverse impacts to the air, water, vegetation, wildlife, and general aesthetics of the area. This proposed reclamation plan will establish a permanent, diversified vegetation cover capable of self-regeneration and soil stabilization that will support the post-mining land use of limited rangeland and wildlife habitat.

VALLEY CAMP OF UTAH
BELINA HAUL ROAD RECLAMATION
TYPICAL HAUL ROAD CROSS SECTION
Figure 1-1



SECTION 2 - GEOTECHNICAL INVESTIGATION

2.1 General

The geotechnical investigation for the Belina Haul Road was performed in three phases. Phase I was a site evaluation of the natural talus in the local region. Phase II identified the areas considered to be critical. Phase III was the slope stability analysis for typical sections of the road before and after reclamation. Conclusions were then based upon all three phases.

Soils in this region are considered young and primarily consist of weathered rock high in quartz. The Unified Soil Classification System would consider this material as SP since it is gravelly sand which is poorly graded and has very few fines. This type of soil has essentially no cohesion; therefore, it is considered a pure phi (Ø) soil which will control the type of slope failures and geometry of the natural talus slopes.

2.2 Natural Talus Evaluation

Natural talus slopes in the haul road area widely vary between 30 percent to over 100 percent. By considering the friction angling (Ø) of the soil to be constant across the region, the depth to bedrock will control the natural talus slope stability. Shallow soils are stable at greater slopes than deep soils. The length of run also plays a major role in the stability of the slopes. The natural talus in the region was self-stabilizing due to small failures creating a terracing effect across the hillside. The stabilizing of the natural talus slopes is still occurring and numerous natural slope failures

may be seen around the vicinity of the Belina Haul Road. The friction angle of the talus was derived from the geometry of a recent natural slope failure. This failure analysis produced a friction angle equal to 31°. This value is very typical for SP classified soils.

2.3 Critical Fill Areas

Critical fill areas are defined for this discussion as areas which have localized evidence of recent slope failures, slopes which exceed the friction angle of the soil, or slopes that have similar characteristics of recent failures in the region, such as deep soil horizons. These critical areas are listed in Table 2.1:

TABLE 2.1

POTENTIALLY UNSTABLE SLOPES*

AREA	Station Location	Linear Distance	Slope Pre-Construction	Slope Post-Construction
1	21+10 to 22+70	160'	63%	70%
2	24+06 to 29+34	520'	63%	72%
3	30+40 to 32+00	160'	55%	68%
4	37+18 to 44+00	682'	63%	70%
5	51+17 to 52+75	158'	65%	75%
6	61+00 to 64+12	312'	70%	80%
7	73+00 to 75+60	260'	84%	128%
8	77+18 to 82+46	528'	84%	143%

TOTAL = 2,780 Feet

*Typical Geometries for each one of these reaches are illustrated in Figures 2.1 to 2.8.

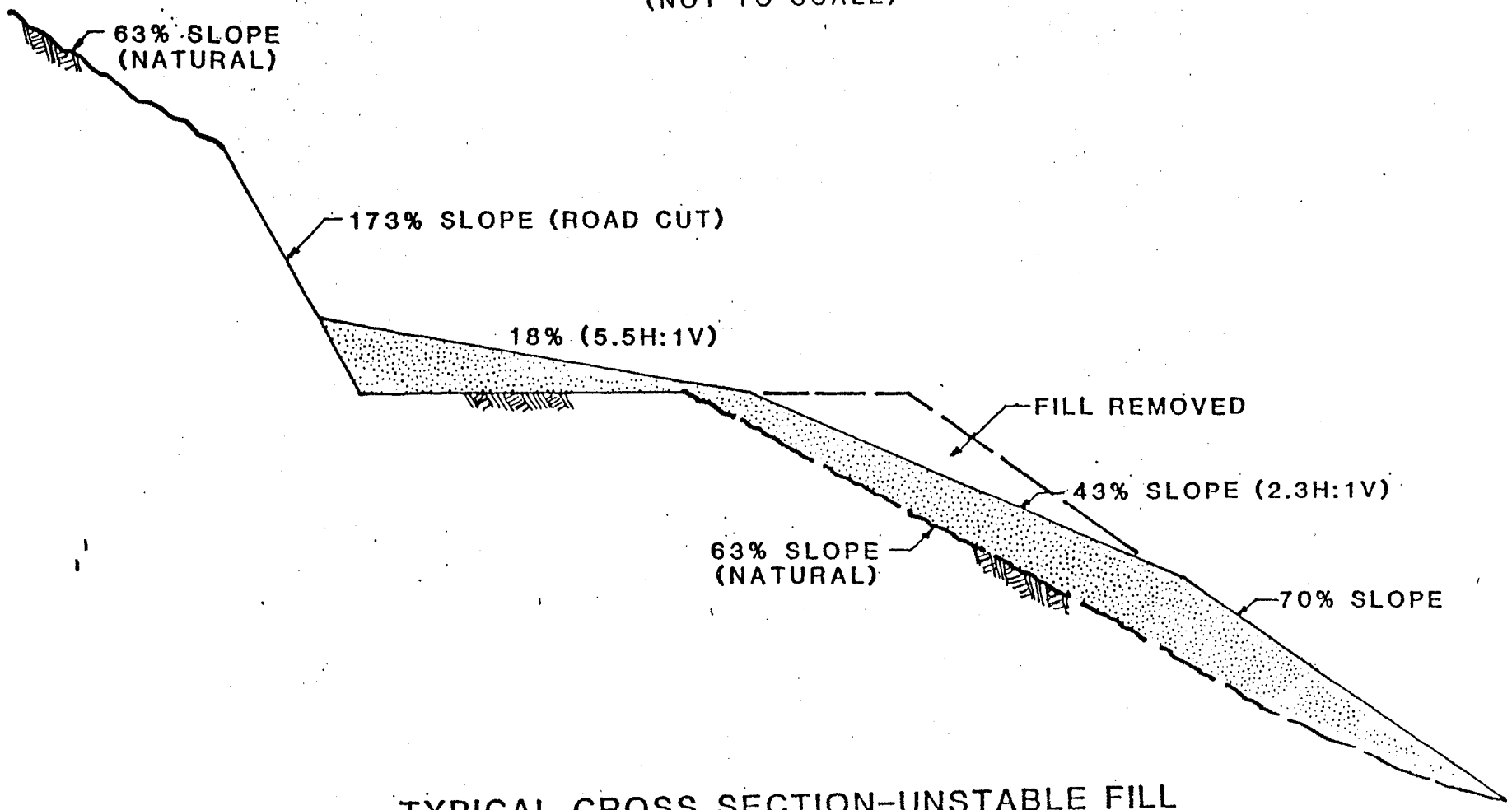
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-1

(NOT TO SCALE)



TYPICAL CROSS SECTION–UNSTABLE FILL

STA 21 + 10 TO 22 + 70

AREA 1

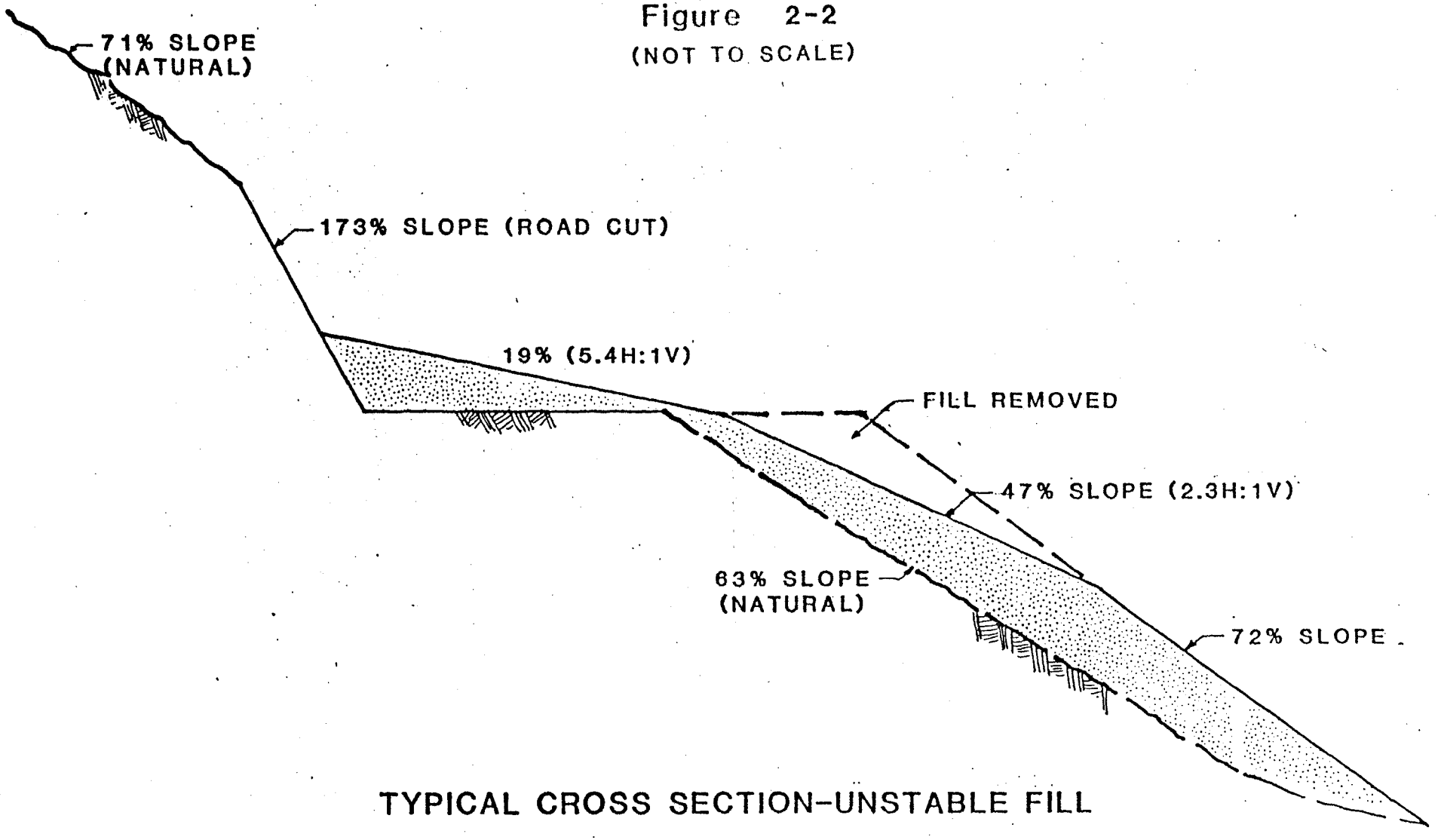
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-2

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 24 + 06 TO 29 + 34

AREA 2

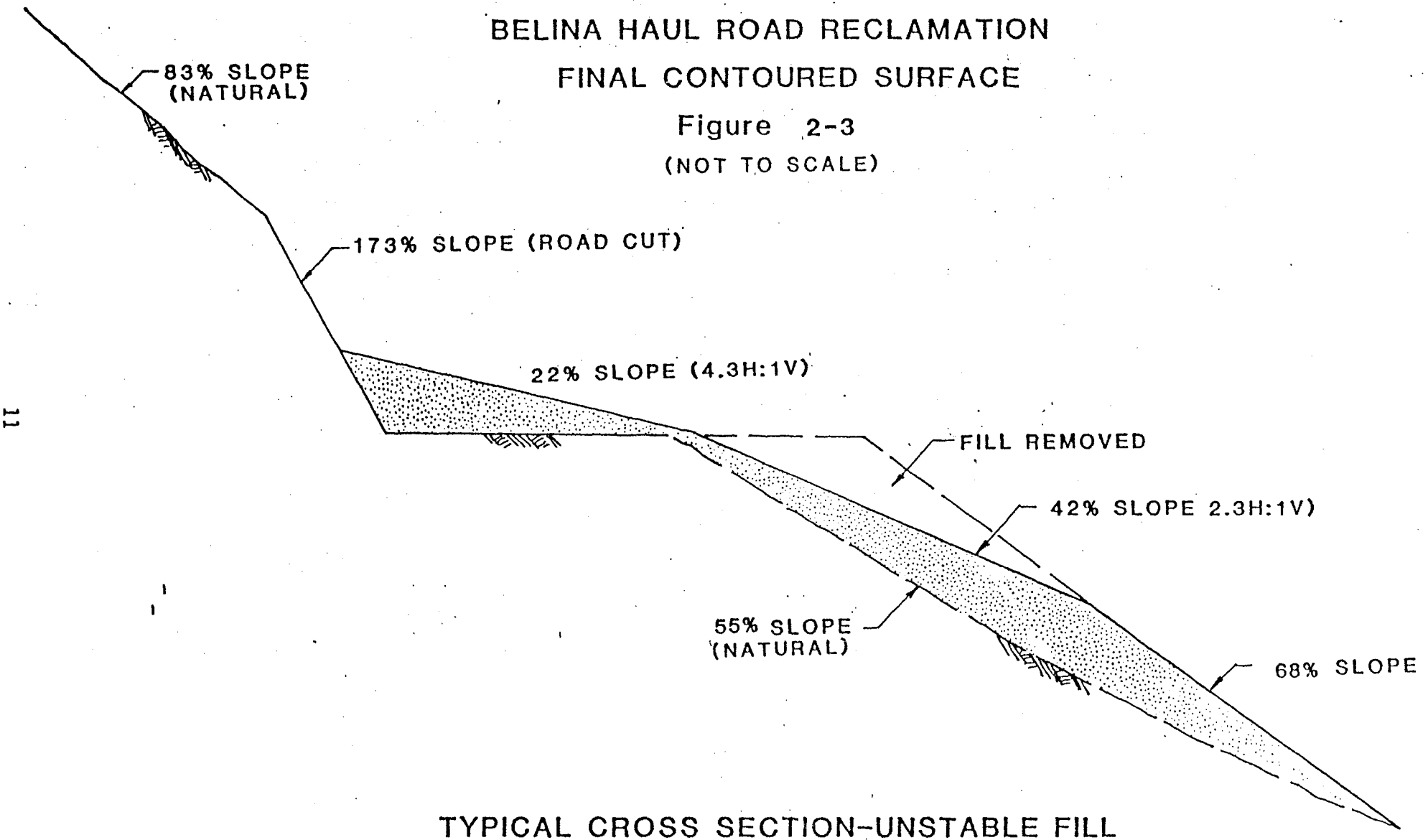
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-3

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 30+40 TO 32+00

AREA 3

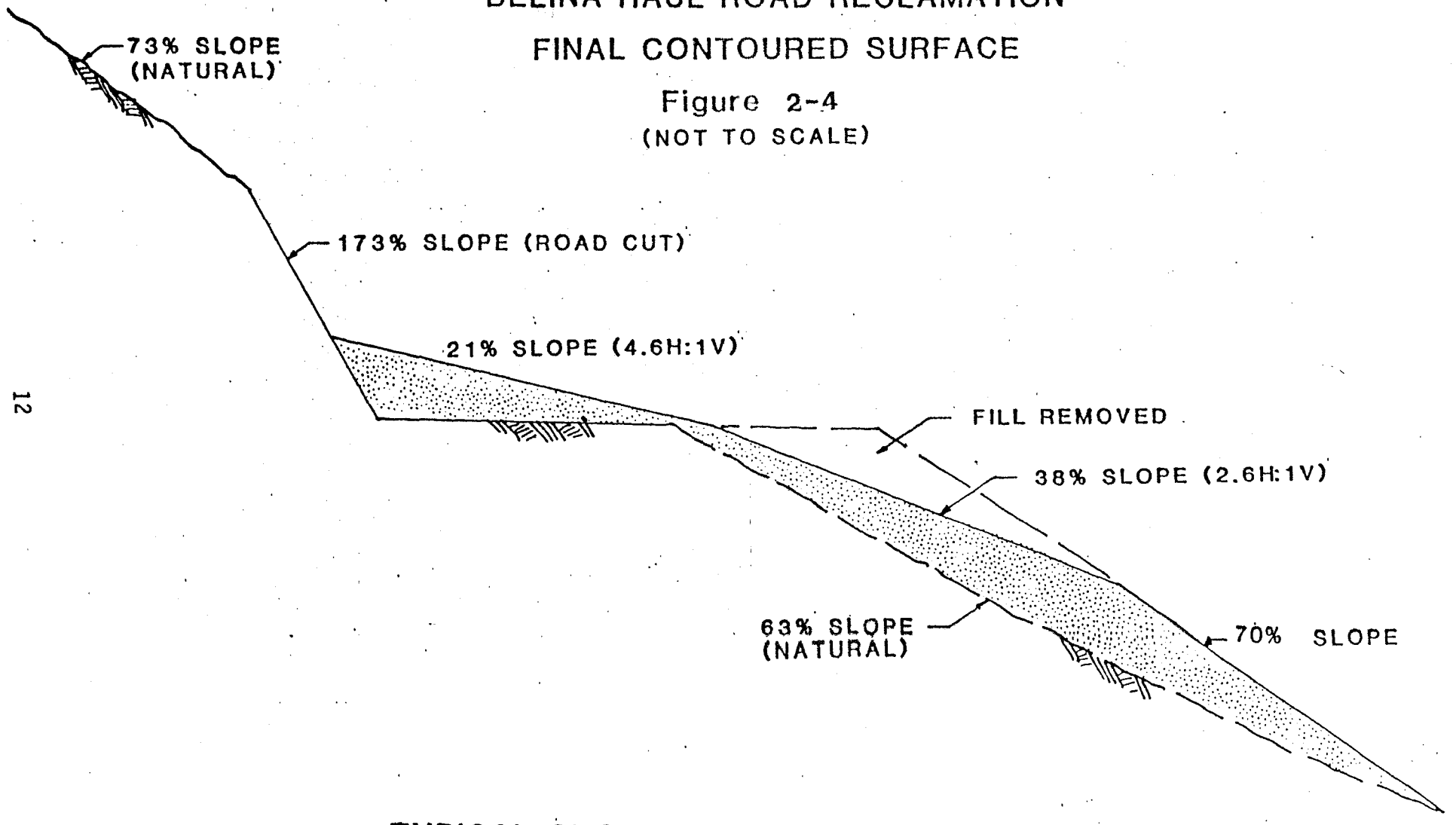
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-4

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 37 + 18 TO 44 + 00

AREA 4

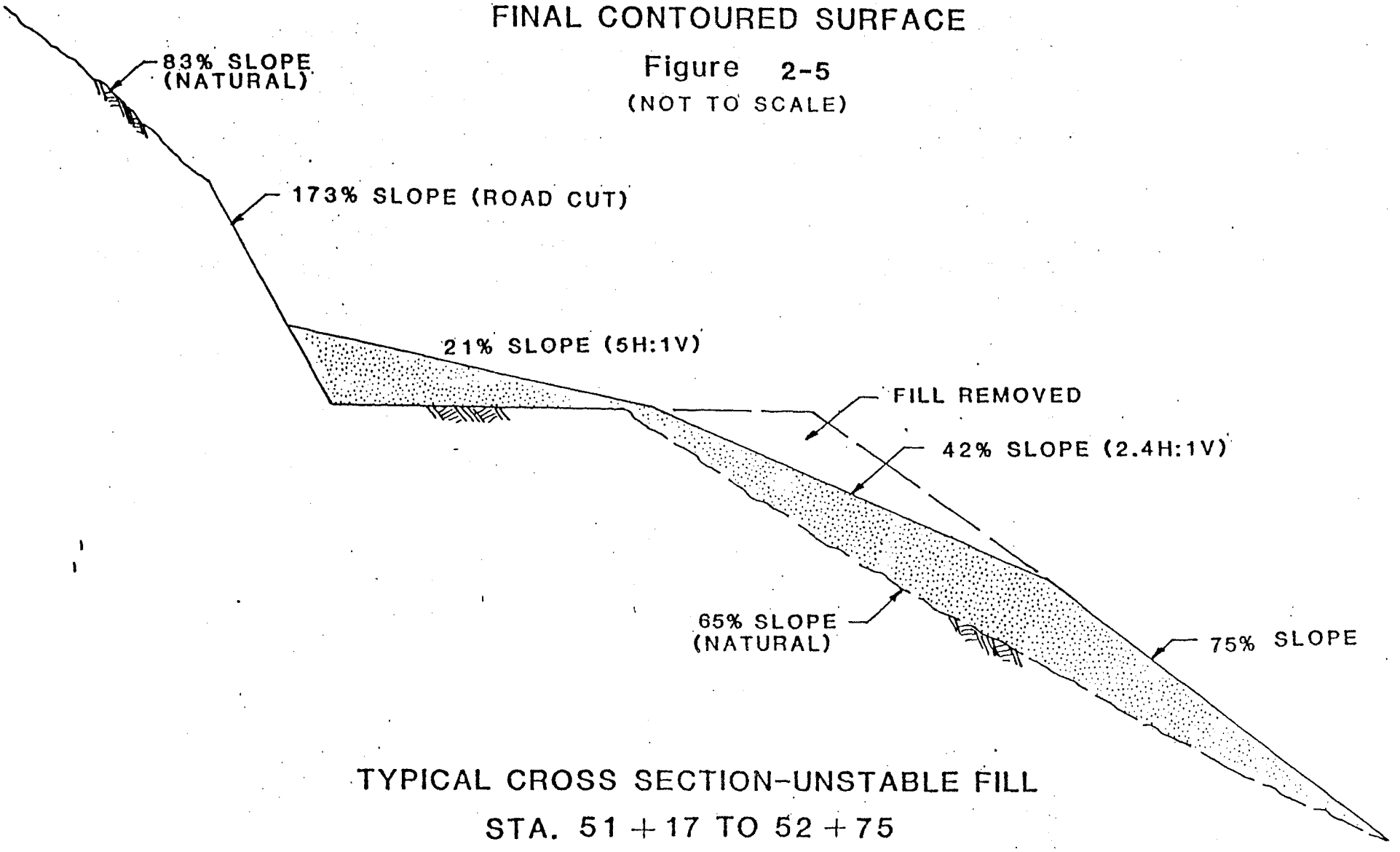
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-5

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 51 + 17 TO 52 + 75

AREA 5

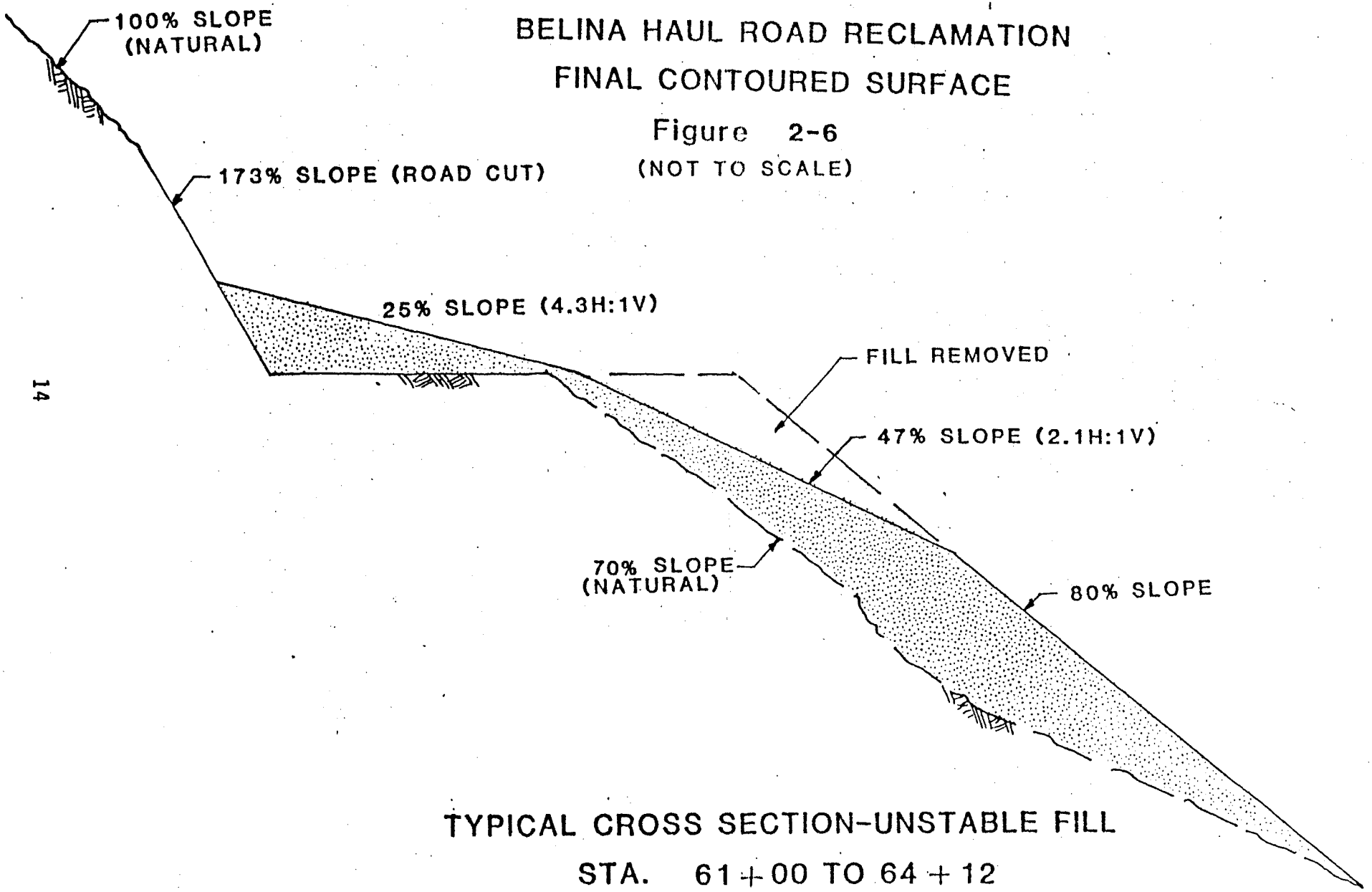
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-6

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 61+00 TO 64+12

AREA 6

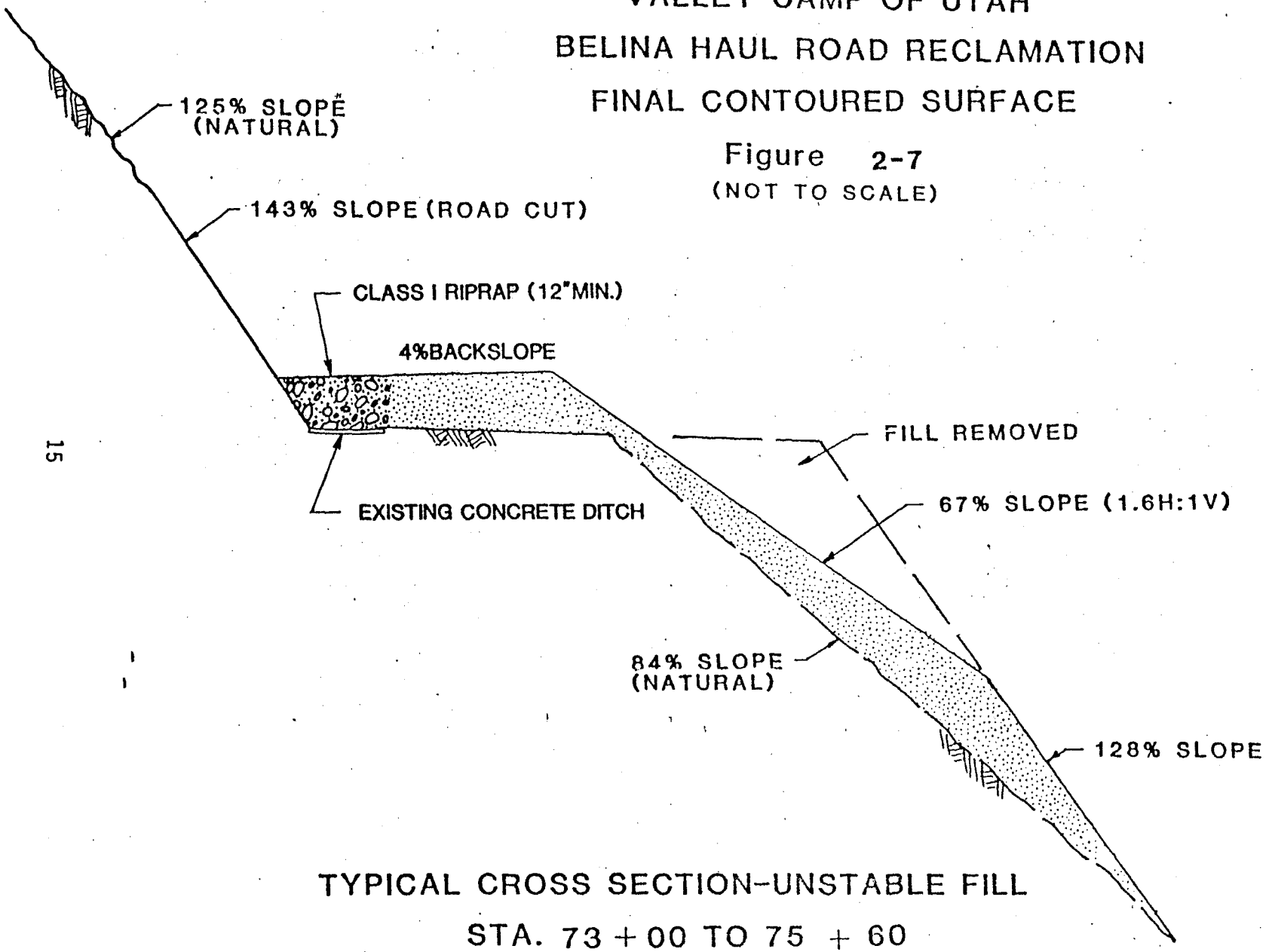
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-7

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 73 + 00 TO 75 + 60

AREA 7

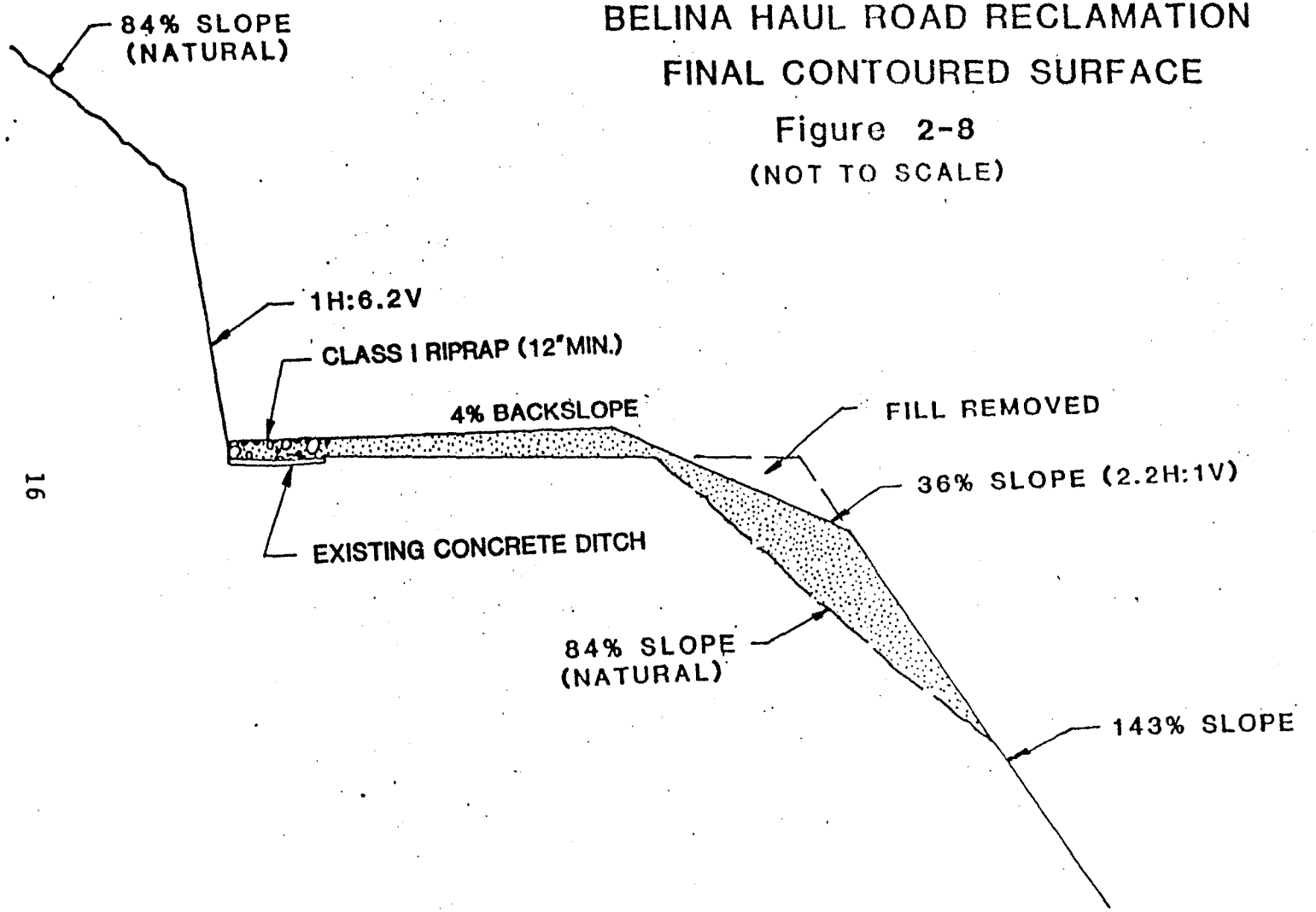
VALLEY CAMP OF UTAH

BELINA HAUL ROAD RECLAMATION

FINAL CONTOURED SURFACE

Figure 2-8

(NOT TO SCALE)



TYPICAL CROSS SECTION-UNSTABLE FILL

STA. 77 + 18 TO 82 + 46

AREA 8

The Bowel Crossing has not been considered to be a critical fill area due to the reclamation plans in this reach. By removing the top portion of the fill, this region does not present a slope stability problem and should remain stable.

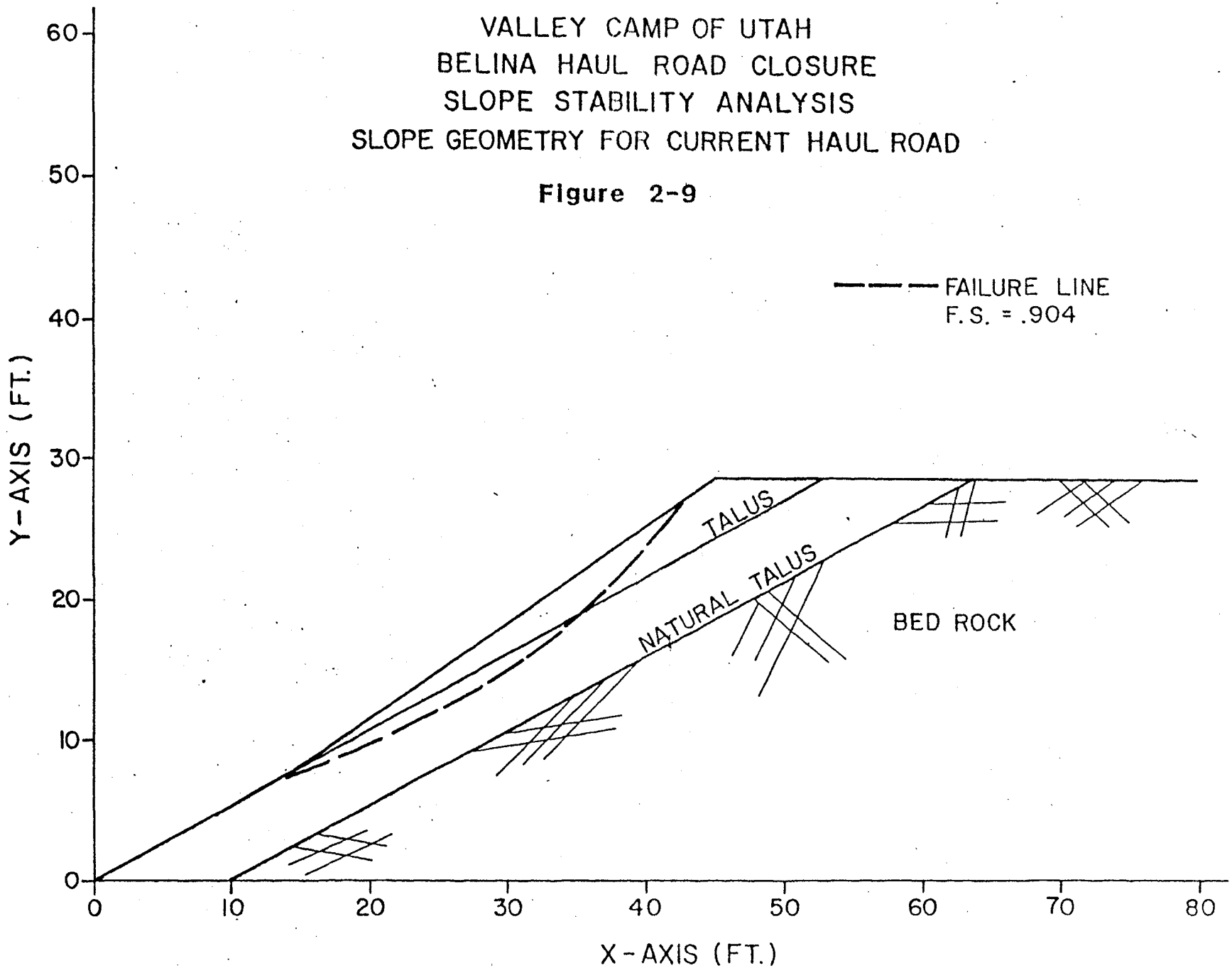
2.4 Methods and Results of the Slope Stability Analyses

The slope stability analysis was performed using the computer model STABL 5. Typical geometries before and after reclamation of the Belina Haul Road are illustrated in Figures 2.9 and 2.10. The natural talus slope used for model input was set equal to 53 percent and the talus slope to 68 percent. The reclamation slope was based upon the capability of a backhoe to reach downslope 25 feet. The soil density was assumed to be 100 pounds per cubic foot with a phi value of 31°.

The factor of safety for the talus on the current haul road was estimated to be .904, which is reasonable since the talus' phi value input is 31° and no adjustment was made for the irregular bedrock formation. The factor of safety after reclamation was estimated to be 1.08, which increases the factor of safety from the original haul road geometry by 19 percent. This increases the factor of safety to be greater than most of the natural talus since many of the natural slopes are unstable. Most natural talus slopes in the region have a factor of safety equal to 1.00 for their given geometry. Note that the failure plane configuration produced by the model shows shallow, circular failures which are predominant in this region. The very steep slopes noted in this study were made up of coarser sands and gravels which have considerably higher friction angles than the soil used for the typical section modeling. This non-homogeneity is common in young, shallow soils with some deviation in parent material and weathering exposure.

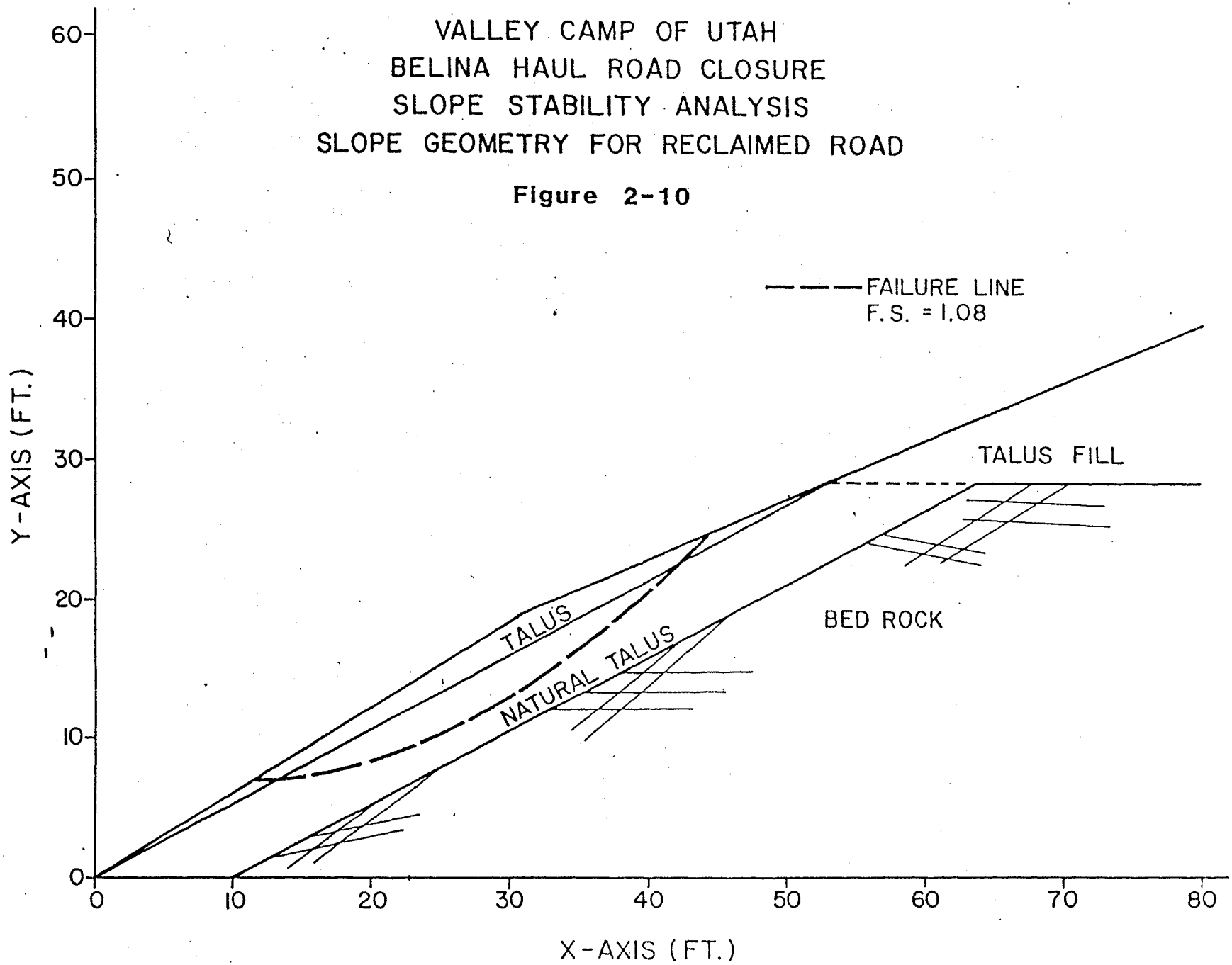
VALLEY CAMP OF UTAH
BELINA HAUL ROAD CLOSURE
SLOPE STABILITY ANALYSIS
SLOPE GEOMETRY FOR CURRENT HAUL ROAD

Figure 2-9



VALLEY CAMP OF UTAH
BELINA HAUL ROAD CLOSURE
SLOPE STABILITY ANALYSIS
SLOPE GEOMETRY FOR RECLAIMED ROAD

Figure 2-10



SECTION 3.0 SURFACE HYDROLOGY/HYDRAULICS

3.1 General

Surface water runoff was determined for the seven small drainages on the Belina Haul Road using the Soil Conservation Service (SCS) curve number method and the TR-20 Computer Program. Once flows were determined for each of the drainages, typical channels were developed and the velocity was determined so that the riprap sizing could be developed. Also included as part of the surface water design are the water bars to be constructed along the recontoured road.

3.2 Design Flows

The design storm for the seven drainages shown on Exhibit 3-1 was the 100 year, 24 hour, which has a rainfall amount of 3.65 inches. This is based on information developed for the Clear Creek Summit, Utah. Table 3-1 shows the precipitation depths versus return period for the Clear Creek Summit Site. The flows were developed based on a Type II rainfall distribution and are shown in Table 3-1.

The major parameters used in determining the runoff with the TR-20 model are the drainage area, time of concentration and CN. The time of concentration is defined as the time required for water to travel from the most hydraulic point of the watershed to the point of interest. It is computed by adding together the time for various segments of the conveyance system. For the mountainous drainage along the Belina Haul Road the time was estimated following the steps outlined in the SCS TR-55 publication and consist of three parts, sheet flow, shallow concentrated flow and open channel flow. The time of travel for each segment was computed and added together to determine the time of concentration for the drainage.

TABLE 3-1

Estimated precipitation depths for various return periods and durations at Clear Creek, Summit, Utah (from Richardson (1971).

RETURN PERIOD (years)	DURATION 5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.10	.16	.20	.28	.35	.46	.57	.84	1.08	1.33
2	.12	.19	.25	.34	.43	.57	.70	1.04	1.34	1.65
5	.16	.24	.31	.43	.54	.72	.90	1.34	1.73	2.14
10	.19	.29	.37	.51	.65	.86	1.06	1.55	1.99	2.45
25	.24	.38	.48	.66	.84	1.08	1.31	1.88	2.39	2.92
50	.25	.38	.48	.67	.85	1.13	1.40	2.07	2.67	3.29
100	.27	.42	.53	.73	.93	1.24	1.54	2.29	2.96	3.65

Runoff curve number (CN) are based on hydrologic soil group, cover type, and antecedent moisten condition of the soil. The soils and vegetation maps from Valley Camps' approved mining permit application (UT-0013) were used to determine the CN value for each of the drainages. The USFS has recently completed classifying their lands and assigning CN values and was contacted to see how values compared. In general the values computed for the haul road agreed quite closely and were slightly higher giving a more conservative estimate of the flow and were judged to be reasonable for forest lands. Table 3-2 below shows the date used to compute the design flows for each of the drainages.

TABLE 3.2

WATERSHED SIZE AND FLOW CHARACTERISTICS

Watershed #	CN	tc hrs.	Area, AC	Q cfs
1	60	.49	18.8	6.7
2	60	.35	9.6	4.3
3	60	.74	11.8	3.2
4 (Bowl Crossing)	60	.71	147.8	44.0
5	60	.71	14.2	4.0
6	60	.56	25.0	8.3
7 (Eccles Creek)	60	1.37	2087.0	378.

3.3 Channel Design

It is proposed in the reclamation plan that the existing culverts be removed and the ephemeral channels reestablished at their original slope and be protected with riprap. Figure 3.1 shows a typical section through the road after regrading and contouring and the various hydraulic data.

The slope will vary from about 15 percent across the road to a maximum of 65-70 percent along the slope face. To replace the culverts on five of the smallest drainages, a small "V" ditch will