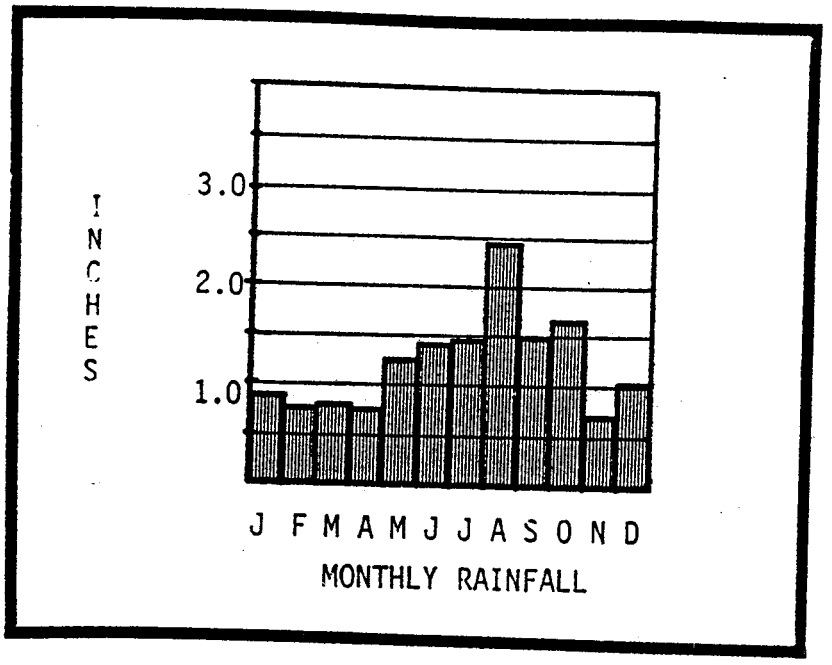
Summary

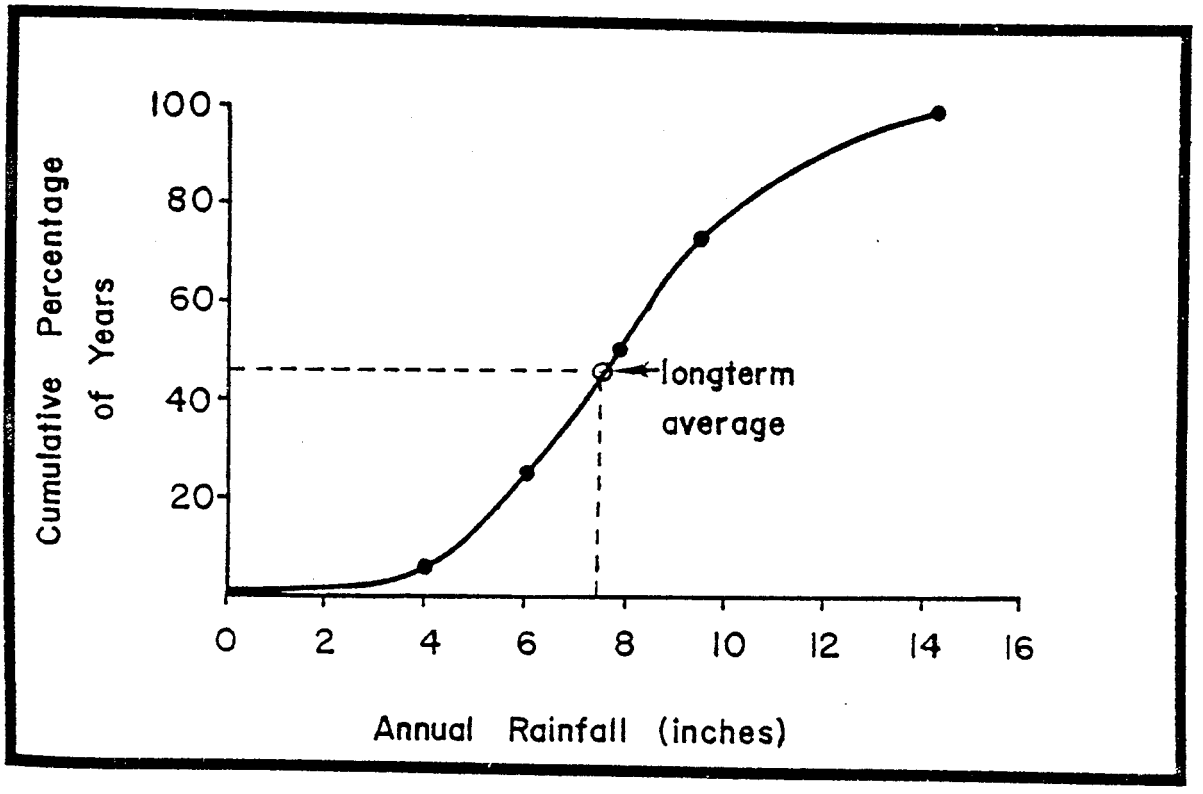
The results of the revegetation efforts must be considered with respect to the rainfall patterns which prevailed during the term of the experiment. Mean annual rainfall for Emery is 7.55 inches, compared to the median of 7.9 inches. Figure 61A shows the distribution of precipitation throughout the year by monthly means, while Figure 61B gives the relative probability of a given annual rainfall level compared to the actual amounts of rainfall recorded during the revegetation trials at the study site, and the amount of deviation from the monthly totals.

Success of germination and establishment of certain grasses and shrubs planted as seed appears to be related to the seasonality of precipitation experienced during the first growing season. During January, February and March, 1978, precipitation was 300% of average, while April and May were slightly below average, and June through October was only 30% of normal (Figure 62). Because of the heavy precipitation in winter months, soil moisture levels were relatively high during early spring, but decreased quickly in the early summer. Given this pattern, species which germinate early and concentrate growth during the cooler months of April and May would be expected to establish most effectively for this year. Data collected on the plots seeded to both grasses and shrubs showed that both Russian wildrye and crested wheatgrass did well, while winterfat was the most successful of the shrubs. Each of these species is adapted to take advantage of early spring rainfall before becoming dormant through hot summer months and although this is not an exclusive ecological strategy, it insures successful germination and establishment in years with wet winters and dry summers.

Revegetation experiments carried out at the Emery site are expected to be continued for several more growing seasons, and data from the first year may be compared to results from similar experiments carried out elsewhere in Utah. Tests of 2 grasses and 3 shrubs were performed on the west side of the Henry Mountains, about 50 miles south of the Emery study site. The area is similar climatically with an average rainfall of 6-9 inches. Container grown stock of fourwing saltbush, cuneate saltbush, shadscale, Russian wildrye, and indian ricegrass were transplanted to prepared sites on 6 different types of substrate. Experimental variables included applications of nitrogen, phosphorous and potassium, compared to control plantings. Supplementary water was required through-



A. Seasonal Precipitation Patterns



B. Annual Precipitation - Cumulative Probability

Figure 61. Precipitation Patterns

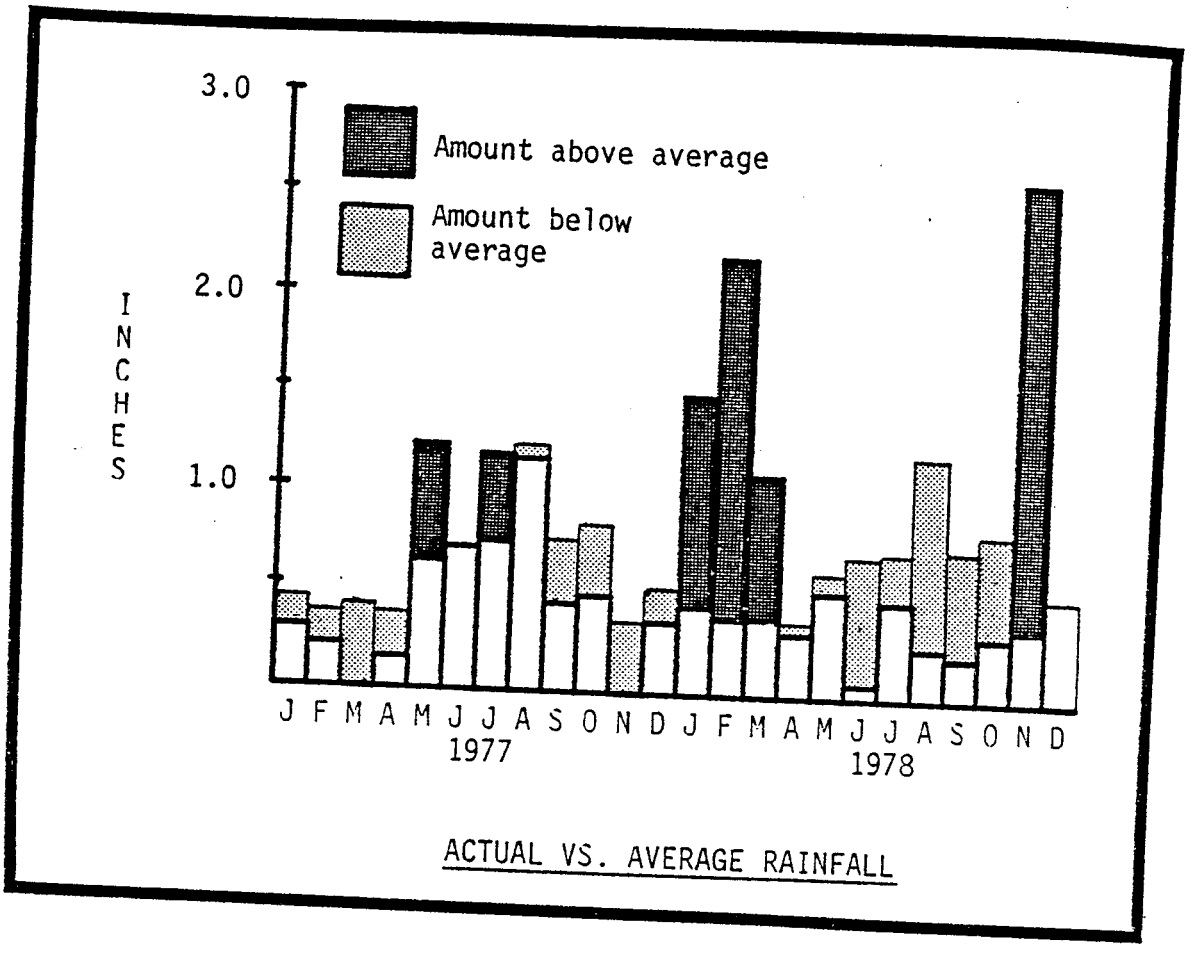


Figure 62. Actual vs. Average Precipitation for Study Period.

out this study due to drought. Although the main conclusions of species trials at Henry Mountains concern the suitability of the various substrates some comments on species performance apply to the Emery area. No differences in survival could be attributed to the effects of N, P, or K applications on any of the six types of substrate. Soils which performed best in field experiments were generally coarse in texture, while companion studies of the same substrate in a greenhouse showed best growth on the the substrates with a high proportion of clay and silt. In fact, regression of field vs. greenhouse experiments with the same soils yields a correlation coefficient of -.827, indicating that soils which performed well in the field are likely to produce poorly in the greenhouse and vice versa. The explanation for the apparent paradox probably lies in the lower rates of infiltration of fine soils, and consequently greater water loss as runoff (This problem is further discussed under soils). Species performance results showed that cuneate saltbush survived best, followed by shadscale, Russian wildrye, indian ricegrass and fourwing saltbusn, respectively. The significance of these results is dubious due to the fact that the study design measured only "apparent survival", and did not test growth rate, germination potential, or other factors, and there were no control plots for comparison. The experiment seems to have tested the ability of 5 species to survive transplantation from the greenhouse to 6 substrate types, given supplemental irrigation.

At Alton, Utah revegetation trials were carried out using the same approach as the Emery study, namely evaluation of species, soil amendments, and surface treatments on substrates subjected to simulated mining. The Alton region is considerably more moist than either Emery or Henry Mountains as indicated by the more mesic species which compromise the natural vegetation. Annual rainfall averages 16 inches and supports relatively tall stands of pinyon, juniper and gambel oak with a sparse understory of shrubs and grasses, and nearly pure stands of big sagebrush. Based on the results of the Alton experiments, indian ricegrass, standard and fairway crested wheat grass, western, blue bunch and intermediate wheat grasses, pubescent wheat grass, Russian wildrye and bottlebrush squirrel tail have been recommended as the best adapted grasses for revegetation. These should be planted in a mixture with selected

shrubs in seedbeds prepared by applications of phosphorous and nitrogen, rotovated into the replaced topsoil with an organic mulch (BLM, 1975). Relative to the Emery site, the Alton coal field may be more effectively reclaimed at a lower cost because of the higher precipitation and abundance of topsoil.

Remote Sensing Experiments

Remote sensing with color infrared film can be considered from the point of view of evaluating remote sensing techniques for long term monitoring of coal reclamation sites to recognize areas under stress, so as to take timely remedial action. Further, it can be used to read out the results of an experiment such as the one conducted at the Emery site to obtain bulk biomass data on a detailed geographic grid. In either case, it offers an inexpensive, rapid supplement to traditional methods. The results of such an experiment conducted after a full growing season, and into the start of a second are shown in Figures 63, 64, and 65.

Lessor vigor is evident in the region which had topsoil removed (see Figure 63). Cultipacked perimeter is inferior in growth, as are grass plots. Inexplicably, the mulched areas are less productive at this time. Otherwise the gauged and harrowed areas appear to have the best growth (see Figure 64). Overall performance in this area is better with the exceptions of the two white spots in the center of the plot (see Figure 65).

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SEDIMENTS

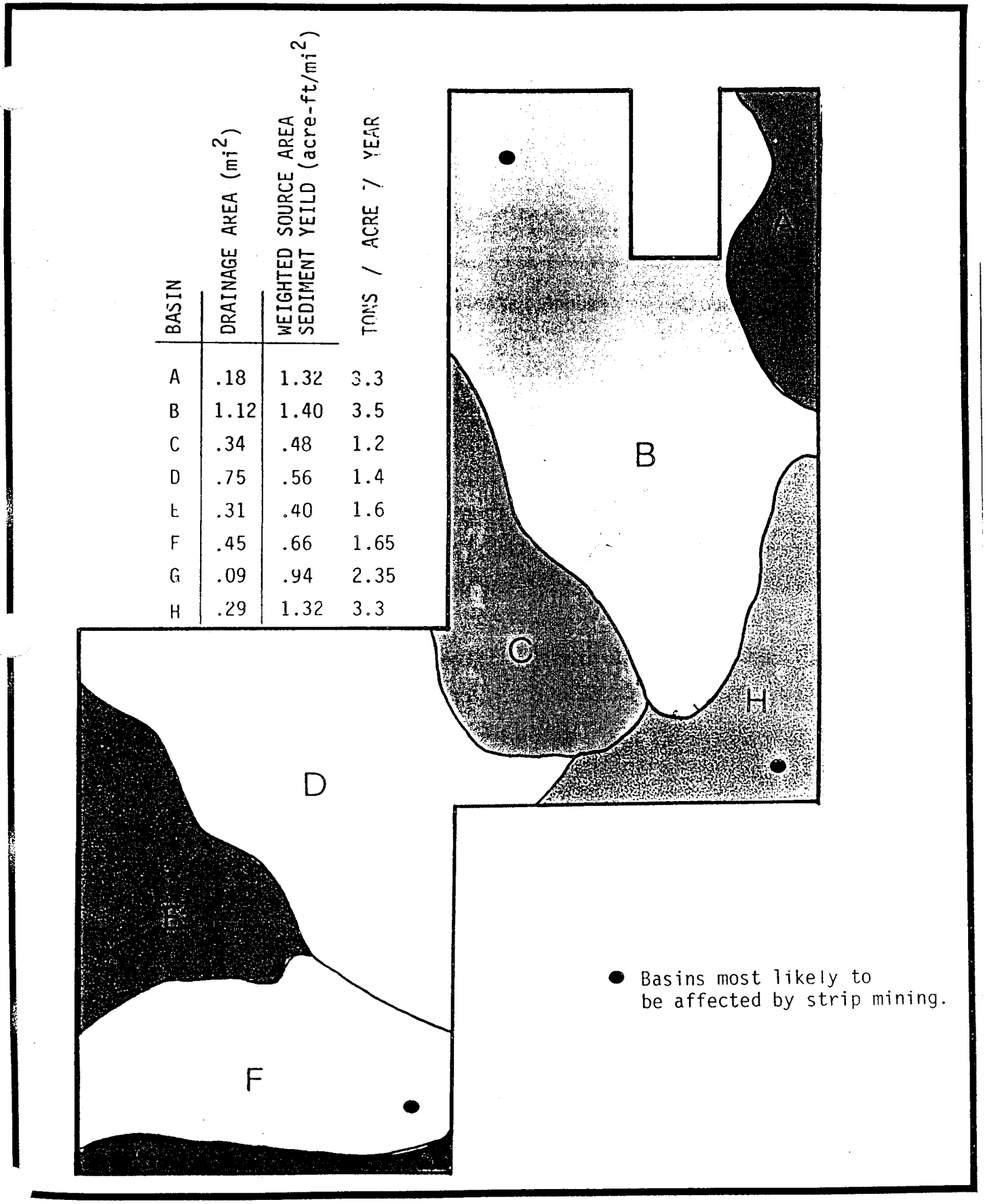
The objective of this section is to derive a realistic estimate for current sediment yields from the study site, and to evaluate how they would be altered by strip mining. In order to evaluate the effects of strip mining on sedimentation and stream turbidity, a baseline of present conditions must first be established and than a method of predicting changes due to mining be applied, utilizing the same basic units of measurement. It would be best to develop coefficients to predict effects of strip mining in quantitative measures of sedimentation. A prior EMRIA study of Henry Mountains (1978) on similar soil units presented what appeared to be inconclusive data. To resolve these difficulties, a number of experimental answers were explored.

Procedure

For comparative purposes, sediment yield estimates calculated here were derived using multiple techniques: (1) the PSIAC (Pacific Southwest Interagency Committee) method (1968); (2) the modified southwest Universal Soil Loss Equation (USLE); (3) stock pond coring; (4) long term sediment collections; (5) "standard" in situ rainfall simulation technique (e.g. Lusby, 1976); and (6) a one meter Planchet simulation using ground core materials. The results of these various approaches is tabulated in Table 24. The procedure utilized in each of the cases was to establish a suitable mapping unit over which to summarize pertinent characteristics of unknowns from each of the applicable technologies. A 1:7200 scale map (enlarged from 1:24,000 topographic map for easier transfer of aerial photographic data) was divided into grid cells 1000 by 1000 feet and the various data accumulated on a cell-by-cell basis. Cells from each hydrologic subbasin were aggregated separately. Many basic data are common to each sediment yield technique. These basic data consist of surface geology or soils, meteorology, slope or topography, ground cover, and derived production figures based on various combinations of the foregoing factors. Data were obtained from original field, airphoto, and laboratory studies conducted by GSC. Figure 66 displays the hydrologic subbasins into which the area is divided.

PSIAC

The PSIAC approach is dependent on 9 basic factors: surface geology, soils, climate, runoff, topography, vegetative cover, land use, land erosion, channel erosion and sediment transport. Though developed for use on sediment classification of large uniform areas, investigators such as Shown (1970) have reported representative results for small



BASIN	DRAINAGE AREA (mi^2)	WEIGHTED SOURCE AREA SEDIMENT YEILD (acre-ft/mi^2)	TONS / ACRE / YEAR
A	.18	1.32	3.3
B	1.12	1.40	3.5
C	.34	.48	1.2
D	.75	.56	1.4
E	.31	.40	1.6
F	.45	.66	1.65
G	.09	.94	2.35
H	.29	1.32	3.3

Figure 66. Sediment Basins on Study Site.

Table 24

Comparison of Estimates of Sediment Yield by Different Methods for the Emery Study Site Basins.

Basin	Drainage Area (sq. mi.)	Weighted Source Area Sediment Yield (acre-ft/sq. mi.)	Estimated Annual Basin Sediment Yield (tons/year)	Ground Cover Estimatable Soil (%)	Stock Pond Annual Yield (T/acre/yr)
A	.18	1.32	3.30	36.3	.90
B	1.12	1.40	3.50	35.0	---
C	.34	.48	1.20	38.0	---
D	.75	.56	1.40	32.0	.59
E	.31	.40	1.00	30.0	---
F	.45	.66	1.65	48.0	---
G	.09	.94	2.35	54.0	---
H	.29	1.32	3.30	36.3	---

Basin	Estimated Annual (Sediment Trough) Yield (T/acre/year)	Estimated Annual (Planchet Test) Yield (T/acre/year)	Estimated Annual (Rain Simulation) Yield (T/acre/year)	Estimated Annual (USLE) Yield (T/acre/year)
A			.45	.36
B			1.02	2.24
C			.84	.71
D			1.20	1.50
E	.084*	.030	.56	.64
F			.84	.93
G		.080	.17	.21
H			.45	.59

* 1.1 inch cloudburst storm, 12% slopes in subbasin

drainage basins. Various adjustments are needed for such applications: (1) the topographic factor is developed without use of floodplain or deposit data, (2) channels originating outside the study area completely crossing it were not treated with respect to sediment transport capabilities. In this evaluation, the sediment conveyance factor was utilized to accomodate the difference. Slope data were obtained from the enlarged quadrangle map noted in figure 66. Percentages of bare soils were generally derived from the concurrent soil survey and from the vegetation transect and photo analysis, discussed in the corresponding sections. Channel characteristics were determined at specific locations though only streams larger than Strahlers' (1952) fourth order were delineated for channel classification.

The sediment conveyance factor was determined after the methods of Frickel, Shown, and Patton (1975). It is dependent on: (1) channel width and gradient; (2) degree of gullying; (3) bed material size; (4) intermittent gullying within channel system; (5) deposition in channels and alluvial fans; (6) bottom land deposition.

Universal Soil Loss Equation

A great deal of basic research has been involved in the original development of the USLE by Wischmeir and Smith (1960, 1965) with subsequent modification (Foster and Wischmeir, 1974) and adaptations e.g. Anderson (1975). It was originally developed for uniform agricultural land east of the Rocky Mountains and until recent years only applied to uniform slopes. Work has proceeded to extend it to irregular slopes. Adaptation to sheet erosion in western lands is being made e.g. Tew (1973) has developed a nomograph for estimating soil losses from Utah watershed. Anderson's work parallels Tew's in that the USLE is converted to a logarithmic equivalent.

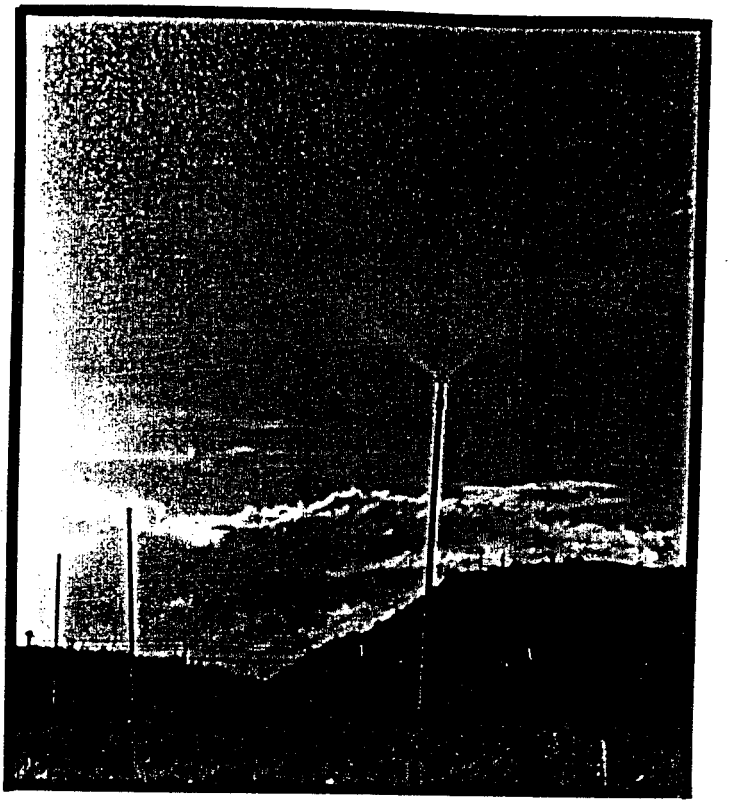
Table 24 summarizes the results of applying the USLE to the cellurized study area. In order to use it, K values were obtained from soil survey. The rainfall factor was determined from the climatology section and Forest Service data. Slope length and gradient were determined on an average period basis. The erosion control practices factor and cropping factor were taken as 1 in this evaluation. In part, the difficulty of applying USLE for erosion in wildlands is that as runoff is concentrated in channels e the size of rills, the actual erosion surface and its dynamics become

too complex to treat with a general equation. Extensive modeling with the USLE is beyond the scope of this program. It's application here is to provide the counterpoint to data from other sources.

Rainfall Simulation

In order to apply a rainfall technique to the study area, the dominant land types in the strippable portion of the study area were determined. These were designated Hydrologic Classes A and B. Class A consisted of dominantly sandy material and Class B had a large clay fraction. These data will provide a baseline comparison for post-mining studies. The "disturbed" Class B site simulates changes to be expected from stripping. The site was ripped and "fluffed" in preparation for a revegetation experiment. It is taken to represent a post mining "fill" situation. An additional site at the BLM Price office was occupied in order to determine a "cut" slope response. This was in Mancos Shale and could be considered analagous to Blue Gate Shale underlying Class B sites. Simulation (Fig. 67 & 68) locations were chosen as close as possible to existing revegetation sites in order to provide long-term control. At some unspecified future date, it would be useful to perform a rainfall simulation run on the revegetation zone itself to determine the effectiveness of the program in returning sediment production to pre-disturbance levels by establishing vegetation. To some extent the responses of these sites can be directly applied over the area of the sites shown in Figure 30 as strippable.

These rainfall simulation experiments collected the following information summarized in Table 24: (1) runoff - measured from volumes collected at one minute intervals and converted to discharge in cubic feet/second. The total volume of runoff is computable in terms of inches per unit area. An infiltration rate curve can be calculated by subtracting runoff from applied rainfall for the same unit time (inches/hour); (2) precipitation a network of raingages within the study area provides a measure of incident rainfall. Total area rainfall was computed using a modified polygon technique; (3) sediment yield was sampled at 4 minute intervals outflow and analyzed in the lab to determine suspended sediment concentration. Total sediment load is expressed in tons per square mile and can be alternatively obtained at various points in the rainfall cycle or as an average over the test time; (4) area - a topographic survey of the chosen site yields the area in square feet; (5) weighted mean slope - the area between contours was weighted according to the percent of overall area; (6) antecedent



Detail of a Sprinkler Pattern

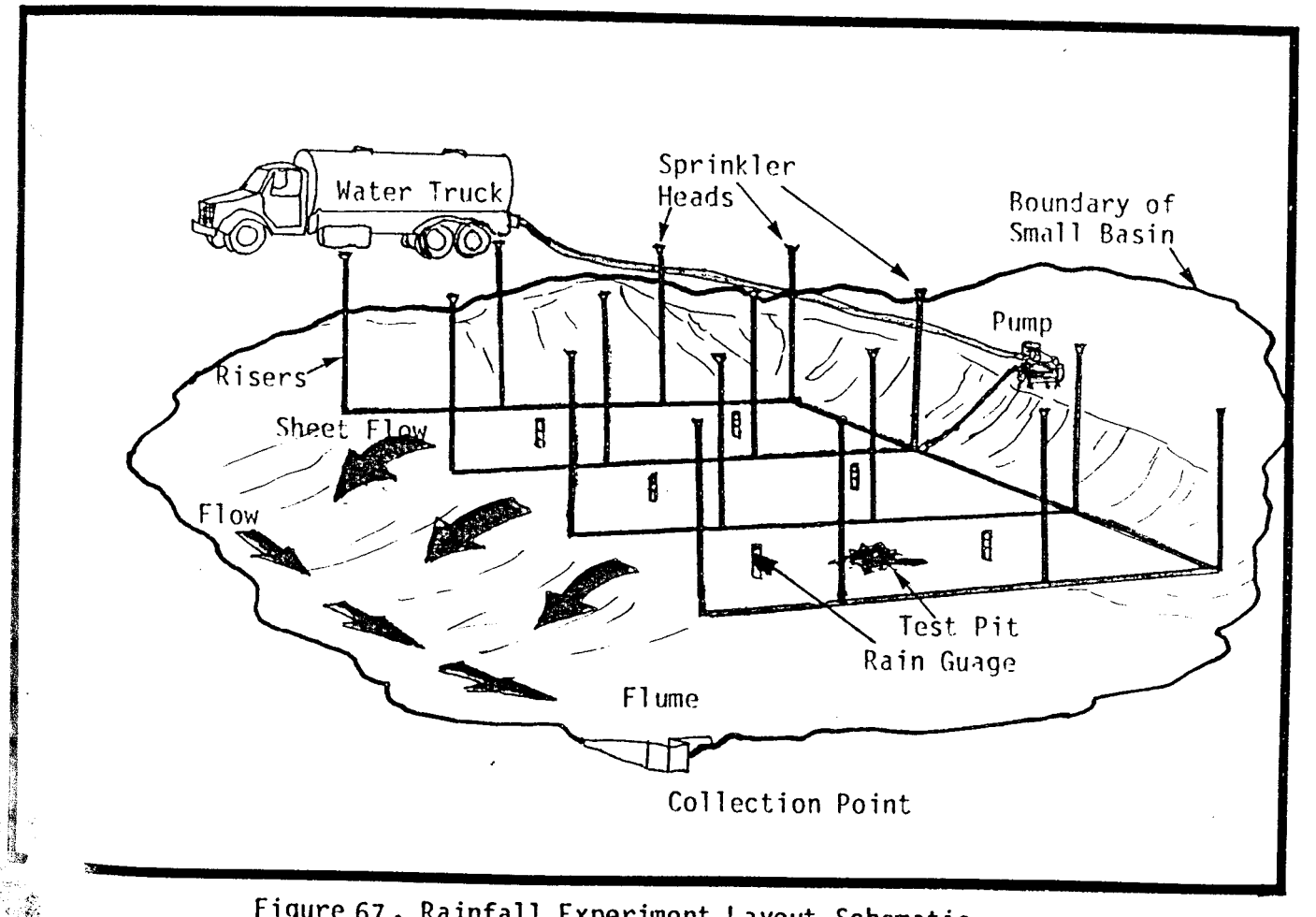
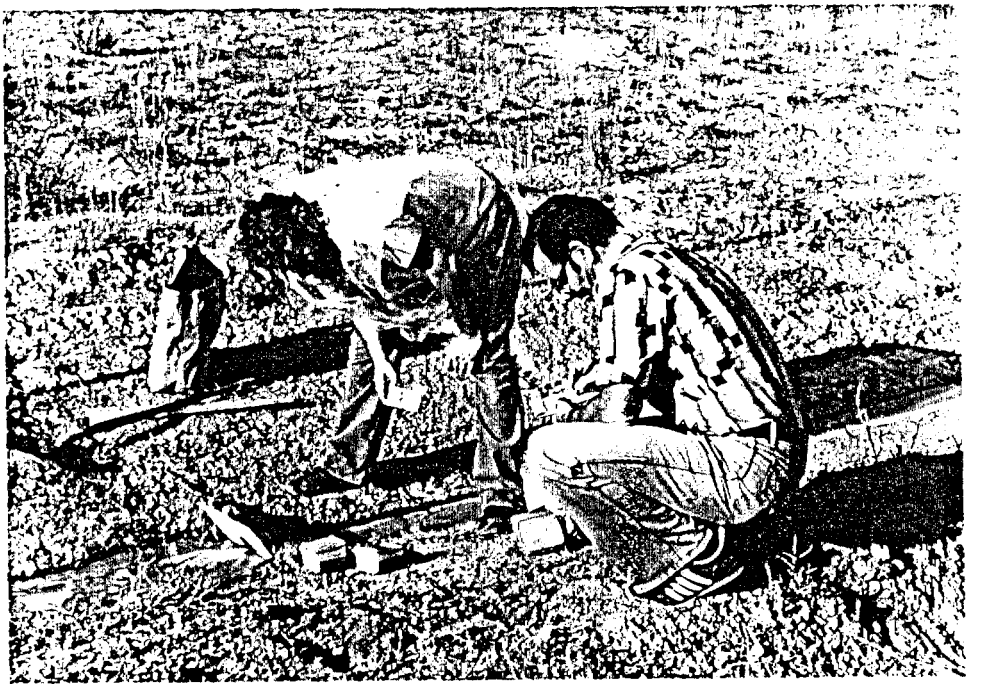


Figure 67. Rainfall Experiment Layout Schematic.

Onset of Puddling - Runoff



Measurement of Flow Rate

Figure 68. Rainfall Simulation Experiment

moisture - obtained from gravimeter samples of 5-6 inches of soil. Three locations were sampled and averaged for the final results (results expressed as percentage by weight); (7) clay - analysis of percent clay was made from the gravimeter sample (weight percent); (8) root concentration - the amount of fibrous material in the 5-6 inches of soil (in ounces per 10 ounces of soil); (9) bare soil and rock - obtained from three 20 foot transects with site using a transect line and vertical drop first contact point method at 2 inch intervals (expressed as percent).

Calculations of the expected runoff from total areas of the site were made by multiplying the total area of the hydrologic class by the sediment production from a unit of the summed test. This is not entirely representative since variables for the simulated test site do not remain constant throughout the area of the hydrologic class. It is assumed however, for purposes of comparison, that all factors are the same with the exception of slope. A slope correction factor was applied by observing empirical variations in the laboratory planchet runs. The results are displayed in the composite yield tabulation (Figure 69 and in Table 25).

Laboratory Simulation Studies

Because the number of different field environments which could be treated had to be resolved into a few hydrologic classes (which did not completely describe a post-100 foot stripping situation) for manageability, thereby limit the statistical aspect of the data, it was decided that laboratory measurements for a unit area (one square meter) could be made at various slope angles, and compositional nature. Thus we chose to simulate surface conditions resulting from crushed materials within the 100 foot or so zone of potential stripping. Two principal "core" classes were selected from the overlain cored site material - chiefly carbonaceous shale and medium grained sandstone as being most probable amendments. The soil experiments arrangement of elevated sprinklers at continuous pressure gave droplet control similar to the infield experiment. The one meter square box was adjusted at various angles for each run. Three settings of slopes were utilized for each of the hydrologic classes selected. Runoff was collected at the base of the planchet in a trough. Runoff values and sediment content determinations were then made in the lab. "Rainfall" was measured at various distances from the solitary source. Runoff results from the experiment are displayed in Figure 70. In general these indicate

Table 25. Simulation Study Data

VARIABLE	HYDRO SITE CLASS A (Sandy Site)	HYDRO SITE CLASS B (Clayey Site)	HYDRO SITE CLASS B DISTURBED	HYDRO SITE CLASS C (Mancos Shale) Cut Slope
Date	10/10/78	10/16/78	10/16/78	10/18/78
Area (sq. ft.)	2400	2400	2400	2400
Weighted Mean Slope (%)	8	10	5	2.1
Antecedent Moisture	4.5	4.0	4.2	4.0
Clay (%)	10	35	35	40
Root Concentration (g/100g)	.320	.210	.020	.000
Bare Soil and Rock (%)	40.8	12.5	95.1	96
Precipitation (inches)	.90	.72	.78	.56
Runoff (inches)	.31	.16	.06	.14
Sediment Yield (tons/sq mile)	.45	1.09	1.40	1.88

Table 26

Sediment Yield Obtained From Surveying Impoundments

ond	Mean Basin Depth (in.)	Age	Basin Area (sq. ft)	Drainage Area (Upstream) (sq. mi)	Annual Sediment Yield (tons/sq/mi)	Average Watershed Slope (%)	Estimated Bare Soil (%)	Drainage Density (mi/sq mi)
	18	12	2400	10	.90	12	6	3.5
	4	4	350	2	.59	11	17	7.4

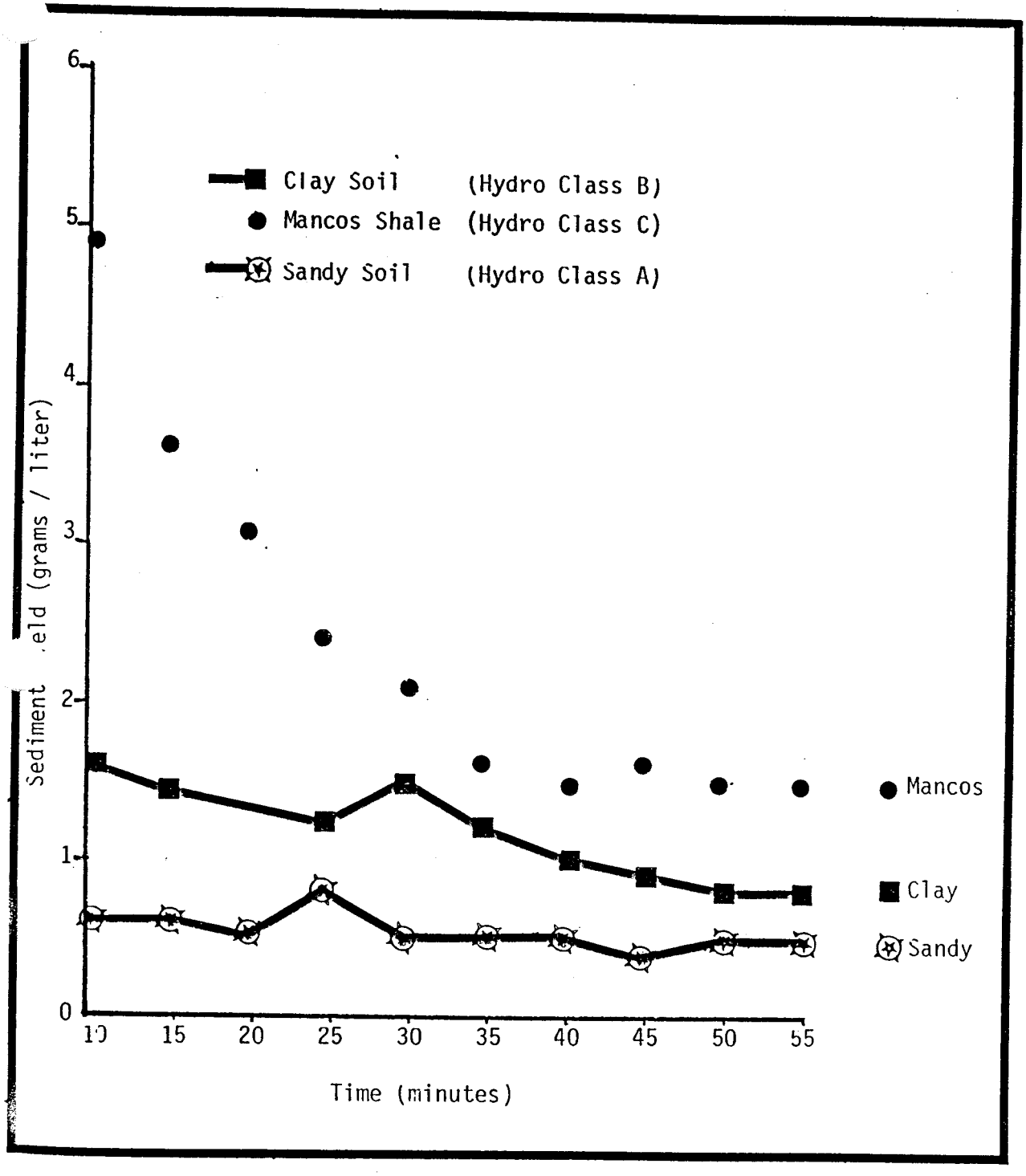


Figure 69. Results of Rainfall Simulation.

Table 27 Comparison of Sediment Yields
(Weighted Source Area)

YIELD			AREA
Low	Moderate	High	
.05 to 3.5 (acre/ft/mi^2)	.36 to .90 (acre/ft/mi^2)	.90 to 1.25 (acre/ft/mi^2)	Hanging Woman
1-10% Slope	10-20% Slope	20-40% Slope	
Small Subbasin	Basins CDEFG	Basins ABH	
less than .35 (acre/ft/mi^2)	.40 to .94 (acre/ft/mi^2)	1.32 to 1.40 (acre/ft/mi^2)	Emery
-----	3-14% Slopes	9-14% Slopes	
1 ton/acre/yr	1.2 to 2.35 (tons/acre/yr)	3.3 to 3.5 (tons/acre/yr)	

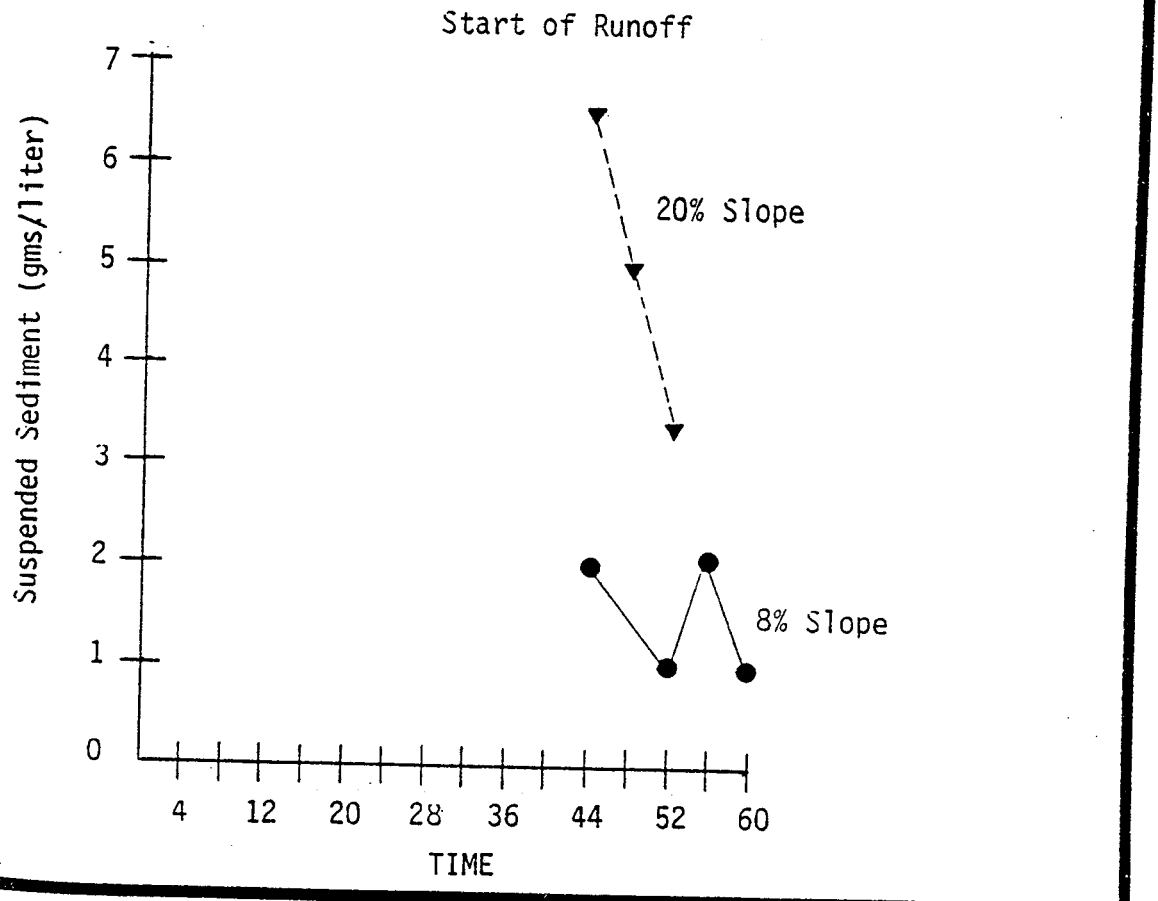


Figure 70. Lab Tests of Sandstone Overburden
First 100 ft. of Bore Hole #5.
- Planchet Tests -

On the other hand the infiltration/runoff relationships resemble the disturbed clayey site of Hydrologic Class B.

Trough Experiment

The chief limitations of the simulation experiments is their short duration, perticularly the planchet tests. In order to derive a longer term viewpoint on sedimentation production from small subsets of the drainage basins, small troughs were emplaced to interdict outflow from the selected small areas and on the coal burn area of surface soil disturbance. The basins so selected averaged some 300-400 square feet and had geometries which allowed for constriction. Troughs were modified rain gutter sections set flush with the surface of the terrain. Sediment from overland flow was collected at long intervals and weighed. Particle size analysis indicated slight losses in fines, perhaps resulting from trough overflow. These results are treated as representative of specific hydrological subbasin behavior and a unit area production number derived and multiplied by the area of the specific basin. The results are tabulated in Table 25. Unfortunately, due to vandalism, all but one of the traps were destroyed prior to the 1.1 inch November 1978 storm. This surviving trap was located on the coal burn area, and hence represents a disturbed soil (post strip mining simulation).

Stock Pond Analysis

Stock ponds in the area were cored with the results shown in Table 26 above. One of these, above Miller Canyon was reported to be partially spring fed. This is however questioned, after two seasons of observation.

Summary

In comparison to Hanging Woman (1977) sediment analyses, the Emery site appears potentially higher despite lesser mean slopes (Table 25). This is apparently due to high clay fractions in the Mancos and the fineness of the Emery sands allowing easier transport. Basins F and G for SE strip area are moderate sediment yield prior to mining, while the balance of strippable areas, basins B and H are already high, using existing surface soils and slopes. The extraordinarily low frequency of cloudburst noted in the climatology section for the past 78 years undoubtedly accounts for the exceptionally low yields indicated by the stock pond experiments (.59 to .90 tons/acre/year). That is, although erodable, these sediments simply have not experienced a cloudburst of sufficient magnitude to produce sheet flow so as to fill the ponds.

The rainfall and planchet tests on disturbed soils and "weathered overburden" produce remarkably similar results to the existing surface soils

(i.e. high to moderate, Table 27). As noted in the planchet tests, slope is not too sensitive a factor for the 1 inch rain storm due evidently to the already high sediment production of these materials for the reasons noted.

Thus although the disturbed soils after mining would evidently fall in the moderate to high yield categories (.45 to 1.2 tons/acre/yr.) with one exception (Basin G .17 tons/acre/year) the key design factor is the rainfall one must plan for. The one inch storm according to the rainfall experiment is apparently no threat. The 2 inch worst case in 78 years at Emery might be more effective but was not tested due to the limits of the experiments performed. The trough experiment for a 1.1 inch storm, is perhaps the most realistic and shows an extremely low sediment yield, indicating that a single such storm does not constitute a decisive threat. Evidently the 2 inch storm should also be treated. In any event due perhaps to the special circumstances on the Emery site no significant increase in sediment yields is predicted by these analyses provided reasonable care in surface shaping is employed, post mining.

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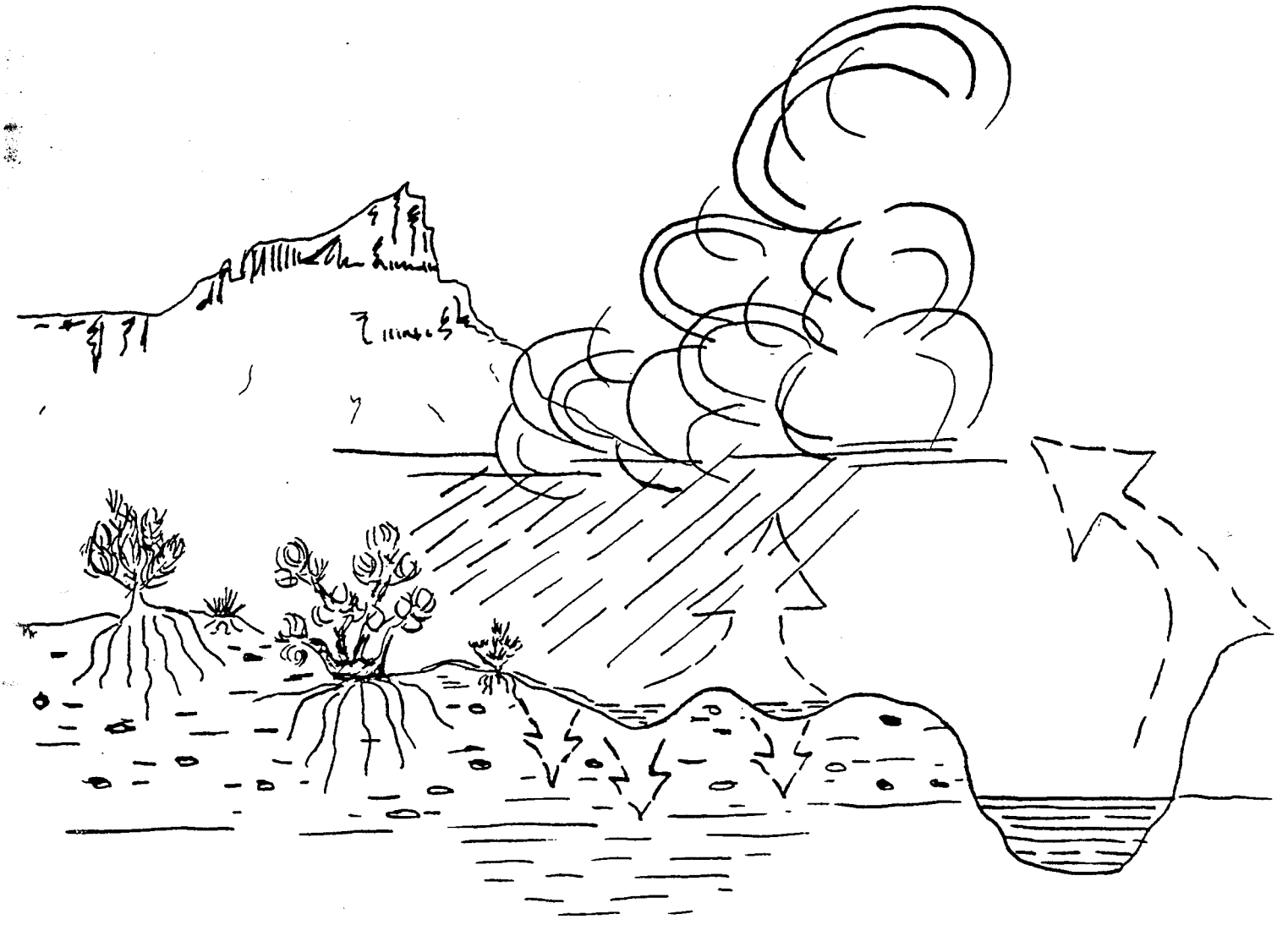


HYDROLOGY & WATER SUPPLY

Surface Water

Raw data made available from ongoing USGS hydologic investigations (Lines, 1979 - personal communications) have been incorporated. However, significantly more analyzed data are expected to be released within two years. The reader is advised to seek this report, when available, to supplement what is presented here.

Regionally, the Emery coal field and the study area are located at the southern end of Castle Valley within the Dirty Devil Basin. Figure 71 shows the Muddy Creek watershed of approximately 1500 sq. miles, and the smaller drainages relative to the study site. Christiansen Wash and Quitchupah Creek flow southward into Ivie Creek above Ivie Creek's confluence with Muddy Creek. Miller Canyon Creek flows directly into Muddy Creek. Muddy Creek eventually empties into the Dirty Devil River above Hanksville, Utah.

The main drainage in the area is the 3rd order Muddy Creek, flowing southward along the eastern escarpment of the mesa bounding the study site. Ivie Creek, a 2nd order tributary flows eastward into Muddy Creek on the south, and 2nd order Quitchupah Creek flows southward into Ivie Creek on the west, isolating the mesa from the lowland. All the first-order tributaries are intermittent, draining the upland west and east into the Quitchupah and Muddy drainages. Nearly all of the 1st order basins on the upland surface drain westward into Quitchupah Creek, with the main exception of Miller Canyon and its tributaries, eroding headward NW toward Emery, capturing the upland drainage, formerly tributary to Christiansen Wash and the Quitchupah drainage. The gradients of these streams are generally small, except locally where they cross the steep to vertical escarpments. On the upland the tributaries are incised slightly and drop 200 to 360 feet per mile and range from 800 feet to 1100 feet per mile across the escarpment. The lowland Quitchupah and Muddy Creeks grade only 30 feet per mile. Tributaries to the main N-S drains merge in the vicinity of Emery on the nearly horizontal upland surface. None of the perennial streams with their low gradient and mean dendritic channel pattern seems capable of carrying excessive sediment load. The intermittent upland channels are also meandering and of low gradient.

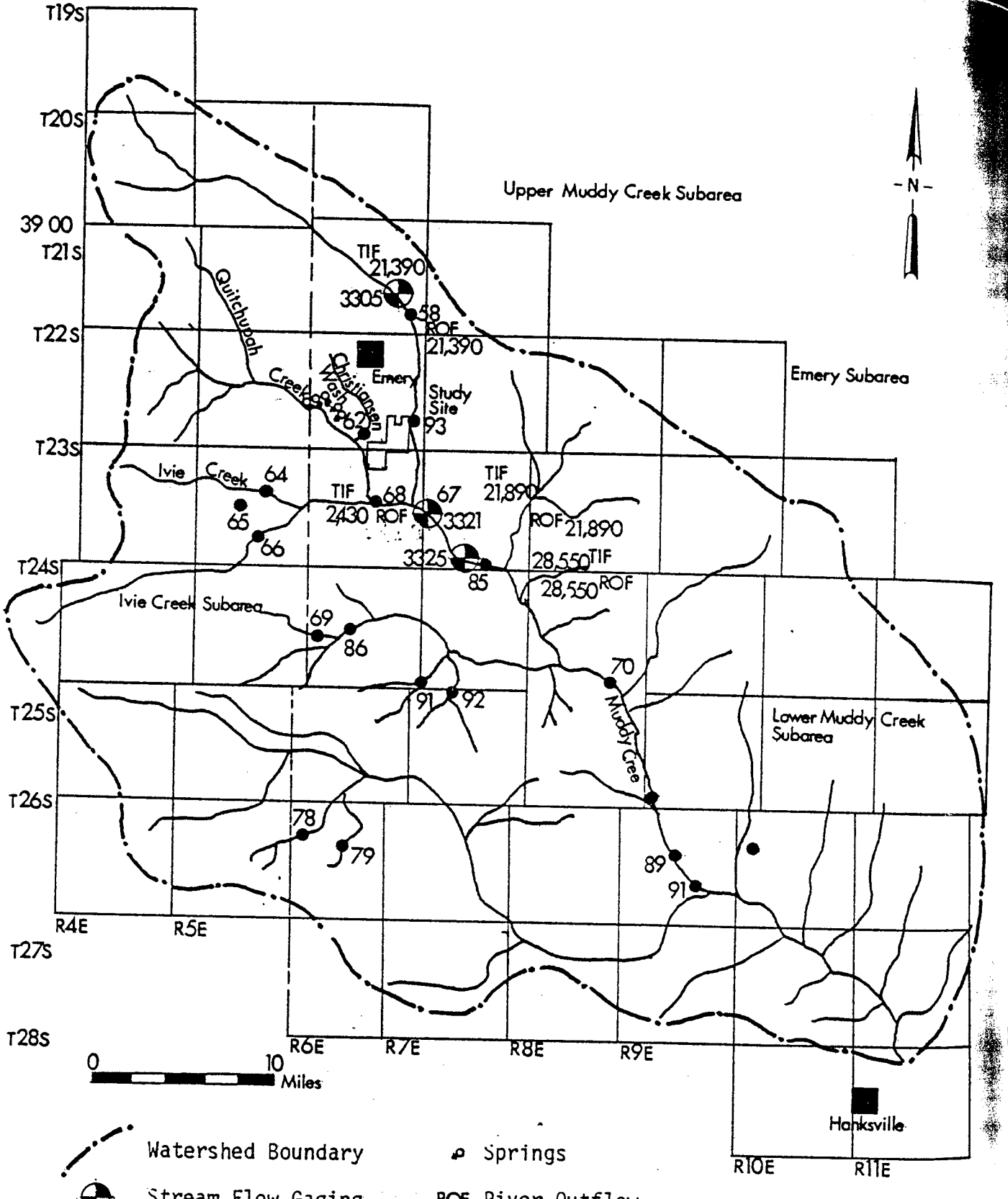


Figure 71. Muddy Creek Watershed.

Summer flash floods are common in the area but evidently scarce at Emery as noted in the climate section (Figure 12). Floods are due to short duration and high intensity summer storms, hence the flood probability is identical to the cloudburst probability previously cited. Strip mines must account for these events with runoff water diversion and barrier systems. The major stream in the area, Muddy Creek, is snowfed, therefore seasonal fluctuation of flow rates is great as shown in Figure 72. Stream flows for both Ivie and Muddy Creeks are greatest during late spring and early summer, decreasing to a minimum flow in early autumn through mid-winter (viz. Figure 72). Note that the peak precipitation is after this (late summer and fall). Hence for mean flows no close relationship is found.

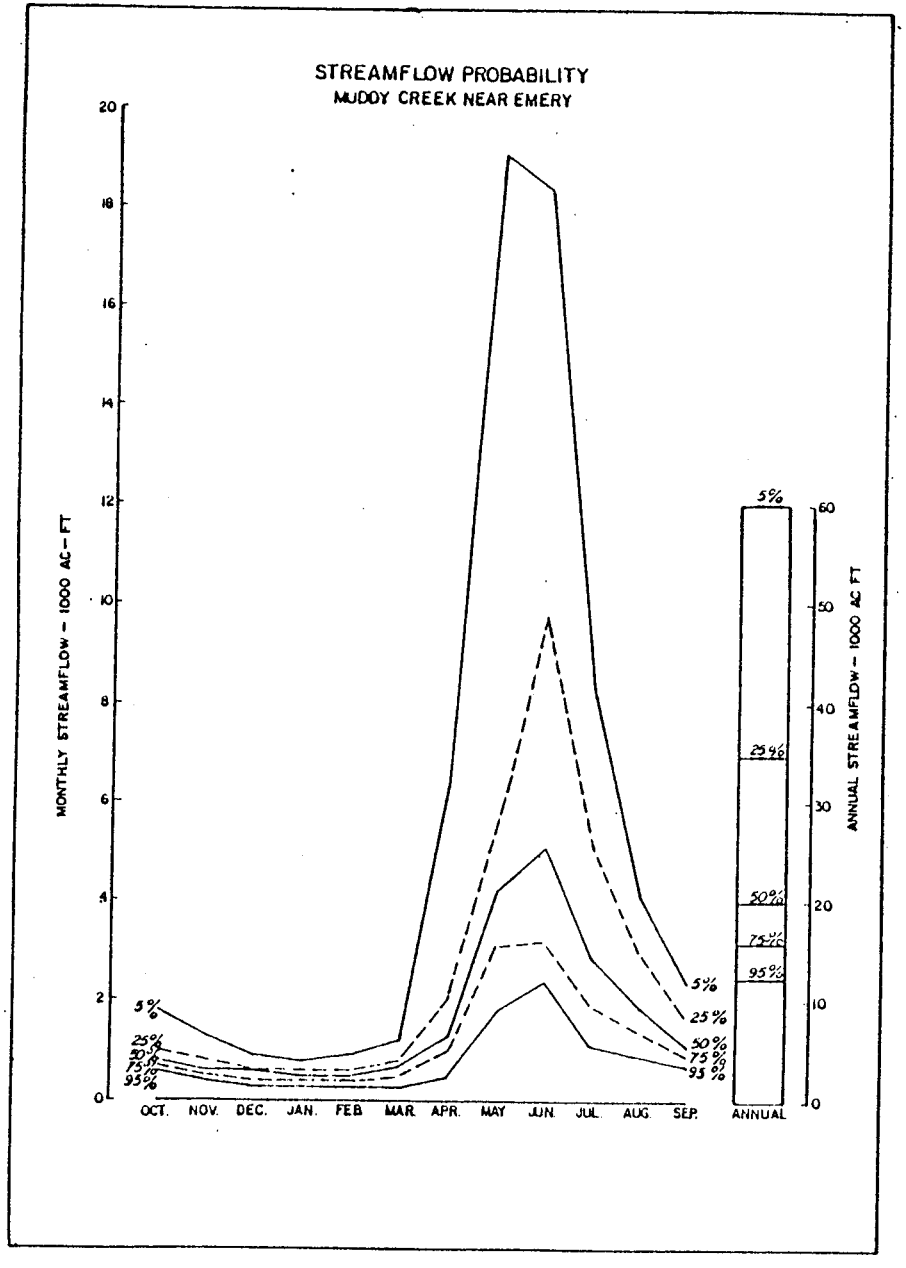
Much of Muddy Creek's water is diverted for irrigation purposes. An irrigation canal system brings water onto farmlands on the Quaternary alluvium and river terrace deposits. Quitchupah Creek is snowfed, to a lesser degree. After entering Castle Valley, its flow generally increases as a result of runoff from the irrigated farmland. Hence any detailed consideration of surface drainage nets must consider the irrigation flows and their variability. Muddy Creek, Quitchupah Creek, and Christiansen Wash are perennial streams. Christiansen Wash's flow is sustained primarily by runoff from the irrigated farmland, unlike the other two.

Water Budget Analysis

A partial budget analysis has been completed for the study area by the Utah Division of Water Resources (1977). This analysis was based on gage records from 1951 to 1961 for Ivie Creek and 1951-1967 for Muddy Creek near Emery (Table 28). Additional flow data were evaluated from measurements taken during October 1974 to September 1975 (USGS, 1976). These have been added to the tributary inflow and river outflow estimates compiled on Figure 71 below Ivie Creek. We have also added the 1951-1961 estimates for this station (3321) to Figure 71.

Upper Muddy Creek Subarea

The Upper Muddy Creek cubarea is comprised of 105 square miles of drainage above the upper gage north of Emery. Man-made depletions are negligible. Nearly all the useable water in the Muddy River basin comes from this subarea. The surface outflow has been measured since 1951 at USGS Station 9-3305. A flow diagram of the water budget is shown in



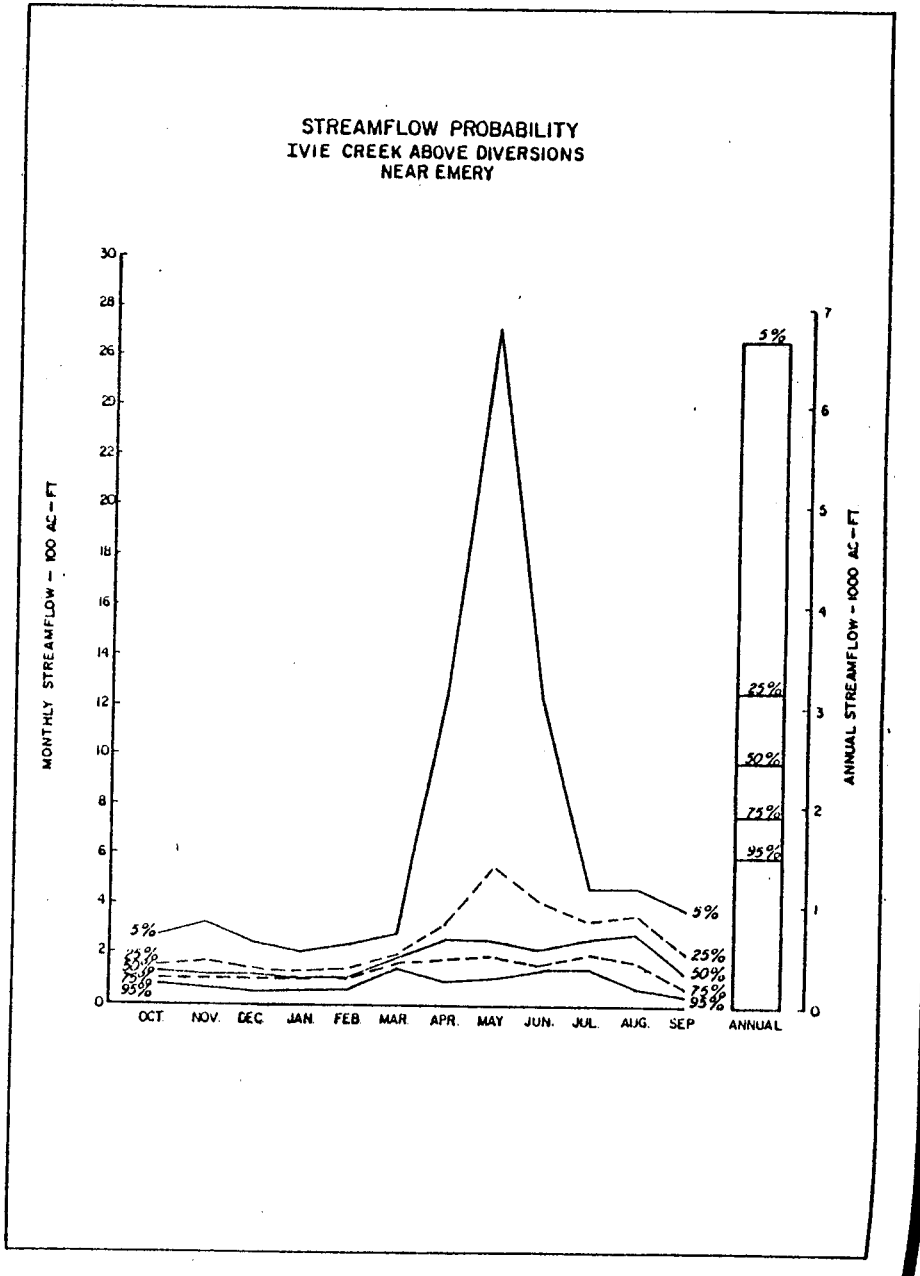


Figure 72. Probable Monthly and Annual Stream Flows, Muddy & Ivie Creeks.

Table 28. Mean Monthly and Annual Water Budgets for Emery Subarea.

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Year	
Measured Inflow														
Ivie Creek	130	120	120	110	110	180	260	260	220	270	280	130	2,430	Gage record, 1951-1961, "Ivie Creek above diversion near Emery"
Muddy Creek	890	590	580	480	490	700	1,290	4,240	5,690	3,660	2,210	1,090	21,390	Gage record, 1951-1967, "Muddy Creek near Emery"
Transbasin Diversion	100	70	60	50	50	80	140	470	630	410	250	120	2,380	1/9 of flow going to Independent Canal C
Tributary Inflow	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed that none reaches stream
Total Available for Diversion	920	640	640	540	550	800	1,410	4,030	5,280	3,520	2,240	1,100	21,440	
Cropland Diversions														
Muddy Creek							310	3,230	2,630	3,250	1,960	970	11,190	Muddy Cr. Water Commissioners Report (Modified to equal 90% flow in July, Aug., Sept.)
Ivie Creek	140						310	610	370	270	280	150	2,130	Ivie Creek (assume complete diversion)
Available for Use (Assume 35% efficiency)	50						220	1,340	1,620	1,440	830	470	5,970	
Cropland Precipitation	480	230	320	290	260	260	240	320	290	400	690	490	4,270	Use Emery data on 7,143 acres
Cropland PCU	590						270	1,420	2,230	2,830	2,370	1,530	11,240	7,143 acres
Deficit	60						0	0	320	990	850	570	2,790	
Cropland PCU	530						270	1,420	1,910	1,840	1,520	960	8,450	
Wetland PCU							630	1,250	1,970	1,960	1,340	820	7,970	4229 acres
Wetland Precipitation	280	130	190	170	160	160	140	190	170	240	410	290	2,530	Emery data on 4,229 acres
Outflow (Calc.)	1,150	1,000	1,150	1,000	970	1,220	890	1,870	1,860	360	480	100	12,050	Muddy Cr. below Ivie Cr., near Emery
Outflow (Act.)	380	330	320	290	460	820	1,520	3,470	2,530	540	930	670	12,260	1951-1961 gage records multiplied by $\frac{28750}{26200}$ to be compatible with inflow
Difference	770	670	830	710	510	400	-630	-1,600	-670	-180	-450	-570	-210	

Figure 71. The distribution of monthly flows is shown in Table 28. This would essentially constitute the water above the potential strip mine areas on the east side of the plateau.

Ivie Creek Subarea

The Ivie Creek subarea contains all the drainage (50 square miles) above USGS stream gage 9-3315. There are unmeasured diversions for 200 miles of meadow in this subarea. Streamflow records are available for the years 1951-1961. Figure 71 shows a flow diagram of the water budget; Table 28 shows the monthly distribution of this budget. Existing data are not sufficient to estimate sub-surface outflow. Due to the lack of a gaging station on Quitchupah Creek and Christiansen Wash, the Ivie Creek data must be taken as representative of the flow from the west side, strippable areas, supplemented by the Ivie Creek flow above the tributary.

Emery Subarea

The Emery subarea is 400 square miles, and contains essentially all of the agricultural land in the Muddy Creek drainage. The water budget is shown on Table 28. The measured inflow consists of Ivie Creek and Muddy Creek above Emery. One export from the basin is the Independent Canal. This diversion is generally one-ninth of the flow at the Muddy Creek diversion dam (directly below the gaging station). The principal water yielding area in the subarea is the Quitchupah Creek drainage, but the stream is ephemeral. In this study (Utah Water Resources, 1977), it was assumed that ungaged tributary inflow was negligible. However, as a point of fact, there would be unallocated water available for storage and irrigation of reclaimed land from this source.

Cropland diversion estimates were obtained from Muddy Creek Commissioner's reports for the period 1961-1963 available to the Muddy Creek Canal. It was assumed that the entire flow of Ivie Creek during the irrigation season was useable. A 35% efficiency was assumed to determine the portion of diversions available to satisfy potential consumptive use.

Note that the gaged outflow is greater than the calculated outflow by 210 acre-feet. This is probably due to the consumptive use estimate.

Lower Muddy Creek Subarea

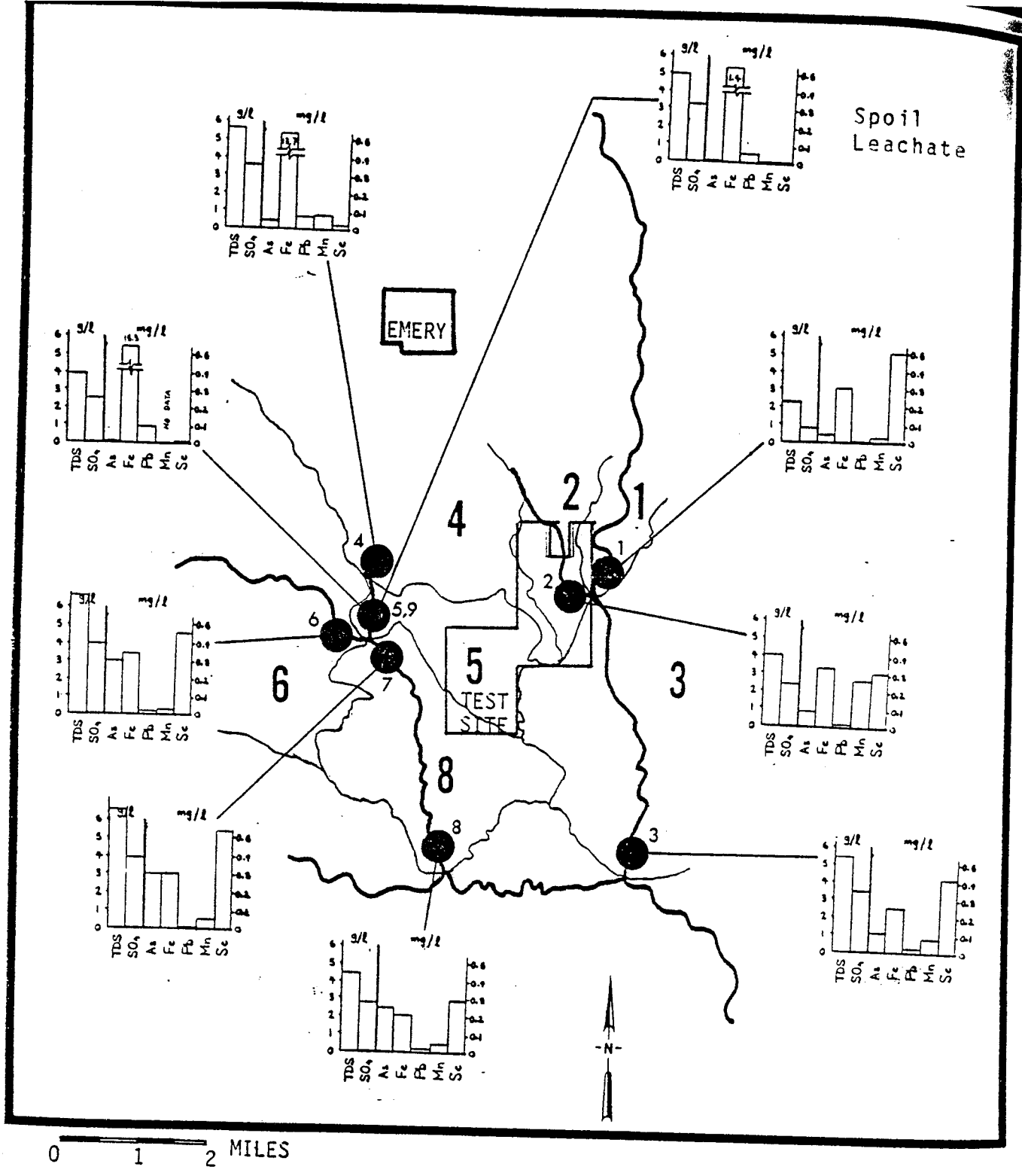
No water budget was prepared for this subarea (944 square miles). There is no gaging station recording surface outflow from the subarea. This would be essentially the receiving sub-basin for mine discharges and should be evaluated.

Water Quality

Water in the Ferron Sandstone, below the I-J coal is apparently better quality than water in the underlying and overlying shales and water in streams (Muddy Creek and tributaries - see section of overburden analysis). Table 29 and Figure 73 show representative water quality analyses from the study area (Lines, 1979). There is not enough information regarding the aquifer characteristics of the Ferron Sandstone and the hydraulic connection between the aquifer and surrounding shales to determine the amount (if any) and quality of water that will leak into the strip mine. An example of solute that will be leached from the stockpiled overburden is given in Figure 73. Comparing the spoil leachate to the stream sample shows no appreciable difference (compare 5 and 9 - see Table 29) for chemical content between the two. Judging from these values (Figure 73) large amounts of soluble salts and sediment may be added to the Muddy Creek drainage if flooding occurs. Vertical fractures evidently serve to provide major significant water transport. The aquatic life in streams though evidently lacking, could be affected by an increased silt load.

Table 29. Surface Water Quality (mg/l) - Lines, 1979

Sample Location	TDS	SO_4	As	Fe	Pb	Mn	Se
1) Muddy above Miller	2210.000	776.000	0.041	0.308	0.003	0.029	0.495
2) Miller	4050.000	2340.000	0.090	0.330	0.010	0.270	0.310
3) Muddy above Ivie	5380.000	3330.000	0.112	0.350	0.017	0.087	0.415
4) Upper Christiansen	3960.000	2520.000	0.002	15.300	0.100	no data	.002
5) Christiansen above Quitch.	5573.077	3592.308	0.040	13.745	0.077	0.082	0.115
6) Upper Quitchup.	6450.000	3960.000	0.294	0.330	0.011	0.019	0.442
7) Quitchupah below Christ.	6350.000	3940.000	0.305	0.307	0.006	0.064	0.528
8) Quitchupah below Ivie	4410.000	2710.000	0.240	0.207	0.014	0.038	0.290
9) Browning Mine	4970.000	3160.000	0.001	1.450	0.050	0.005	0.001



1 – Drainage Sub-Basins

Figure 73. Surface Water Quality and Drainage Sub Basins.

Surface Water Quality Sample Sites

1 Upper Muddy Creek
2 Miller Creek
3 Lower Muddy Creek
4 Upper Christiansen Wash
5 Lower Christiansen Wash
6 Upper Quitchupah Creek
7 Middle Quitchupah Creek
8 Lower Quitchupah Creek
9 Mine Tailings

Figure 74 shows routine sample measurement locations as provided by the Bureau of Land Management. Figure 75 and Table 30 show stream samples pH and suspended sediment collected and analyzed during 1978 by G.S.C. Table 31 gives EPA (1973) reccomended limits for geochemical constituents.

Summary

The study area is drained by Quitchupah Creek, Christiansen Wash, Ivie Creek and Muddy Creek. Many small streams are ephemeral and flow in direct response to precipitation or snowmelt. Snowmelt is a major contributor to streamflow. Snow at these elevations is generally stored through most of the winter and gradually melts during the spring and early summer. Ground water is a major contributor to streamflow, and it provides the continuity of flow (base flow) in the perennial streams, as well as some seasonal flow to intermittent streams. Summer precipitation does not usually produce much runoff. Intense rainfall may cause heavy flooding at times, but the areas affected are usually small, hence total runoff is small. The 100-year 6-hour precipitation ranges from 1.8 inches at lower elevations to 2.5 inches in the mountains (Miller and others, 1973).

The quantity of water applied annually to croplands averages 3.6 acre-feet per acre, and consumptive use on croplands averages 1.6 acre-feet per acre according to reports of the Utah Division of Water Resources (1975, 1976).

Both ground water and surface water are allocated and utilized in Muddy Creek drainage basin. Surface water is used in greatest quantity, about 25,000 acre-feet in the Muddy Creek basin. Coal-fired electric power plants to the north, in operation or under construction, will use about 62,000 acre-feet per year, not all of which is consumed. Ground water is used locally for irrigation, culinary and stock purposes, and public supply. Although the total ground water use is small, it is the principal source of water for the small communities. Water from both wells and springs is utilized.

Long Term Water Supply Flow and Duration

Low flow frequency curves may be used with evapotranspiration data to redetermine storage requirements for relatively short time periods (less than one year); for example, to retain the water from a high spring runoff for use during the summer of that same year as a supplemental source for revegetation. As was shown, stream flow is highly variable

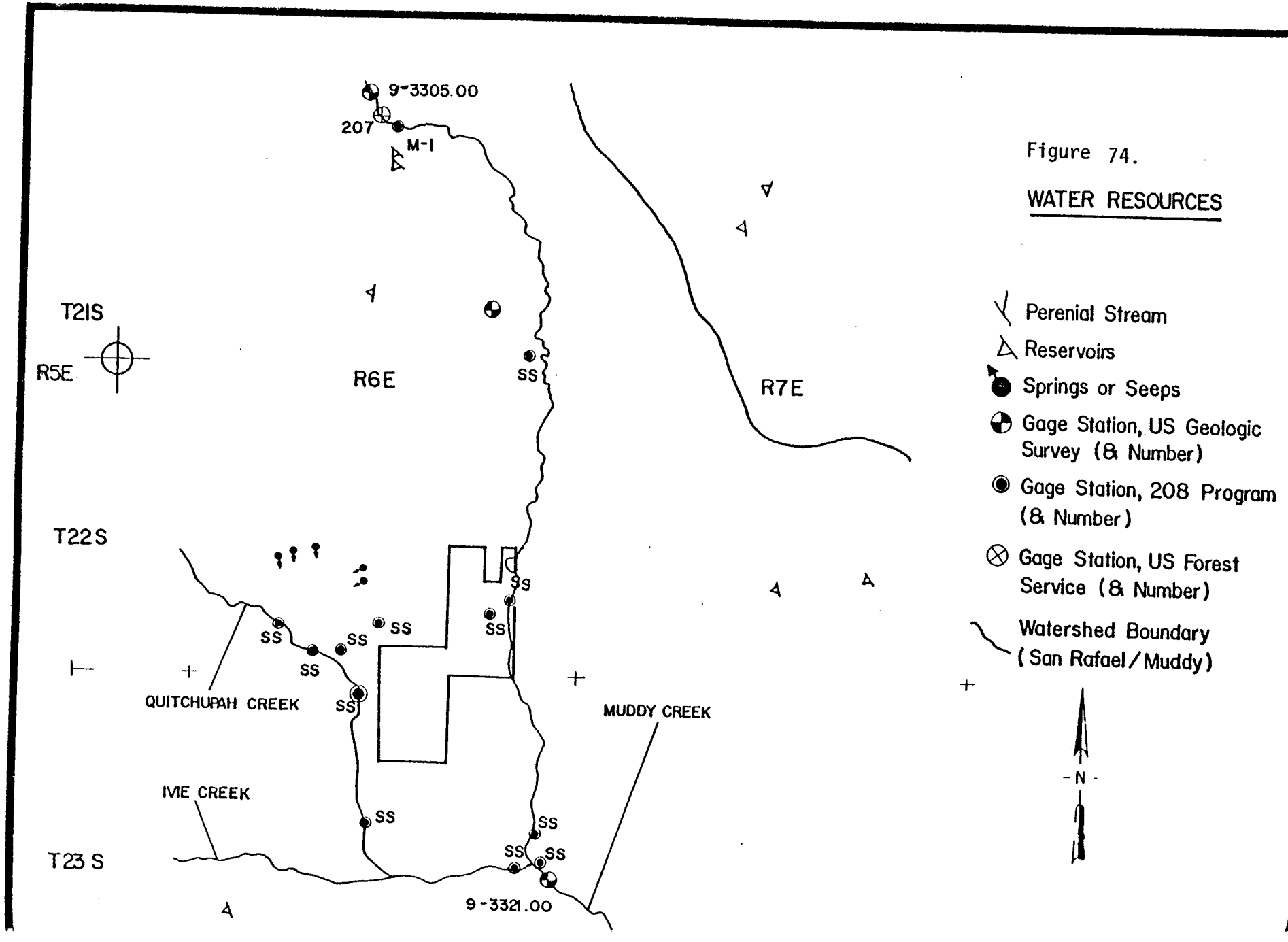


Figure 74.

WATER RESOURCES

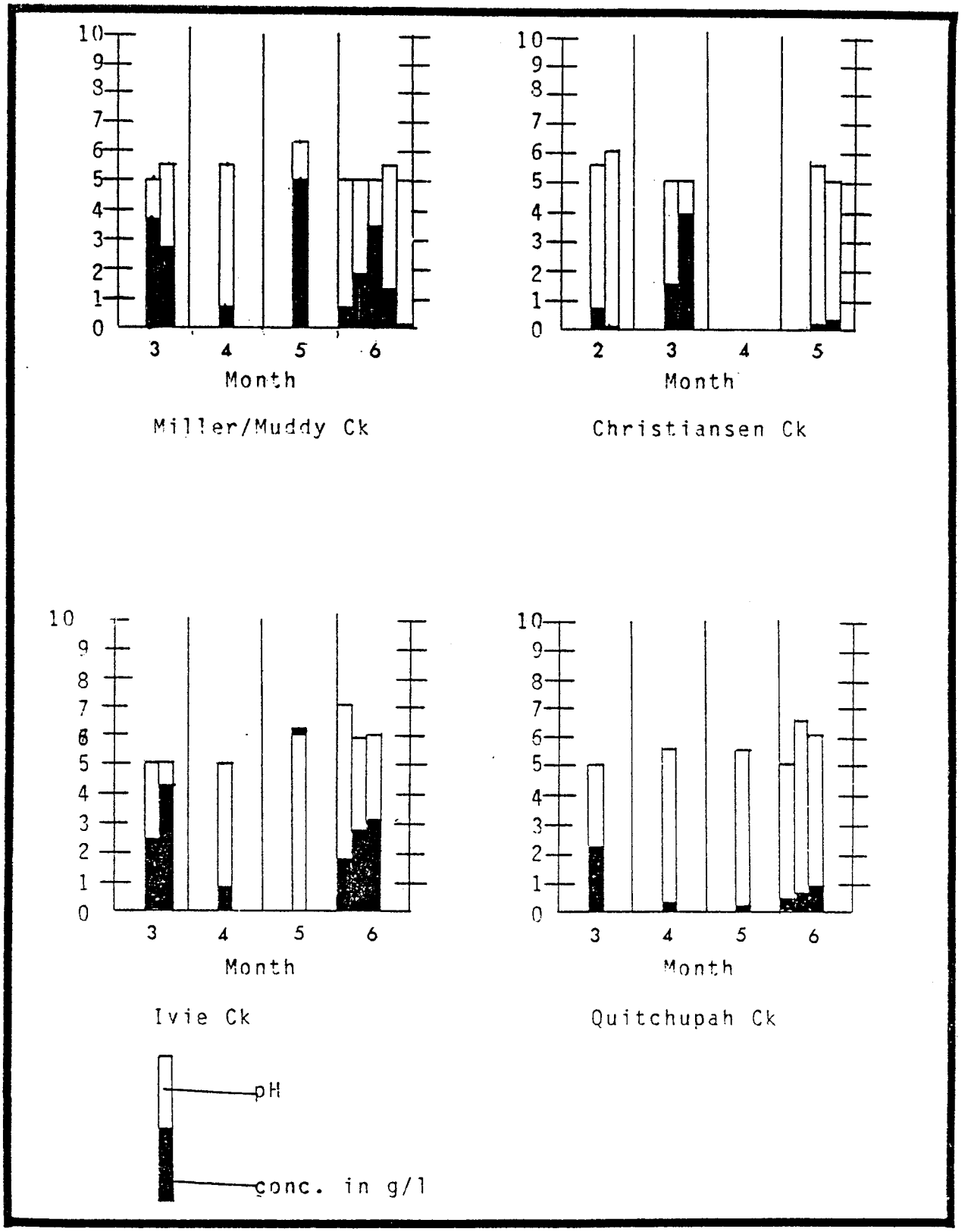


Figure 75. Suspended Sediment and ph From Stream Samples by GSC in 1978.

Sediment Yield and PH for Emery Area Streams - Table 30

Sample #	Date	Stream	Conc. in g/L	ph
1	6/21/78	Miller Cyn Ck	0.19	5.0
2	3/12/78	Muddy Ck	2.60	5.5
3	3/27/78	Muddy Ck	3.91	5.0
4	4/18/78	Muddy Ck	0.81	5.5
5	5/12/78	Muddy Ck	6.38	5.0
6	6/2/78	Muddy Ck	1.37	5.5
7	6/13/78	Muddy Ck	3.48	5.0
8	6/21/78	Lower Muddy Ck	1.70	5.0
9	6/21/78	Upper Muddy Ck	0.66	5.0
10	2/2/78	Christiansen Wash	0.61	5.5
11	2/2/78	Christiansen Wash	0.02	6.0
12	3/12/78	Christiansen Wash	1.51	5.0
13	3/27/78	Christiansen Wash	3.90	5.0
14	5/12/78	Tributary to Christiansen Wash	0.27	5.5
15	5/12/78	Christiansen Wash	3.78	5.0
16	3/12/78	Ivie Ck	2.40	5.0
17	3/27/78	Ivie Ck	4.21	5.0
18	4/18/78	Ivie Ck	0.81	5.0
19	5/12/78	Ivie Ck	6.07	6.0
20	6/2/78	Ivie Ck	1.89	7.0
21	6/13/78	Ivie Ck	2.72	5.8
22	6/26/78	Ivie Ck	3.16	6.0
23	3/12/78	Quitchupah Ck	2.13	5.0
24	4/18/78	Quitchupah Ck	0.29	5.5
25	5/12/78	Quitchupah Ck	0.11	5.5
26	6/2/78	Quitchupah-Consolidate Mine	0.47	5.0
27	6/13/78	Quitchupah - Consolidate Mine	0.65	6.5
28	6/21/78	Quitchupah-Consolidate Mine	0.86	6.0

Table 31. Water Quality Criteria

[Source: EPA, 1973]

Chemical parameter	Public supply limit (mg/L)	Aquatic life threshold (mg/L)
Aluminum	--	0.1
Arsenic	0.1	1.0
Barium	1.0	--
Cadmium	0.01	[1] [3] 0.03
		[1] [4] 0.004
Chloride	250	--
Chromium	0.05	0.05
Cobalt	--	5.0
Copper	1.0	[3] 0.015-0.033
		[4] 0.011-0.018
Cyanide	0.2	--
Flouride	[2] 1.4-2.4	--
Iron (soluble)	0.3	--
Lead	0.05	[1] 0.03
Manganese (soluble)	0.05	--
Mercury	0.002	[1] 0.05
Nickel	--	0.01
Nitrate-Nitrogen	10.0	--
Nitrite-Nitrogen	1.0	--
Selenium	0.01	10.0
Silver	--	0.001
Sulfate	250	--
Zinc	5.0	0.005
Unionized ammonia	--	0.02
Free chlorine	--	0.01

[1] Recommended maximum level.
[2] Dependent upon ambient temperature.
[3] Hard water.
[4] Soft water.

from year to year. It is possible to store excess spring runoff in some years, but not often. (See Table 32).

Table 32. (Jeppson et al., 1968)

Comparison of Storage Requirements From Frequency Mass Curve Analysis at the 95% Probability Level With Mass Curve Analysis.

Station Name and No.	Demand level (percent of mean annual flow)								Runoff April-June (inches)
	110		95		80		65		
	M[a]	F-M[b]	M	F-M	M	F-M	M	F-M	
(9-3305) Muddy Cr. nr. Emery	19	15.0	9.3	8.6	5.5	4.6	2.5	3.0	8.91
(9-3315) Ivie Cr. nr. Emery	2	1.9	1.2	0.9	0.7	0.3	0.3	0.1	0.51

The difficulty is that periods of critically low-flow often extend over several years (five years in the most recent drought) and cannot be predicted with any reliability. It is necessary, in the design as well as the operation of reservoirs for reclamation to use the flow characteristics of streams over more extended periods of time to predict the stream flow that may be stored during periods of high-flow for release during periods of drought. The reservoir capacity must be large enough to maintain the minimum required irrigation water, while holding down construction costs and excessive evaporation losses.

The mass curve method (Jeppson et al., 1968) relates storage requirements and demand levels in a simple way (Figures 76 and 77). The disadvantage of the mass curve approach is that it is difficult to assign a recurrence interval or a probability of occurrence to the storage requirement, as we saw in the climate section.

Note that a combination of two or more moderately dry years in a series may be more serious than the single isolated low year of flow. A mass curve, which is a cumulative plotting of net reservoir inflow over the period of record or portion thereof, permits an inspection of the entire record or any portion of it to be made rapidly. Evapotranspiration and seepage losses from the reservoir in excess of that from the natural watersheds covered by the reservoir waters must be added to the amount indicated in Figure 76 to get actual storage requirements.

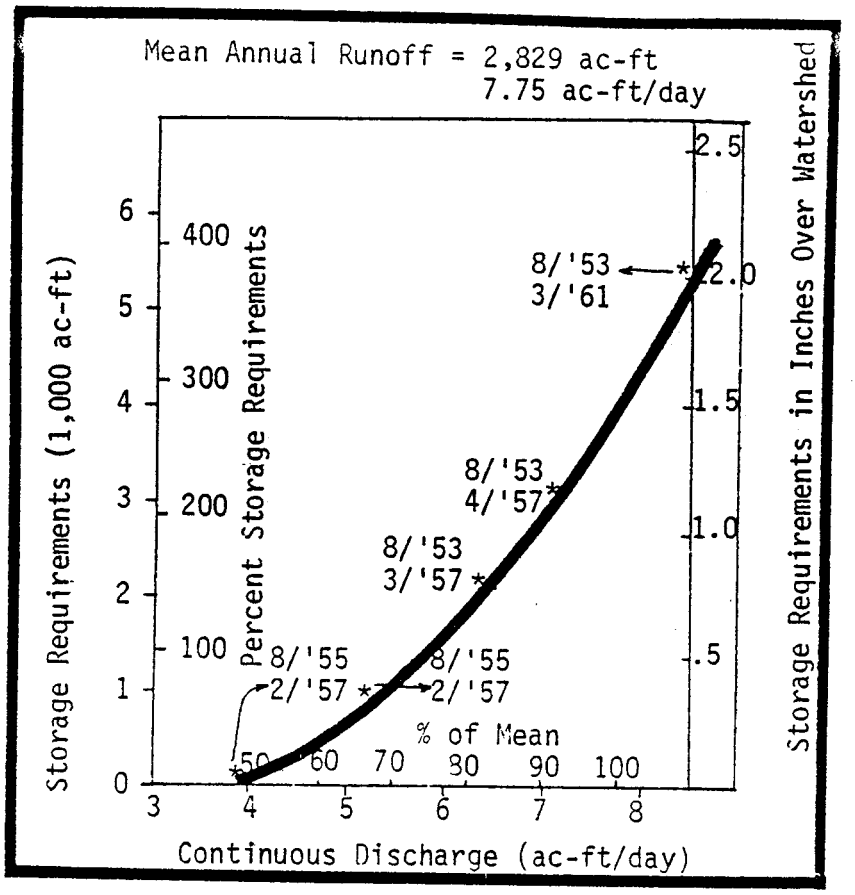


Figure 76. Mass Flow

Muddy Creek

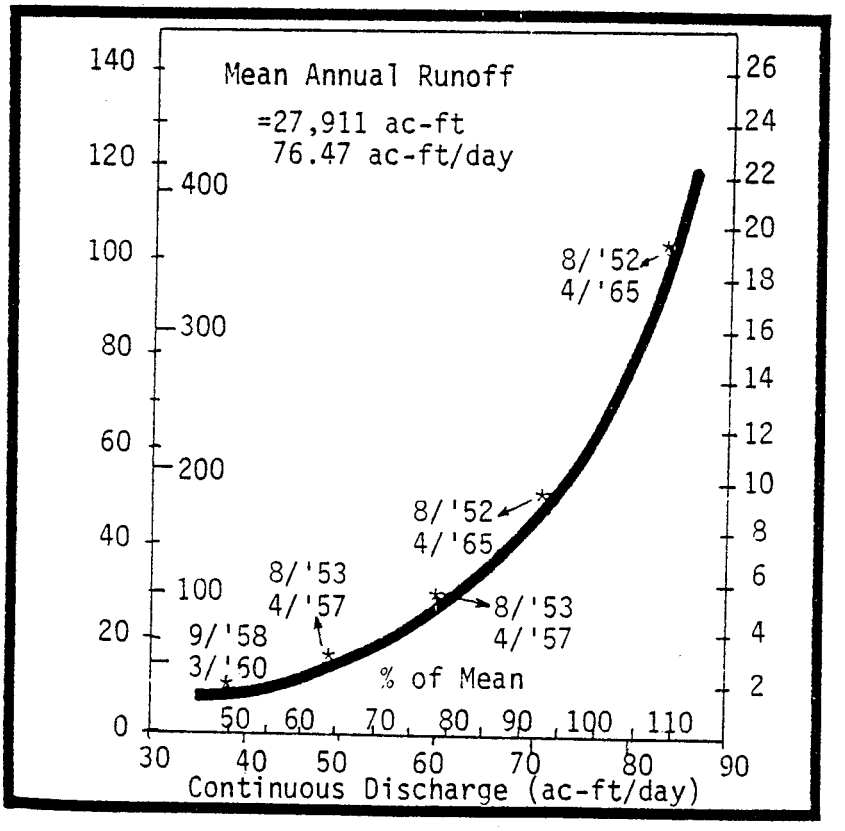
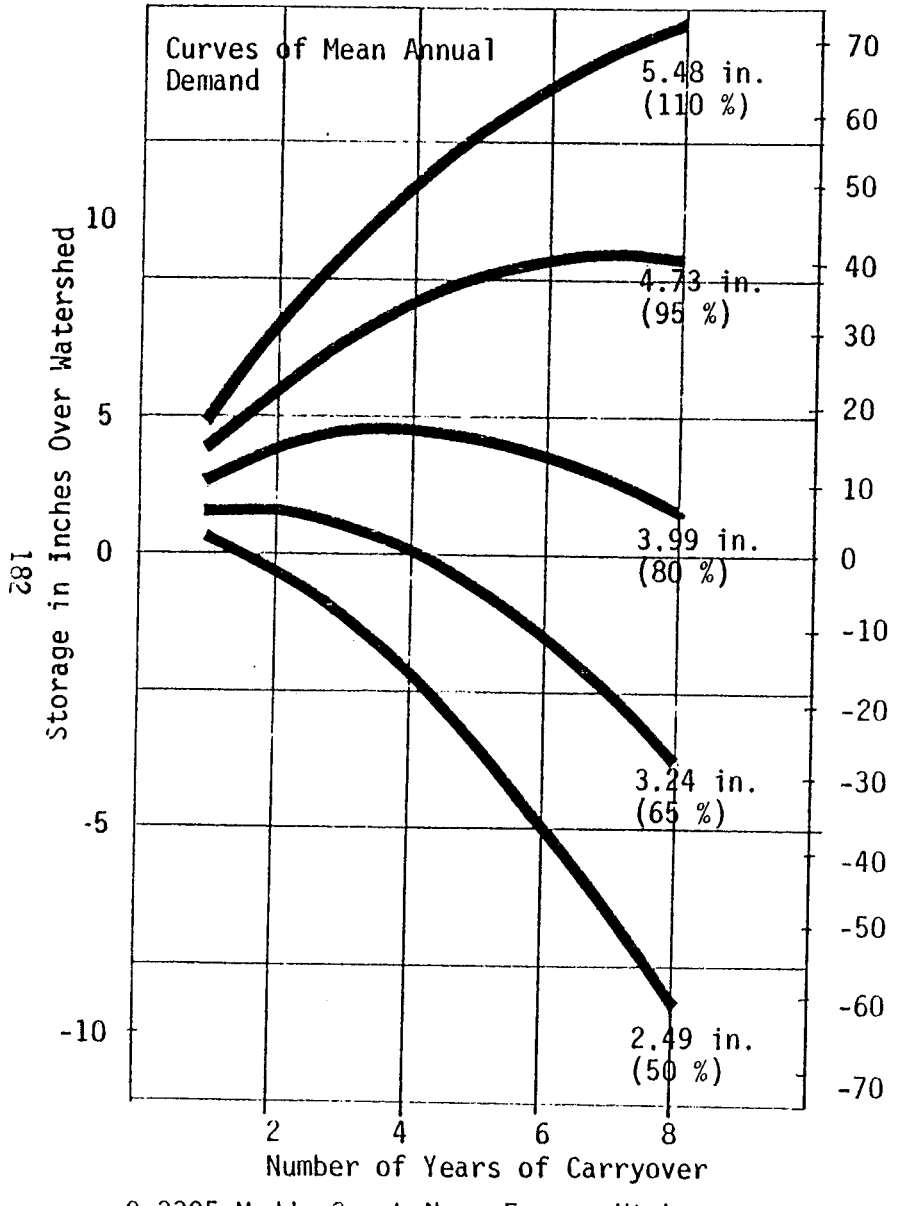


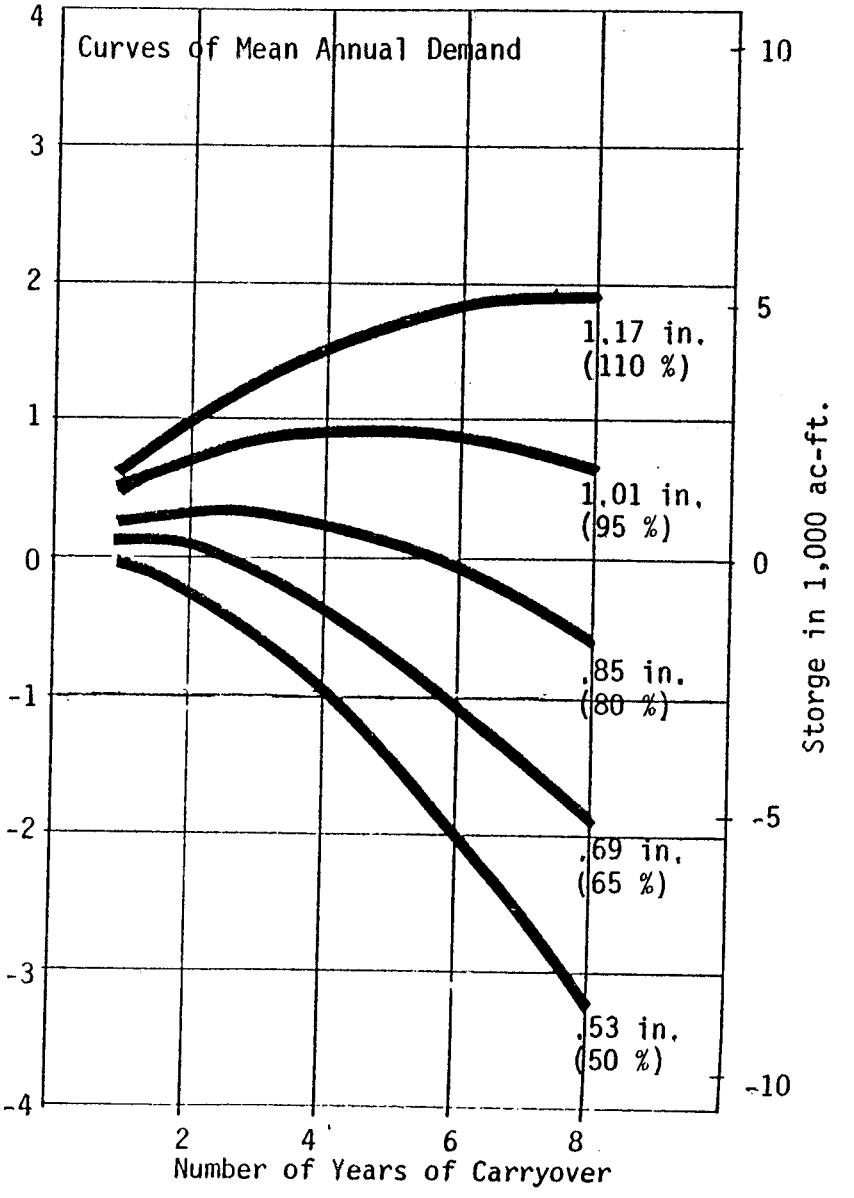
Figure 77. Mass Flow

Ivie Creek

Figure 78. Storage Requirements Related to Demand Level and Period of Carry Over as Obtained by Frequency Mass Analyses at the 95 Percent Probability of Occurence.



9-3305 Muddy Creek Near Emery, Utah
(95% Probability Level or 17.3 Year Recurrence Interval)



9-3315 Ivie Creek Above Diversions Near Emery, Utah
(95% Probability Level or 10.1 Year Recurrence Interval)

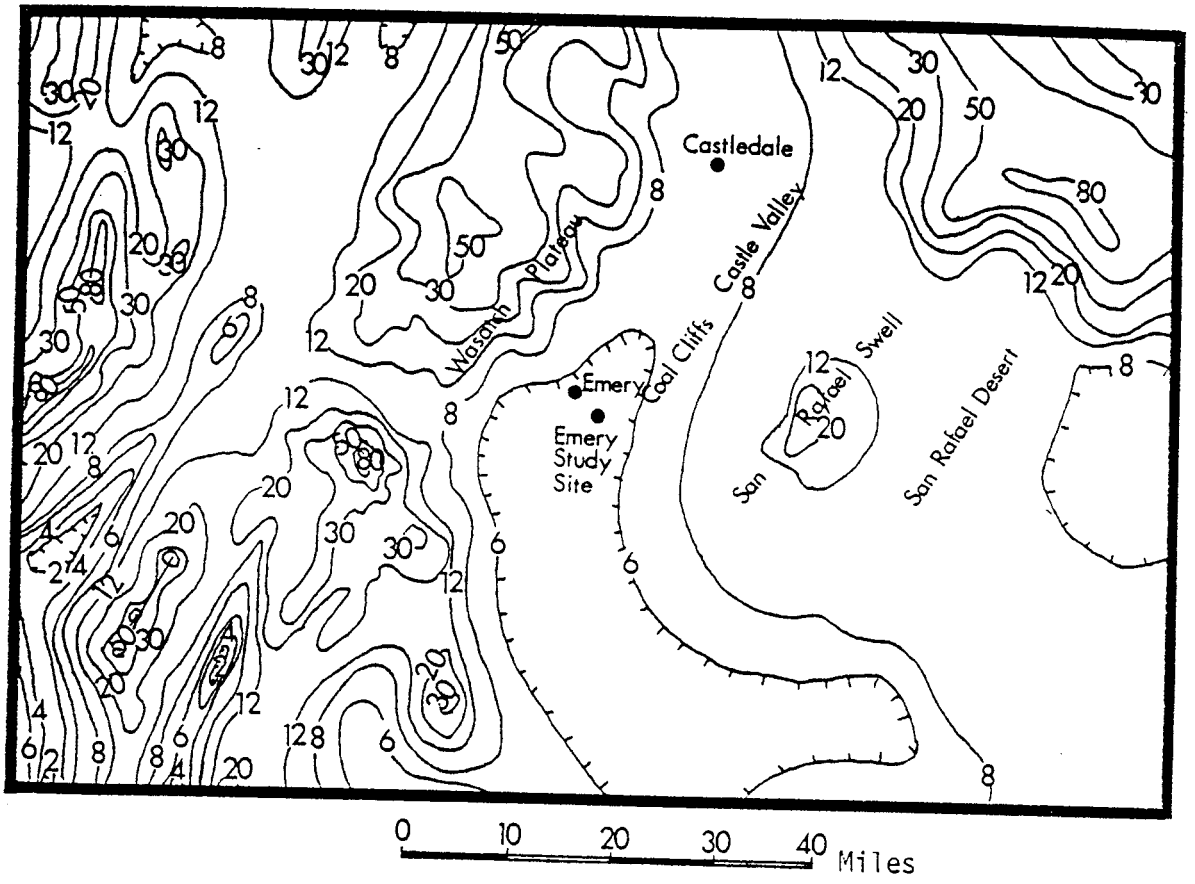


Figure 79. Flood Flows at 50 Year Recurrence Interval.

To the extent that the past is an indication of the future, Figure 78 (Jeppson et al., 1968) indicates what average high- and low-flows might be expected for any specified number of consecutive days at any desired probability level, or recurrence interval, by use of the frequency analysis method.

Flooding

Plotting the peak observed flows against drainage area for all watersheds in a given region defines an upper boundary for flows that may reasonably be expected. This upper limit, or envelope curve, is often used synonymously with the maximum probable flood. Figure 72 is a plot of peak discharges in Utah. The equation fitting the envelope curve defined by Figure 72 is:

$$Q_p = 3140A^{0.435}$$

where Q_p is the momentary peak discharge in cfs and A is the drainage area of the watershed in square miles.

The 50-year flood may be determined directly from Figure 79 by a method analagous to determining mean elevation from a topographic map. After the 50-year flood has been obtained for the selected area, flow rates for other return periods may be calculated by multiplying the Q_{50} value by the ratio obtained from the Q/Q_{50} versus T curves for the proper hydrologic area.

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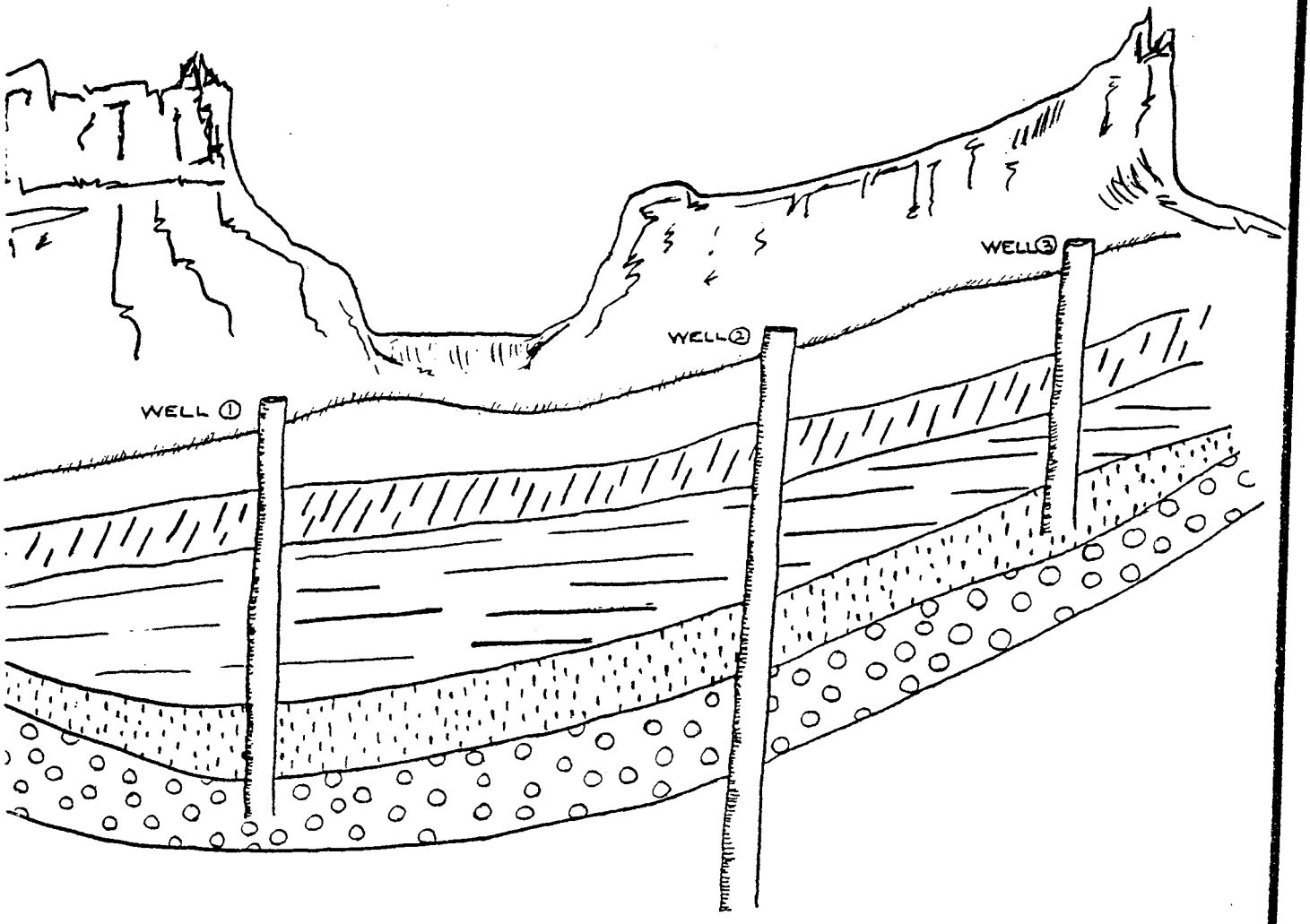

GROUNDWATER HYDROLOGY

Within the study area, there is evidence for shallow perched aquifers only within the surface regolith. The locales of these shallow aquifers are alluvium and colluvium in the main valleys and mountain fronts, or deeply weathered sandstone or deeply weathered zones on the mesa uplands. Perennial springs draining into Quitchupah Creek flow from the alluvium and are recharged from the northwest. Potential seasonal intermittent springs may flow into Quitchupah Creek from the east, fed from surface aquifers in deeply weathered zones in the upper Ferron Sandstone member or possibly perched above the coal beds. However, no such flow was evident during the study period. Recharge is evidently only via local snowmelt and to a lesser extent, precipitation, because of stream capture of the upland cachement areas. No significant springs should occur on the reverse slope of the mesa draining into Muddy Creek due to unfavorable dip angles of the exposed beds. Marginal infiltration and significant impermeability of the unweathered siltstone caprock layers evidently prevents recharge of deeper sandstone layers despite their greater permeability.

The Blue Gate Shale; or in the weathered sandstone, the first siltstone layer appears to be the confining layer above the Ferron Sandstone aquifer. This aquifer is used by the city of Emery and local stockmen for water supplies. Blasting and removal of the Blue Gate north of the study area may cause upward leakage from the Ferron into the mined area along vertical joints. If in quantity, water may leach the Blue Gate along the walls of the mine. Head differences between water in the Ferron Sandstone and water in the confining shales of the Blue Gate may also change. If this occurs over a long period of time, and if connected, a large amount of water removed from the mine could come from the lower confining layers. If significant dewatering of the Ferron in the mine area occurs, upward leakage into the Ferron from permeable units within the Mancos shale below the aquifer could be induced. Although the piezometric map does not support this view, water quality in the Ferron Sandstone and the quality of the water pumped from the strip mine may alter accordingly. The mine water may be impounded and infiltrate or be pumped into streams on the Muddy Creek drainage. Dewatering of the coal might close existing wells and springs on the plateau, reduce the base flow of streams, and alter ality of water in the deeper Ferron Sandstone aquifer to a lesser extent (see Figure 80).

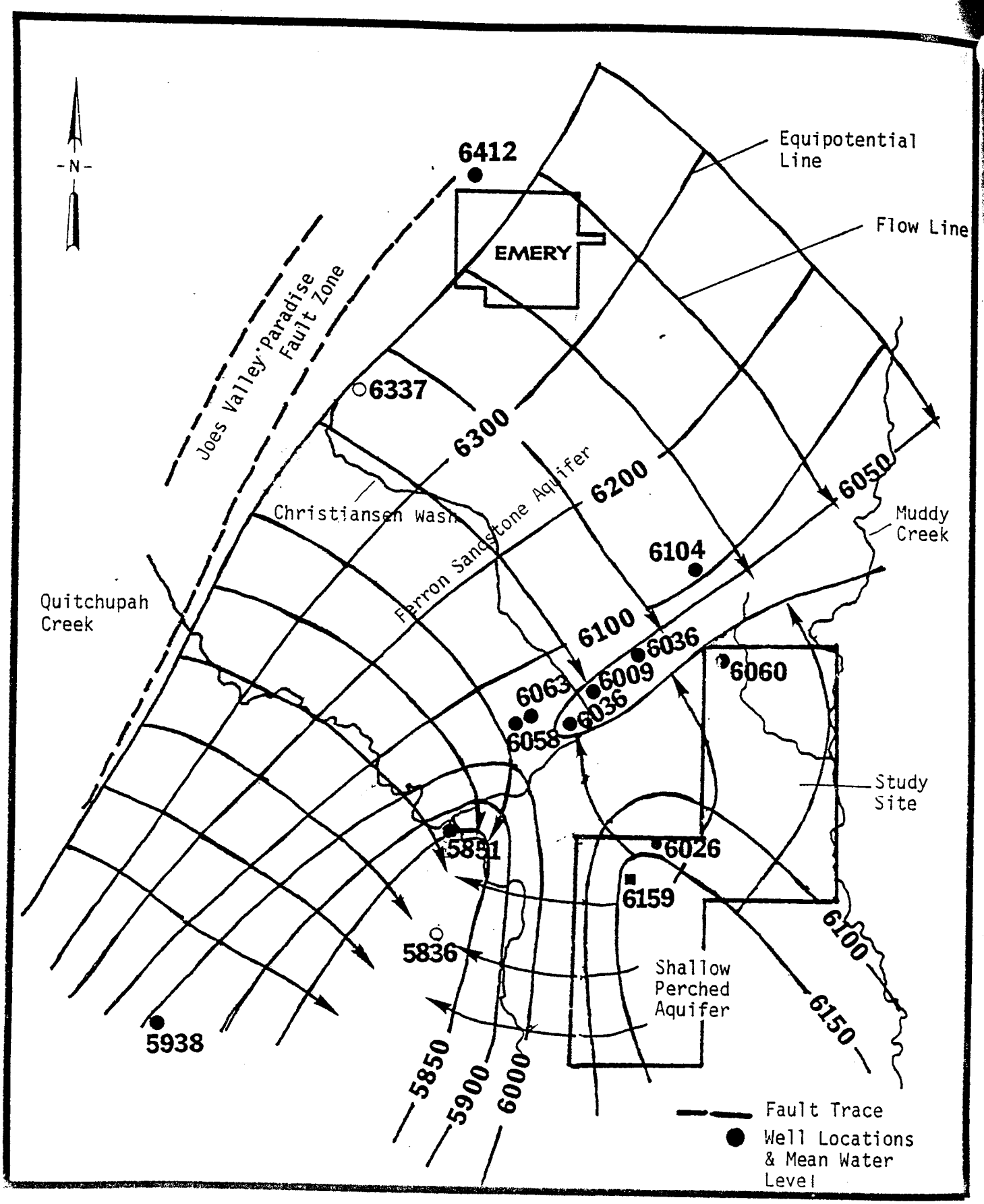

Figure 80. Potentiometric Map Flow Net and Observation Wells for the Emery Site.

Aquifers

Two significant aquifer types are found on or adjacent to the study area (Figure 81). The first is a shallow aquifer, formed by the Quaternary alluvium river terrace deposits and deeply weathered sandstones. These cap the Blue Gate Shale and siltstone units of the Ferron Sandstone. The second aquifer of major significance to the town of Emery is a confined aquifer formed by the Ferron Sandstone member. Deeper aquifers may exist in the marine sandstone but these would not primarily be involved in strip mining considerations. An exception would be in the vicinity of significant vertical joints which would permit upward or downward ground water migration.

Unconfined Aquifer

The boundaries of the minor unconfined aquifers are indicated in Figure 81 as the limits of the Quaternary deposits and small scale perched aquifers present in wet years above and perhaps within the coal in the study area. Recharge to these aquifers is sustained either by local snowmelt or irrigation returns as noted above.

Numerous reported springs at the contact of the Quaternary deposits and the Blue Gate Shale and Ferron Sandstone members were not found to be flowing throughout the period (1977-1978) of our field study. Due to the rolling topography of the Blue Gate Shale, prior water flows from some of these springs or seeps have created alkalic evaporites in swales. Elsewhere, spring waters may enter Quitchupah Creek, Christiansen Wash, Muddy Creek, and Miller Canyon during wet years. The location of recorded springs would imply that the general direction of ground water flow is to the south and east. However, our potentiometric map, derived from USGS well level data (Lines - USGS - 1979), would imply a more complex movement. We are evidently looking at a superposition of ground water movements. The flow off the surface to the SE is evidently from the shallow perched aquifer described above the site itself. Due to their salinity these waters are now usable only for stock watering.

Ferron Aquifer

The Ferron sandstone aquifer is confined above by the Blue Gate Shale of impermeable siltstones where the Blue Gate is absent. It is confined below by the Tununk shale.

Ground water levels measured by the USGS in the EMRIA wells and in the Emery municipal well, Kemmerer Coal Company well, and other moni-

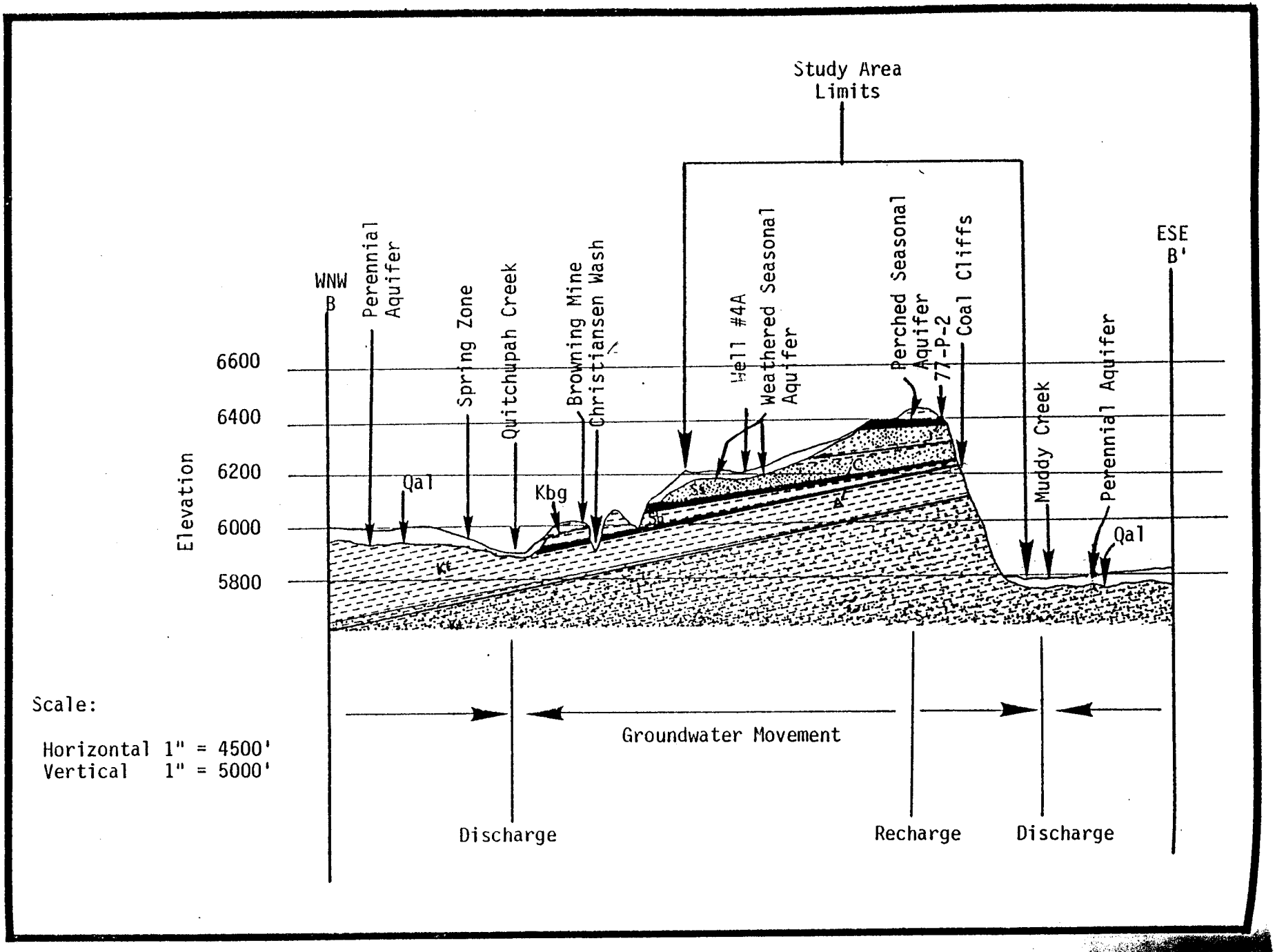

Figure 81. Study Area Aquifers.

toring wells (Figure 80) imply that the potentiometric surface is above the land surface within the study area which would indicate an artesian condition in this area.

Static water levels varied during the monitoring period, requiring some adjustments to fit potentiometric surfaces. The flow net in Figure was constructed from the static water level data by drawing flow lines perpendicular to the potentiometric surface lines (or equipotential lines). The arrows indicate the direction of flow. Elsewhere, the ground water is evidently draining into Christiansen Wash, Quitchupah Creek (where the Ferron sandstone outcrops), Miller Creek and into Muddy Creek during wet years. The flow net implies that the ground water in the aquifer flows up-dip and perpendicular to the Joe's Valley-Paradise fault zone from the west-northwest, until reaching the Christiansen Wash-Quitchupah Creek drainage, where spring discharge occurs (Spring Zone of Figure 81). This aquifer then continues under the study site. This suggests that modest recharge to the aquifer occurs from the study area plateau through open vertical jointing fractures.

The average hydraulic conductivity (K) of the coal and upper sandstone producing zone of the aquifer has been estimated from mine data to be 1.743 ft/day. This value is typical of a medium-grained sandstone. This estimate was based on the assumption that the producing zone is approximately isotrophic (i.e. properties are independent of direction). Secondly, the producing zone was assumed homogeneous or uniform. A 100 foot producing zone, with four flow channels and an 800 foot potential drop was assumed to reach this estimate, together with a mine inflow of about 70,000 cubic ft./day.

The average velocity of ground water flow can then be computed by a form of Darcy's law:

$$V = K \frac{dh/dl}{\theta} = 10 \text{ feet/day}$$

where dh/dl is the hydraulic gradient and θ is the porosity, using an average gradient of 80 ft./mile from Figure 81 and assuming a θ of .25 for a typical medium grained sandstone.

The approximate transmissivity (T) of the producing zone can thus be estimated as 174 ft^2/day; the product of the estimated average hydraulic

conductivity (1.74 ft/day) and the saturated thickness of the producing zone (100 ft.). The storage coefficient of the confined producing zone may be of the order of magnitude of 10^{-5}. This analysis would imply a relatively low rate of transmission for contaminants by this route. Transport along vertical fractures would of course by much more rapid. The value for K given above may also be too low, but no other is available now.

A general ground water availability map, to be published by the USGS (Sumption, 1979), shows that well yields from the Ferron aquifer will be less than ten (10) gallons per minute (GPM). This is perhaps consistent with the above calculations. However, wells which intersect major fractures, particularly near the Joe's Valley-Paradise fault zone, may yield as much as a few hundred gallons per minute. The Emery municipal well and the Kemmerer Coal Company well, which are both artesian, are two good examples. On September 10, 1975, the USGS Water Resources Division measured a flow of 375 gpm from the Emery municipal well without pumping; and, on May 3, 1973, Layne Western Company measured a flow of 343 gpm while pumping from the Kemmerer Coal Company well. It is doubtful that such high flows will be encountered in the study area.

Summary of the Effects of Strip Mining of Ground Water Hydrology

Potential Effects on Surface and Subsurface Water Supplies

The crux of the hydrology problem at the Emery site is whether the coal and superadjacent sandstone layers do in fact form a significant aquifer which if tapped or drained could produce problems for the Emery municipal water supply. This view is evidently a concern at this time for some workers within the USGS.

We however, do not agree with this view. From our evaluation of the drilling logs and related data, we doubt the present existence of more than a shallow (40-50 ft) perched aquifer above the strippable coal, which is sealed off from deeper penetration by a relatively impermeable siltstone layer at its base (see Figure 82). It is doubted that the coal on the study site now contributes significantly to the local ground water. The following points are offered in support of this viewpoint:

1. Water Loss During Drilling

   To set the stage for the analyses, we should recall that in every case (holes 3 thru 6) excessive water losses occurred (e.g.

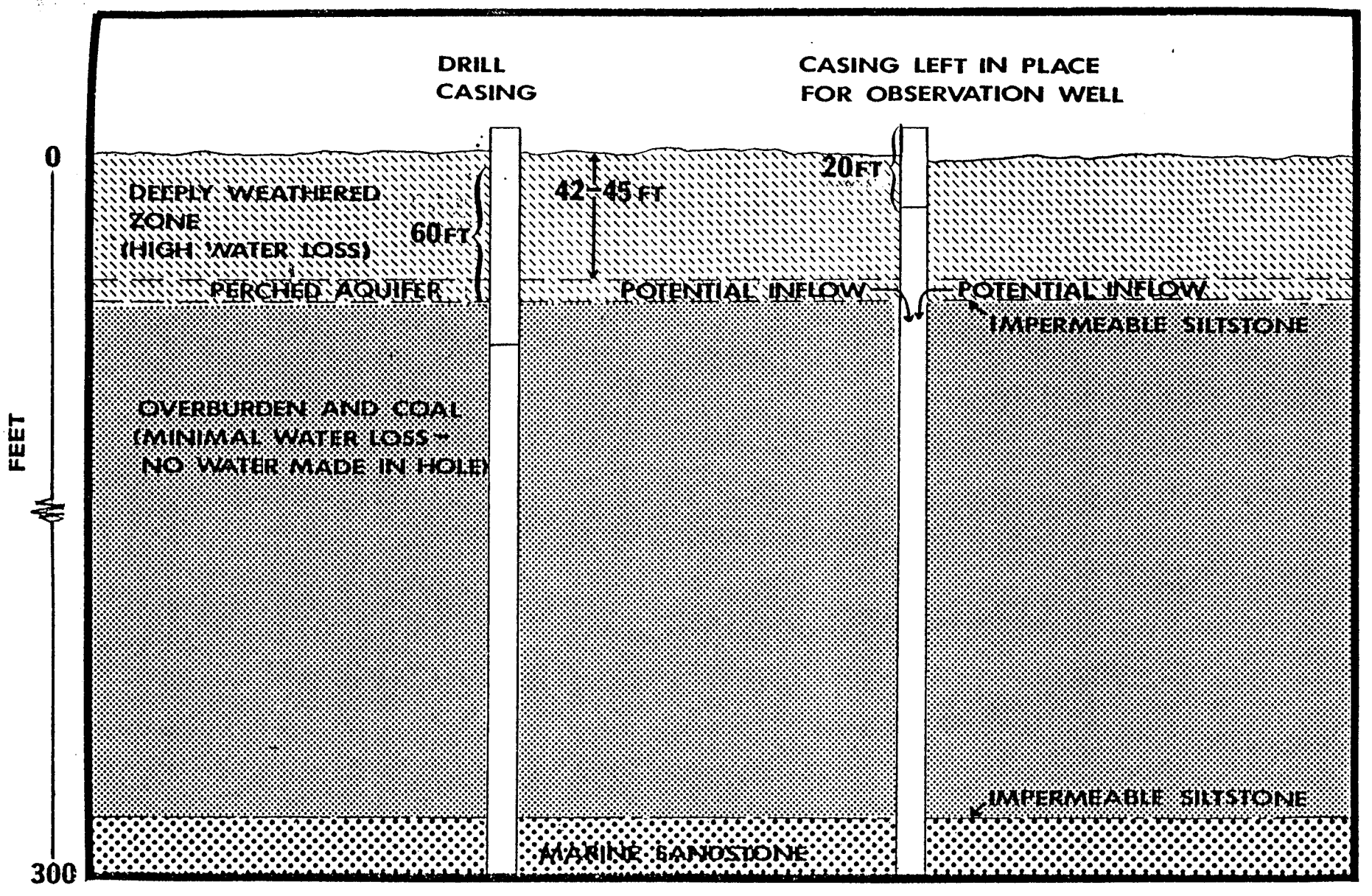

Figure 82. Interpetation of Drilling Data on Observation Well Hydrology.

refer to Figure 83 for outcrop permeability ranges). Although we at first thought that this was due to the inopportune interception of open vertical jointing fractures, we later questioned this interpretation as this situation repeated itself on later holes. Moreover, as we bypassed this deeply weathered zone, the hole would generally seal. To us, this implies a very low permeability for the unweathered section (Figure 82). Unfortunately no lab permeability data from sampled cores are available from the USGS at this time, to confirm or deny such an interpretation. In any case what we are concerned with is the impermeability of the siltstone caprock over the site which appears to deny recharge, except possibly at the site of vertical jointing fractures.

2. Seepage from Coal Outcrops

Coal outcrops and the Cowboy and Miller Canyon Mines were inspected for seepage in the spring of 1978. Despite the fact that higher than average precipitation had been recorded, (in particular snowfall, which is most efficient at infiltration) no evidence of seepage from coal beds or reported springs was found. If indeed the coal beds are a significant aquifer, this is inexplicable.

3. Conditions of Recovered Coal

As viewed in the field when retrieved from the core barrel the coal was competent, and unchecked (in the initial 1977-78) drilling program. Neither its physical appearance or the analyzed moisture contents support the concept of a saturated coal layer.

4. Methane Gas

Methane gas was noted in some but not all of the drill holes. Two possible coal oxidation processes for the evolution of methane gas (CH_4) are given below:

1) $\underbrace{2C \cdot 2H_2O}_{\text{(Saturated Coal)}} \longrightarrow CO_2 + CH_4$

2) $\text{Coal} + O_2 \longrightarrow \underbrace{\text{Clinker}}_{\text{(Oxidized Coal)}} + CH_4$

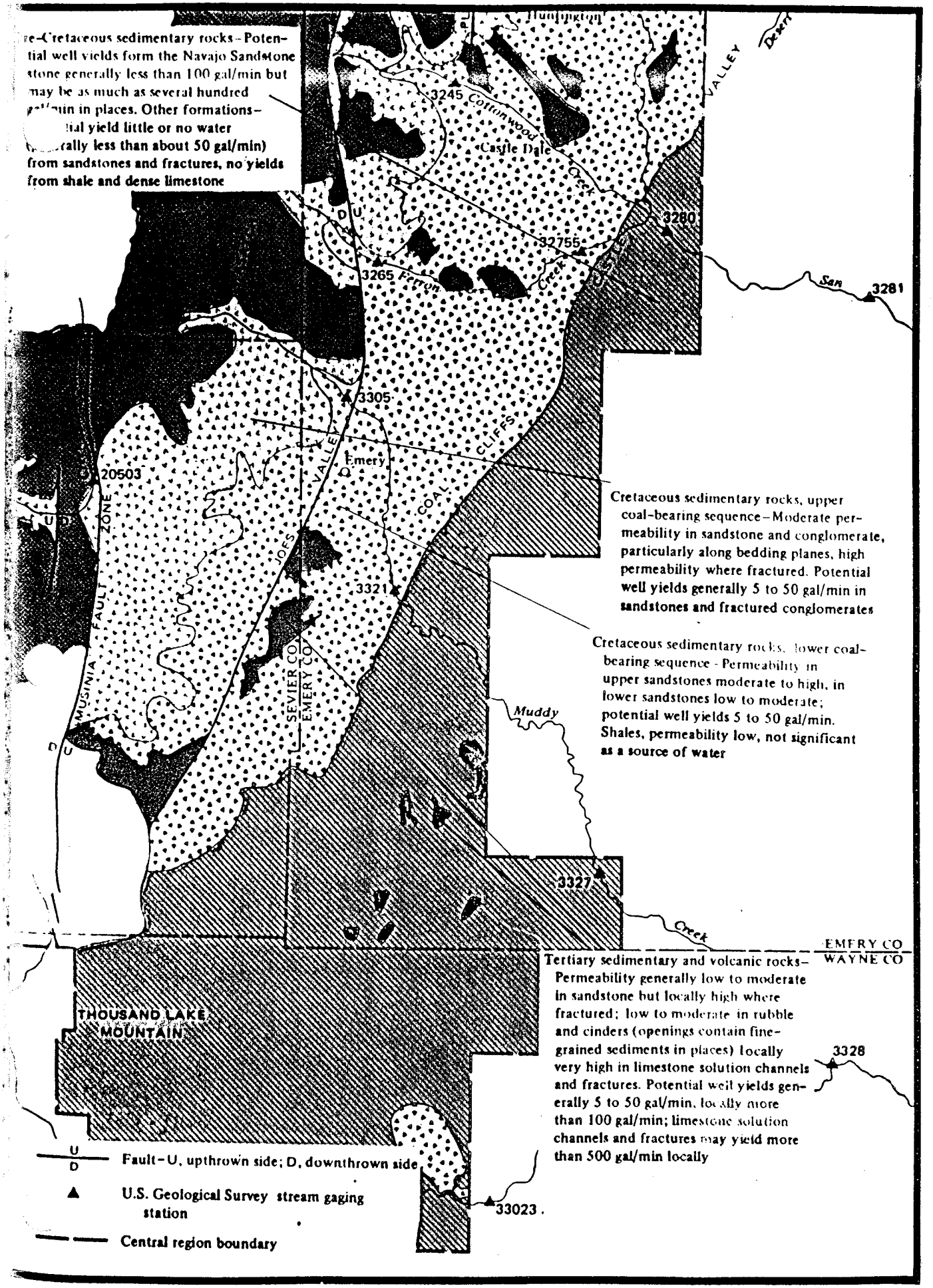

Figure 83. Surface Permeability

If the coal beds were universally saturated, we would expect the general presence of methane gas. Instead we find that substantial gas was found only adjacent to or up-dip from the continuing coal burn zones. We thus conclude that the gas noted is due to underground coal fires (Process 2).

Finally we are left with the conclusion that due to the hydrologic isolation of the study site coal beds from the deeper Ferron Sandstone aquifer, no serious threat is posed to the proposed strip mining activities. Further, based on the slow ground water movement rates given by our estimates from the best available data, contaminates if introduced into this aquifer would not readily affect the "downslope" existing uses if indeed sufficient vertical fractures for such seepage were present, and if indeed the artesian "head" of the Lower Ferron Sandstone aquifer is lost as it becomes exposed in Quitchupah wash.

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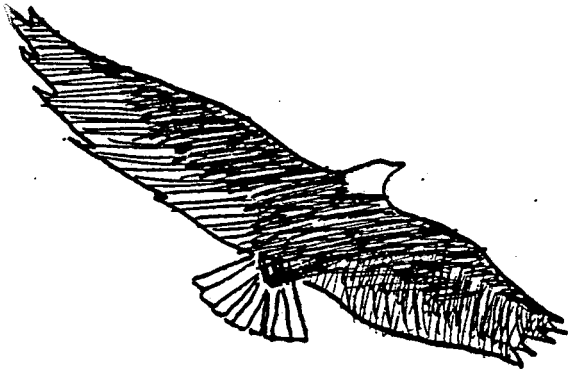
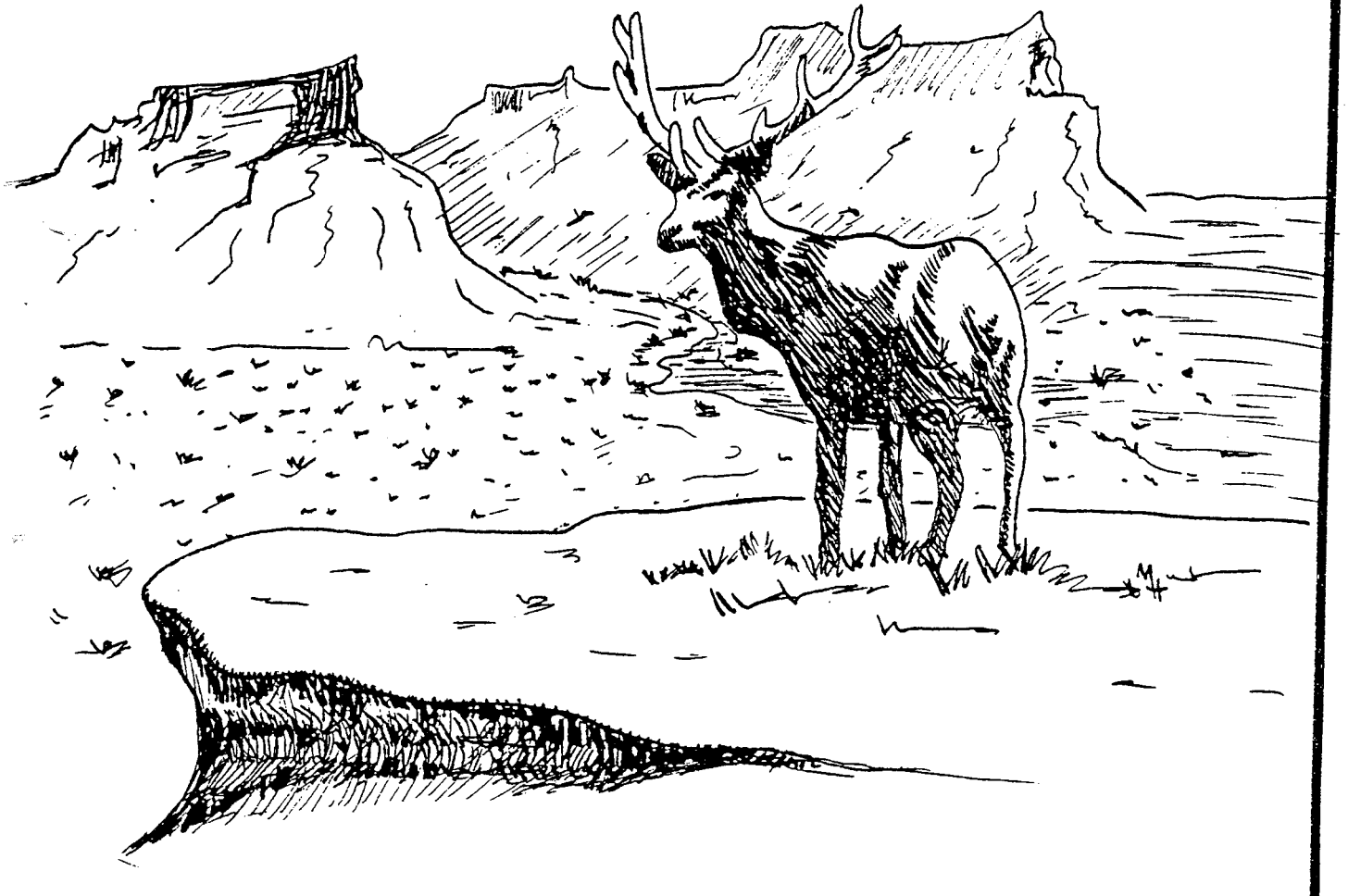
WILDLIFE





Present and Potential Wildlife

Recent applicable quantitative data for the study area and the surrounding environment are scanty. The general visual counts and some correlation to existing data were used to form opinions and/or conclusions about potential wildlife use and effects of surface mining on the wildlife that either does or may exist in the area.

Biotic communities and habitat types within the area are somewhat diversified. They vary from juniper and shrub covered mountains to riparian vegetated areas along the Ivie and Muddy Creeks and the Christiansen Wash. The present dominant biotic community throughout the district is semi-arid saline desert. In spite of this generally dry nature of both the study location and the general area, topographic variation in plant growth limit wildlife populations to the numbers that can survive under minimal conditions from year to year.

Our field trips (1978-1979) have evidenced remarkably few sightings or sign of wildlife with the exception of a few scattered rabbit droppings. The revegetation sites, left unfenced most of the summer, show little evidence of any disturbance by rodents or any other wildlife. Grazing appears to be the largest single prior use of lands within the study area as well as in the surrounding areas. Overgrazing and drought seem to have been a problem in the past from which recovery is incomplete. Selected birds sighted in the area include: Western Tanager, Dark-eyed Junco, Starling, Black-billed Magpie, Screech Owl, Red-tailed Hawk, Turkey Vulture, Ring-necked Pheasant, Chukar, Great Blue Heron, and Snowy Egret.

Regional Perspectives

Even though little wildlife sign was found within the study area (Figure 84), some wildlife species could be impacted in the large potentially strippable resource area. In this sense, the study area may not be representative of the strippable area as a whole, since it appears to have a relatively lower wildlife density.

Two species could be greatly affected by strip mining activities in the wider region. Winter habitat of the bald eagle (Figure 85), an endangered species, is found in riparian areas within the Coal Cliffs region. In addition, a poriton of Muddy Creek is considered crucial winter range for elk and deer. Any mining activities in these areas could adversely affect the eagles, deer, or elk using them (BLM-San Rafael Planning Unit-Draft Report: Wildlife).

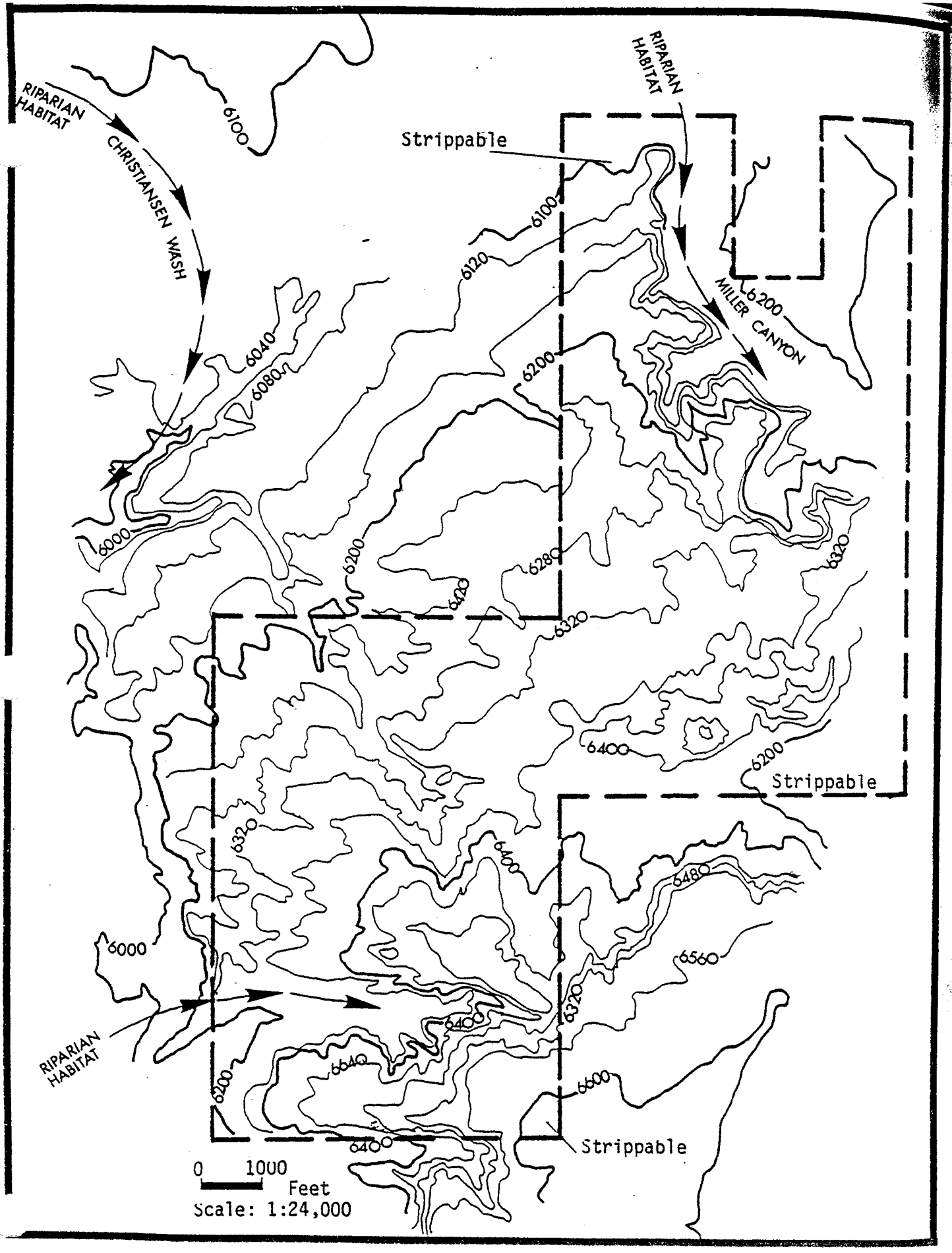
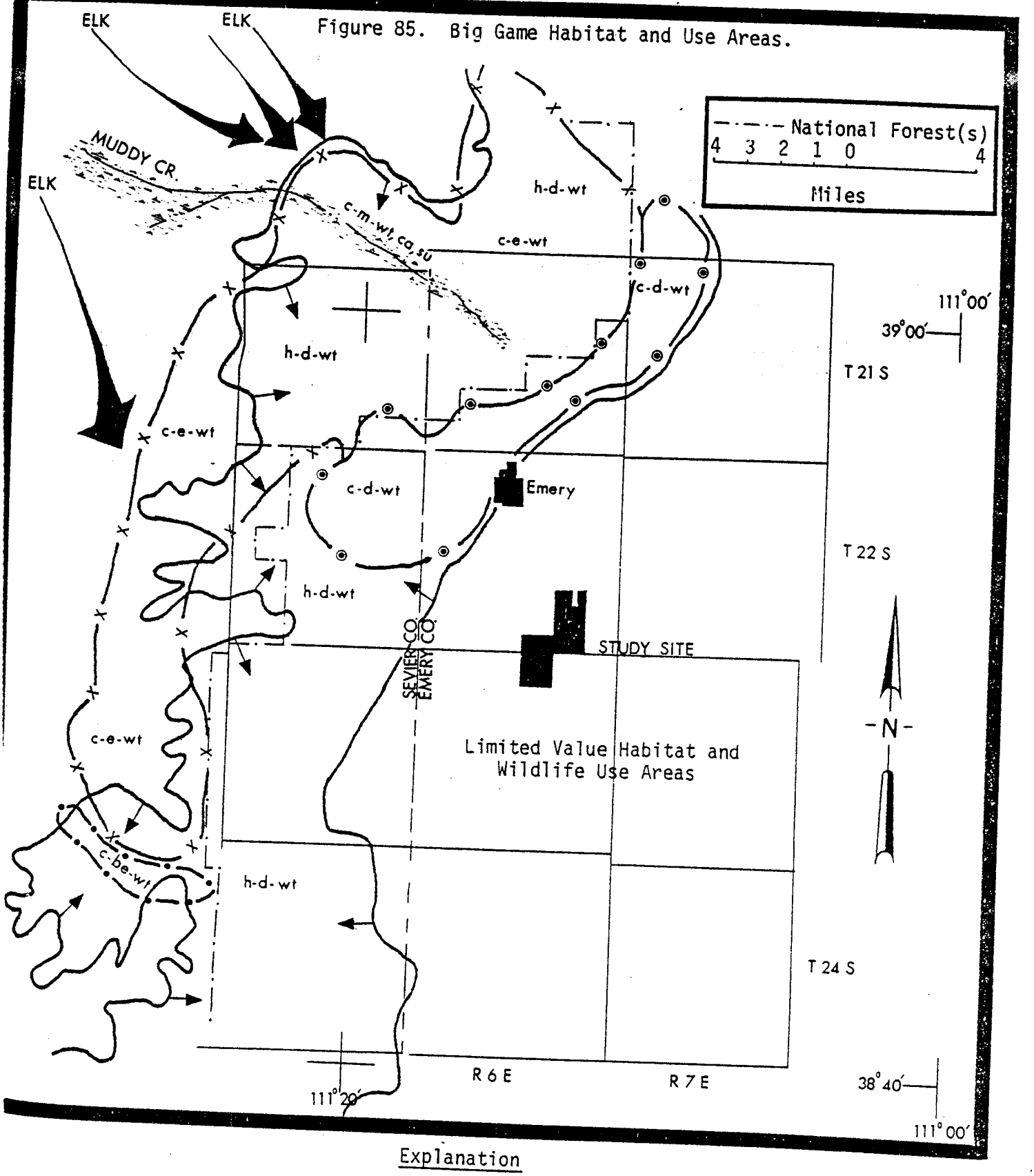


Figure 84. Key Wildlife Habitats on the Study Site.

Figure 85. Big Game Habitat and Use Areas.



Explanation

c-d-wt = crucial-critical winter range for deer.

h-d-wt = high priority winter range for deer. (Arrows indicate direction of migration)

c-e-wt = crucial-critical winter range for elk.

c-be-wt = crucial-critical winter range for the bald eagle.

c-m-wt,ca,su = crucial-critical winter range, calving area, and summer range for moose.

(Riparian habitat)

Other species known to use the Muddy Creek include beaver, chukar and several species of waterfowl. Although greatly declined in numbers from prior years, beaver is the most valuable furbearer in Utah and Muddy Creek has one of the largest populations of beavers in the area. Some beaver habitat has already been lost in this area. The chukar is found throughout the area, but one of the highest concentrations is along the Muddy Creek near Moore.

The desert cottontail is common in the open plains, foothills, and low valleys. Any removal of vegetation from these areas would adversely affect this species.

Other small mammals as well as several species of birds are found (Figure 86), but impact on these species is considered low since they are not common on the area designated as strippable (Figure 84). In addition mining of the strippable area is not expected to have any major regional wildlife impact due primarily to evident low density of species in the potentially mineable area.

A classification system has been developed (Dalton et al., 1977) for use areas and habitats for wildlife in the area around Emery. The system was developed to promote an awareness of wildlife needs in the face of man's increasing activity and development on wildlands. The use area types were defined using the following criteria:

1) The classification by Utah Division of Wildlife Resource of Utah's fishing waters; and the importance of use areas to terrestrial wildlife species of high interest.
2) Status of endangered species.
3) Status of threatened species.
4) Potential for reclamation and restoration of habitats and use areas; and the availability of acceptable mitigation for damage or loss to habitats, use areas and/or individual wildlife.

The resulting four classifications were:

1) Crucial-Critical wildlife use areas.
2) High-Priority wildlife use areas.
3) Substantial Value wildlife use areas.
4) Limited Value wildlife use areas.

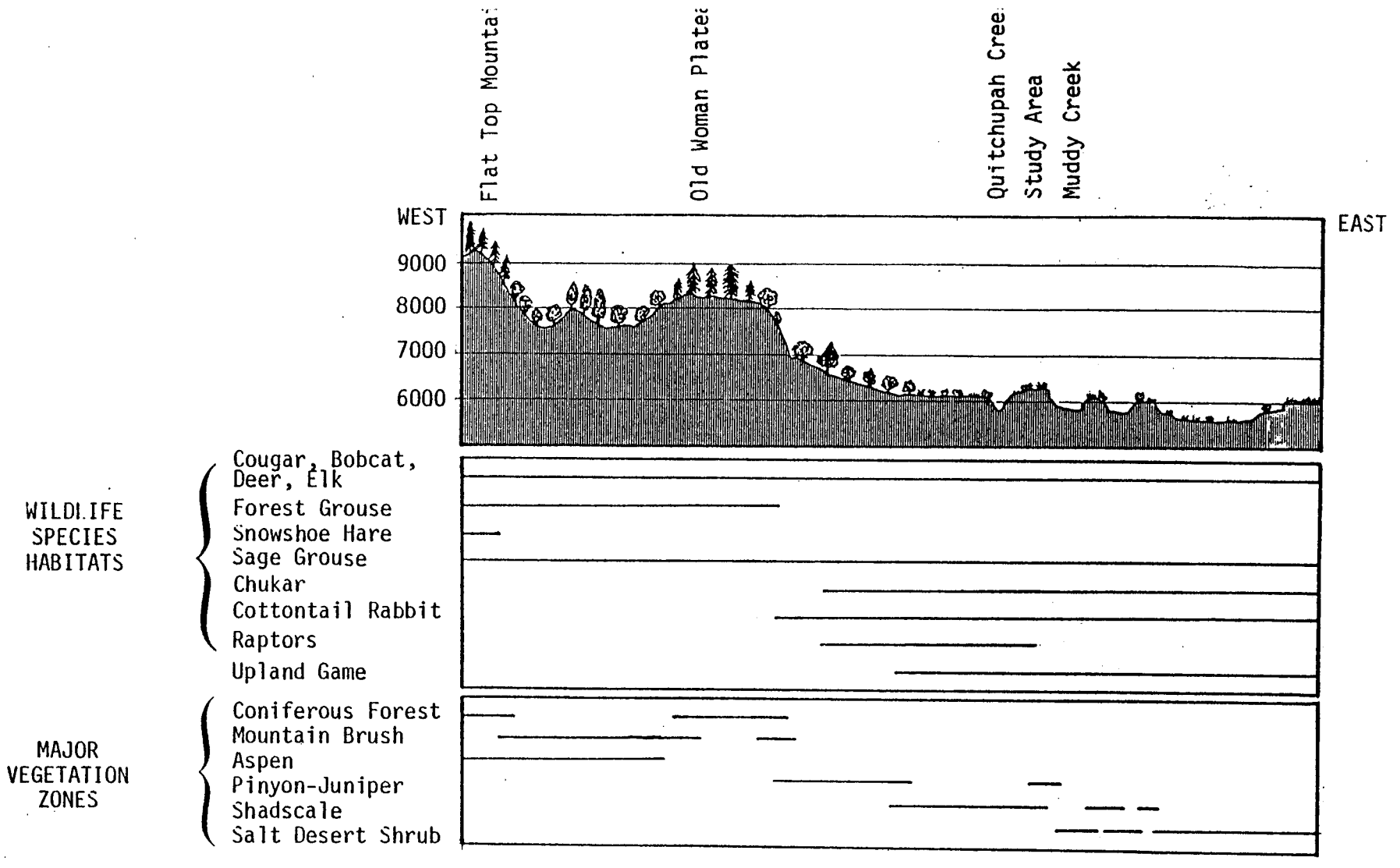


Figure 86. Relationship of Elevation to Vegetation Zones and Potential Wildlife Habitat for the Emery Coal Field Region.

Figure 85 displays this classification as it pertains to the wildlife surrounding the EMRIA study site. The surrounding wildlands (contained mainly in the Manti la Sal and Fish Lake National Forests) support "high interest wildlife" on the whole, these being any wildlife species classified as game species, any economically important species (from either a consumptive or non-consumptive perspective) and any species of special aesthitic, scientific or educational significance (reference Dalton et al., 1977, Species List of Vertebrate Wildlife that Inhabit Southeastern Utah, Utah State Division of Wildlife Resources, 67 p.).

The classification system incorporates three sets of letters for easy identification purposes. The first letter identifies one of the four use area rankings- c, crucial-critical; h, high-priority; s, substantial value; l, limited value. The second letter or letters defines the particular wildlife species involved- d, deer; e, elk; be, bald eagle; m, moose etc. The third set of letters identifies the primary wildlife use of the area- wt, winter range; su, summer range; ca, calving area etc. Those lands marked as a crucial-critical use area represent a critical requirement in the animal's life cycle or represent a biologically important area for a wildlife population. Examples are areas on big game winter ranges experiencing concentration of use; critical corridors for movement of wildlife; display, breeding and rearing areas for avifauna--strutting grounds; lambing or calving areas; and ecologically unique areas such as riparian zones and wetlands.

The high priority ranked areas basically represent the same biologically important areas as the crucial-critical with the exception of not representing a critical requirement in the lif cycle of an individual animal or a biologically important area for a wildlife population.

Summary

The study area itself lies in a limited value wildlife use area, where sporadic or unpredictable occurrence of any "high interest wildlife" could be expected. This classification complies with the lack of any significant sightings of wildlife in the area during the EMRIA program.

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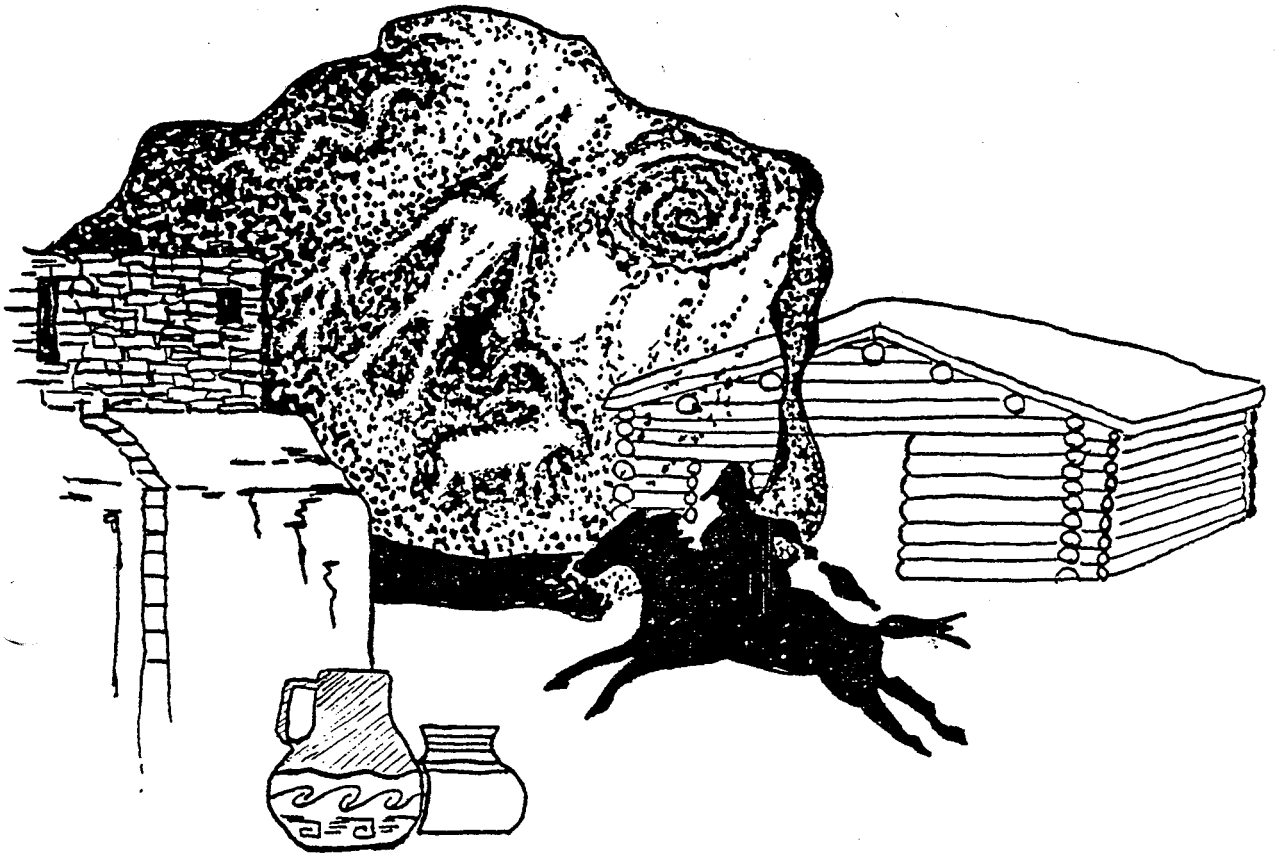

HISTORICAL & CULTURAL RESOURCES

HISTORICAL/CULTURAL RESOURCES RESUME OF EMERY COUNTY

Emery County takes its name from George W. Emery, Territorial Governor of Utah from 1875 to 1880. Previously, Emery County included what is now Carbon, Sanpete, Grand and Emery Counties. Emery County is about the size of the state of Connecticut. Figure 87shows the location of selected historical sites.

Early History

Conquistador Lopez de Cardenas entered southern Utah in 1540. The northernmost point in the 1500 mile Spanish Trail Route opened from Sante Fe to Los Angeles by Franciscan priests, Dominguez and Escalante in 1776, was the crossing of Huntington Creek at the old pioneer site of Wilsonville, five miles east of Castledale, on the road to Green River.
Whites entered Emery territory along one of the routes of the Old Spanish Trail at least 150 years ago, although the date is uncertain. Markers along the highways in Emery County show where the Old Spanish Trail was. Spanish trade continued into the 1850's. Gunnison followed the Castle Valley branch of the trail in 1853. One of his party, Dr. James Schiel, described the area as, "wild and unproductive", with gypsum covered soil, and open canyons and sandstone hills without a trace of vegetation. John C. Fremont and others followed the same route. In the late 1840's the western slope of the Wasatch Mountains was first occupied by Mormon colonizers. From there scouts went eastward over the mountains in the early 1850's to establish settlements and find pasture for their stock. In 1875, Orange Seely drove the cooperative herd of the Mt. Pleasant United Order into Castle Valley. Others followed their lead, and the first true settlement of 8 to 10 families was made in Orangeville, in 1877.

Recent History

Within 135 years, Emery County has developed into a valley of 10 towns with fine schools, churches, civic organizations, highways, reservoirs, and a few industries. Figure 88 shows the recent density of cultural resources relative to the coal area. The main sources of income have been from agriculture and coal mining until construction started on the Utah Power and Light Plants. The Emery coal fired plant is the most recent addition. Honey, fruit, bricks, cheese and lumber have also been produced. In recent years, Emery County residents have been "small" farmers and stockman. During the winter months many seek supplemental

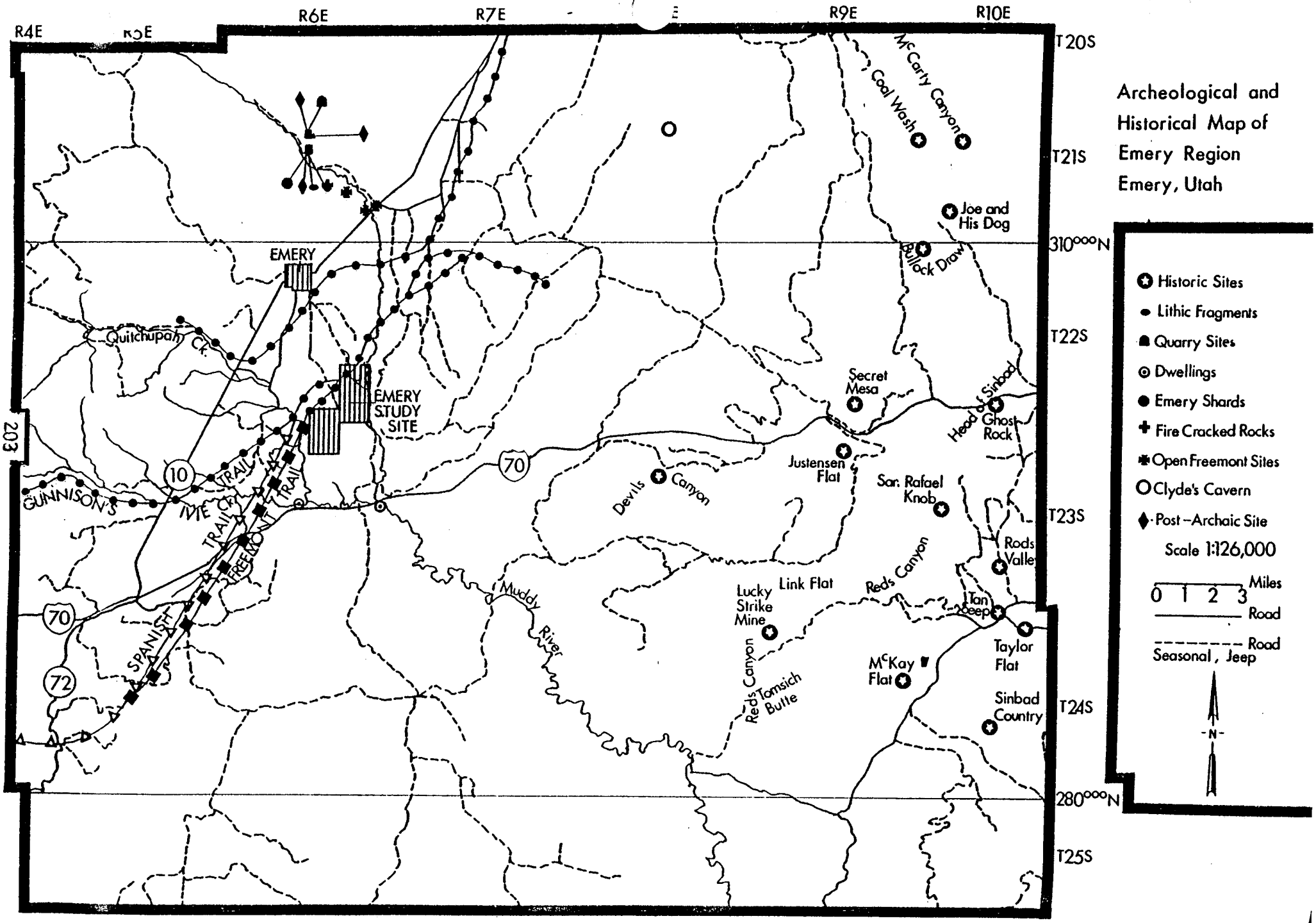

Figure 87. Archeological and Historical Map of Emery Region, Emery, Utah.

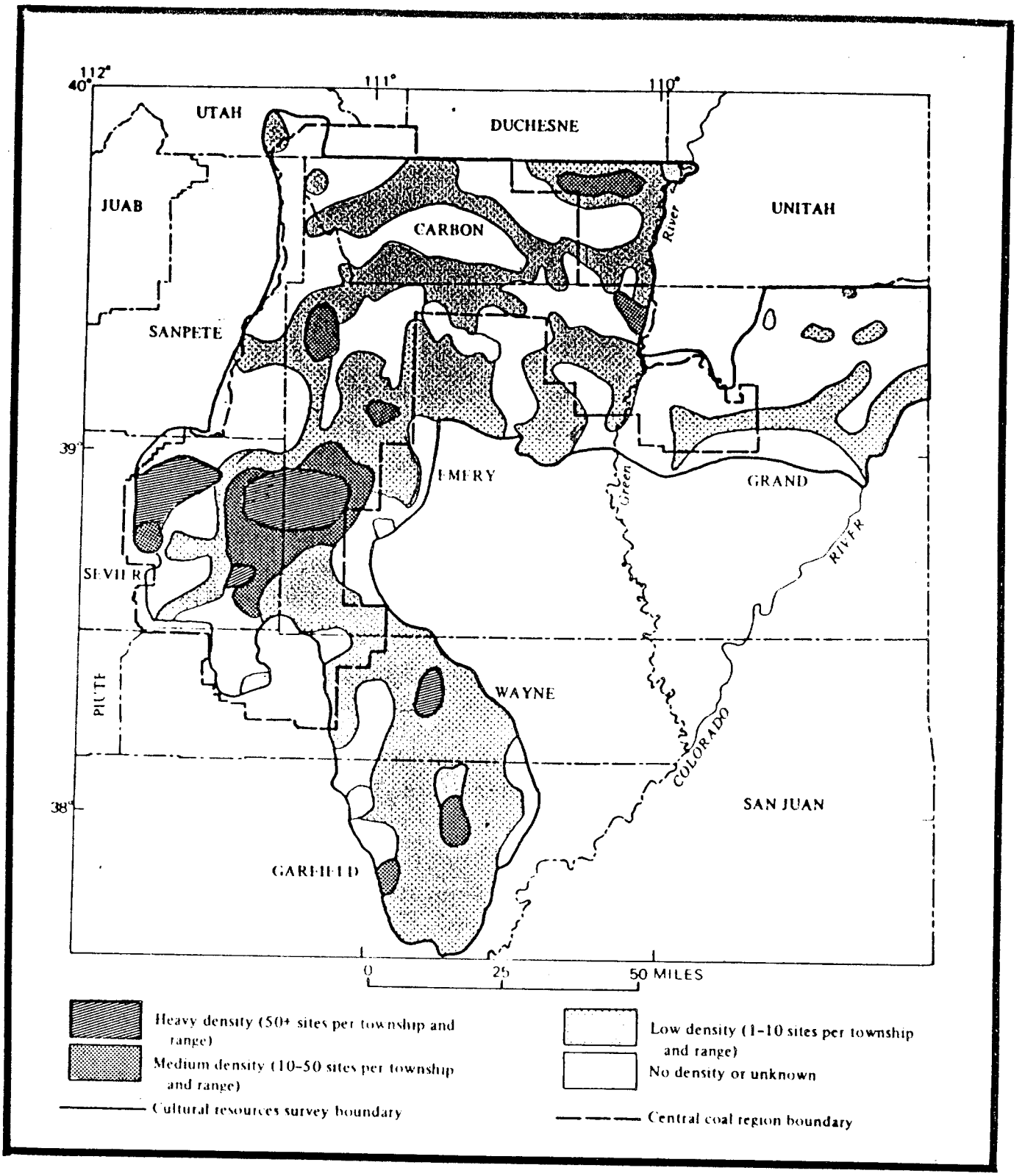

Figure 88 .--Map of the central Utah coal region showing cultural resource density sites. Based on AERC Class I and Class II survey, 1977.

employment in the coal mines of Emery and Carbon Counties. Dairying has been a recent stimulus to the economy of Emery County. Orchards including peaches, apples, apricots, pears and cherries have been established in the Ferron and Huntington Canyon area. Melons are produced in the Green River area using water from the Green River for irrigation. Most of the produce is consumed within the County, with little marketed elsewhere. Three meat processing plants have been established in Emery County. The chief crop of Emery County is alfalfa hay, but good crops of wild hay, corn, wheat, barley, and oats are also raised. Field corn is chopped for sillage and fed along with hay for winter feed.

The Joe's Valley Dam above Orangeville has a reservoir with a capacity of 31,400 acre feet of water, which is capable of irrigating 48,000 acres of land. Millsite Dam above Ferron is the largest dam built to date under the PL-566 small water project within Utah. Water from this dam is used to supply Ferron, Clawson, and Molen with a culinary water supply as well as irrigation water for over 10,000 acres of farmland. Dedicated in June, 1971, the Huntington North Reservoir at Huntington State Park, was constructed in 1965 and 1966. Electric Lake, located on Huntington Creek, provides cooling and make-up water for the Huntington Power Plant.

The Cleveland-Lloyd Dinosaur Quarry is the largest operational quarry in the world, and is located 15 miles east of Cleveland. At least six different varieties of dinosaur have been taken from this site since its discovery in 1927. Some 30 skeletons are now on display in the United States (including the quarry in Vernal, Utah), Canada, Scotland, Italy, and Japan.

Historical Locations

According to Finken (1977), descriptive place names given to locations within the San Rafael Swell were generally related to an event, a practical use, or names of an individual associated with that particular area. Names from the "Tales of the Arabian Nights" are also found. Listed below are some examples:

Swasey's frequently bestowed their names on land forms. Just south of the Head of Sinbad, Rod Swasey supposedly found what he thought was the most beautiful valley he had ever seen and named it Rod's Valley. In Rod's Valley is Tan Seep, named for Nathaniel "Tan" Crawford, while George

Crawford is remembered in the name of George's Draw.

In the Head of Sinbad is Reid Nielson's Draw, which according to Royal Swasey, was named for an early sheepherder. Justensen Flats, north of the San Rafael Knob, was named for sheepherders Orsen and Buck Justensen.

Ghost Rock was named one day when fog in the Head of Sinbad hid the base of the rock from view and gave the appearance of a ghost floating in the air. Because it often stood out in bad weather, the Ghost Rock was an important landmark. Not far from the Ghost Rock, behind Swasey's cabin, stands the Broken Cross, named by cowman Seeley Peterson; a fractured rock formation resembling a cross.

Royal Swasey indicates that Coal Wash probably was named because of an exposure of tar sand that could have been mistaken for coal. The formation of Joe and His Dog, which resembles a dog sitting up and begging next to a big man, reminded early cowboys of Joe Swasey and a pet dog - perhaps the same dog that took a bath at Baptist Tanks.

Bullock Draw is a canyon that was fenced off and used to hold bulls when they were separated from the herd.

There are two variations regarding the naming of Secret Mesa. According to Seeley Peterson, the name was applied because access was difficult to find and only a few people knew the way into it.

Royal Swasey went beyond the remoteness of the Mesa to indicate that because of its isolation, it was sometimes used as a secret hiding place for stolen livestock.

One of the most intriguing names assigned to an area of the San Rafael is the name of "Sinbad Country". Local folklore attributes the name to early Spanish travellers who likened rock formations in the Head of Sinbad to the scenes or castles described in the Arabian Nights. This seems reasonable due to the long Moorish influence on Spain and the resulting familiarity of these travellers with the tales of Scherezade.

With the exception of the anglicized San Rafael, none of the many other Spanish names in the region remained in use much beyond the 1850's.

Summary

As shown in Figure 87, the Old Spanish, Gunnisons, and Fremont's trails all lie between the town of Emery and the study site. Hence mine haul roads and the like should cross on existing rights of way. In any case no known structures or historical artifacts are involved on the site or rights-of-way.

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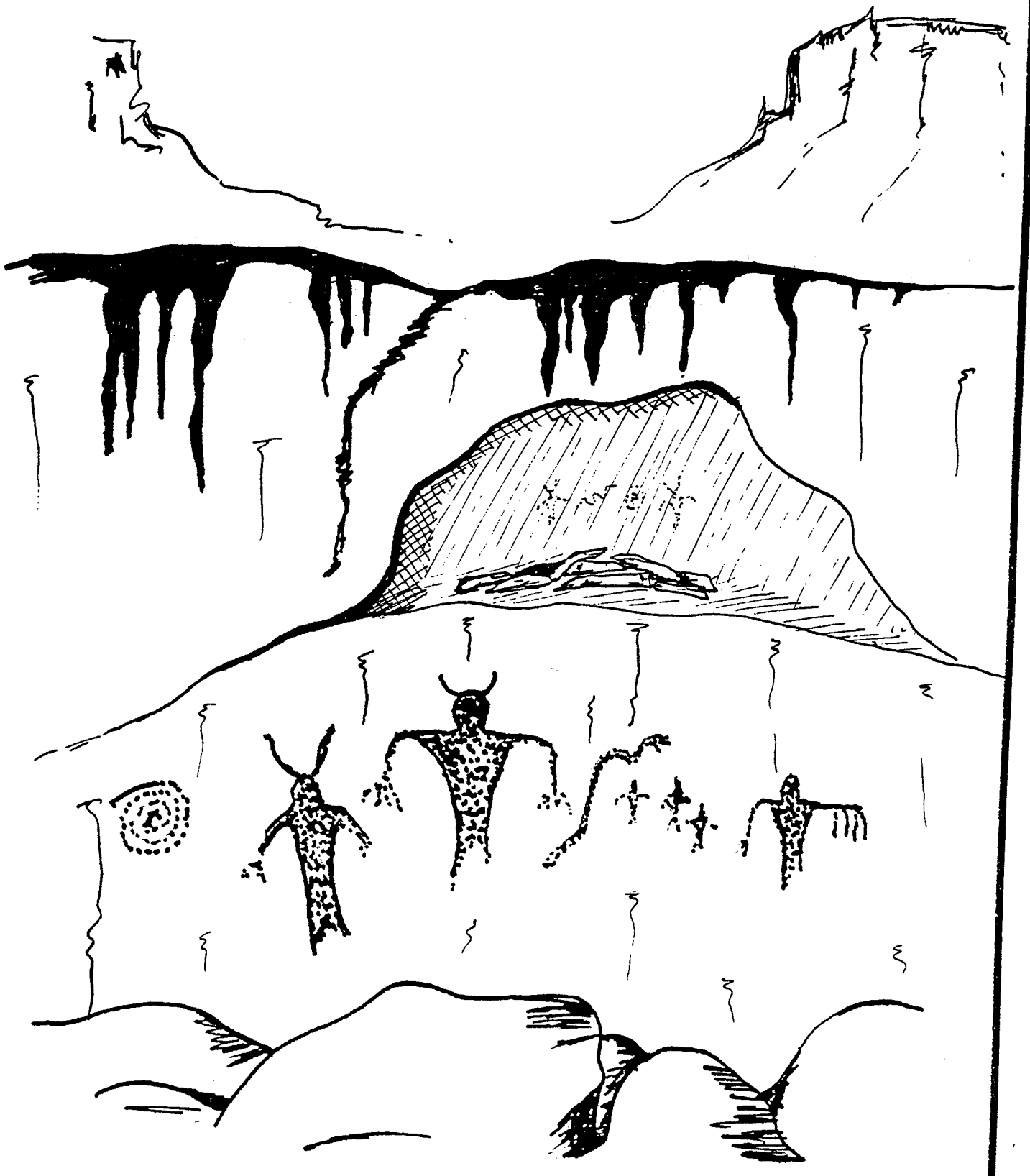


ARCHAEOLOGICAL RESOURCES

Previous Research

Major professional archeological investigations in Carbon and Emery counties began along the river drainages of these two counties in 1928. Between 1928 and 1931, William Claflin and Raymond Emerson sponsored four archeological expeditions to the western drainages of the Colorado River in Utah. The Claflin-Emerson expedition located sites along the Nine-Mile Canyon on the border of Duchesne and Carbon County; along Range Creek, in southeastern Carbon and northeastern Emery County; and on the Green River between Nine-Mile Canyon and Range Creek Canyon. In southern Emery County, sites were located along the Muddy River on Last Chance Creek, in Barrier Canyon, and on the Green River near the mouth of Barrier Canyon.

Aside from the descriptive archeological reports of the thirties, Julian H. Steward (1933) divided the northern periphery of the southwest into cultural areas. Steward's Culture Area I included the Fremont of Emery and Carbon counties. This culture was first defined by Noel Morss, who participated in the Claflin-Emerson expedition in 1928 and 1929, most of which took place in the Fremont River area.

In the 1950's more research was carried out in the area. Morss (1954) in his discussion of figurines of the American Southwest includes a study of Fremont figurines from Pillings Cave in Range Creek Canyon. Gunnerson (1957a) recorded many sites and excavated a few of them during his reconnaissance of the Fremont area in Uintah, Duchesne, Carbon, Emery, Grand, Sevier, Wayne, and Garfield counties. In Emery County, Gunnerson reported sixty-three sites along Ferron Creek, Ivie Creek, Last Chance Creek, Muddy River, Range Creek, and Robbers Roost. In addition to his survey of the region, Gunnerson (1956) excavated a possible Paleo-Indian site, the Silverhorn site (42Em8). Gunnerson (1957b, 1962) has also reported unusual artifacts such as bone harpoon points, a zoomorphic vessel, eccentric chipped stone artifacts and figurines found by a local collector near Ferron.

In the 1970's numerous archeological surveys and some test excavations have been carried out in Emery and Carbon counties. Most were in response to the Federal Government's cultural resource management policies. Archeo-

logical surveys have been conducted by the Antiquities Section of Utah State Historical Society (M. Berry, 1975); Archeological Environmental Research Corporation (various reports by F.R. Hauck and AERC in 1976 and 1977 are cited in the bibliography); Brigham Young University (Berge, 1973, 1974a, 1975b, 1975c, 1975d, 1976); Southern Utah State College (Dykman and Thompson 1976); and the University of Utah (C. Berry 1973, 1974).

Most recently, AERC completed an archeological reconnaissance of the Central Coal Project Area in Utah (Haulck et al., 1977). From May to September 1977 an intensive archeological field survey was conducted in portions of Carbon, Emery, Garfield, Grand, Sanpete, Sevier, Utah, and Wayne counties. Ten Bureau of Land Management planning units and three U.S. Forest Service planning units were sampled. The survey included a sample of 312 quarter sections. The Emery Study Site was toured by an archeologist and there were no significant finds within the study area (B. Louthan, 1977).

In the last few years, several sites have been excavated in Emery County. These sites are Pint-Size Shelter (Lindsay and Lund, 1976); Clyde's Cavern (Wylie, 1971); Windy Ridge, Crescent Ridge, and Power Pole Knoll (Madsen, 1975); and Innocents Ridge (Schroedl and Hogan, 1975). Joe's Valley Alcove was excavated by the Forest Service in 1973 (Sargent 1977: 20), but no report is available at the present.

Prehistory

Paleo-Indian

The Paleo-Indian period in the New World ended approximately 10,000 years ago. The economy of this period was characterized by the hunting of large, now-extinct mammals supplemented by gathering of wild plants. Little evidence exists for the latter. The archeological evidence for the Paleo-Indian period usually consists of fluted, lanceolate projectile points sometimes found in association with extinct fauna such as mammoth (Mammuthus columbi) and bison (Bison antiquus).

Archaic

With the extinction of large mammals, the Paleo-Indian hunters turned to a subsistence based on the exploitation of smaller present-day fauna

and on a heavier reliance on the gathering of wild plants. The earliest dates for the Desert Archaic period are 8000-9000 B.P. In areal extent the Desert Archaic covered the western third of the United States from Canada to the Mexican Plateau (Jennings, 1964).

Sargent (1977:17) ascertained that sixteen of the recorded sites in Emery are definitely Archaic. Seven of these are caves or rockshelters. Three of these cave or rockshelters, Pint-Sized Shelter (42Em625), Joe's Valley Alcove (42Em693), and Clyde's Cavern (42Em177) have been excavated. They also have a Fremont component in addition to Archaic components.

Pint-Sized Shelter is located in Castle Valley near the confluence of Ivie Creek and the Muddy River. The Archaic occupation at the site dates between 4250 ± 120 B.P. and 3390 ± 170 B.P. According to Lindsay and Lund (1976:56),gypsum projectile points from this level are contemporary with those from Sudden Shelter and mark the initial appearance of those projectile points in the Castle Valley region. Gypsum points occur at the same time in the southeastern Great Basin (Fowler, Madsen, and Hattori, 1973).

Joe's Valley Alcove is located west of Huntington on the Wasatch Plateau near Huntington Creek in northwestern Emery County. For the Archaic sequence at this site, Evan DeBloois in a personal communication to Schroedl (1976:59, 69) reports that Bed I is between 8200 B.P. and 6200 B.P. and Bed II is dated around 2400 B.P.

At Clyde's Cavern, near the San Rafael River, 20 miles southeast of Ferron, the Archaic sequence begins later than at other sites as determined by one radiocarbon date of 3070 ± 130 B.P. from Layer I (Winter and Sylie, 1974). In Layer I, a rabbitskin robe cached beneath three stacked slab metates represents the earliest cultural material recovered from the site (Wylie, 1971:27, 28).

Fremont

The Fremont period spans the time between A.D. 400 and A.D. 1200. The Fremont culture evolved from the Archaic lifeway by diffusion of Mexican traits. Dwellings such as semisubterranean pit houses and masonary structures; the cultivation of corn, squash, and beans; and pottery are new traits which characterize this period. The bow and arrow replaced the atlatl of the Archaic. The Fremont people sup-

plemented their horticulture diet with hunting and gathering much more than the Anasazi to the south.

Along with many other distinctive characteristics, the Fremont people developed their own art style. This is typified by horned, trapazoidal-bodied anthromorphs (human-like objects) evidently made everywhere the Fremont people lived. They also developed a stylized way of making spirals, zig-zags, scorpions, mountain sheep, deer snakes, and hunting scenes.

The distribution of the San Rafael variant of the Fremont encompasses all of Emery and most of Carbon County (cf. Marwitt, 1970). One hundred forty two Fremont sites have been recorded for Emery County (Sargent, 1977:24). Only a small percentage of these have been excavated. The Claflin-Emerson expedition excavated a Fremont site in Range Creek Canyon in northeastern Emery County. In Castle Valley on the Muddy River just below Ivie Creek, eight miles south of Emery, the Claflin-Emerson expedition excavated another site (their FL4-4, now 42Em762) which consisted of several open structures of basalt boulders set in adobe (Gunnerson, 1969:79). Gunnerson (1957:126-129); Figs. 29 and 30; 136-137) also excavated a deep pit house (42Em47) located two miles east of Emery, one half mile from the Muddy River.

As mentioned above, Clyde's Cavern, Pint-Sized Shelter, and Joe's Valley Alcove also contained Fremont components. The reader may refer to Sargent (1977:26) for more information on the Fremont components at these sites.

Post Fremont

A.D. 1200 agriculture ceased, permanent dwellings were abandoned, and the Fremont culture disappeared. The Fremont may have migrated south into the Anasazi region, or they may have been absorbed by intrusive groups. Exactly what transpired is unclear, but a return to the hunting and gathering economy had continued in the Great Basin until the arrival of the Europeans.

Numic speaking peoples are believed to have migrated from a region near Death Valley around A.D. 1000 spreading across the Great Basin to the east and north. The Southern Paiute reached the Southwest around A.D. 1150

Table 33.

Summary of Archeological Documentations

Listed below are four archeological sites previously located and site surveyed by University of Utah. They are all found within the ranges R 4 E to R 10 E, and townships T 20 S to T 25 S in Emery county, Utah.

1) Disturbed Fremont: Open Air
   Section 16, T 21 S, R 6 E
2) Lithic Scatter
   Section 16, T 21 S, R 6 E
3) Lithic Scatter, Quarry Activity
   Section 16, T 21 S, R 6 E
4) Lithic Scatter
   Section 15, T 21 S, R 6 E

The three sites listed below have been identified but there is no site survey information available.

1) Pint-size Shelter is located in Castle Valley near the confluence of the Ivie Creek and Muddy Creek, south of the town of Emery, Utah.
2) Gunnerson excavated a deep pit house located 2 miles east of Emery, ½ mile from the Muddy River.
3) In Castle Valley on the Muddy River just below Ivie Creek, eight miles south of Emery, the Claflin-Emerson expedition excavated another site which consisted of several open structures of basalt boulders set in adobe.

The sites listed below may be impacted by the proposed mining in the area:

1) 42Em22
   Emery East Quad., SW¼ Sec. 25, T 21 S, R 6 E
   Open Fremont Site.
2) 42Em49
   Emery East Quad., NW¼ Sec. 26, T. 21 S, R 6 E
   Open Fremont Site including a walled up overhang.
3) 42Em177
   Emery 1 NE Quad., NE¼ Sec. 16, T 21 S, R 8 E
   Site known as Clyde's Cavern, excavated in 1971.
4) 42Em179
   Emery East Quad., NE¼ of SW¼ Sec. 25, T 21 S, R 6 E
   Post-Archaic open site containing surface pottery scatter.
5) 42Em494
   Emery East Quad., SW¼ of SW¼ Sec. 25, T 21 S, R 6 E
   Open Fremont Site.

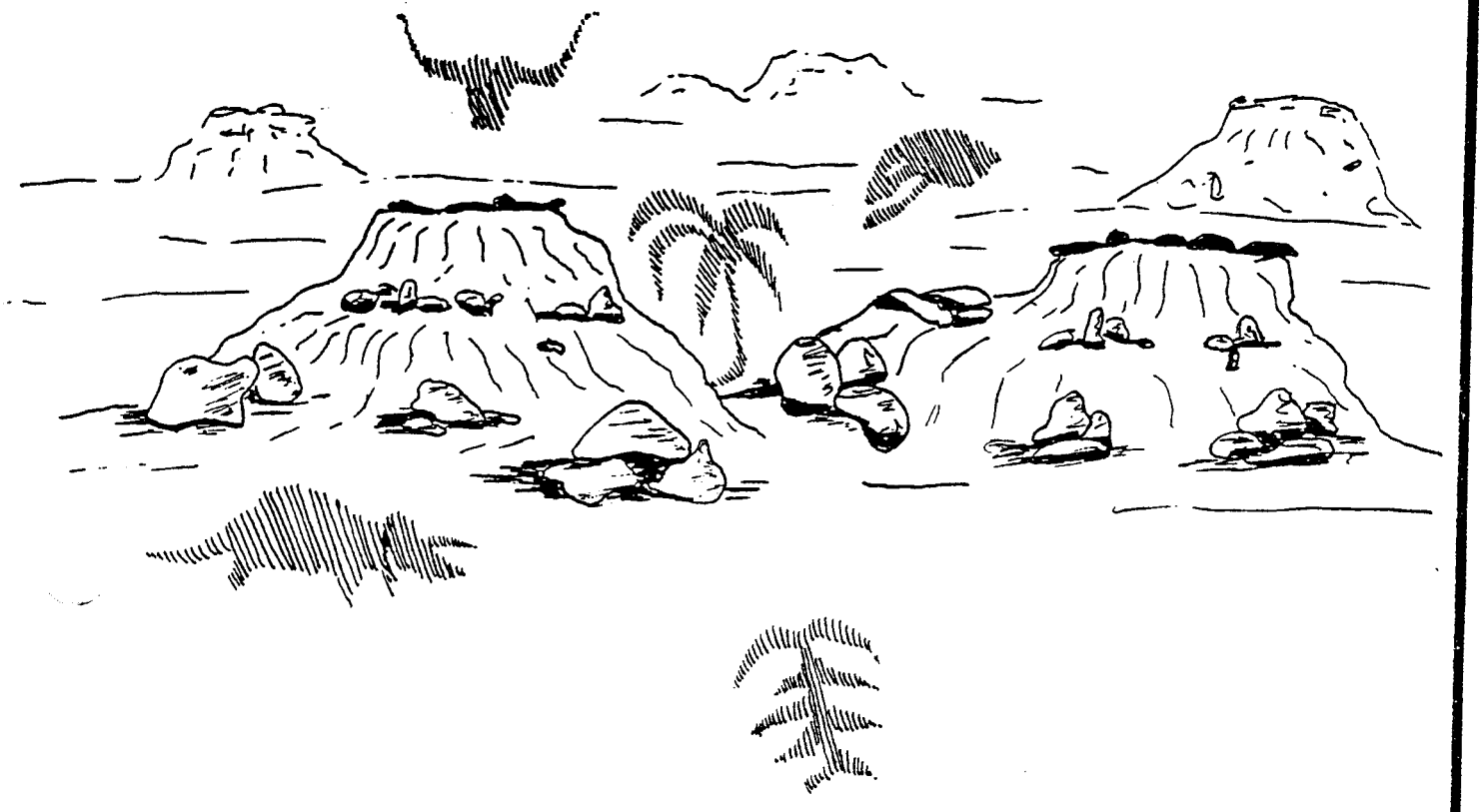
All of the above listed sites were located and plotted on the Emery heological and Historical map of the Emery region, Utah; Figure 87

(Euler, 1964), and the Utes evidently reached the Gunnison Basin in Colorado by about the same time (Smith, 1974).

Numic sites in Emery and Carbon County are not well known. Sargent (1977:24, 16-17) reports eleven possible dual component Fremont and Numic sites. Only two sites definitely indicate Paiute-Shoshone occupation.

References

Sargeant, Kay Emery County : An Archeological Summary, Antiquities - Division of State History, Utah
(all other references cited in this section contained in Sargeant)



PALEONTOLOGY

Regional Paleontology

Vertebrate and plant fossil-bearing rocks occur throughout the region. Figure 89 shows, in a general way, the distribution of the vertebrate and plant fossil-bearing rocks and their value as fossil-bearing units. This map was developed by the US Geological Survey, 1978, from data supplied by Dr. Wade Miller, Brigham Young University. Of particular importance is the North Horn Formation of Late Cretaceous and Paleocene age which contains dinosaur and mammal remains. Studies of these rocks may help provide insight relative to the extinction of dinosaurs. The Emery site does not lie in a recognized area of significance as indicated in Figure 89. Fossil plant material may of course be anticipated wherever coal is, since coal is itself composed of fossil plant remains.

For the region, no published comprehensive lists of fossils are known. Vertebrate fossils have been described by Dr. James H. Madsen, Utah State Paleontologist; Dr. W.L. Stokes, University of Utah; Drs. Wade Miller and James Jensen, Brigham Young University; and others. Invertebrate and plant fossils have also been described from the region. Scattered descriptions of fossils are found in the professional geologic and paleontologic literature.

Summary

The coal strata in the study area near Emery are contained entirely in the resistant Ferron Sandstone member of the Late Cretaceous Mancos Shale Formation. In younger, roughly equivalent coal beds elsewhere, as at Helper, Utah, reptile footprints are known to exist in the top of the coal and extensive large vertebrate bones have been recovered in older formations at Cleveland sufficient to be set aside as a protected site and museum. Locally, however, isolated mollusks (Pelecypoda, Ammonoides) plant fragments, and some ripplemarks have been identified in the overlying Blue Gate Shale member and underlying Tununk Shale member. No fossils have been recovered from the Ferron Sandstone member in the vicinity of the Emery study site. Miller and others (1978) noted significant vertebrate fossils in the Morrison and Cedar Mountain Formations near Clawson but these units would not be involved in strip mining at the present site.

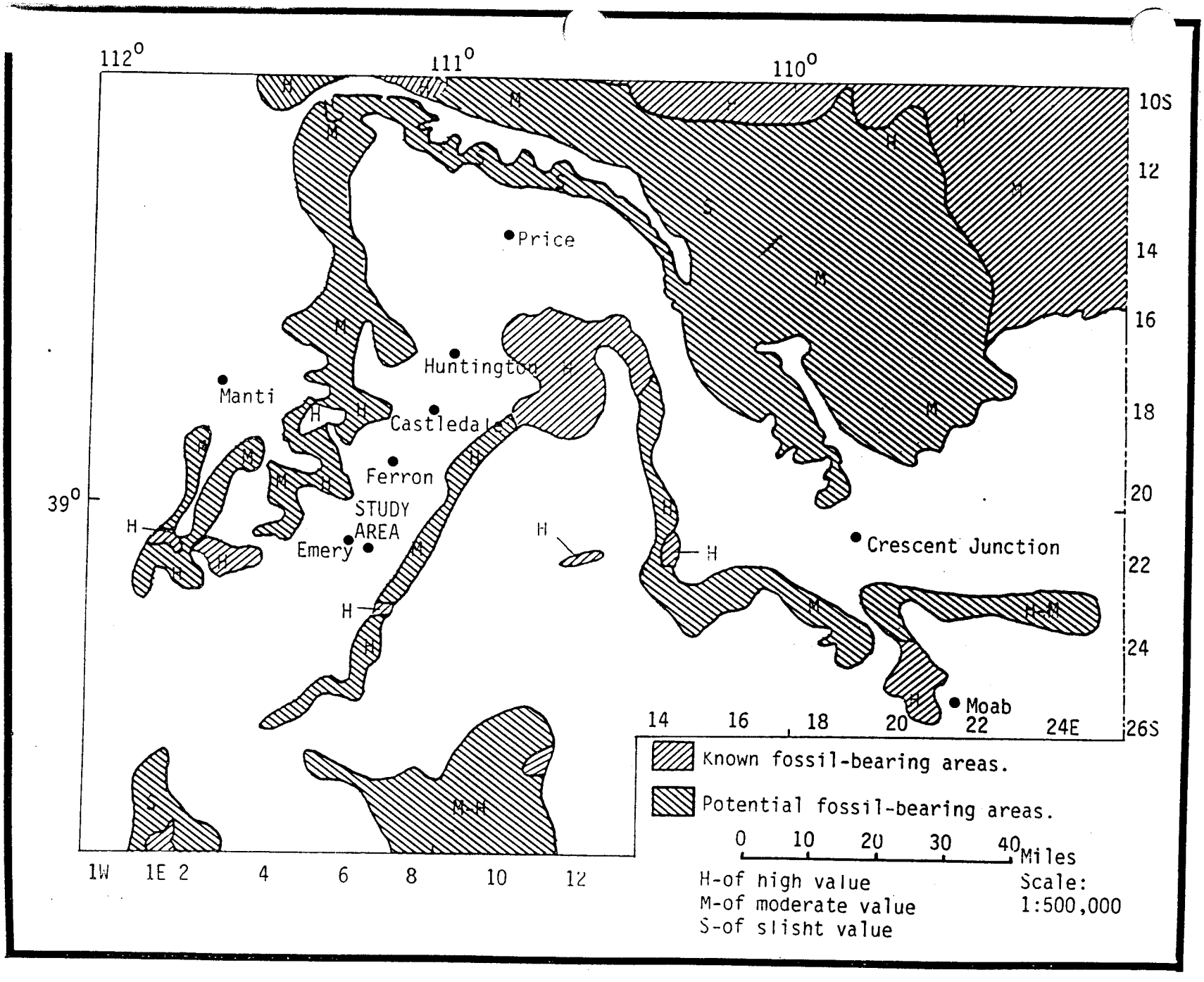


Figure 39. Map of Central Utah coal region showing vertebrate and plant fossil-bearing areas.

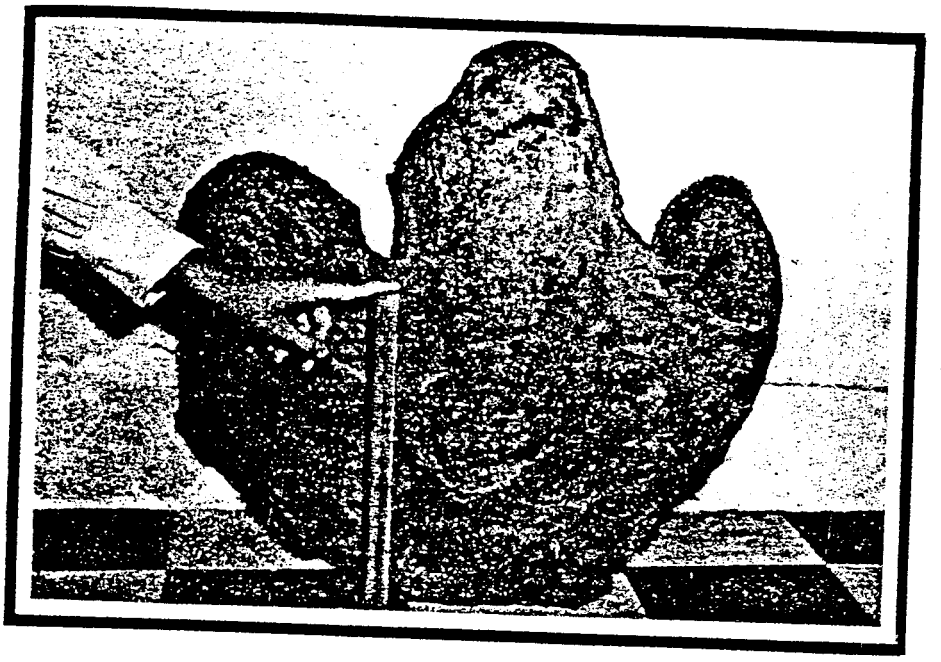
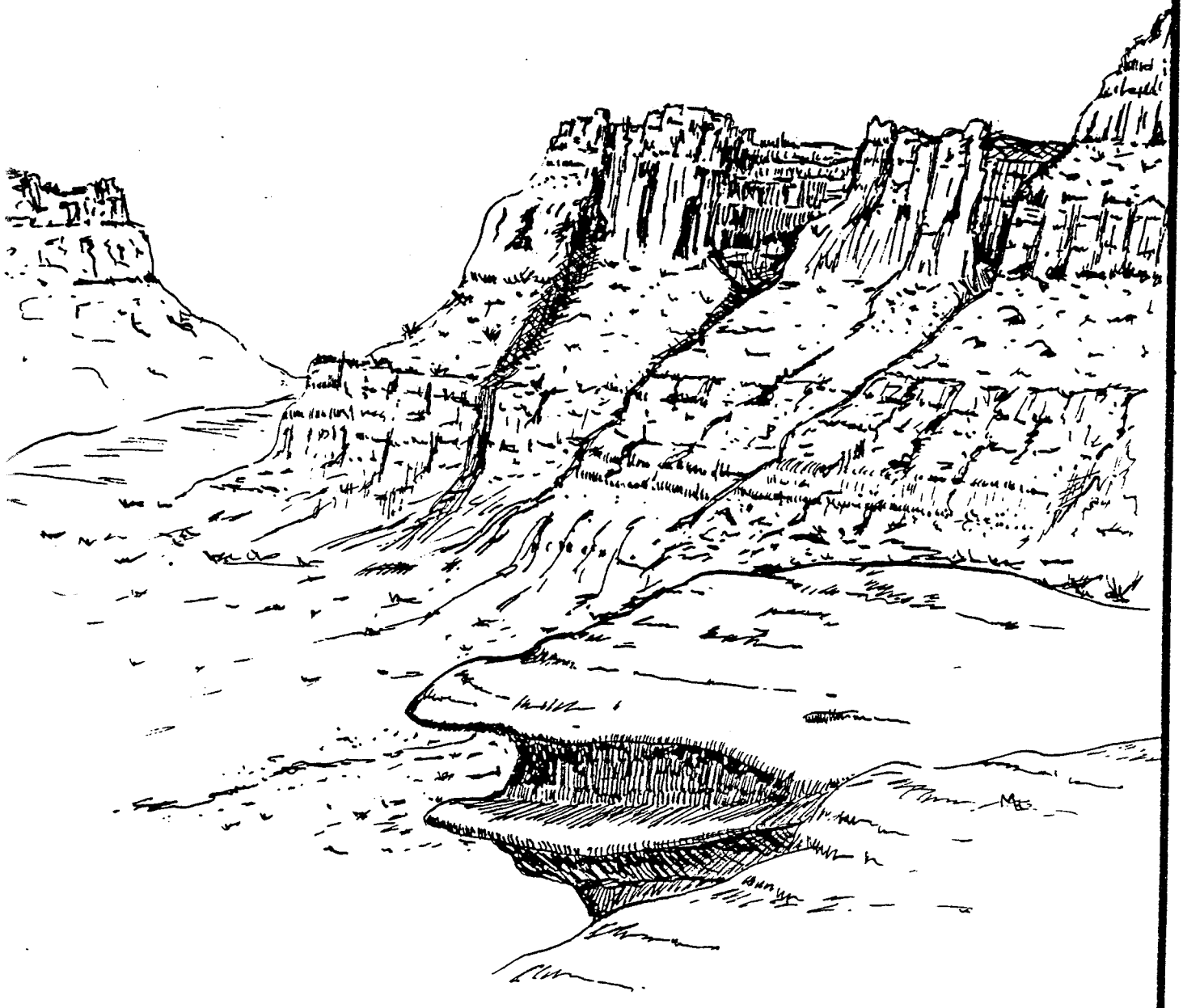


Figure 90. Dinosaur Track in Upper Coal Beds. (Helper Museum)

REFERENCES

Miller, W.E., S.F. Robison and S.K. Webb, 1978; "Report of the 10% Paleontological Survey of the 3 and 4 plant site, Emery Cottonwood Canyon, Emery- Muddy Creek Pipelines and Reservoir Sites, Vaughn Hansen and Assoc., Salt Lake City.



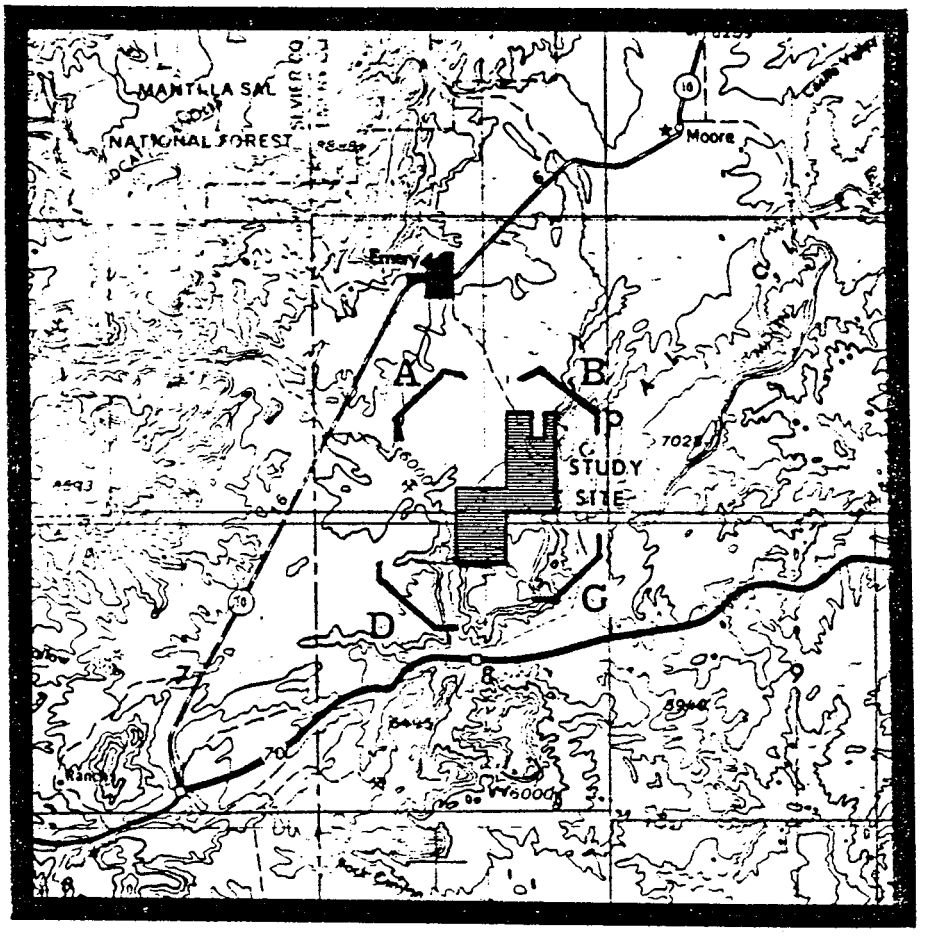
VISUAL RESOURCES

As covered more fully in the section on Physiography, Drainage and Relief, landscape characteristics of the area are common to the semi-arid Colorado Plateau country of central and south-central Utah. The general area, ranging from 5,000 to 12,000 feet in elevation, is characterized by broad elevated plateaus, desert valleys, and canyon lands. Erosion of the low-lying desert terrain has produced a rolling panorama with some deeply incised gullies and low escarpments (Figure 91). Locally gypsum coats poorly drained soils and imparts a barren badlands tableau. The impression conveyed by the better portions of the area is one of a dramatically sculptured canyon and panoramic desert landscape. The landscape character is developed grassland and desert shrubs. The air quality for viewing scenery during our observations, 1976-1979, were very good. Visibility measured from the town of Huntington during September 1970 to March 1971 averaged 67 miles. More recently, (1974) average visual range from particle size distributions was about 45 miles, yet most of the region has been classed as a "Class II" area for purposes of significant air quality degradation with the exception of Capitol Reef, which is "Class I".

Major scenic attractions include the San Rafael Swell, Manti-La Sal National Forest, and several National Parks. Visual resource inventory and evaluation system was used to identify and assess scenic quality, sensitivity level, and distance zones (BLM, 1976). The results of this analysis are given in Figure 92, which shows the classified scenic quality, the types of visual zones by distance and the visual sensitivity levels respectively.

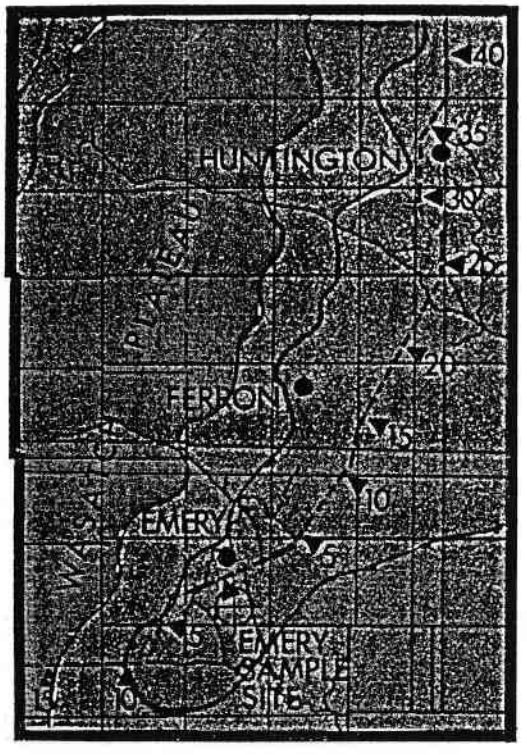
Summary

The local visual impact of a strip mine on the study area would be strong. At present, Interstate 70 and Highway 10 are the major transportation corridors through the area (Figure 91). From Interstate 70, the visual impact of a strip mine would be negligible because the area cannot be seen from the Interstate. The present view towards the study area consists of sheer rock faces which surround the site. If we assume that mining will not alter these vertical walls, there will be no impact on scenic quality to travellers on I-70. From Highway 10 however, the visual impact of a strip mine will be strong, as such a mine would be a dominant feature of the landscape. At present, the mesas above the Coal



Scale 1:250,000

Figure 91- Topography of the Emery area. Brackets indicate locations and orientations for perspective views in Figure 93 .



CLASS A

CLASS B

CLASS C

LEGEND:

CLASS A

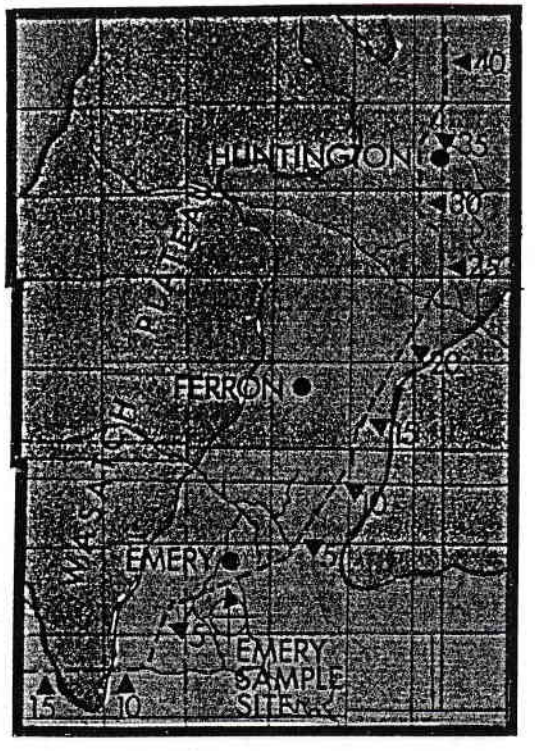
Those areas where features or landform, waterform and vegetative patterns are of unusual or outstanding visual quality.

CLASS B

Those areas where features contain variety but not outstanding; and lacking outstanding features.

CLASS C

Those areas where features have little variety and



FOREGROUND-MIDDLEGROUND

BACKGROUND

SELDOM SEEN

LEGEND:

FMg - Foreground-Middleground

The area that can be seen from each travel route or use area from the distance of 0 to 3½ miles.

Bg - Background

The remaining area that can be seen from each travel route or use area from the distance of 3½ miles to approximately 15 miles.

Ss - Seldom Seen

Untraveled areas.

HIGH

MEDIUM

LOW

LEGEND:

HIGH SENSITIVITY

Public values of the visual resource are important; concern for the quality is major.

MEDIUM SENSITIVITY

Public values are significant; concern is secondary.

LOW

Public values are secondary; concern is minor, the number of people viewing is low.

N

Figure 92. Scene Quality, Visual Zones and Sensitivity Levels.

Cliffs, which include the Emery coal field, form the dominant landscape viewed by southbound traffic for several miles around the town of Emery (Figure 93). This figure gives four different views of how two of the most probable strip mine areas would appear against a computer model of the existing topography.

REFERENCES

Bureau of Land Management, 1976; "Final Environmental Statement - Emery Power Plant", U.S. Government Printing Office, pp. 2-56, 2-60.

US Geological Survey, 1978; "Draft Environmental Statement - Development of Coal Resources in Central Utah", U.S. Governemt Printing Office, pp. II-31, II-34.

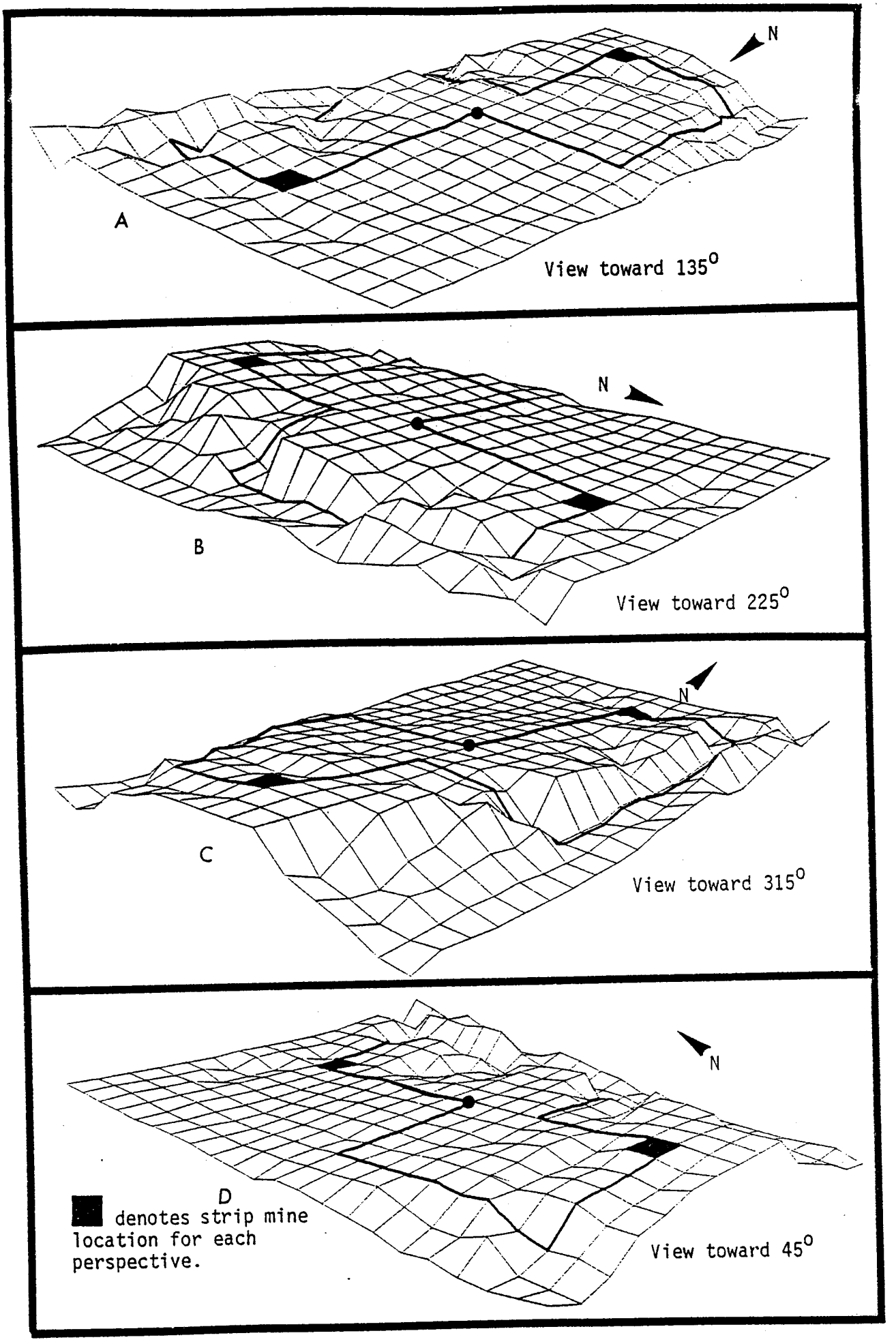
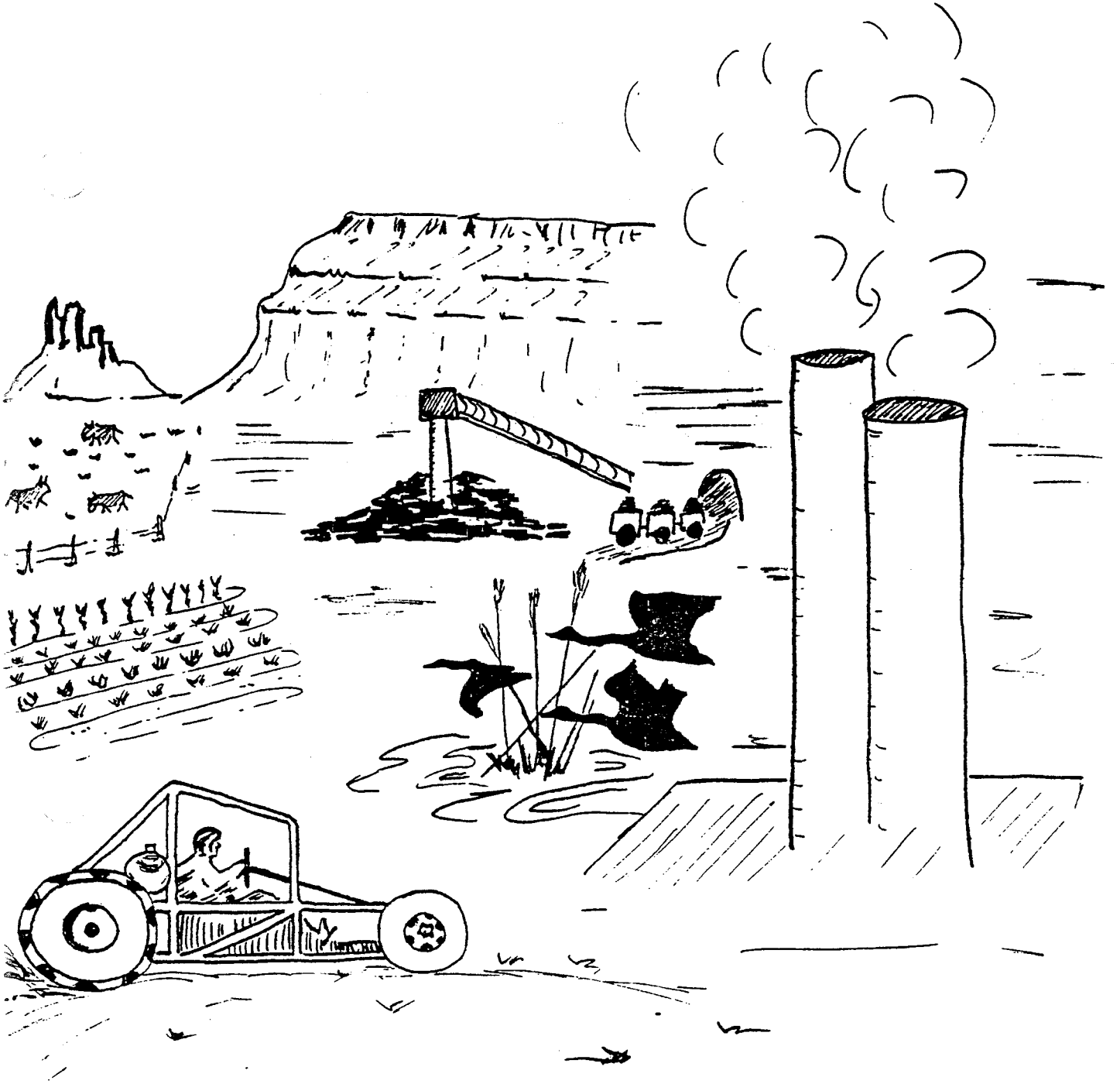


Figure 93 . Computer Perspective Views of Emery Study Area.



PRESENT LAND USE

The rural nature of the Emery region landscape is reflected in Figure 94 which shows land use in the vicinity of the study area. The town of Emery has a population of 219, most of whom are involved in ranching, limited agriculture, or employed at the Emery Deep Mine. Although sugar beets were previously an important crop in the area, present day agriculture consists of alfalfa and improved pasture land. Livestock grazing is practiced on open and fenced range on the mesas to the south and southeast of Emery. The town of Emery has a small number of commercial developments, churches, a post office, and a park. The Emery power plant generating complex, located off Highway 10 between Clawson and Castledale, is the most significant tax base in the area. Coupled with this is the production of the necessary coal to operate the plant for its 35 year estimated life from the nearby Wilburg Mine. Of more direct geographic impact is the associated power transmission corridor which traverses the immediate vicinity of the study area (see Figure 92).

A regional view of present land use is shown in Figure 94, interpreted from satellite imagery. On the west, the Wasatch Plateau consists of high lands in the Fish Lake National Forest. Recreation and timbering takes place in these Ponderosa Pine and Spruce-Fir forests. The east side of the Wasatch Plateau drops almost vertically to Castle Valley, which has extensive agriculture. Most of this is alfalfa, but some areas are planted to corn during certain years. Soils with high salinity are mostly used as range. The east side of Castle Valley is formed by the Coal Cliffs, which support dense stands of Pinyon-Juniper woodland. This land is used for low intensity livestock grazing, firewood and fence posts. Beyond the Coal Cliffs, the vegetation is dominated by salt desert species, and is suitable for livestock range. Valley floors and flood-plains are planted to alfalfa where groundwater may be economically pumped for irrigation.

Summary

Land use data made available from the Bureau of Land Management are presented in Figure 4, in a more detailed map. Limited recreational uses of the land are also found due to the open nature of the land and mixed ownership status, permitting easy access. These uses consist of: off-road vehicle use, rockhounding, sand dragging, horseback riding, and hiking.

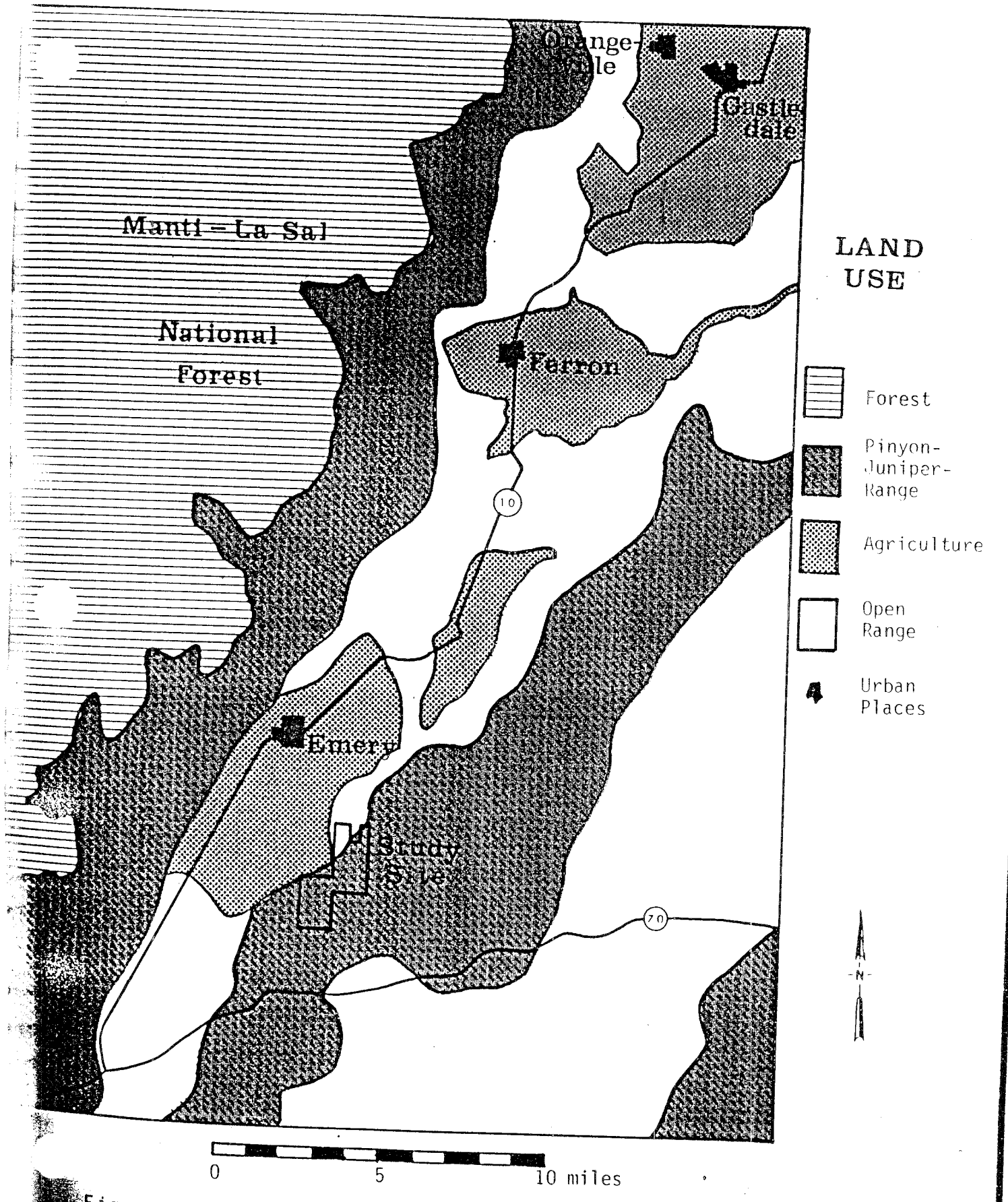
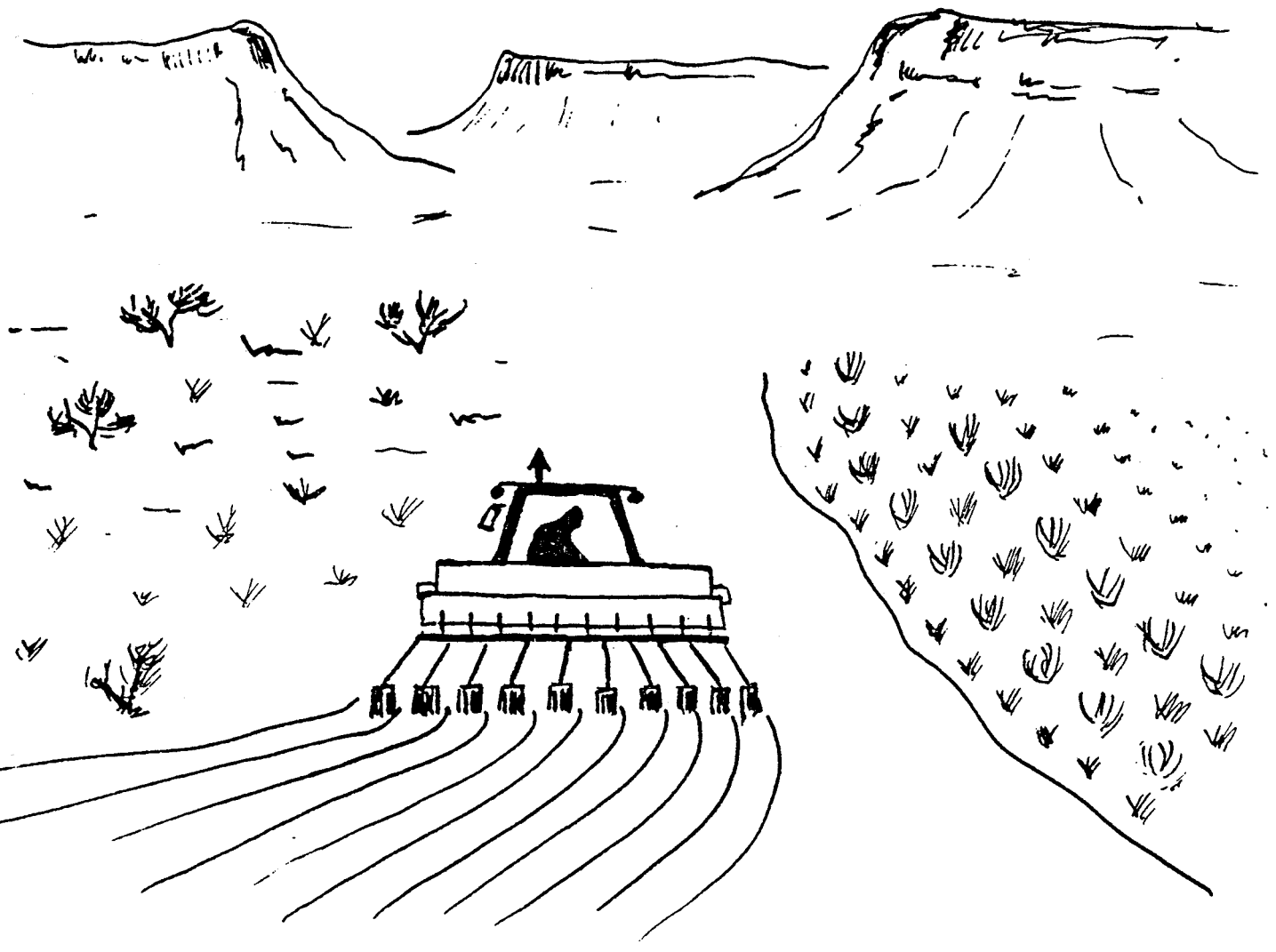


Figure 94. Land Use From LANDSAT Imagery.

. REFERENCES

Bureau of Land Management, 1976; "Final Environmental Statement - Emery Power Plant", p. 6-23, US Government Printing Office.

US Geological Survey, 1978; "Draft Environmental Statement - Central Utah Coal", p. 2-58, US Government Printing Office.



RECLAMATION POTENTIAL

POTENTIAL FOR RECLAMATION

Reclamation Objectives

Compliance with Federal, local and State laws as summarized in Table 34 is mandatory. The rehabilitation problem, with the background previously presented in the baseline study may be viewed as a tension between the issues or potential problems posed by the mining with those restrictions identified against a series of alternative solutions. Finally the costs of reclaiming the site by the sum chain of rehabilitation steps necessarily evoked must be weighed against the coal resource and the residual land value. In view of the marginal utility of the land in its present condition, one might ask what planned uses can be inferred, that might be beneficial, perhaps even exceeding the existing use potential, without incurring excessive costs.

As it now stands, the land has limited range/wildlife habitat/watershed value and possibly recreational value. If the carrying capacity of the land could be increased as a result of an improved "soil" moisture retention capacity due to strip mining, then local long term benefit may accrue in the process. The clear problem in converting this mined land to agricultural use would be the available water.

Secondly, for whatever reason, drought or loss of vegetative cover, historical springs and seeps on and around the plateau are now dried up. Existing stock ponds appear to be essentially snowfed. Thus a reasonable second objective would be to intercept a portion of the precipitation runoff in small basins after mining by surface shaping and producing an increased infiltration surface zone. This could either increase the wildlife potential of the area or support stock use.

Thirdly, after the interruption of the existing stratigraphy by the mining process, a single ground water zone will develop above the floor of the coal mine. This increase in infiltration may serve to dilute near surface salinity and enhance vegetation, and stock water supplies over the mined site. On the other hand, the altered chemical properties of the ground water may produce undesirable characteristics locally or downslope. A balance between these situations is sought.

Fourth, introduction of new grass, forbs and shrub species, as being evaluated by Frischknecht and Ferguson, which are native to the region but not well represented on site could improve the ultimate range carrying

Table 34

Checklist of State Requirements for Utah

(After Imhoff et al., 1976 USGS Circular #731, and Strip Mine Handbook, 1978)

Stage of Program Development	Applicable Items
1) Acts	- Mine Reclamation Act of 1975, and Federal Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87)
2) Rules and Regulations	- Final Interim Regulations (30 CFR part 700)
3) Technical Guidelines	- Not Available
4) Administrative Agency	- Utah Department of Natural Resources, Office of Surface Mining
Reclamation - Main Actions - Standards	
5) Control Water Flow and Quality	- Yes (Iron, pH, Suspended Solids) Section 715.17
6) Conserve and Replace Topsoil	- Yes (Section 715.16
7) Backfill and Grade	- Yes "where practical" - see also Sect. 714.14 and 715.14
8) Reduce Highwall or Pitwall	- Yes (Section 714.14)
9) Bury or Neutralize Toxic Wastes	- Yes under 4 ft. of non toxic and non combustible material (Section 715.14)
10) Revegetate for Beneficial Use	- Yes -priority to non noxious native plants (Section 715.20, 715.14)
11) Landslides	- 20% slope angle criterion (Sect. 722.11)
12) Other Rules	- Program is implemented through orders that recognize individual site and mine conditions.
13) Sediment Control	- Yes (Section 715.17e)
Land Use Planning Requirements	
14) Resource Information Required	- Land Use, Soils, Vegetation and Water Resources
15) Alternative Uses	- Explore capability of lands to support a variety of uses
16) Declaration of End Use	- Yes
17) Local Public Planning Role	- Notification and comments taken under advisement
18) Special Provisions	- None

capacity. The restored strip mined lands offer opportunity for such introduction free of competition from less desirable species.

Fifth, the existing wildlife in the area appears to be meager, if not non-existent. Evidently it would be possible to introduce a superior habitat for deer and elk on the unmined sites by shaping small hills as cover with water nearby. Game could be introduced.

A sixth objective would be to provide superior flood control catchment basins as a by-product of the strip mining operation. As discussed in the strip mine model, a natural result of a mining operation is a final pit which may have inadequate fill. If this pit could be placed to catch excess runoff, it would protect the downslope surface construction, provide water for supplemental irrigation and avoid potential stream contamination by sediment or other runoff water geochemistry.

A seventh objective would be to isolate any toxic waste from the ground and surface water supplies. Essentially we would wish to have a closed cycle system result in such areas with losses to evapotranspiration and input from precipitation. We would wish to avoid excess surface water entering such a zone, and infiltrating. Hence, impoundments, barriers or surface coating with paraffin or asphalt as is employed in water harvesting, might be considered. Vertical fractures below the floor of such a disposal site must be avoided or sealed to avoid contaminating deeper aquifers.

More generally the objectives of reclamation are multi-faceted in that they must address and account for all phases of the activities preceding, occurring during and following strip mine operation. These activities and their interrelationships are depicted in Figure 95.

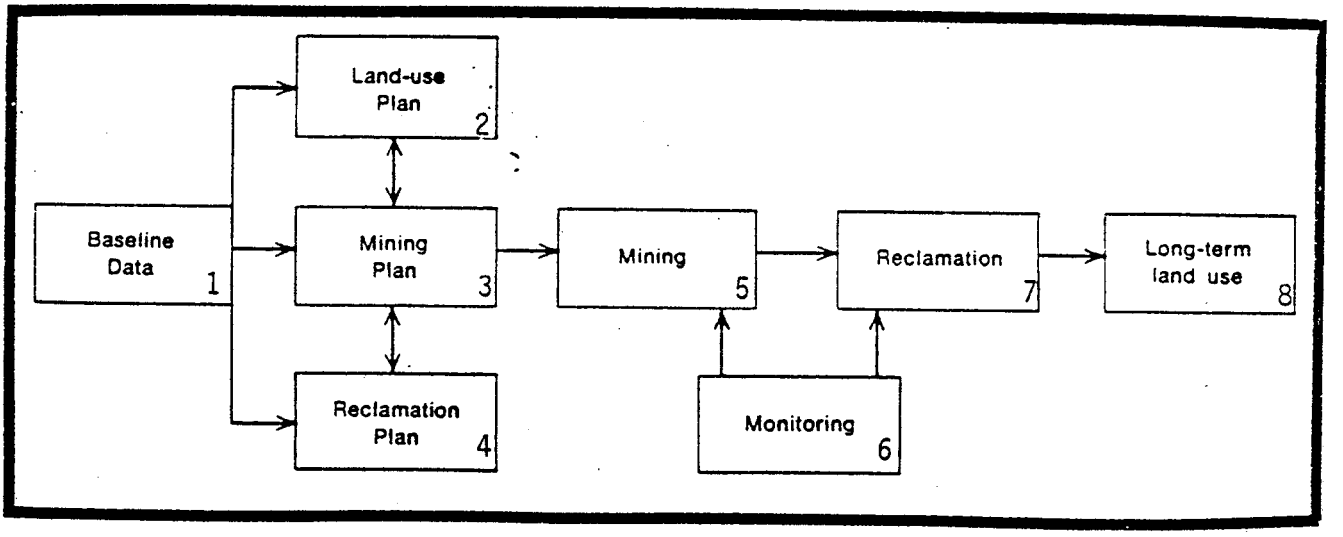


Figure 95.

This report and companion studies underway but not completed will fulfil step 1. The existing land use and new alternatives as given in this section must be completed (step 2) to permit preparation of a responsive mining and reclamation plan (steps 3 and 4). The remaining steps (5, 6, 7, and 8) are completed in logical sequence. We note that step 6, the monitoring will be continued throughout.

To meet State requirements, it is necessary to explore the capability of the mined lands to support a variety of uses (Item 15 in Table 35). This objective is in fact a series of objectives which are covered under the alternatives discussion. A similar situation exists for the compliance objective. Here again a variety of possible responses are feasible for each problem and these are covered as alternatives.

Reclamation Alternatives

Alternatives must be viewed within the context of what disruption is most likely to occur if the area were strip mined. Hence, we must first generate a scenario of stripping and the mineable coal at the Emery site. Three such locations were identified in the geology section, corresponding to slightly different coal resources. This model is intended to be general enough to serve for all.

Strip Mining Model

Two methods exist for strip mining of coal; a) contour or b) area mining. In some cases, a combination of the two may be chosen depending primarily of hte topography of the overlying surface. In rugged, hilly terrain, contour mining works best, while the more gently rolling, relatively flat terrain is more suited for area mining.

Actual strip mining is preceded by the building of access roads and lay-down areas, the clearing of the land, and the erection of various buildings and other structures. The general sequence and timing of major strip mining activities are to be found in Figure 96, which depicts a plan view of a hypothetical strip mine in operation. Not all of the activities related to coal mining are shown, for example lacking are coal benification, coal loading, and mine decommissioning.

The mining proceeds in a series of parallel trenches unless other factors dictate and the overburden is removed in narrow bands, to be

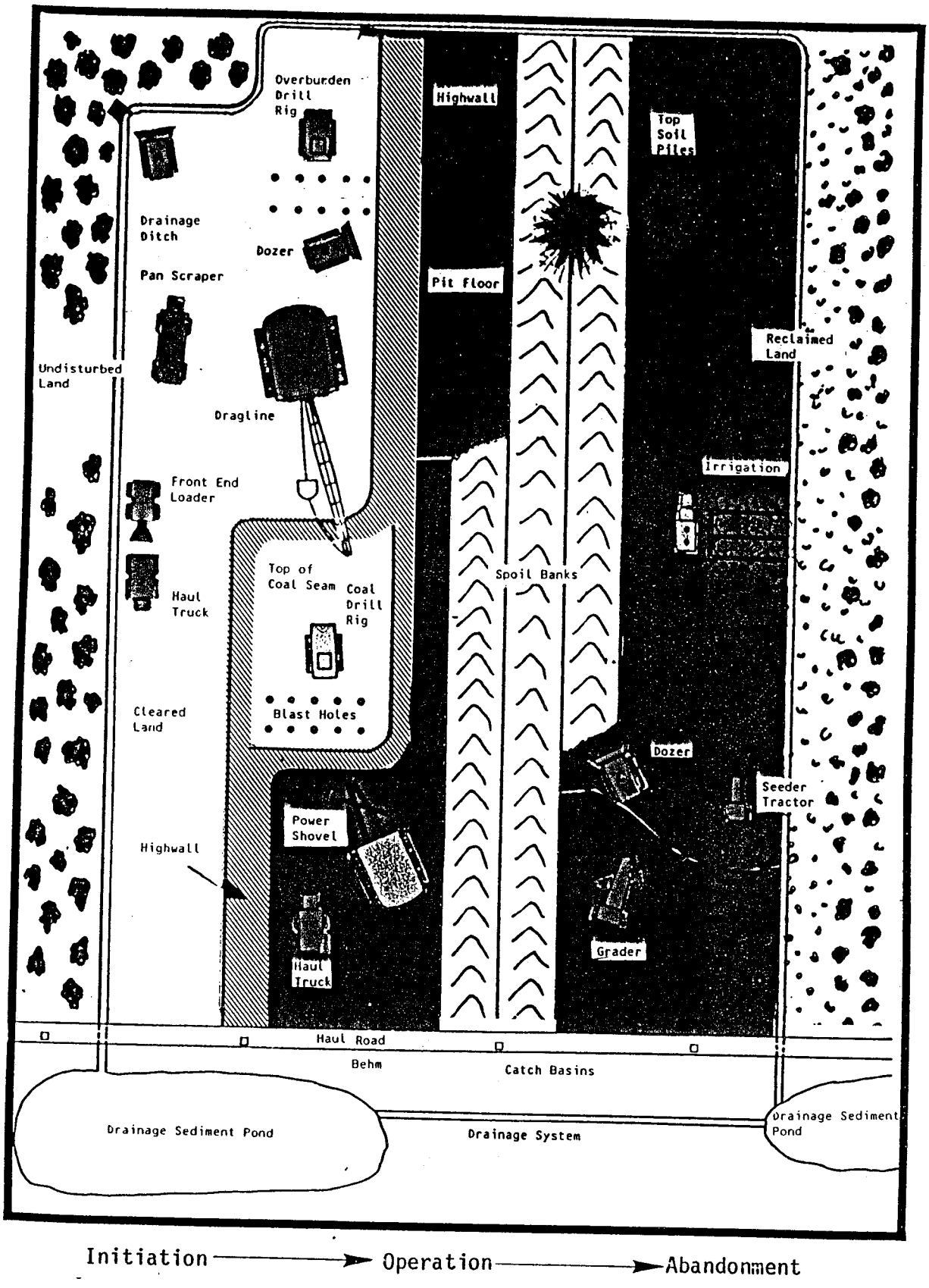


Figure 96. Time Phased Scenario of a Potential Strip Mine Operation

piles in spoil banks on the opposite side of the pit. For the initial trench, or box cut, the overburden is placed on unmined (but cleared of trees) land next to the cut on the side ("upmine") opposite the direction ("downmine") that the series of cuts are to follow. It may be necessary, owing to limitation of the equipment used, to dig a shallow pit upmine from the initial cut for the disposal of the first spoil bank. The dirt and rock removed from the shallow pit are placed even farther upmine (Weimer, 1968).

For the second "parallel" cut, the overburden is placed in the already mined first pit. For each successive cut the overburden is then placed in the previously mined trench. At the final cut, an empty trench would be left unless reclamation measures have included moving some of each previous spoil pile downmine. This, however, represents a rather expensive earth handling measure. The last trench might rather be filled with water, overburden, fly ash from a power plant, municipal wastes or even left as is for other uses such as shown in Table 35.

Table 35

Potential Rehabilitation Uses

1) Sewage Lagoon
2) Fish Hatching
3) Desalinization Plant
4) Flood Control Basin
5) Recreational Area (off-road vehicles, lake)
6) Ground Water Recharge Pond
7) Pump Storage Reservoir (Peak Demand Power Generation)
8) Erosion Control Barrier
9) Landslide Stabilization
10) Landfill Site
11) Bleeding Methane from Adjacent Underground Coal Works

Model Mining Operation

The pits, down to the pit floor, vary from a few tens to 200 feet deep and 100 to 200 feet wide to accommodate the mining equipment and haulage roads. Referring to Figure 96, it can be seen that one of the preliminary

operations involves clearing trees, brush, and grasses and storing them for mulch, by using heavy equipment such as bulldozers, front-end loaders, and haul trucks. At this point, good reclamation practice dictates that topsoil be scraped off for storage and subsequent use.

Drilling rigs are then used to prepare a series of holes in the overburden for explosive loading and shooting. Overburden can then be removed by shoving over the highwall with a bulldozer, by placing a spoils pile by use of a dragline (or power shovel), or by hauling to the spoil pile in a pan scraper depending on the size of the debris.

Judging from its hardness, the coal seam may also require some drilling and blasting before the power shovel can dig and place the coal in the haul trucks. The coal would probably require some form of benification such as washing, crushing and blending before loading, based upon the observed locally high sulphur content.

Earth shaping and additional reclamation is carried out by leveling and grading the spoil piles using bulldozers, graders, and tractor seeders. Grading requirements are reduced if the dragline boom is long enough to allow the operator to drop the spoils in less of a peak/trough fashion.

At the Emery site, multiple seam strip mining is envisaged since coal seams are close enough together, thick enough, and not far from the surface permitting economical extraction.

Dewatering

The digging of both the overburden and the coal seams at the Emery site would evidently interrupt ground water flow by the removal of sections of small perched aquifers as well as by removal of outcropping edges and cracks serving as recharge areas. The elimination of some small springs feeding into local creeks could result, but this is questionable considering the baseline data available. The removal of the necessary overburden should not effect the artesian pressure of the confined Ferron aquifer to the east.

Summary of the Situation on the Emery Study Site

One must first attemp to summarize the relevant portion of the preceding baseline study to assess the reclamation problems and alternatives. One must start with the definition of which areas in fact represent strippable coal, and whether these are actually typical of the Emery coal field at large. With respect to the site itself, the NW and SE portions of the

site appear to meet criteria for stripping (Figure 30). The northwestern area is the only part of the site containing the Blue Gate Shale (Persayo-Chipeta) soil derivatives. However, this appears to be the dominant soil type over the larger strippable resources between the town of Emery and the study site. Thus, although not statistically significant over the study site, at least one of the defined strippable areas is representative of this "worst case" soil type. As a topsoil it appears to be nearly worthless, having the highest salinity (Figure 37), shrink swell potential (Figure 44), and lowest available moisture. It may have some value in creating permeability barriers in site reconstruction if its salinity can be tolerated, but as a topsoil it either requires amendment or disposal.

With regard to the drainage subbasin disrupted by the stripping of the NW strippable area, these would be subbasins B and C of Figure 18. Subbasin C is the Miller Canyon drainage with an area within the study zone of 1195 acres. One notes that continuation of the presumed coal to the north pinch out line in Figure 29, would intercept Miller Creek. One recalls that Miller Creek has served to carry away irrigation water from the agricultural areas to the north and has been capturing small stream drainage as it erodes to the north and they change their channel geometry due to sediment filling. In this case one is faced with diversion of these waters out of the pit by a bypass west to the town of Emery or a return to Miller Canyon further downstream, undoubtedly a more expensive option. If the mine "makes" significant water, this must be added to the diversion. If the first option is chosen, the Miller Canyon Creek would undoubtedly dry up in summer causing loss of the modest riparian habitat previously noted. Perhaps mine water could be used to preserve this habitat if its quality were suitable. This site would be the most visible from the town of Emery (Figure 93). The average slope angle of subbasin C is 8%. The other subbasin involved is subbasin B with an average slope of only 3% over its 1459 acres. However, here no significant streams are involved and prevention of wastes from entering Christiansen Wash by a series of sediment ponds is feasible. For the area the geochemical content of the sampled surface waters are not exceptional.

The second strippable area on the SE corner of the test site, involves

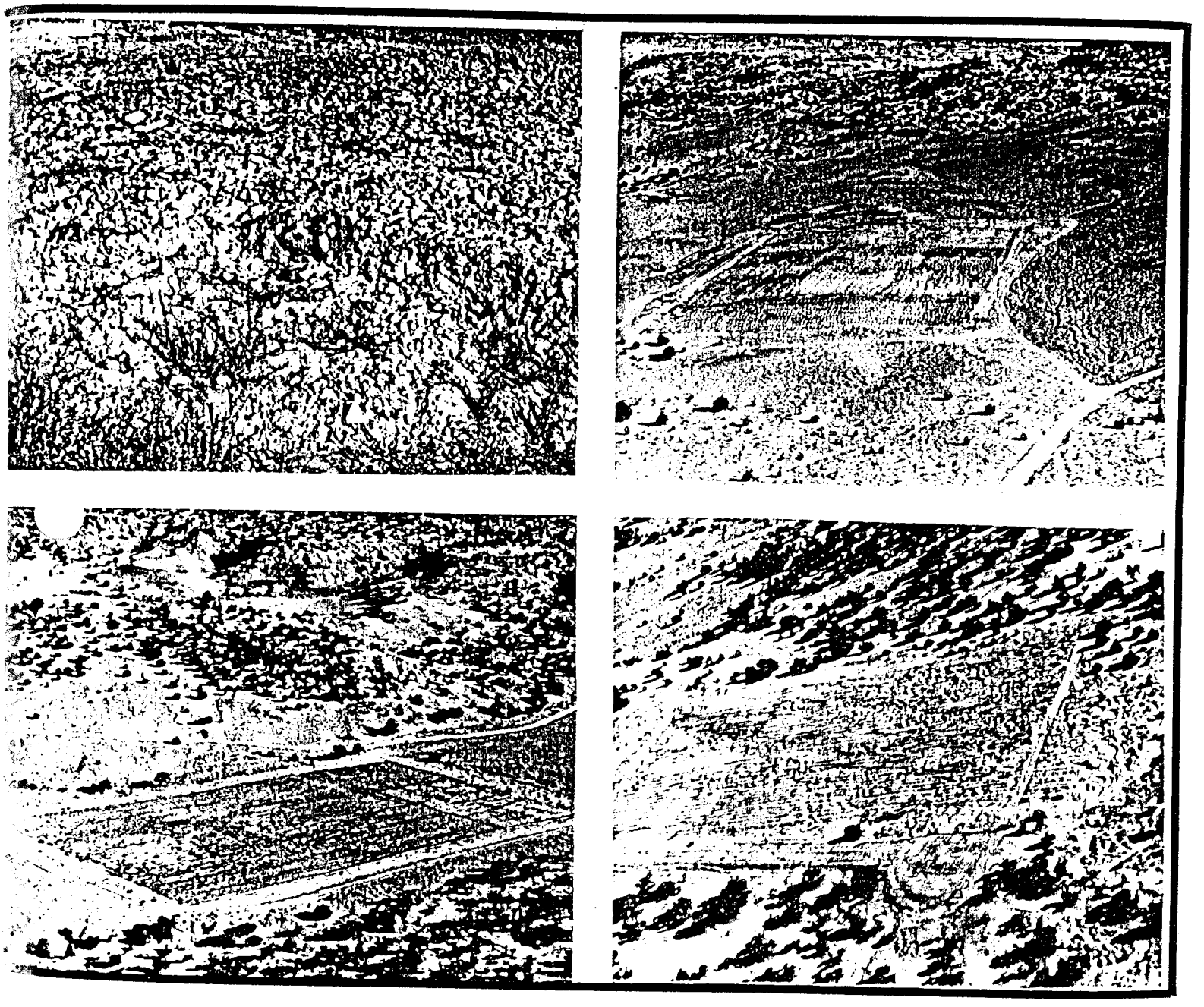
the statistically more typical (for the study site) Castle Valley and Palisade soils. The revegetation test conducted, were essentially on these soils with minor areal exceptions. These experiments certified the soils as reclaimable even with admixture of shallow weathered overburden sandstone, and some shales (Figures 97, 98, 99, and 100. In fact, the bore hole geochemistry for bore holes 5 and 5A indicates the deeper overburden to be (unlike bore hole 3 to the north) a more acceptable soil supplement. But the extremely poor greenhouse results cast doubt on the use of the overburden as a supplement over all the site. Hence in this region, conservation and storage of the topsoil is the obvious choice. The presence of a significant belt of Rock land (Figure 36) over this site would require "stretching" this soil over the Rock land area by amendment and blending with the nutrient poor crushed shallow overburden, fly ash from the adjacent power plants, or as a last choice, some of the less toxic deeper overburden suitably weathered or crushed.

With regard to the drainage subbasins intercepted, these are the smaller subbasins K and N of Figure 29, with areas of 455 and 320 acres respectively, but with higher average slopes (7 and 9%). Any mine discharges would enter the lower reaches of Quitchupah Creek, which by this point, based on the 208 program measurements, has some of the higher trace metal contents overall but only a medial TDS ratio. Note that in GSC's measurements suspended sediment and pH showed significant seasonable variability related to flow.

Finally, although not on the study site, a significant strippable coal resource to the west was noted (Figure 30). These would potentially involve thicker alluvial soil sequences, which if a unitized development were involved, could be borrowed for the topsoil poor strippable regions. The drainage from this site, although the subbasin was not named in the study, would be to the east into Quitchupah Creek; with the same comments as above applying to the surface waters. Here however, it is conceivable that the confined Ferron Sandstone aquifer, with artesian flow could be impacted (Figures 80 and 81). Hence a more significant ground water disposal problem is implicit during mine dewatering and a potential hazard is possible to the municipal water supply of Emery by downward seepage into unsealed vertical joints. Extremely high iron contents were noted in surface waters in the area (Figure 73). These may be taken to indicate the possible presence of other trace elements of greater concern

Figure 97
Simulated Strip Mine
(Note Weathering)

Figure 98
6 Acre Revegetation Site



4 Acre Revegetation Site

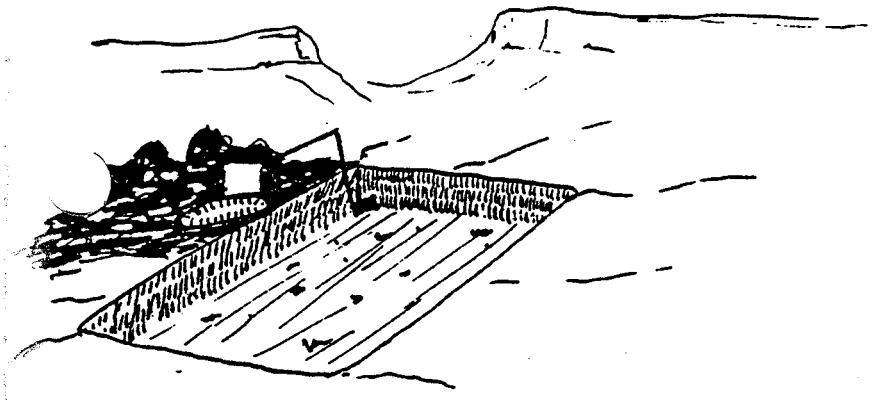
Figure 99

2 Acre Revegetation Site

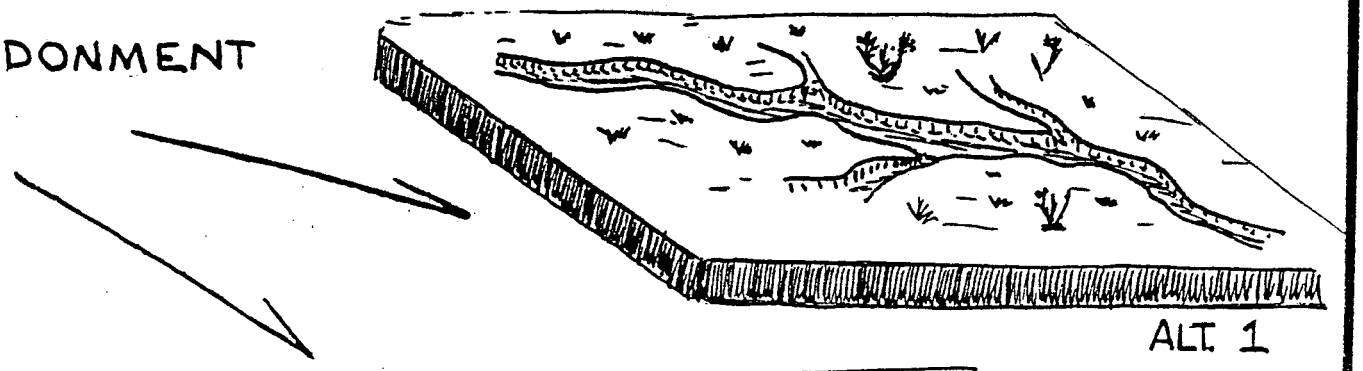
Figure 100

which may be masked by the iron.

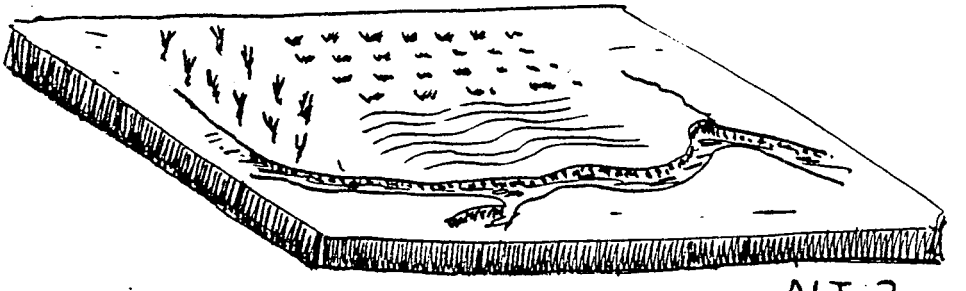
Over all the study area, and implicitly at all the strippable areas, there is the potential vegetation toxicity problem (presumed boron) noted in the greenhouse overburden experiments. This constrains one to use preferably the upper 42 to 45 feet of deeply weathered sandstone, only, as a topsoil supplement, or failing this, a carefully selected segment of deeper overburden. Due to the hole-to-hole variability of overburden geochemistry within a given horizon or "depositional environment", careful testing should precede any such use. The present baseline data are inadequate to the task. The inexplicable geographic variability of the overburden geochemistry from bore hole to bore hole may be interpreted in terms of depositional environments or subsequent reduction or oxidation environments or simply lenses of discrete microdepositional or leaching environments, but that is beyond the scope of this study and in any case hypothetical. Nor does the depositional environment classification adequately segregate these geochemical "classes". Rather it is suggested that the mined spoil be routinely sampled and analyzed to determine the proper management technique to prevent undesirable leachates and suitable methods of disposal or use of the actual layers intercepted. These ideas are systemized in the discussion of reclamation alternatives.



MINE
ABANDONMENT



ALT. 1



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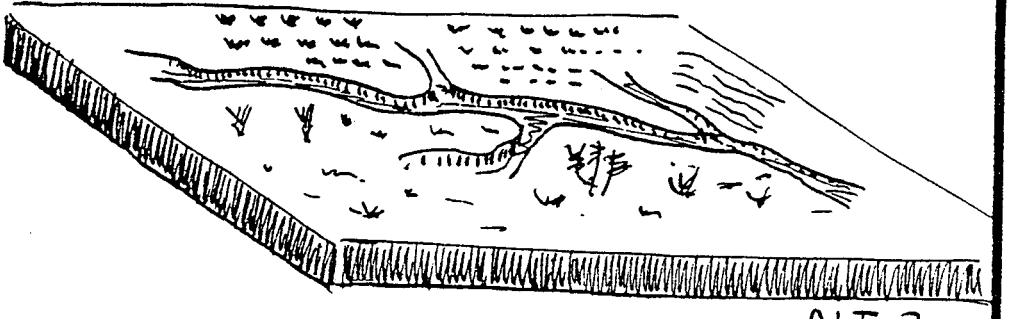

ALT. 3

RECLAMATION ALTERNATIVES

Since the ultimate post-mining land use has not been determined we will consider the major reclamation alternatives in this section. In the ideal case, the physical, chemical, biological, topographical, and hydrological properties of the strip mined site can be nearly perfectly restored. In this case the revegetation problem is no more severe than in the case of restoring a burn area or an area of overgrazing. The literature for the arid shadscale zones of Utah and Nevada is adequate to cover this situation (e.g. Bleak et al., 1965). The problems would be essentially to preserve the topsoil's biological condition while stored and then hold the topsoil from erosion until sufficient vegetative cover can be developed. Usual supplements to this process would be surface gouging for water retention and soil holding, seeding and transplanting of native containerized shrubs, and mulching, with supplemental irrigation as required by rainfall conditions during the revegetation process. What then is unique about the strip mine operation that deserves special consideration, provided that there are no direct land use or habitat conflicts? The primary concerns are hydrologic and revegetative. In the case of the strip mine operation, saturated coal and overburden aquifers must be dewatered, surface drainages rerouted, and water stored or disposed of. Geochemical classification of overburden layers disrupted by the mining and mapping of the surface and subsurface hydrology of the site are the key to successful control of this problem area. Hence a series of site studies have been conducted to determine the variability of these problems sampling from coal field to coal field. The Emery field study evidently justifies this approach in that it poses some unique hydrologic/revegetative problems not experienced elsewhere (viz. Figure 101).

In the first place, as discussed in the vegetation and soils section in greater detail, analysis of the total volume of available topsoil indicates a lack of the recommended minimum topsoil for restoration, due to the thinness of the topsoil cover over some of the potentially strippable areas. Secondly, greenhouse and geochemical tests indicate that the ground overburden (simulated weathering) is the poorest growth medium of any so far tested (R. Heil - Personal Communication, 1979). Despite the incomplete nature of these tests, it is presumed that a substantial quantity of the overburden, in addition to being nutrient deficient, actually contains toxic levels of at least boron. Heil's tests were supplemented on unfertilized overburden samples using native, more salt tolerant, species in lieu of the western wheatgrass tested by Heil. The results were even worse, with

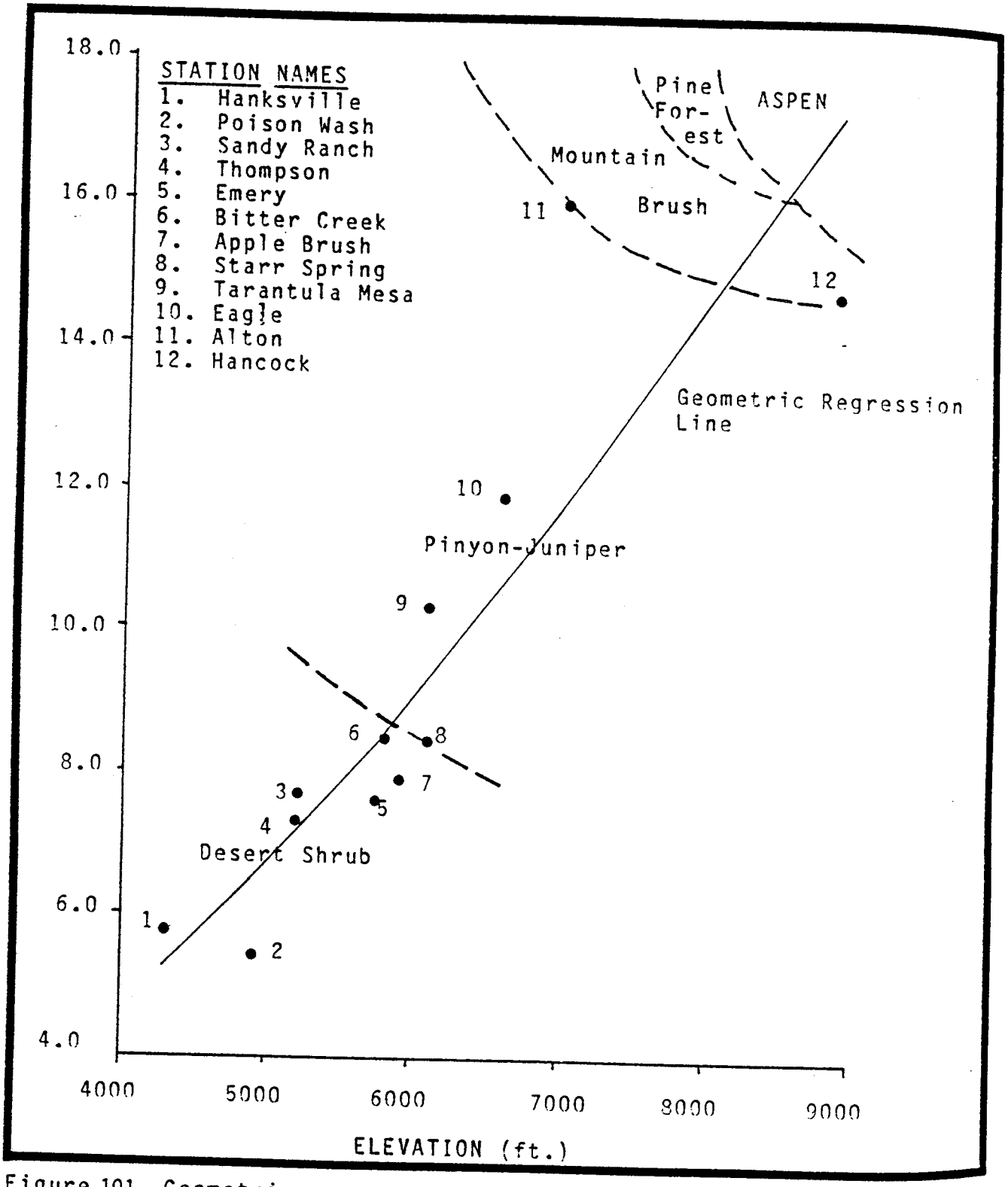

Figure 101- Geometric regression of elevation vs. annual temperature for stations in Central and Southern Utah. Vegetation types are indicated approximately in relation to these two variables.

virtually complete die out of the started seedlings within a few weeks. Evidently overburden for topsoil amendment must be selected very carefully at the Emery site or borrow materials used in their place.

This is not the end of the problem. Even if a suitable topsoil amendment is made up, we cannot simply bury the "toxic" overburden and forget it as suggested in some earlier studies. This would be a risky procedure at the Emery site in particular.

Systemization of Reclamation Alternatives, and Economic Evaluations

1. Actions during the pre and post mining period

Soils/Overburden/Toxic Materials

The key soils problems on the Emery site may be categorized in three ways:

1) The Mancos shale derived soils as they exist on the surface in their natural state are unsuitable physically and chemically as plant growth media, and would pose excessive revegetation hazards.
2) Viewing the strippable areas as units they are deficient in topsoil volume of any type suitable to restore a 30 inch deep soil cover for rooting of shrubs.
3) A significant portion of the overburden appears to have toxic properties. This holds for western wheatgrass, which was used as a control in greenhouse studies and to a lesser but serious extent to native plant species.

The forseeable alternate responses to these problems are shown diagrammatically in Figure102. Review of these alternatives shows that within the range of low to moderate reclamation costs, these reclamation problems could be countered. Land values in the area approximate $100 to $500 per acre, as range land. Benefication of the site by leveling or production of ground water for agricultural uses, could actually increase land values over small areas to the order of the reclamation costs, $1000 to $2000 per acre. This type of reasoning is not actually valid however, since the value of the recovered coal must be factored in, and reclamation is now a legal requirement. According to La Fevers (1978) these new reclamation costs are now in practice reaching $6000/acre at some sites. Recent lease costs for BLM coal are $3,400/acre plus royalties (Coal Age, 1979 - Colstrip So. Montana). For perspective, coal values at the Emery site, assuming a 20 ft. seam could reach

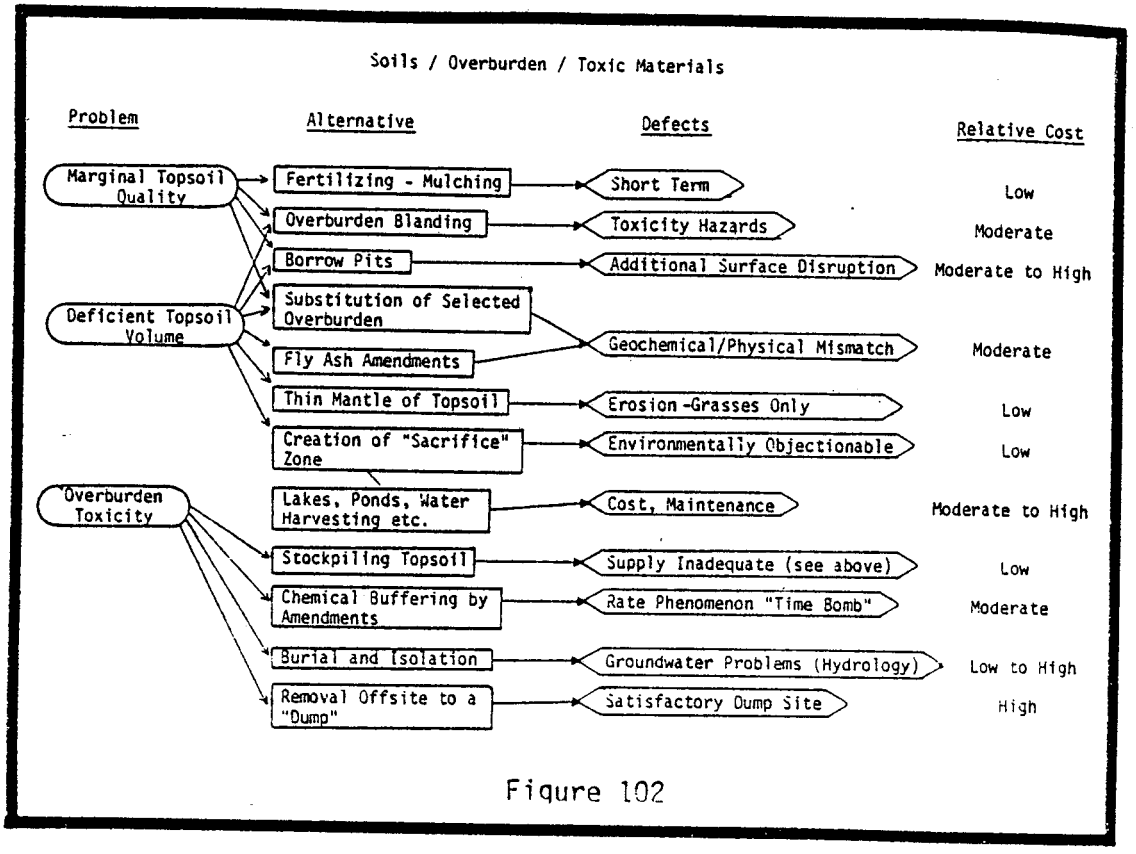

Figure 102

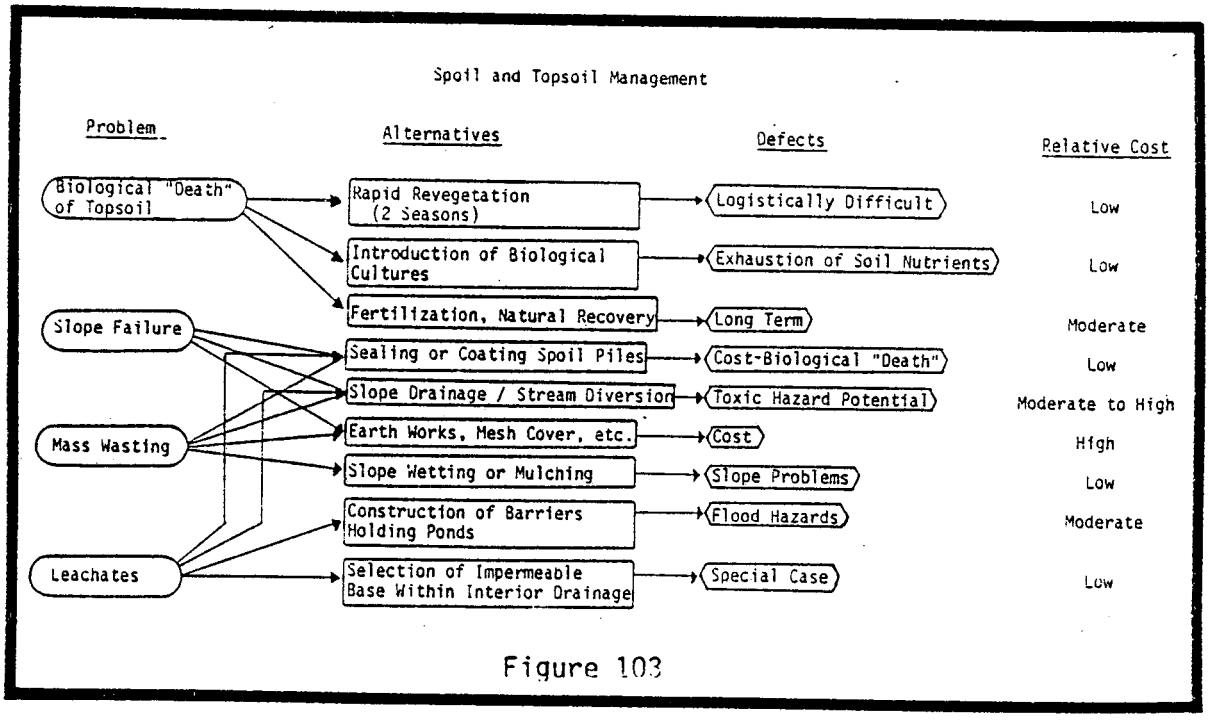

Figure 103

$35,000/acre. Thus a 10% of value allocation to reclamation would be $3500/acre or a 20% allocation of $7000/acre. Top soiling, stockpiling and shaping now becomes the major portion of the cost. The fractional breakdown of these cost estimates is as follows:

Irrigation system cost (if needed)	- $1000/acre	
Backfilling grading	- $1300/acre	
Topsoil handling	- $ 675/acre	Restoring 18" Topsoil
Seeding, Soil amendments	- $ 400/acre	

Spoil and Topsoil Management (Figure 103)

The problems attendant to this area may be defined as follows:

1) Long term storage of topsoil may lead to biological "death" of micro organisms necessary to soil nutrients.
2) Increased infiltration into spoil banks may lead to slope failure, even at normal "angles of repose".
3) Mass wasting of spoil or topsoil erosion may lead to fugitive dust or loss of topsoil, and sediment choking streams.
4) Undesirable leachates may enter streams or the underground water supply.

The spoil management problems are routine aspects of strip mining activities. The biological death and leachate problems are of special concern here.

Surface and Ground Water Reclamation Options (Figure 104)

The hydrologic problems have been touched upon to a degree in prior sections dealing with toxic overburden. The main residual concerns are listed below:

1) Shallow perched aquifers of limited quality are found on the site. They have historical use for watering livestock, maintaining stream and spring flow.
2) Normal precipitation is marginal for successful revegetation, irrigation or increasing moisture retention properties of soils are necessary.
3) A potential for strippable resources west of the study area exists for contamination of deeper confined aquifers.
4) Mine dewatering in the latter case may require disposal of lower quality ground water.

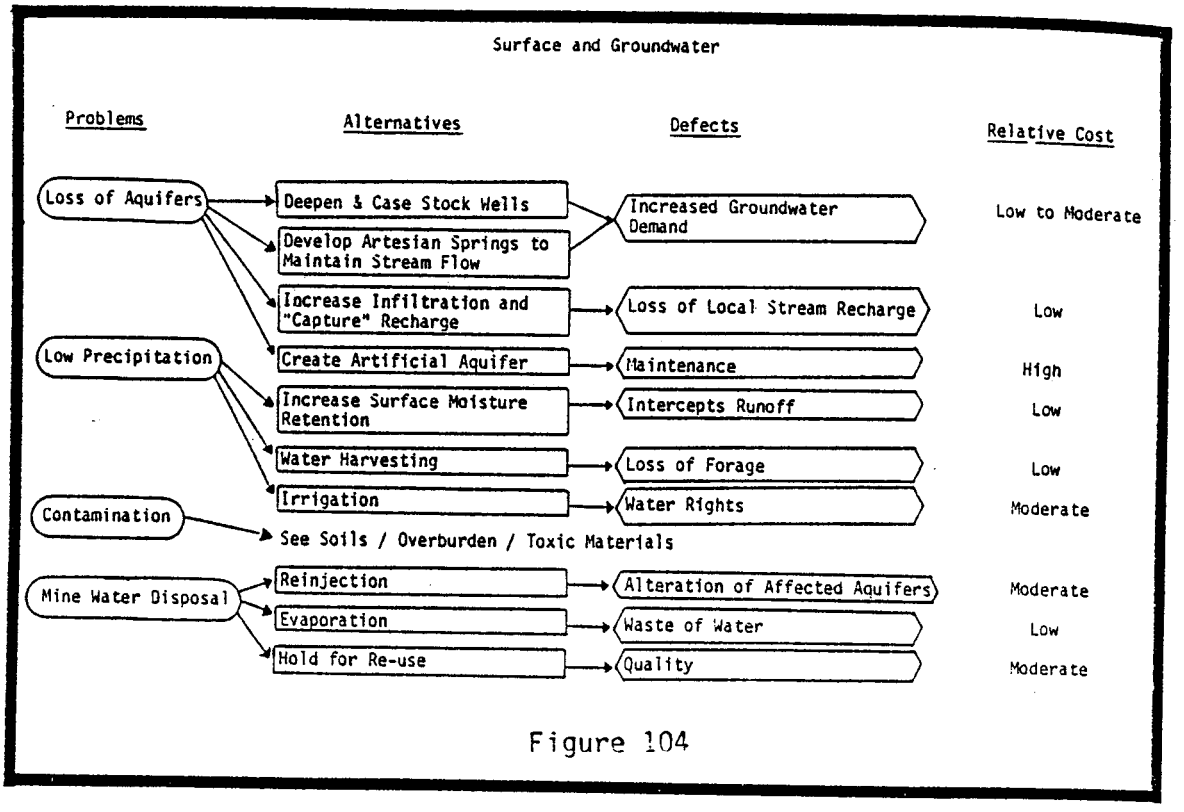

Figure 104

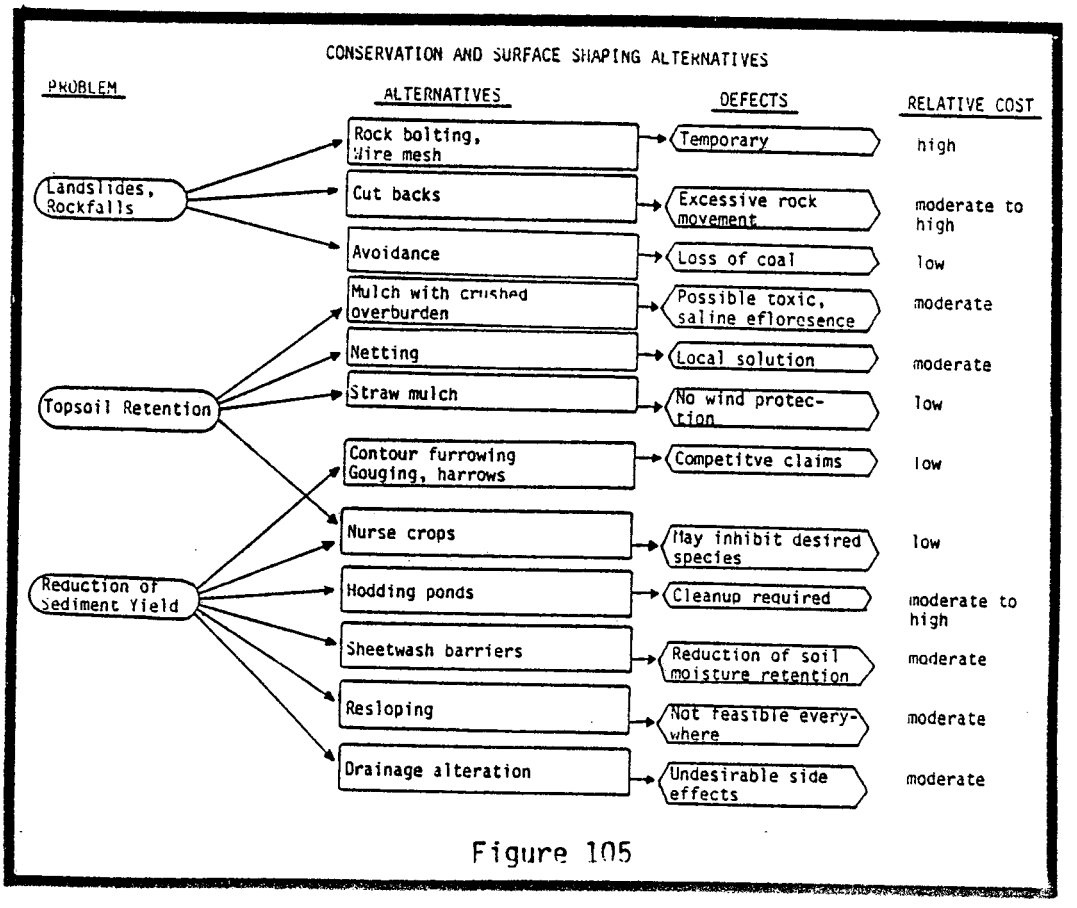

Figure 105

Conservation and Surface Shaping (Figure 105)

The mining operation present the possibility of altering existing surface by landslides, rockfalls, and drainage diversions. Finally stabilization of the surface will involve shaping techniques to hold water and soil, prevent erosion, and avoid high sediment yields. These problems are summarized below:

1) Landslides and rockfalls may result from road cuts, mining operations, etc.
2) Retention of topsoil structure and compliance with regulations on surface restoration is required.
3) Newly prepared surfaces will need protection from erosion until vegetation is established.

Summary of Vegetative Reclamation Recommendations

Pre-Mining

1) Greenhouse studies by Heil (1979), and revegetation experiments by Frischknecht and Ferguson (1979), should be expanded to include test of local varieties of species which are found to be most suited to rehabilitation in the preliminary plots. These should include at least the following shrubs: Atriplex canescens, A. confertifolia, Chrysothamnus nevadensis, and Ceratoides lanata; and these grasses: Hilaria jamesii, Bouteloua gracilis, Oryzopsis hymenoides.

2) Selective breeding of plant species should be considered as a means of developing species most capable of colonizing the barren ground of the post mining landscape. There is on-going research in this area, but it is aimed primarily at restocking depleted rangeland. Particular attention should be focused on developments in this area.

3) Collection of seed stock - Local varieties of native plants have specific adaptations to local climatic and edaphic conditions which increase their potential for survival. Seed stock from selected species should be collected for at least two years prior to stripping of the surface to provide a viable seed supply.

4) Collection of adult plants - Adult plants of selected species should be removed from the site prior to any grading operations. These should be kept alive in a local greenhouse for eventual transplant to the post-mining landscape, and to provide a continuing seed source for

the local variety of each species.

During Mining

1) Existing vegetation (especially pinyon and juniper trees) should be removed and stored for mulching into topsoil. Based on our data, there is at least tons of existing plant material on the study site which could be mixed into the topsoil

2) Timing of mining operations - Removal of topsoil which is to be stockpiled should be timed to follow the period of maximum seed protection. Unfortunately, however, the most plentiful soil, (Castle Valley Series) has only a very sparse understory of shrubs and grasses, and therefore will leave only a small seed stock. However, some of the species produce seed capable of remaining dormant for several years, although the viability of most seed declines with time.

3) Seasons for soil stockpiling - As much as possible, soil stock piling should be confined to the late summer months after all seed has been produced. Soil stockpiling would be most advantageous following wet winters. If stockpiling is to take place following a dry year, it would be advantageous to consider irrigation during the spring in order to produce a seed crop to be stockpiled within the soil.

Post Mining

1) Germination and establishment of specific species depends on the seasonality of rainfall. A seed mixture should be used which takes advantage of rainfall at any time of the year. The seed mixture in Table 36 is proposed.

Table 36

Proposed Seed Mixture

Common Name	lbs./acre
Alkali sacaton	1
Indian ricegrass	2
Russian wildrye	2
Crested wheatgrass	2
Squirreltail grass	1
Blue grama	1
Sand dropseed	2
Shadscale saltbush	3
Fourwing saltbush	2
Nevada ephedra	1
White sage	3

2) Seed for the above mixture should be collected from a wide geographic range, but with a majority from the local area to permit tolerance of local climate. The range of seeds should give the mixture the greatest range of tolerances and potential for successful establishment.

3) Plant materials cleared from the pre-mining landscape should be mulched into the topsoil at the rate of one ton/acre. Alfalfa hay or other organic material should be added to bring the total organic additive content to a minimum of 2 tons per acre. This should alleviate the general N-K-P deficiencies noted, and will prevent wind erosion. Four-wing saltbush has been observed to emerge better and grow taller on spoil so treated (Aldon, 1978).

4) Irrigation should supplement natural rainfall according to the calendar below. This is particularly important in the first post mining year when seedlings lack drought tolerance. Summer irrigation is most critical.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Water (in.)	-	.5	.5	1.5	2	3	4	4	3	1	1	-	20.5

5) Container stock should be planted in small plots (40' x 40') dispersed throughout the site to promote natural reseeding.

6) According to Aldon(1978), drilling is the most common method of planting seeds on reclaimed areas in the west. However, the handbroadcast methods employed here were successful, and appear adequate for the Emery site. In fact cultipacked areas seem to show poorer vegetation vigor than areas not so treated.

7) Figure 106 presents a summary of surface shaping reclamation measures required to comply with new legislation as outlined in Table 34.

Reclamation Checklist

Topsoil Handling

Initially, at least six inches of topsoil must be removed over the pit and stockpiled. Topsoil to qualify for stockpiling must have an exchangeable sodium ratio (SAR) less than 15 (clay ratio less than 40%), and be six inches

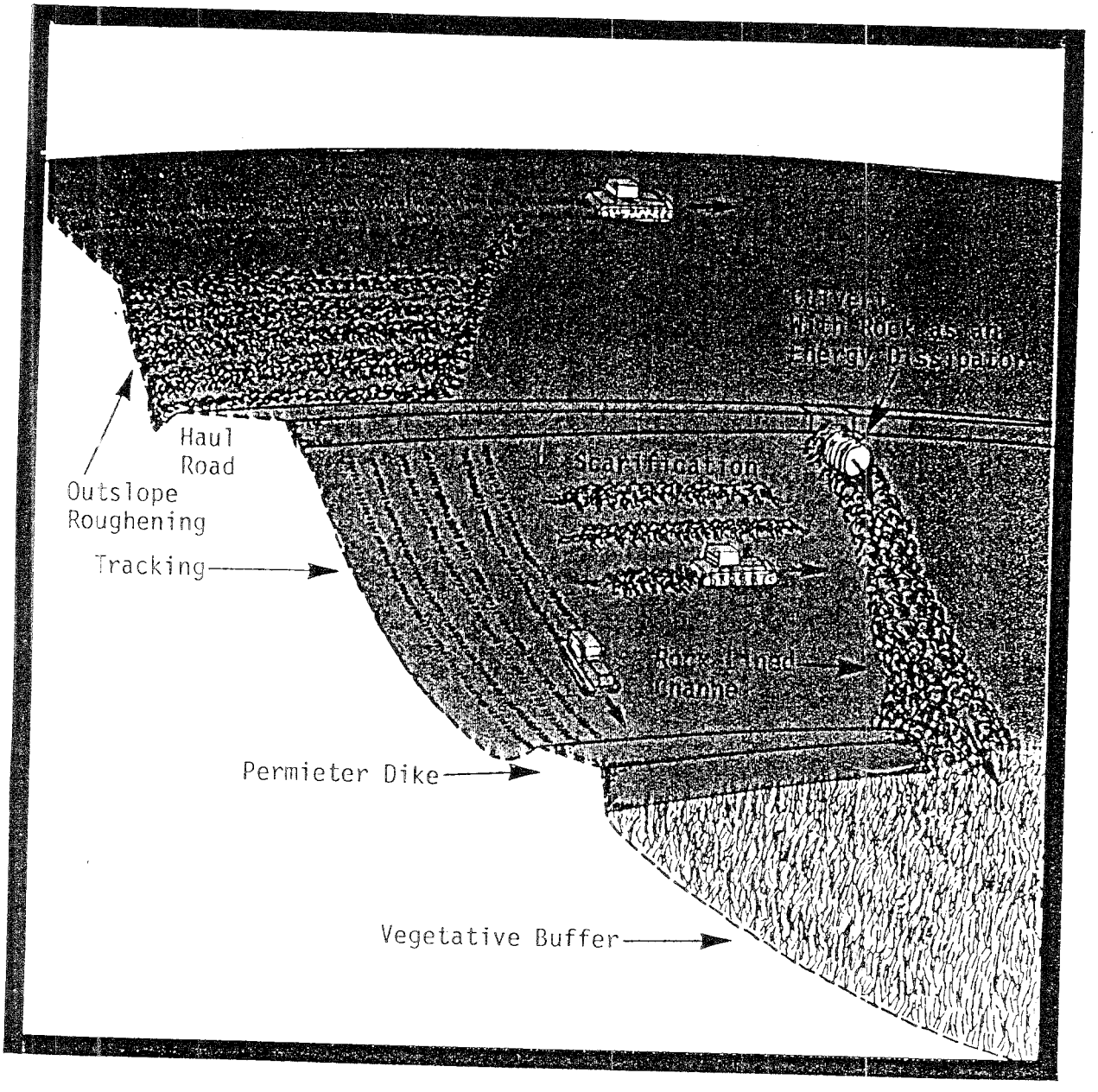

Figure 106. Earth Shaping Measures Required to Comply with Recent Legislation.

or greater in depth. Stockpiled topsoil must be protected from wind and water erosion.

Overburden

In this area the overburden must be tested to determine the presence of adverse contaminants since there are recognized geochemical problems with no clearly defined spatial or layering patterns. Note that at bore hole #5 the delta front marine sequences show plant growth potential virtually throughout, but for no other bore hole (Figure 5). This would imply that suitable materials for topsoil amendment occur above and between the I-J and C coals at this location, which is a strippable site. This does not appear to be the case for the other recognized strippable sites. In these cases, the upper 40 to 60 feet of deeply weathered overburden should be segregated for topsoil amendment, if geochemical tests support such use on a local basis. All such materials deemed suitable should be mapped and graded appropriately in the back fill operations.

Hydrology

Interruption of the Miller Creek drainage by northward extension of the study defined strip area would involve a "head of hollow" fill operation in restoration of the surface. Such a fill would require rock underdrains, spoil compaction at four foot intervals, terrace outslope less than 50%, with terrace widths of at least 20 feet, and the top of the terrace less than 5% slope. The objective would be to have all surface drainage from above the field directed away. The primary concern here would be the introduction of toxic spoil leachates or sediments into what for the area is a significant stream, or disturbance of the "normal" flow of Miller Creek. More generally over the strippable areas the concern is for the runoff during rare summer cloudbursts, or from shallow ground water tables breached by the strip mining operation. During mining with concurrent reclamation, all such discharges are to be contained by a perimeter system of diversion ditches. Regulations now govern allowable pH (6 to 9), iron (7 mg/l), manganese and total suspended solids (/0 mg/l) in such waters. The temporary diversion structures must be designed for a 10 year extreme probability recurrence precipitation event and any permanent diversion construction for a 100 year recurrence interval. Settling ponds, stream

gradients, roughness and the like are required to bring discharged waters to the required standards. In this case, due to the unfavorable greenhouse results, it is also recommended that additional monitoring of boron levels be conducted. It should be noted though (refer back to Figure 49), that many of the streams in the area already exceed the prescribed limits of these substances. There should be some consideration of this in final plans. Such ponds and ditches are to be removed when the land is finally reclaimed. This must also be considered in terms of the surface shaping for long term affects.

Finally, of concern is the longer term problem of ground water contamination due to so-called "toxic" leachates from buried spoil. The operator is now required, by federal statute, to segregate, hold from leaching, and finally bury with at least four feet of cover, any "toxic" material; obviously to protect the shallow ground water. The boron "toxicity" problem, in terms of greenhouse experiments previously discussed in this report, may not qualify any of the Emery overburden material as "toxic" material in the sense of the law. This more relates to the public health water standards noted elsewhere. On the other hand, the second greenhouse crop of salt tolerant species fared more poorly than the less tolerant western wheatgrass on the same spoil sample, which differed only by weathering and leaching. This is of concern, as it implies a potential prompt as well as long term threat to revegetation efforts. The most conservative approach would be to restore as much of the deeply weathered (40 to 60 feet top section) overburden as feasible to serve as a buffer to the unleached overburden. An impermeable barrier should be interposed.

Surface Treatment

The high seasonal wind, and to a lesser extent, rain erosion probabilities affect both spoil heap and reclaimed land surfaces. Measures to counteract such erosion for the site involve either discing or compaction of the of the surface soils as indicated by the specific tests and ripping of barren slopes. In all cases admixture of mulch is indicated, to prevent erosion. Retention and chipping of the native pinyon-juniper would probably cut mulch costs in half. A two step procedure would be to first plant a suitable crop into which native species could be fall seeded. Generally, straw or alfalfa mulch should be applied and lightly disced for anchoring immediately following seeding. Cross crimping of the mulch will hold it

against wind erosion. Fly ash, which is available in the area has been shown to be a suitable substitute for straw mulch elsewhere (Utah International). Modest irrigation (about 2 to 3 inches per year) may be required depending on rainfall actually experienced. The schedule for this irrigation would be May through September at biweekly and finally monthly intervals on an as needed basis. Conventional farm machinery and methods are probably adequate for the task. It has been noted that federal regulations now control natural slope restoration, and erosion protection; as part of the required surface shaping. These goals can be achieved in an integrated operation.

Current Reclamation Practices

A variety of reclamation practices have been successfully demonstrated in the west and no single method seems to be clearly superior at this writing. Rather, the operator should be aware of all of these practices and techniques to recognize those which might be applicable to a particular problem or opportunity (e.g. fly ash availability) that one may encounter. Table 37 gives a summary of current reclamation practices and costs. The mines covered are from the states of Montana, New Mexico, North Dakota, and Wyoming. The source for the information is recent issues of COAL AGE magazine. These data are compiled in a single source as indicated in the reference for the figure.

From the point of view of an analog to the Emery site, the Utah International Navajo mine in New Mexico seems the closest, primarily with regard to precipitation and soils problems. The Emery site, based on the analyses completed, shares the top-soil scarcity, salinity and crusting problems encountered at Navajo Mine. Although all the mines summarized in Table 37 share an approximate 8-12 inch per year rainfall, the seasonal pattern of this rainfall is most significant. At Emery, for example, both spring and summer grasses are present, taking advantage of snowmelt and late summer cloudburst precipitation respectively. Thus one can expect some differences in successful practices, based on climate, soil and topography from mine to mine. Yet the noted variations seem too great to account for all these differences. The range in costs, for example, seems too great for what in some instances appears to be an effectively identical practice.

Further, many of the methods listed appear to have been applied in an experimental mode, and now may have been superceded by more efficient, less costly methods. The common feature in all of these is the use of dual purpose mining or conventional farm machinery, with the possible exception of the hydromulching equipment. Surprisingly, the almost universal lack of irrigation and reliance on conditional rainfall events shows that a long view (5 to 10 years) is taken in successfully revegetation of properly treated areas. However, in the event of a prolonged drought, with increased wind erosion, desication of deeper root zones and loss of cover crops, supplemental measures to what is listed would be required.

Table 37

SUMMARY OF CURRENT RECLAMATION PRACTICES IN WESTERN STRIP MINES

(Adapted from Coal Age Operating Handbook of Surface Mining 1978)

MINE	IRRIGATION	MULCH	PROBLEMS	FERTILIZER	TREATMENT	PLANTINGS	COST	MACHINES
NACCO, ND Indian Head Falkirk Underwood	None	None	P deficiency	18% N 46% P 125 lbs/acre	30 in. topsoil on ripped slopes, grading	nurse crops large grain grass shrubs, trees, forbs	$3500/acre	D-9 Cats, Dozers Scrapers, Farm Tractors, Discs, Harrows, Seeder
Peter-Kiewit, MT Decker Bighorn Rosebud	Hydromulched	Hay-Straw Hydromulched Crimped 200 lbs/acre				grasses containerized shrubs		Terex TS15, TS24, Cat D8, D9, 637, 651, Farm Tractor; Finn 3000 Hydro-mulcher
Bridger, WY	None	Grass-Hay 2 tons/acre	High pH, low iron, high salts, sodium Soil Crusting	None Nitrogen 2nd or 3rd year	Slopes ripped	grasses, legumes	$2500/acre	Cat 657, 638, D9 16 grader, Page 732 drag line (part time use)
Wyodak, WY	None	None		None	Temporary Stabilization w/ Spring Oaks	grasses, alfalfa	$850/acre	
FMC, WY Skull Point		None		None		grasses, forbs, shrubs	$60 to $80 per acre	
Knife River Coal Co., ND Beulah Gascoyne (prelaw)	None			18% N, 36 lbs per acre 46% P, 92 lbs per acre.	Chisel plowed on contour nurse crop	grasses, legumes trees	$1600 to $2400/acre	Cat D8, D9, 637 834, Scrapers, Hough D-126, IH TD-25
Westmoreland, MT Absolaka		None	Minimal June rain erosion	None after establish 30 lb. N, 30 lb. P, per acre	10 lb/acre spring wheat nurse crop, rapid topsoil cycle	grasses, forbs, shrubs		D9 Cats, D8 Dozer Cat Scrapers, Rome 36 in disc, Melrose Seed Drill, Spreader

Table 37 cont.

SUMMARY OF CURRENT RECLAMATION PRACTICES IN WESTERN STRIP MINES (Cont.)

MINE	IRRIGATION	MULCH	PROBLEMS	FERTILIZER	TREATMENT	PLANTINGS	COST	MACHINES
Sunedco-Cordero, WY	Hydromulched	Wood fiber, 1 ton/acre Hay, 2 ton/acre Hydromulch		Leonardite	Hydroseeding, Rapid topsoil cycle, Slope ripping		$500/acre	D9 Cat, 637 Scraper, 824 Dozers, 166 Grader, Bowie Hydro Mulcher, Seed Drill, Farm Tractors, Farm Clodbuster, Harrow
Baukol-Noonan Inc.,ND Center Larson			Minimal erosion	150 lb. Nutro-grow (10-10-5) per acre (Leonardite)	No ripping or terracing Rapid topsoil cycle	grasses, legumes, trees, rye	$3000/acre	D9 Cat, 637 Scraper Hough 500 Dozer, Farm tractors, Drills, Harrows, Cultivators, Discs
Pacific Power & Light, WY	None	Grass/straw blown at 2 ton per acre More on slopes	Wind, water erosion, Moisture retention, N deficiency Thin soil (2")		Fall nurse crop (wheat-barley) Ripping	18 lb. per acre in fall and spring	$2000 to $3000/acre	D9 Ripper, Standard Tractors
Utah International, NM -Navajo Mine	0.08 in/hr every 3rd day (emergence) Then less frequent last two, 30 days apart, Total 10 in. (sprinkler)	Straw blown on 1.5 tons/acre Later changed to bottom ash	Some topsoil unusable due to SAR, Low H_2O retention in sandy top-soil, Rooting in overburden interface	Bottom ash, 12 overburden layers used for amendment, Gypsum manure	Discing prior to seeding and to anchor straw mulch	grasses, forbs shrubs		Conventional hand moved sprinkler, Farm machinery

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GLOSSARY

GLOSSARY

Annual Plant (annuals), A plant that completes its life cycle and dies in 1 year or less.

Aspect, The direction toward which a slope faces. Exposure.

Available Nutrient, The part of the supply of a plant nutrient in the soil that can be taken up by plants at rates and in amounts significant to plant growth.

Available Water, The part of the water in the soil that can be taken up by plants at rates significant to their growth. Usable: obtainable.

Bedrock, Any part of the consolidated geologic formation, soft, weathered or hard that has remained in place and is relatively unchanged.

Broadcast Seeding, Scattering seed on the surface of the soil. Contrast with drill seeding which places the seed in rows in the soil.

Buffer, Substances in soil or water that act chemically to resist changes in reaction or pH.

Calcareous Soil, Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold 0.1 normal hydrochloric acid.

Capillary Water, The water held in the "capillary" or small pores of a soil, usually with tension greater than 60 centimeters of water. Much of this water is considered to be readily available to plants.

CFS, Cubic feet per second - measurement of water flow.

Channel Stabilization, Erosion prevention and stabilization of velocity distribution in a channel, using jetties, drops, revetments, vegetation, and other measures.

Clay (soils) (1) A mineral soil separate consisting of particles less than 0.002 millimeter diameter. (2) A soil textural class. (3) (engineering) A fine-grained soil that has a high plasticity index in relation to the liquid limits.

Compaction, The closing of the pore spaces among the particles of soil and rock, generally caused by running heavy equipment over the area, as in the process of leveling the overburden material of strip mine banks.

Companion Crop (See Nurse Crop)

Conifer, A tree belonging to the order Coniferae, usually evergreen with cones and needle-shaped or scale-like leaves and producing wood known commercially as "softwood."

Contour, An imaginary line connecting points of equal height above sea level as they follow the relief of the terrain.

Cool-Season Plant, A plant that makes its major growth during the cool portion of the year, primarily in the spring but in some localities in the winter.

Deciduous, Refers to a tree that sheds all its leaves every year at a certain season.

Deep Chiseling, Deep chiseling is a surface treatment that loosens compacted spoils. The process creates a series of parallel slots on the contour in the spoils surface which impedes water flows and markedly increases infiltration.

Density, Forage, The percent of ground surface which appears to be completely covered by vegetation when viewed directly from above.

Density, Stand, Density of stocking expressed in number of trees per acre.

Broadcast Seeding, A method of establishing a stand of vegetation by sowing seed on the ground surface.

Dissolved Solids, The difference between the total and suspended solids in water.

Disturbed Land, Land on which excavation has occurred or upon which overburden has been deposited, or both.

Dozer or Bulldozer, Tractor with a stell plate or blade mounted on the front end in such a manner that it can be used to cut into earth or other material and move said material primarily forward by pushing.

Ecology, The science that deals with the mutual relation of plants and animals to one another and to their environment.

Ecosystem, A total organic community in a defined area or time frame.

Effective Precipitation, That portion of total precipitation that becomes available for plant growth. It does not include precipitation lost to deep percolation below the root zone or to surface runoff.

Effluent, Any water flowing out of the ground or from an enclosure to the surface flow network.

Environment, All external conditions that may act upon an organism or soil to influence its development, including sunlight, temperature, moisture and other organisms.

Erodibility, The relative ease with which one soil erodes under specified conditions of slope as compared with other soils under the same conditions; this applies to both sheet and gully erosion.

Erosion, The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Detachment and movement of soil or rock fragments by water, wind or ice, or gravity.

Essential Element (plant nutrition), A chemical element required for the normal growth of plants.

Evapotranspiration, A collective term meaning the loss of water to the atmosphere from both evaporation and transpiration by vegetation.

Excavation, The act of removing overburden material.

Fertilizer, Any natural or manufactured material added to the soil in order to supply one or more plant nutrients.

Fertilizer Grade, The guaranteed minimum analysis in whole numbers, in percent, of the major plant nutrient elements contained in a fertilizer material or in a mixed fertilizer. For example, a fertilizer with a grade of 20-10-5 contains 20 percent nitrogen (N), 10 percent available phosphoric acid (P_2O_5), and 5 percent water-soluble potash (K_2O). Minor elements may also be included. Recent trends are to express the percentages in terms of the elemental fertilizer (nitrogen (N), phosphorous (P), and potassium (K)).

Fill, Depth to which material is to be placed (filled) to bring the surface to a predetermined grade. Also, the material itself.

Forage, Unharvested plant material which can be used as feed by domestic animals. Forage may be grazed or cut for hay.

Forest Land, Land bearing a stand of trees at any age or stature, including seedlings and of species attaining a minimum of 6 feet average height at maturity or land from which such a stand has been removed but on which no other use has been substituted. The term is commonly limited to land not in farms; forests on farms are commonly called woodland or farm forests.,

Germination, Sprouting; beginning of growth.

Gradation, A term used to describe the series of sizes into which a soil sample can be divided.

Grain Size, Physical size of soil particle, usually determined by either sieve or hydrometer analysis.

Ground Cover, Any living or dead vegetative material producing a protecting mat on or just above the soil surface.

Ground Water, Subsurface water occupying the saturation zone, from which wells and springs are fed. In a strict sense the term applies only to water below the water table. Also called plerotic water; phreatic water.

Growing Season, Determined by the Lowery-Johnson Method.

Gully Erosion, Removal of soil by running water, with formation of deep channels that cannot be smoothed out completely by normal cultivation.

Hydroseeding, Dissemination of seed hydraulically in a water medium. Mulch, lime, and fertilizer can be incorporated into the sprayed mixture.

Impervious, Prohibits fluid flow.

Infiltration, Water entering the ground water system through the land surface.

Intermittent Stream, A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and is dry for a large part of the year.

Land Classification, Classification of specific bodies of land according to their characteristics or to their capabilities for use. A use capability classification may be defined as one based on both physical and economic considerations according to their capabilities for man's use, with sufficient detail of categorical definition and cartographic (mapping) expression to indicate those differences significant to men.

Land Use Planning, The development of plans for the uses of land that, over long periods, will best serve the general welfare, together with the formulation of ways and means for achieving such uses.

Leaching, The removal of materials in solution by the passage of water through soil.

Leachate, Liquid that has percolated through a medium and has extracted dissolved or suspended materials from it.

Legume, A member of the legume or pulse family, leguminosae. One of the most important and widely distributed plant families. Includes many valuable food and forage species, such as the peas, beans, peanuts, clovers, alfalfas, sweet clovers, lespedezas, vetches and kudzu. Practically all legumes are nitrogen-fixing plants.

Lime, Lime, from from the strictly chemical standpoint, refers to only one compound, calcium oxide (CaO); however, the term lime is commonly used in agriculture to include a great variety of materials which are usually composed of the oxide, hydroxide, or carbonate of calcium or of calcium and magnesium. The most commonly used forms of agricultural line are ground limestone, marl, and oyster shells (carbonates), hydrated lime (hydroxides), and burnt lime (oxides).

Quicklime	- limestone + heat (calcined) CaO
Hydrated lime	- quicklime + H_2O $Ca(OH)_2$
Slaked lime	- same as hydrated but slaking equipment is used for adding water
Milk of lime	- water mixture containing lime in solution + lime in suspension

Micro-Climate, A local climatic condition near the ground resulting from modification of relief, exposure, or cover.

Micro-Nutrients, Nutrients in only small, trace, or minute amounts.

Mined-Land, Land with new surface characteristics due to the removal of mineable commodity by surface mining methods and subsequent surface reclamation.

Mulch, A natural or artificial layer of plant residue or other materials placed on the soil surface to protect seeds, to prevent blowing, to retain soil moisture, to curtail erosion, and to modify soil temperature.

Natural Revegetation, Natural reestablishment of plants; propagation of new plants over an area by natural processes.

Natural Seeding (Volunteer), Natural distribution of seed over an area.

Neutralization, The process of adding an acid or alkaline material to water or soil to adjust its pH to a neutral position.

Neutral Soil, A soil in which the surface layer, at least to normal plow depth, is neither acid nor alkaline in reaction. For most practical purposes, soil with a pH ranging from 6.6 through 7.3.

Nitrogen Fixation, The conversion of atmospheric (free) nitrogen to nitrogen compounds. In soils the assimilation of free nitrogen from the air by soil organisms (making the nitrogen eventually available to plants). Nitrogen fixing organisms associated with plants such as the legumes are called symbiotic; those not definitely associated with plants are called nonsymbiotic.

Nurse Crop, A planting or seeding that is used to protect a tender species during its early life. A nurse crop is usually temporary and gives way to the permanent crop. Sometimes referred to as a companion crop.

Nutrients, Any element taken into a plant that is essential to its growth.

Overburden, The earth, rock, and other materials which lie above the coal.

Percolation, Downward movement of water through soils.

Permeability, The measure of the capacity for transmitting a fluid through the substance. In this report the substance is overburden (soil and bedrock).

pH, The symbol or term refers to a scale commonly used to express the degrees of acidity or alkalinity. On this scale pH of 1 is the strongest acid, pH of 14 is the strongest alkali, pH of 7 is the point of neutrality at which there is neither acidity or alkalinity. pH is not a measure of the weight of acid or alkali contained in or available in a given volume.

Pollution, Environmental degradation resulting from man's activities or natural events.

Pond, A body of water of limited size either naturally or artificially confined and usually smaller than a lake.

Rain (1) Heavy--Rain which is falling at the time of observation with an intensity in excess of 0.30 in. per hr (over 0.03 inch in 6 min). (2) Light--Rain which is falling at the time of observation with an intensity of between a trace and 0.10 in. per hr (0.01 inch in 6 min). (3) Moderate--Rain which is falling at the time of observation with an intensity of between 0.11 in. per hr (0.01+ inch in 6 min) and 0.30 in. per hr (0.03 inch in 6 min).

Range Land, The natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs.

Percolation Rate, Usually expressed as a velocity, at which water moves through saturated granular material. The term is also applied to quantity per unit or time of such movement, and has been used erroneously to designate infiltration rate or infiltration capacity.

Reclamation, The process of reconverting mined land to its former or other productive uses.

Reconstructed Profile, The result of selective placement of suitable overburden material on reshaped spoils.

Recreation Land, Land and water used, or usable primarily as sites for outdoor recreation facilities and activities.

Reforestation, The natural or artificial restocking of an area with forest trees.

Regrading, The movement of earth over a depression to change the shape of the land surface. A finer form of backfilling.

Rehabilitation, Implies that the land will be returned to a form and productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.

Strip Mining (See Surface Mining)

Stripping, The removal of earth or non-ore rock materials as required to gain access to the ore or mineral materials wanted. The process of removing overburden or waste material in a surface mining operation.

Subsoil, The B horizon of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil) in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as "subsoil."

Substratum, Alluvial, colluvial and bedrock material that lies below the soil profile.

Surface Soil, That part of the upper soil of arable soils commonly stirred by tillage implements or an equivalent depth (5 to 8 inches) in non-arable soils.

Suspended Solids, Sediment which is in suspension in water but which will physically settle out under quiescent conditions (as differentiated from dissolved material).

Terrace, Sloping ground cut into a succession of benches and steep inclines for purposes of cultivation or to control surface runoff and minimize soil erosion.

Terraced Slope, A slope that is intersected by one or more terraces.

Texture, The character, arrangement and mode of aggregation of particles which make up the earth's surface.

Topdressing Material, Material that is well suited for plant media. Desired characteristics include: fertile, good tilth, permeable, contains organic matter, nonsaline, nonsodic and has water stable aggregates.

Tilth, The physical condition of a soil in respect to its fitness for the growth of a specified plant.

Topography, The shape of the ground surface, such as hills, mountains or plains. Steep topography indicates steep slopes or hilly land; flat topography indicates flat land with minor undulations and gentle slopes.

Revegetation, Plants or growth which replaces original ground cover following land disturbance.

Ripping, The act of breaking, with a tractor-drawn ripper or long angled steel tooth, compacted soils or rock into pieces small enough to be economically excavated or moved by other equipment as a scraper or dozer.

Runoff, That portion of the rainfall that is not absorbed by the deep strata: is utilized by vegetation or lost by evaporation or may find its way into streams as surface flow.

Saline-Sodic Soil, A soil having a combination of a harmful quantity of salts and either a high degree of sodicity or a high amount of exchangeable sodium, or both, so distributed in the soil profile that the growth of most crop plants is less than normal.

Saline Soil, A soil containing enough soluble salts to impair its productivity for plants but not containing an excess of exchangeable sodium.

Sandstone, A cemented or otherwise compacted detrital sediment composed predominantly of quartz grains, the grades of the latter being those of sand.

Saturation, Completely filled; a condition reached by a material, whether it be in solid, gaseous, or liquid state, which holds another material within itself in a given state in an amount such that no more of such material can be held within it in the same state. The material is then said to be saturated or in a condition of saturation.

Sediment, Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Sediment Basin, A reservoir for the confinement and retention of silt, gravel, rock, or other debris from a sediment-producing area.

Seedbed, The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Seep, A more or less poorly defined area where water oozes from the earth in small quantities.

Shale, Sedimentary or stratified rock structure generally formed by the consolidation of clay or clay-like material.

Silt, Small mineral soil grains the particles of which range in diameter from 0.05 to 0.002 mm (or 0.02-0.002 mm in the international system).

Soil (See Acid Soil and Alkaline Soil), Surface layer of the earth, ranging in thickness from a few inches to several feet composed of finely divided rock debris mixed with decomposing vegetative and animal matter which is capable of supporting plant growth.

Soil Conserving Crops, Crops that prevent or retard erosion and maintain or replenish rather than deplete soil organic matter.

Soil Porosity, The degree to which the soil mass is permeated with pores or cavities. It is expressed as the percentage of the whole volume of the soil which is unoccupied by solid particles.

Soil Profile, A vertical section of the soil through all its horizons and extending into the parent material.

Soil Structure, The combination or arrangement of primary soil particles into secondary particles, units, or beds.

Solum, The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons. Usually the characteristics of the material in these horizons are quite unlike those of the underlying parent material. The living roots and other plant life and animal life characteristic of the soil are largely confined to the solum.

Spoil, The overburden or non-coal material removed in gaining access to the coal or mineral material in surface mining.

Spoil Bank (Spoil Pile), Area created by the deposited spoil or overburden material prior to backfilling. Also called cast overburden.

Stratified, Composed of, or arranged in, strata or layers, as stratified alluvium. The term is applied to geological materials. Those layers in soils that are produced by the processes of soil formation are called horizons, while those inherited from parent material are called strata.

Strip, To mine a deposit by first taking off the overlying burden.

Strip Mine, Refers to a procedure of mining which entails the complete removal of all material from over the product to be mined in a series of rows or strips; also referred to as "open cut," "open pit," or "surface mine."

Toxic Spoil (See also Acid Spoil), Includes acid spoil with pH below 4.0. Also refers to spoil having amounts of minerals such as aluminum, manganese, and iron that adversely affect plant growth.

Transpiration, The normal loss of water vapor to the atmosphere from plants.

Unconsolidated (soil material), Soil material in a form of loose aggregation.

Vegetation, General term including grasses, legumes, shrubs, trees naturally occurring and planted intentionally.

Vegetative Cover, The entire vegetative canopy on an area.

Volunteer, Springing up spontaneously or without being planted; a volunteer plant.

Weathering, The group of processes, such as chemical action of air and rainwater and of plants and bacteria and the mechanical action of changes in temperature, whereby rocks, on exposure to the weather, change in character, decay, and finally crumble.

Wildlife, Undomesticated vertebrate animals, except fish, considered collectively.

APPENDICES

APPENDIX 1

Precipitation by Months at Emery, Utah

Precipitation by Months at Emery, Utah (38°55 N, 111°15 W, 1893 m MSL)

	OCT	NOV	DEC	JAN	FEB	MAR	WINTER	APR	MAY	JUN	JUL	AUG	SEP	SUMMER	YEAR
1901-02	T	T	0.00	0.10	T	0.10	0.20	0.00	T	0.00	T	0.45	T	0.45	0.65
1902-03	T	0.29	T	T	0.40	0.26	0.95	T	0.65	0.85	0.72	T	1.52	3.74	4.69
1903-04	1.03	0.00	0.00	T	T	T	1.03	T	0.74	1.30	T	0.93	0.76	3.73	4.76
1904-05	0.75	0.00	0.40	0.08	3.01	0.62	4.86	0.39	0.70	0.00	T	0.90	0.65	2.64	7.50
1905-06	T	0.48	0.40	1.73	0.20	1.30	4.11	2.07	0.75	T	0.75	1.28	1.40	6.25	10.36
1906-07	0.60	2.00	1.70	1.10	0.90	0.34	6.64	0.40	1.52	0.55	1.06	1.91	0.90	6.34	12.98
1907-08	1.83	0.10	0.20	0.10	0.80	T	3.03	0.20	0.20	T	0.77	2.00	1.05	4.22	7.25
1908-09	1.02	0.40	0.40	1.00	1.33	T	4.15	T	T	0.65	0.75	5.42	3.48	10.30	14.45
1909-10	0.00	0.50	1.70	0.30	0.20	T	2.70	0.00	T	0.45	0.20	1.35	1.44	3.44	6.14
1910-11	0.95	0.65	0.50	0.70	0.50	0.30	3.60	0.20	0.00	1.55	1.95	1.05	1.55	6.30	9.90
1911-12	0.00	T	0.20	T	0.70	1.40	2.30	0.10	0.83	T	2.03	1.00	0.70	4.69	6.99
1912-13	1.01	0.10	0.22	0.20	0.70	0.40	2.63	0.52	T	0.35	1.22	0.70	0.20	2.99	5.62
1913-14	0.90	0.20	1.80	0.80	T	T	3.70	0.88	0.85	1.50	2.11	0.80	1.65	7.79	11.49
1914-15	0.35	T	T	0.70	1.40	T	2.45	0.30	0.97	0.60	T	0.20	1.84	3.91	6.36
1915-16	T	1.17	0.70	2.50	0.09	1.36	5.82	T	0.00	0.00	1.12	0.83	0.56	2.51	8.33
1916-17	3.85	T	0.40	0.38	0.30	0.10	5.03	2.60	2.23	0.20	1.75	0.15	1.72	8.65	13.68
1917-18	0.00	0.00	0.00	0.40	T	1.97	2.37	0.65	T	T	1.74	1.30	1.10	4.79	7.16
1918-19	1.23	0.50	0.20	0.00	1.60	0.22	3.75	T	0.71	0.00	1.13	1.86	2.11	5.81	9.56
1919-20	T	0.68	0.18	0.35	0.30	T	1.51	0.25	0.60	0.50	0.15	0.85	0.25	2.60	4.11
1920-21	0.97	0.00	0.50	0.10	0.00	T	1.57	0.30	0.10	T	----	----	----	----	----
1921-22	----	T	1.00	0.27	1.21	0.28	----	1.00	1.30	0.03	0.30	1.30	0.25	4.18	6.94
1922-23	0.20	0.60	0.40	0.25	0.70	T	2.15	0.30	0.60	0.00	1.36	1.26	0.60	4.12	6.27
1923-24	0.55	0.52	0.30	0.28	0.20	0.78	2.63	0.10	0.00	0.00	0.83	0.44	1.00	2.37	5.00
1924-25	0.50	0.25	1.19	T	0.43	0.15	2.52	0.18	0.00	1.59	1.12	1.55	0.99	5.43	7.95
1925-26	1.30	0.10	T	T	0.60	0.62	2.62	1.05	0.00	0.17	0.71	0.47	T	2.40	5.02

Precipitation by Months at Emery, Utah (cont.)

	OCT	NOV	DEC	JAN	FEB	MAR	WINTER	APR	MAY	JUN	JUL	AUG	SEP	SUMMER	YEAR
1926-27	0.21	0.25	0.63	0.16	0.73	1.26	3.24	0.00	0.00	1.95	1.15	1.74	2.07	6.91	10.15
1927-28	1.27	0.00	0.15	0.15	1.25	0.95	3.77	0.00	4.00	0.00	0.00	0.70	0.22	4.92	8.69
1928-29	1.15	0.40	0.15	0.61	0.60	0.72	3.63	0.10	0.75	0.00	0.25	1.21	1.18	3.49	7.12
1929-30	T	0.00	0.45	1.70	0.00	0.25	2.40	0.90	1.07	1.08	1.01	2.50	1.75	8.31	10.71
1930-31	0.30	0.40	0.00	T	0.25	0.60	1.55	0.10	0.00	0.05	0.45	0.16	0.20	0.96	2.51
1931-32	0.62	0.18	0.55	0.51	0.96	0.05	2.87	0.05	0.00	0.10	2.14	2.31	0.15	4.75	7.62
1932-33	0.50	0.00	0.77	1.16	0.57	0.20	3.20	0.15	0.80	0.00	2.15	0.88	1.13	5.11	8.31
1933-34	0.24	0.65	T	0.34	0.30	0.00	1.53	0.10	1.40	0.45	0.17	0.82	0.27	3.21	4.74
1934-35	T	0.15	0.10	0.12	0.32	1.13	1.82	1.17	0.57	0.00	0.59	0.85	0.30	3.48	5.30
1935-36	0.00	0.16	0.45	0.19	0.19	0.24	0.94	T	0.65	0.56	2.78	1.29	0.33	5.61	6.55
1936-37	1.10	0.00	1.54	0.70	0.43	0.47	4.24	0.00	0.55	0.50	1.98	1.65	1.10	5.78	10.02
1937-38	0.50	0.00	0.81	0.70	0.45	0.72	3.18	0.46	0.08	0.63	0.69	1.05	1.49	4.40	7.58
1938-39	1.09	0.15	0.33	1.03	0.47	0.43	3.50	0.62	0.21	0.00	0.68	0.95	2.75	5.21	8.71
1939-40	0.60	0.25	T	0.65	0.70	0.00	2.15	0.15	0.38	0.80	0.08	0.75	2.59	4.75	6.80
1940-41	1.13	0.45	0.63	0.92	0.70	0.92	4.75	2.10	1.78	1.40	0.49	2.63	1.44	9.84	14.59
1941-42	3.58	T	0.88	0.11	0.30	0.24	6.11	0.36	0.03	0.00	0.74	0.33	0.67	2.13	8.24
1942-43	1.23	T	0.00	0.46	T	0.92	2.61	0.49	0.20	0.70	0.35	0.90	0.53	3.17	5.68
1943-44	0.50	0.69	0.21	1.01	0.32	0.55	3.28	0.62	T	1.30	0.20	0.12	0.00	2.24	5.52
1944-45	0.37	0.00	T	0.30	0.30	1.00	1.97	0.61	0.03	0.62	0.55	0.78	0.35	2.94	4.91
1945-46	1.32	0.17	0.70	0.37	0.00	0.63	3.19	0.17	0.81	0.00	0.13	0.74	T	1.85	5.04
1946-47	0.90	1.48	0.20	T	0.10	T	2.68	0.46	0.97	1.90	0.58	5.47	0.00	9.38	12.06
1947-48	0.79	0.50	1.14	T	0.85	0.50	3.78	T	T	0.42	0.29	0.80	0.07	1.58	5.36
1948-49	1.47	T	0.80	1.70	0.96	0.55	5.48	0.11	1.06	0.38	1.03	0.79	0.47	3.84	9.32
1949-50	0.71	T	1.38	0.20	0.03	T	2.32	T	0.21	0.00	1.94	0.78	0.30	3.23	5.55
1950-51	0.00	0.59	0.52	0.22	0.17	0.34	1.79	0.16	1.95	0.14	0.10	2.54	0.36	5.25	7.04

Precipitation by Months at Emery, Utah (cont.)

	OCT	NOV	DEC	JAN	FEB	MAR	WINTER	APR	MAY	JUN	JUL	AUG	SEP	SUMMER	YEAR
1951-52	0.97	1.04	1.08	0.76	0.05	1.37	5.27	0.16	0.05	1.25	0.20	0.62	1.41	3.69	8.96
1952-53	0.00	0.48	0.73	0.22	0.06	0.35	1.84	0.27	0.14	0.46	0.87	1.49	0.00	3.23	5.07
1953-54	1.29	0.47	0.48	0.47	0.00	0.65	3.36	0.59	1.03	0.83	0.45	0.51	1.91	5.32	8.68
1954-55	0.14	0.35	0.67	0.61	1.12	0.00	2.89	0.00	0.20	0.47	0.31	2.18	0.47	3.63	6.52
1955-56	0.00	0.16	0.61	1.11	0.21	0.00	2.09	0.53	0.21	0.03	0.20	0.12	0.39	1.58	3.67
1956-57	0.10	0.00	0.62	1.47	0.27	0.11	2.57	1.56	2.56	0.47	0.83	1.34	0.00	6.76	9.33
1957-58	3.17	1.50	0.28	0.25	0.45	0.93	4.58	0.31	0.57	0.08	0.47	0.42	1.43	3.28	7.86
1958-59	0.16	0.77	0.00	0.10	1.22	0.00	2.25	0.26	0.15	0.25	0.30	1.41	0.78	4.15	6.40
1959-60	0.46	0.59	0.55	0.67	1.11	0.70	4.08	0.18	0.28	0.11	0.33	0.05	1.52	2.47	6.55
1960-61	2.64	0.58	0.00	0.14	0.09	1.50	4.95	0.66	0.33	0.00	0.37	1.92	2.81	6.09	11.04
1961-62	1.16	0.09	0.54	0.18	1.42	0.12	3.51	0.00	0.81	0.12	0.20	0.04	0.78	1.95	4.46
1962-63	1.02	0.09	0.07	0.50	0.00	0.34	2.02	0.54	0.16	0.47	0.27	2.47	2.06	5.97	7.99
1963-64	0.23	0.20	0.00	0.00	0.00	0.40	0.83	0.65	1.37	0.36	0.68	0.53	0.00	3.59	4.48
1964-65	0.00	0.25	1.04	0.06	0.49	0.51	2.35	0.65	1.27	1.93	0.68	1.17	1.15	6.85	9.20
1965-66	0.03	1.10	0.68	T	0.79	----	----	----	----	----	----	0.94	----	----	----
1966-67	----	----	0.86	0.38	0.05	0.19	----	0.24	0.82	1.45	0.20	0.90	0.50	4.11	----
1967-68	0.01	0.34	1.59	0.29	0.60	0.24	3.07	0.48	0.78	0.74	2.07	1.91	0.18	6.06	9.13
1968-69	0.68	0.00	0.56	1.19	0.36	0.28	3.07	0.16	1.02	3.34	4.26	0.91	2.25	11.94	15.01
1969-70	0.68	0.21	0.04	0.47	0.11	0.62	2.13	0.41	T	0.72	2.10	0.46	0.56	4.25	8.38
1970-71	1.36	0.26	0.89	0.23	1.04	0.05	3.83	0.04	0.82	0.14	0.85	0.91	0.01	2.77	6.60
1971-72	2.94	0.28	0.85	0.07	0.05	0.05	4.24	0.17	0.01	0.81	0.28	0.44	0.85	2.56	6.80
1972-73	2.26	0.99	0.20	0.39	----	----	----	----	----	----	----	0.30	----	----	----
1973-74	----	0.19	0.65	1.38	0.06	0.60	----	0.33	0.00	0.00	0.80	0.84	0.28	2.25	----
1974-75	1.84	0.51	0.16	0.46	0.91	0.47	4.35	0.26	0.34	0.71	1.76	0.41	0.62	4.10	8.45
1975-76	0.30	0.35	0.02	0.25	0.26	0.02	1.20	1.05	2.33	0.00	1.19	1.28	0.46	6.31	7.51
1976-77	0.54	0.00	T	0.32	0.20	0.00	1.06	0.16	1.21	0.73	1.17	1.13	0.45	4.85	5.91
1977-78	0.49	0.02	0.40	1.48	1.67										

APPENDIX 2

Snow Depth and Water Content - Muddy Creek

Snow Depth and Water Content (Inches) in Late March or Early April 1945-1978, at Two Snow Courses in Headwaters of Muddy Creek:

Black's Fork, No. 11K14, 39°01'N, 111°27'W, 9200 ft. = 2800 m. MSL
Dill's Camp, No. 11K15, 39°02'N, 111°27'W, 9200 ft. = 2800 m. MSL

Year	Month	Date	Black's Fork		Dill's Camp	
			Depth	Water	Depth	Water
1945	April	12	44	13.2	41	14.3
1946	April	9	43	12.9		
1947	April	12	44	17.5	32	12.7
1948	April					
1949	April	15	50	20.0	43	16.7
1950	April	4	46	18.9	35	14.2
1951	April	4	42	16.4	35	13.7
1952	April					
1953	April	1	44	15.8	37	12.8
1954	March	31	38	11.3	32	9.8
1955	April	5	48	14.8		
1956	April	5	36	11.9	35	11.4
1957	March	30	47	15.9	46	15.4
1958	April	1	62	19.9	58	18.1
1959	March	23	33	11.1	27	8.4
1960	March	31	36	13.2	32	11.4
1961	March	24	31	8.6	25	6.6
1962	March	20	56	18.1	51	16.4
1963	March	19	38	10.1	38	10.3
1964	March	20	26	5.8	24	4.9
1965	March	22	45	15.7	42	14.4
1966	March	22	39	11.1	34	8.8
1967	March	27	29	9.8	26	8.4
1968	March	28	47	16.7	46	15.8
1969	March	21	55	20.6	54	19.3
1970	March	26	50	16.2	46	14.2
1971	April	1	38	12.8	38	12.7
1972	March	28	22	8.5	20	7.5
1973	March	27	53	15.7	50	14.4
1974	March	26	40	15.1	40	14.8
1975	April	1	53	15.9	47	13.1
1976	April	1	31	10.3	28	7.8
1977	April	1	19	5.4	18	4.7
1978	April	1	31	9.8	51	20.3

Extracted from pp. 223-224 of:
Whaley, Bob L., and David C. McWhirter, "Summary of Snow Survey Measurements for Utah, 1924-1947." Salt Lake City, Soil Conservation Service, USDA, and State Engineer of Utah, xxii + 299 pp. (1975-78 data obtained by correspondence).

APPENDIX 3

Daily Rainfall Probabilities
1931 - 1961

EMERY, UTAH

PROBABILITY THAT A GIVEN DAY WILL BE WET OR DRY 422484

P(WET)=1 - P(DRY) P(WET/DRY)=1 - P(DRY/DRY) P(WET/WET)=1 - P(DRY/WET)

PERIOD BEGINS	WET ≥ 0.01 INCHES			WET ≥ 0.05 INCHES			WET ≥ 0.10 INCHES		
	DRY	DRY/DRY	DRY/WET	DRY	DRY/DRY	DRY/WET	DRY	DRY/DRY	DRY/WET
MAR 01	92	94	69	93	94	66	96	96	99+
MAR 08	92	92	88	94	93	99+	94	94	99+
MAR 15	92	93	73	92	93	74	95	96	94
MAR 22	95	96	75	96	96	99+	97	97	99+
MAR 29	94	95	78	94	95	80	95	96	90
APR 05	94	96	69	94	96	74	95	97	67
APR 12	98	99	94	99	99	93	99	99+	94
APR 19	94	95	94	95	95	99+	96	96	99+
APR 26	89	92	68	90	91	82	92	92	88
MAY 03	91	94	54	92	96	50	95	96	75
MAY 10	89	92	67	91	93	67	93	94	74
MAY 17	90	91	79	92	93	75	94	95	72
MAY 24	93	94	71	94	96	64	95	96	64
MAY 31	91	92	78	91	93	75	94	94	90
JUN 07	96	97	86	97	98	86	97	98	83
JUN 14	94	95	86	95	95	90	97	97	99+
JUN 21	94	95	88	95	96	85	96	97	92
JUN 28	93	94	90	95	96	88	96	96	94
JUL 05	86	91	38	87	92	37	89	92	46
JUL 12	89	92	77	90	93	74	93	95	71
JUL 19	88	90	84	89	90	82	94	95	88
JUL 26	84	89	61	86	89	63	89	91	67
AUG 02	85	88	69	88	89	83	90	91	81
AUG 09	84	87	63	85	88	63	87	89	69
AUG 16	85	89	66	86	89	72	88	91	61
AUG 23	83	87	69	85	86	78	88	91	74
AUG 30	90	93	60	91	94	71	92	94	77
SEP 06	88	91	61	88	92	61	89	92	59
SEP 13	94	96	64	96	97	66	97	98	96
SEP 20	91	92	81	92	94	78	94	95	78
SEP 27	91	92	73	92	92	87	92	92	94
OCT 04	94	95	75	94	95	75	94	96	75
OCT 11	90	92	74	90	92	74	91	92	79
OCT 18	92	95	55	92	95	55	92	95	55
OCT 25	93	93	78	93	94	78	94	95	83
NOV 01	95	97	61	95	97	61	95	97	64
NOV 08	95	96	90	95	96	90	95	96	88
NOV 15	94	95	81	94	96	81	95	96	81
NOV 22	97	98	90	97	98	90	97	98	90
NOV 29	89	92	54	90	93	54	92	94	68
DEC 06	93	93	87	93	94	85	93	94	83
DEC 13	95	96	83	96	96	83	96	97	83
DEC 20	91	93	65	91	94	64	93	95	62
DEC 27	89	90	82	89	90	82	92	92	93
JAN 03	92	93	87	93	93	89	96	96	95
JAN 10	91	95	40	91	95	38	92	97	33
JAN 17	87	88	74	88	89	74	89	90	81
JAN 24	91	93	78	92	93	84	93	94	82
JAN 31	93	93	90	94	94	99+	96	96	99+
FEB 07	92	92	97	92	92	97	94	94	96
FEB 14	95	95	93	95	95	93	96	96	99+
FEB 21	92	93	78	94	94	83	95	96	83

Conditional and unconitional probablities of daily rainfall amounts for each week of the Farmer's year, based on data from March 1931 through February 1961. (From Heermann, Dale F., Morris D. Finkner, and Edward A. Hiler: "Probability of Sequences of Wet and Dry Days for Eleven Western States and Texas." Technical Bulletin 117, Colorado State University Experiment Station, 1971, 303 pp.)

APPENDIX 4

Precipitation Means and Probabilities

EMERY, UTAH 422484

PRECIPITATION MEANS AND PROBABILITIES FOR 1-WEEK PERIODS

PERIOD BEGINS	MEAN PCPN	PROB O-T	PROBABILITY (PERCENT) OF RECEIVING AT LEAST THE FOLLOWING AMOUNTS (IN) OF PRECIPITATION								
			0.06	0.10	0.20	0.40	0.60	0.80	1.00	1.40	2.00
MAR 01	.10	65	31	28	20	9	4	2	1		
MAR 08	.12	62	35	31	22	9	4	1	1		
MAR 15	.10	62	35	32	22	8	3	1			
MAR 22	.10	68	30	27	19	7	2	1			
MAR 29	.07	72	27	25	17	6	2	1			
APR 05	.11	76	22	20	14	6	3	2	1		
APR 12	.03	78	18	16	11	5	2	1			
APR 19	.08	67	29	26	17	7	2	1			
APR 26	.16	58	39	35	24	10	4	1			
MAY 03	.09	64	33	30	22	11	6	3	2		
MAY 10	.17	67	30	27	22	14	9	5	3	1	
MAY 17	.17	62	33	30	24	15	9	6	3	1	
MAY 24	.14	60	35	32	25	14	8	4	2	1	
MAY 31	.16	64	32	30	23	13	7	3	2		
JUN 07	.07	72	25	23	17	8	4	2	1		
JUN 14	.07	71	26	24	17	7	3	2	1		
JUN 21	.15	65	31	28	21	10	5	3	2		
JUN 28	.10	63	34	31	24	14	9	5	3	1	
JUL 05	.27	60	38	35	28	17	11	7	5	2	1
JUL 12	.12	56	41	37	27	13	7	4	2	1	
JUL 19	.12	50	45	41	30	13	4	1			
JUL 26	.22	44	52	49	39	20	9	4	2	1	
AUG 02	.27	43	54	51	42	25	14	8	4	2	
AUG 09	.26	43	54	51	42	28	18	11	7	3	1
AUG 16	.36	40	56	53	44	30	19	12	8	3	1
AUG 23	.27	44	52	48	40	26	16	10	6	2	1
AUG 30	.20	54	42	40	33	22	14	9	6	2	
SEP 06	.28	63	35	34	29	21	14	9	6	3	1
SEP 13	.12	68	31	29	25	17	11	7	4	2	
SEP 20	.17	63	34	31	24	13	7	4	2	1	
SEP 27	.11	61	36	33	24	11	6	3	2	1	
OCT 04	.15	67	31	29	23	15	10	6	4	1	
OCT 11	.24	69	30	29	27	23	17	11	6	2	
OCT 18	.22	69	31	30	29	23	16	10	6	2	
OCT 25	.15	74	26	25	24	17	11	6	3	1	
NOV 01	.10	80	19	19	17	12	7	4	2	1	
NOV 08	.08	77	21	19	15	9	5	3	2		
NOV 15	.10	73	25	22	16	8	4	2	1		
NOV 22	.07	72	26	24	19	10	5	2	1		
NOV 29	.18	64	34	32	24	11	6	3	1		
DEC 06	.10	63	36	33	23	8	3	2	1		
DEC 13	.07	68	29	27	19	6	2	1			
DEC 20	.10	65	33	30	22	9	3	1			
DEC 27	.14	59	39	35	24	9	3	1			
JAN 03	.07	62	35	31	20	6	2	1			
JAN 10	.11	61	35	31	22	9	4	2	1		
JAN 17	.18	53	43	40	30	14	6	2	1		
JAN 24	.15	53	44	40	30	12	4	1			
JAN 31	.09	58	37	32	22	8	3	1			
FEB 07	.10	63	33	28	18	6	2	1			
FEB 14	.07	64	33	30	18	5	1				
FEB 21	.10	64	32	29	18	6	2	1			

EMERY, UTAH 422484

PRECIPITATION MEANS AND PROBABILITIES FOR 2-WEEK PERIODS

PERIOD BEGINS	MEAN PCPN	PROB O-T	PROBABILITY (PERCENT) OF RECEIVING AT LEAST THE FOLLOWING AMOUNTS (IN) OF PRECIPITATION								
			0.06	0.10	0.20	0.40	0.60	1.00	1.40	2.00	4.00
MAR 01	.23	43	51	47	37	21	12	4	1		
MAR 15	.20	43	54	50	38	18	8	1			
MAR 29	.17	60	38	36	29	16	8	2			
APR 12	.11	53	41	37	27	13	6	1			
APR 26	.25	38	58	54	43	24	12	3	1		
MAY 10	.34	43	51	47	39	27	19	9	4	1	
MAY 24	.30	42	54	50	41	27	17	7	3	1	
JUN 07	.14	51	46	42	33	17	9	2	1		
JUN 21	.25	41	54	50	40	26	16	7	3	1	
JUL 05	.40	38	59	55	46	32	21	10	5	2	
JUL 19	.34	17	79	74	60	35	19	5	1		
AUG 02	.53	16	82	79	70	52	36	16	7	2	
AUG 16	.63	20	77	74	66	51	38	20	10	4	
AUG 30	.47	38	61	59	53	40	30	15	8	3	
SEP 13	.29	45	52	50	43	30	20	9	4	1	
SEP 27	.26	41	56	52	44	28	18	7	3	1	
OCT 11	.46	50	49	49	46	37	29	16	8	3	
OCT 25	.25	61	38	37	34	26	18	8	3	1	
NOV 08	.19	53	43	40	31	17	9	3	1		
NOV 22	.24	44	53	49	39	23	12	3	1		
DEC 06	.17	45	53	50	39	19	8	1			
DEC 20	.24	43	55	52	41	22	10	2			
JAN 03	.18	38	57	52	39	20	10	2			
JAN 17	.32	33	63	60	49	29	16	5	1		
JAN 31	.19	40	56	51	38	18	8	1			
FEB 14	.17	43	54	50	37	16	6	1			

EMERY, UTAH 422484

PRECIPITATION MEANS AND PROBABILITIES FOR 3-WEEK PERIODS

PERIOD BEGINS	MEAN PCPN	PROB O-T	PROBABILITY (PERCENT) OF RECEIVING AT LEAST THE FOLLOWING AMOUNTS (IN) OF PRECIPITATION								
			0.06	0.10	0.20	0.40	0.60	1.00	1.40	2.00	4.00
MAR 01	.33	32	64	60	50	32	20	7	3		
MAR 22	.27	43	56	54	45	26	14	3	1		
APR 12	.27	33	61	56	44	26	14	4	1		
MAY 03	.43	28	67	63	54	38	27	13	6	2	
MAY 24	.37	31	64	60	51	35	23	10	5	1	
JUN 14	.33	28	65	61	50	33	22	10	4	1	
JUL 05	.52	22	74	71	62	45	31	15	8	3	
JUL 26	.75	3	96	94	87	69	51	26	12	4	
AUG 16	.82	12	87	86	80	67	54	32	18	7	
SEP 06	.56	29	69	67	61	47	35	18	9	3	
SEP 27	.50	29	69	67	61	47	34	17	8	3	
OCT 18	.48	47	52	51	47	39	31	18	10	4	
NOV 08	.25	39	58	54	45	28	17	5	2		
NOV 29	.35	28	70	67	56	34	18	5	1		
DEC 20	.32	29	67	63	52	32	18	6	2		
JAN 10	.43	25	73	70	61	42	26	9	3		
JAN 31	.26	28	68	63	50	28	14	4	1		

Precipitation means and probabilities for periods of 1, 2, and 3 weeks of Farmer's year, based on data from March 1931 through February 1961. (From Gifford, Richard O., Gaylen L. Ashcroft, and Marvin D. Magnuson: "Probability of Selected Precipitation Amounts in the Western United States." Publication T-8, University of Nevada Agricultural Experiment Station, unpaged, 1967.)

APPENDIX 5

Hourly Wind and Temperature Observations SW of Emery

Air movement was recorded continuously for almost ten months, from 1500 MST on 2 November, 1972 to noon on 23 August 1973, at a site 6,200 feet (1,890 m) MSL, 1 mile SE of the village of Emery and 2 miles north of the Emery EMRIA site. Temperature and relative humidity also were recorded there, beginning at 1300 MST on 25 December, 1972. Hourly values from this site are given in this Appendix.

The wind instruments, manufactured by R.M. Young Co., were on a tower 33 feet (10 m) above the flat rangeland; a hygrothermograph (Epic Co.) was operated in a standard instrument shelter 5 feet (1.5 m) above ground. From the charts, the air temperature and relative humidity for each hour were extracted and entered on punchcards, along with five measures of wind: average direction (subjective average, in degrees colckwise from true north) and speed (miles per hour) for the 10 minutes ending on the hour, and speed and direction also for the full 60 minutes since the last hour; the total directional variation of the wind during the hour was extracted at first but soon ignored.

The station was operated, along with two other 20 miles farther north, by North American Weather Consultants of Goleta, CA, as part of a detailed site study for Utah Power and Light Co. in planning for a new coal-fired power plant, eventually built just southeast of Castlegate, 20 miles north of Emery. From a copy of the data tape, purchased from NEWC with the permission of UPL, the data were organized into three tables: hourly wind direction and speed, 10-minute wind direction and speed, and hourly temperature. The relative humidity seemed to have insufficient value for extraction; some of the temperature readings are questionable, but are presented as they appear on the data tape.

The wind data are presented as recorded, without analysis, but the temperatures were subjected to a detailed computer program which gives characteristics for each day and also for each hour of each month. In addition, the hourly temperatures are arrayed in a frequency diagram, with cumulative totals of occurrence for four 6-hour periods of the day.

Unfortunately, only a few comparisons can be made between these hourly temperatures and the daily observations at the long-term climate station at Emery, which was closed during most of the time of operation of the automatic station. Merlin H. Christiansen, observer since 1960, became "too busy" and terminated his appointment on 17 July, 1973; his observations had been too irregular for publication in December 1972, resumed for most

of January, but ceased thereafter. Dandy M. Anderson became the new observer, and instruments were moved 200 ft. south to the rear of the postoffice. But he was unable to maintain the daily schedule and only one month, August 1973, of his data was published. On 6 November, 1973, Elbert T. Blackburn assumed the post moving the instruments 0.3 mile southwest of the postoffice, and maintained a useful record for more than five years.

During the two months of simultaneous operation, January and August, the automatic station, on flat bare rangeland, appears to have been cooler at night and warmer in the daytime than the village station, so that its "average" temperature was about the same. When only maximum and minimum temperatures are obtained their average, technically the midrange, is used as the average, defined internationally as the average of 24 equally-spaced observations. At the two Emery stations, values for the two months were:

	Maximum		Minimum		"Average"		
	COOP	AUTO	COOP	AUTO	COOP	AUTO	24HR
January	30.3	27.1	3.4	7.4	16.9	17.2	16.2
August	86.2	84.1	53.7	55.7	70.0	70.1	67.4

The following temperature tables give, for each day, both the midrange (MR) and the 24-hour mean (MN), as well as the range (RG), the European style average (3H) of the temperatures at 0700, 1400, and 2100 taken twice (i.e., the 9 p.m. value is given double weight), and the standard deviation (SD). For each hour during a month, three values are given: the mean (MN), the standard deviation (SD), and interdiurnal variation (IV), the mean absolute successive differences, a measure of day-to-day change.

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, NOVEMBER 1972

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1																								
2																								
																				280 09	265 07	000 00	260 07	275 11	280 10	000 00
3	275 10	350 03	340 03	310 04	265 03	255 01	340 05	010 01	000 00	110 01	150 03	170 03	150 03	170 03	180 05	185 05	160 04	120 04	000 00	305 03	290 06	000 00	350 03	015 02
4	000 00	360 01	000 00	350 02	230 02	330 01	360 04	225 04	000 00	355 03	030 05	075 03	100 05	185 04	090 05	350 04	010 05	005 05	010 04	355 06	015 06	360 04	030 03	345 05
5	240 02	295 04	040 02	210 02	210 06	255 13	230 13	245 10	260 09	245 16	245 14	245 21	245 19	250 10	255 17	255 14	250 16	250 18	250 15	250 14	290 04	230 06	240 06	115 02
6	280 05	280 06	255 07	000 00	250 14	260 16	270 11	320 03	285 09	275 07	275 02	240 02	080 05	110 06	170 06	090 04	000 00	125 02	100 02	290 07	285 07	325 03	350 02	200 02
7	000 00	000 00	000 00	000 00	200 02	000 00	270 02	210 01	355 01	330 01	015 02	035 02	050 05	020 06	005 08	015 06	085 07	335 03	005 02	355 06	340 05	350 05	015 04	340 04
8	335 04	345 03	335 03	275 02	270 04	000 00	260 03	000 00	170 01	050 02	170 05	140 01	020 01	200 13	160 08	080 05	260 12	245 10	310 05	265 05	260 12	255 12	290 05	065 04
9	295 13	270 07	285 03	260 07	270 08	305 06	265 05	275 11	270 10	250 11	255 07	160 05	160 06	140 05	070 04	145 06	140 04	100 04	130 01	280 08	275 10	300 06	350 04	265 02
10	360 05	000 00	005 01	340 02	305 03	350 06	355 03	015 04	345 04	055 02	020 10	045 07	020 06	030 06	020 04	110 06	080 03	005 04	005 09	010 08	020 09	010 08	005 03	355 06
11	345 05	310 03	350 07	115 01	345 06	040 02	040 04	010 05	005 03	015 01	160 01	105 03	070 02	150 03	000 00	160 10	140 06	145 05	360 06	090 04	010 08	040 10	015 12	015 15
12	005 13	005 12	015 13	010 16	005 12	350 06	210 02	240 02	270 05	210 03	275 04	290 02	255 07	280 08	275 10	095 05	290 11	265 12	265 10	255 11	260 10	250 09	260 08	045 01
13	280 06	340 02	030 02	005 05	355 02	000 00	330 01	230 01	165 04	090 02	150 03	115 08	125 05	255 04	105 02	135 05	170 05	260 01	000 00	000 00	330 04	000 00	000 00	000 00
14	000 00	055 02	105 01	095 00	360 02	005 05	025 05	015 08	025 08	035 08	010 07	060 03	070 04	100 04	120 08	145 05	215 02	270 02	020 05	360 03	360 03	005 06	010 07	005 06
15	035 03	361 02	210 01	165 04	215 01	180 02	215 02	195 02	210 01	200 03	200 02	130 03	200 05	140 04	200 07	170 03	210 02	195 04	210 05	190 03	240 01	275 02	270 01	240 03
16	300 03	340 02	000 00	325 02	040 02	360 04	300 01	360 03	245 03	000 00	100 01	070 01	145 01	180 07	270 08	325 01	340 02	330 05	020 04	070 05	010 02	070 06	030 06	030 05
17	010 05	020 07	025 11	025 09	030 08	015 13	020 10	030 08	025 07	030 04	035 06	035 06	030 08	055 08	020 05	040 04	060 04	360 03	005 03	295 03	275 03	000 04	030 00	030 02
HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
18	360 05	345 01	005 04	305 02	360 04	345 03	275 05	275 10	270 09	245 09	260 10	260 16	260 13	255 14	250 10	260 09	250 11	255 04	215 03	300 05	015 02	195 02	285 05	185 02
19	050 03	015 01	000 00	360 05	015 02	150 01	000 00	000 00	195 01	250 03	000 00	080 02	135 03	240 01	360 01	321 01	025 05	010 07	025 00	025 00	035 07	250 02	345 02	360 03
20	010 03	090 02	010 03	280 10	290 14	280 05	290 13	260 12	255 09	280 10	285 07	270 15	330 09	265 16	275 17	275 15	275 12	275 15	285 11	270 10	250 06	270 08	270 13	265 10
21	275 12	280 12	270 13	285 13	285 14	300 08	325 07	335 07	050 02	010 01	295 05	265 05	165 02	360 02	045 05	280 05	345 04	310 04	280 03	350 05	305 03	320 00	000 00	260 05
22	265 03	360 04	000 00	315 02	330 02	360 03	360 03	295 01	120 01	190 03	200 03	050 04	040 05	015 03	030 03	000 00	345 03	330 01	315 05	245 06	260 05	340 04	290 03	000 00
23	300 05	000 02	345 04	025 02	000 00	030 00	245 01	000 00	000 00	000 00	195 03	195 03	205 03	180 04	230 03	210 03	235 02	360 02	000 00	245 01	010 02	000 04	000 00	320 07
24	295 09	275 15	270 09	270 11	275 20	270 17	330 05	285 22	280 21	240 15	270 16	265 15	260 09	270 07	260 09	250 12	260 13	290 19	310 05	360 09	335 05	360 05	360 05	275 10
25	270 10	265 18	265 16	265 06	265 12	300 04	335 05	350 01	210 03	315 05		050 05	295 10	295 14	285 05	255 08	250 13	265 18	265 18	265 20	265 24	265 18	265 17	265 15
26	260 17	315 05	235 17	205 13	345 08	360 05	010 05	015 07	025 10	010 07	030 07	115 06	280 18	295 12	275 19	265 25	280 20	275 20	290 20	235 15	265 19	275 36	275 28	250 18
27	260 13	290 12	295 25	295 38	280 43	275 45	280 43	280 38	300 23	265 16	275 22	285 18	325 07	280 10	285 12	280 18	275 13	275 07	280 05	270 10	300 06	005 09	005 07	020 05
28	355 04	350 05	355 04	265 03	310 03	005 04	000 00	340 01	035 03	000 00	175 02	095 04	125 03	185 05	170 06	200 04	120 03	035 08	005 04	010 10	015 10	030 12	040 05	035 05
29	145 04	265 08	270 14	280 13	265 12	260 16	250 17	265 18	275 16	265 17	265 22	250 16	220 06	230 10	250 12	025 13	025 10	360 07	015 05	150 04	340 10	355 10	005 09	310 05
30	055 05	345 03	240 10	260 15	280 10	250 15	255 14	360 10	035 09	015 06	070 06	260 15	235 14	235 16	255 15	150 03	005 06	355 05	290 14	045 03	020 04	040 03	015 05	015 05

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, DECEMBER 1972

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	005	355	350	355	360	345	010	010	010	000	190	180	100	135	085	065	015	360	360	355	000	000	355	355
	05	05	08	10	11	10	07	08	07	00	05	06	05	03	04	05	06	06	05	05	00	00	04	02
2	000	220	310	360	005	260	030	005	225	155	045	035	025	055	030	040	015	005	355	355	345	360	360	295
	00	05	02	05	05	05	00	04	02	03	10	05	05	05	05	04	06	05	06	06	05	07	07	04
3	360	005	005	350	030	345	285	250	000	045	075	190	100	100	120	105	140	360	355	345	350	275	220	245
	05	04	05	04	00	05	03	02	00	01	03	06	05	05	05	03	03	06	07	08	08	03	05	08
4	270	000	105	000	030	085	360	020	180	175	205	215	265	255	270	275	265	265	265	230	250	260	260	275
	03	00	04	00	04	02	02	01	20	17	07	10	16	16	16	13	11	15	15	07	14	15	13	13
5	280	270	290	285	275	270	265	280	265	260	250	255	260	270	250	255	285	270	280	315	275	345	085	285
	15	13	12	10	15	11	13	18	12	13	13	12	15	18	18	18	11	10	10	07	09	04	03	03
6	240	000	020	345	360	005	360	005	010	025	250	205	125	310	290	290	360	010	360	355	355	105	360	335
	03	00	05	06	03	05	05	06	05	05	04	05	03	05	05	04	10	09	08	04	05	03	05	06
7	355	000	240	140	205	205	225	000	145	175	170	205	260	275	265	265	275	270	270	295	355	020	025	010
	05	00	04	02	03	02	02	00	02	03	04	13	18	20	16	16	15	12	05	07	04	11	12	06
8	355	005	325	205	335	355	355	000	070	235	265	210	215	245	190	175	145	230	145	160	305	000	300	265
	06	03	01	04	03	04	05	03	03	04	16	23	23	23	18	15	11	04	03	10	03	00	01	15
9	296	306	265	270	240	265	175	280	280	290	270	280	270	265	265	275	275	275	275	280	305	350	345	025
	10	13	13	20	15	13	08	23	25	25	24	25	22	21	21	19	16	16	16	14	10	04	04	01
10	275	265	340	000	030	360	270	000	000	025	315	040	025	025	025	025	035	015	025	360	025	000	195	330
	07	05	05	00	01	01	04	00	00	02	05	09	10	10	12	10	10	09	06	05	02	00	03	01
11	340	315	000	000	000	000	000	145	000	006	325	265	265	265	270	270	265	270	270	270	270	275	275	280
	02	02	00	00	00	00	00	01	00	00	02	10	12	13	16	19	21	23	23	22	20	20	20	17
12	010	360	355	015	010	000	010	355	360	000	140	040	035	030	035	015	015	025	310	025	360	005	360	355
	06	06	08	04	02	00	03	03	02	00	05	04	06	05	05	08	08	08	05	05	03	05	05	05
13	360	355	350	215	000	155	000	115	235	175	025	030	025	050	075	025	325	275	270	270	275	265	295	240
	05	05	05	03	00	02	00	01	01	01	03	08	06	04	01	05	04	13	16	15	15	13	12	05
14	345	340	295	355	270	290	000	170	155	175	165	040	060	050	055	015	020	340	000	360	360	015	000	205
	06	04	05	07	03	01	00	01	02	02	03	04	04	05	04	07	07	05	00	03	06	07	00	04
15	005	275	305	010	000	010	000	000	120	180	145	155	170	155	165	175	065	005	355	360	340	000	010	285
	05	01	02	02	00	00	00	00	01	01	02	03	05	05	04	05	03	05	06	03	03	00	01	02
16	000	210	000	025	025	000	010	240	175	000	075	095	145	120	015	025	355	340	000	360	160	000	000	025
	00	01	00	02	02	00	00	03	02	00	01	02	04	04	09	04	05	04	00	01	03	00	00	03

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
17	350	000	270	000	000	285	000	000	000	115	060	095	070	070	075	025	355	000	330	055	005	320	000	325
	03	00	03	00	00	03	00	00	00	01	01	05	02	03	03	03	03	03	02	01	01	03	00	02
18	000	040	025	060	005	345	025	325	180	205	090	025	025	015	010	355	355	025	355	005	005	235	015	355
	00	02	02	02	04	01	02	01	03	02	04	10	13	11	07	03	05	02	03	05	03	01	02	07
19	005	005	020	355	235	190	115	005	015	010	055	035	020	025	010	355	005	360	360	025	010	040	035	015
	05	07	03	03	02	09	02	06	06	03	03	05	04	08	01	02	08	05	05	05	05	05	05	08
20	035	305	295	295	315	325	310	355	085	310	265	265	240	250	265	260	265	265	255	270	260	260	280	230
	05	15	19	30	20	15	07	08	01	10	09	16	14	17	20	15	06	11	12	08	15	18	10	05
21	295	015	005	015	010	065	095				000	020	055	055	085	100	100	025	360	360	010	355	325	355	340
	07	04	06	07	06	02	02				00	07	03	03	03	03	03	08	07	07	05	05	05	05	03
22	355	270	235	010	275	040	000	000	350		000	035	040	045	045	070	040	040	025	355	005	125	030	190
	01	02	02	01	02	01	00	00	01		00	05	07	08	09	03	09	02	09	05	04	06	02	04
23	280	285	295	295	290	295	270	290	280	025	000	030	135	110	175	180	160	360	360	030	000	000	280	010
	17	20	15	20	14	20	16	10	08	03	00	02	03	05	04	05	04	05	07	00	00	00	03	04
24	030	015	025	005	010	010	300	360	025	010	025	015	040	025	025	055	030	040	025	355	330	260	250	250
	04	07	04	06	04	05	00	04	02	05	03	08	07	01	04	02	04	03	02	00	05	03	06	09
25	270	190	310	260	000	325	275	355	325	030	235	100	160	145	185	275	270	335	295	290	275	280	325	295
	12	07	15	10	00	08	05	05	07	02	03	05	03	03	05	10	10	08	12	15	10	11	04	04
26	180	350	360	295	000	005	040	280	215	030	185	180	180	175	145	115	120	050	355	360	345	000	000	000
	02	05	05	03	00	03	01	02	03	00	01	02	04	05	03	02	03	03	04	03	03	00	00	00
27	000	000	000	000	000		000	000	000	000	190	145	175	130	145	090	025	360	360	355	355	035	345	325
	00	00	00	00	00	01	00	00	00	00	02	01	03	01	04	02	07	07	06	03	02	01	01	02
28	105	350	000	025	005	350	025	360	010	360	010	000	190	000	030	035	005	010	020	315	045	315	025	285
	02	04	00	02	03	01	04	03	03	02	02	00	03	00	03	04	07	08	05	01	04	02	04	19
29	285	275	295	280	280	275	270	265	280	280	275	280	280	275	280	275	280	280	275	285	285	290	285	280
	20	22	20	24	23	22	22	15	26	27	25	20	23	23	23	28	23	22	19	20	25	25	23	18
30	275	255	280	275	275	270	270	270	295	270	265	270	270	265	270	280	280	290	285	285	275	275	275	295
	16	17	16	15	13	18	15	15	12	16	16	19	22	20	24	27	19	22	21	16	15	15	12	19

WIND DIRECTION AND SPEED (MPH), HORLY AVERAGES, AT EMERY, UT, JANUARY 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	275	310	145	255	270	260	000	195	290	190	220	060	050	025	020	040	030	360	325	330	315	360	010	190
	10	06	02	03	05	05	00	02	06	03	03	03	12	08	05	04	07	04	10	07	05	03	02	01
2	270	050	000	205	000	360	000	025	255	175	165	115	175	160	175	130	030	025	005	005	360	005	000	270
	03	03	00	02	00	03	00	01	03	01	03	03	03	04	03	04	08	07	07	06	05	03	00	03
3	060	355	000	000	260	000	310	000	000	160	055	265	120	100	120	330	030	030	020	015	030	360	360	345
	01	01	00	00	06	00	02	00	00	02	03	02	04	05	05	04	09	09	05	05	04	05	04	05
4	355	340	100	000	025	015	275	215	355	000	125	235	000	055	025	355	335	290	280	280	265	280	275	275
	05	02	01	00	02	02	03	03	02	00	03	01	00	03	06	05	05	09	10	14	12	12	10	10
5	270	185	265	275	360	305	120	360	355	300	025	205	160	115	150	115	110	000	360	345	360	360	360	345
	11	02	14	07	03	03	03	05	05	02	04	04	02	07	04	05	01	00	05	05	03	03	04	04
6	335	350	310	020	280	000	000	235	255	340	040	025	065	160	000	180	265	275	260	000	310	000	000	000
	03	03	01	01	04	00	00	02	01	05	02	04	03	04	00	03	04	03	03	00	02	00	00	00
7	245	120	000	000	000	005	300	275	080	000	210	155	175	115	215	235	120	010	360	360	360	000	190	010
	03	00	00	00	00	02	01	02	01	00	04	03	02	03	05	03	03	04	05	03	04	00	00	03
8	265	205	005	360	000	035	020	000	030	000	195	050	030	025	035	040	030	005	360	360	000	360	360	355
	03	02	02	03	00	01	01	00	00	00	02	05	10	06	05	07	07	07	00	04	00	03	02	03
9	000	000	035	000	000	240	280	000	000	000	000	025	040	030	030	020	010	355	360	000	000	330	000	270
	00	00	00	00	00	02	02	00	00	00	00	04	06	06	05	06	14	03	03	00	00	01	00	01
10	055	000	000	000	265	235	000	000	255	000	230	155	120	195	275	275	275	280	295	275	265	360	315	010
	01	00	00	00	01	03	00	00	01	00	03	02	02	04	10	14	13	12	10	13	10	06	04	05
11	360	330	355	000	360	000	000	000	000	000	210	225	190	190	185	115	160	000	000	360	030	360	000	035
	03	03	02	00	03	00	00	00	00	00	03	04	06	05	06	05	03	00	00	03	02	02	00	03
12	030	015	005	000	000	015	015	005	000	000	115	060	130	115	105	035	005	005	035	360	055	025	325	040
	03	03	03	00	00	04	02	02	00	00	01	02	03	05	04	08	04	06	02	03	01	02	01	01
13	360	045	210	360	000	000	345	035	000	210	210	190	085	030	055	145	000	000	235	225	105	000	000	240
	03	01	01	03	00	00	03	02	00	03	03	05	08	07	01	02	00	00	05	02	01	00	00	04
14	035	235	205	270	355	205	000	010	030	000	215	220	175	115	135	225	000	180	220	000	000	015	000	000
	02	03	01	03	04	01	00	03	01	00	04	03	02	02	02	03	00	01	03	00	00	02	00	00
	285	225	285	345	355	340	000	210	000	205		180	205	135	105	115	065	075	360	010	000	250	000	190
	01	02	02	03	01	01	00	01	00	01		01	03	03	04	02	03	03	04	04	00	01	00	02
16	000	035	360	255	275	000	000	000	000	000	125	155	195	220	135	125	105	085	085	040	015	020	005	025
	00	03	02	01	02	00	00	00	00	00	03	02	02	02	03	03	03	02	02	05	05	05	03	03
17	005	035	010	020	360	025	360	010	355	000	285	050	075	115	205	225	050	005	215	150	250	220	250	190
	02	03	05	05	04	05	03	03	03	00	01	01	01	02	02	01	04	04	07	06	08	11	09	08
18	265	245	205	245	190	235	340	340	255	005	010	035	030	020	045	025	025	025	015	360	360	010	360	005
	03	04	04	03	02	04	04	01	01	04	05	05	06	10	07	10	10	11	06	05	02	05	04	05
19	005	335	005	360	360	360	010	265	360	020	030	035	030	020	030	040	025	000	005	280	270	275	280	280
	05	07	06	05	06	04	04	01	03	06	06	08	10	09	09	10	04	00	03	13	17	15	14	18
20	280	275	310	285	275	275	265	270	270	270	275	280	280	280	275	275	275	275	275	275	280	275	280	280
	15	17	17	19	19	22	19	24	19	22	25	25	26	30	25	25	27	28	28	28	29	27	20	19
21	265	275	280	280	355	355	355	310	330	320	310	270	270	275	270	275	280	280	275	270	270	270	270	275
	14	23	20	18	05	06	08	10	09	09	07	16	16	20	20	21	13	15	15	15	17	15	21	24
22	275	275	280	280	280	270	280	270	270	270	315	025	025	030	030	030	020	315	285	285	280	280	275	275
	23	25	23	21	19	19	14	14	14	10	03	16	19	15	19	17	09	02	10	13	15	15	16	17
23	275	270	270	270	330	275	315	355	360	295	050	060	160	095	115	030	025	005	355	000	000	360	265	000
	14	15	13	11	07	06	03	06	02	02	03	04	03	05	03	06	03	03	04	00	00	03	03	00
24	245	000	270	215	360	030	000	000	000	230	190	145	150	180	100	105	115	025	360	360	025	000	000	070
	03	00	01	02	01	01	00	00	00	01	01	03	03	03	06	05	06	03	05	05	02	00	00	02
25	300	000	325	005	275	000	275	000	115	000	175	125	135	100	020	025	015	360	010	360	355	355	355	355
	01	00	01	02	01	03	03	00	01	00	01	03	03	03	03	08	07	05	05	05	04	02	03	03
26	000	295	000	115	360	180	360	000	000	200	105	005	055	050	265	265	265	265	265	265	265	265	265	270
	00	02	00	03	03	02	01	00	00	02	02	01	01	03	20	20	19	28	17	21	20	18	21	21
27	265	265	265	275	275	280	290	280	270	270	265	025	035	035	020	010	010	020	340	340	295	265	285	275
	20	21	15	16	15	18	11	14	13	14	09	07	12	13	15	17	10	08	04	04	03	01	05	05
28	205	360	345	155	245	225	345	265	000	000	125	170	175	170	145	125	115	125	360	360	355	360	000	000
	01	04	03	01	05	01	01	02	00	00	01	04	05	05	04	08	06	06	06	05	05	03	00	00
	000	000	255	000	000	000	000	000	000	210	180	160	145	125	075	020	025	010	360	355	290	000	330	355
	00	00	01	00	00	00	00	00	00	02	01	03	03	04	05	05	07	05	05	05	01	00	01	03
30	280	010	260	000	010	000	000	000	205	000	155	040	060	040	025	025	020	005	005	360	355	355	350	325
	02	00	01	00	02	00	00	00	01	00	02	03	03	04	06	05	05	05	03	04	03	03	04	01
31	260	000	100	005	000	005	005	360	065	265	265	255	265	255	255	305	265	265	260	270	270	270	265	265
	01	00	02	03	00	00	05	03	02	11	11	09	14	15	15	10	14	13	07	10	10	10	13	12

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, FEBRUARY 1973

HOUR: / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	285	290	275	285	275	270	260	275	270	265	250	265	265	250	265	275	275	285	285	305	285	300	305	355
	11	16	16	17	18	15	14	15	14	12	14	14	12	09	14	14	15	18	15	13	14	14	09	06
2	360	360	330	360	350	040	240	000	220	220	160	130	130	160	120	110	030	020	010	010	000	000	360	250
	07	05	03	01	04	01	02	03	02	03	02	04	03	02	03	04	07	07	07	04	00	00	03	02
3	330	300	300	020	270	360	030	010	250	110	130	120	140	150	130	100	070	120	360	360	010	360	360	360
	10	10	00	01	03	01	01	02	03	02	01	04	05	04	04	06	03	03	03	03	04	06	03	03
4	360	310	130	300	000	000	000	000	000	100	030	110	020	350	350	350	350	015	360	350	360	000	200	000
	05	03	01	00	00	00	00	00	00	01	04	05	04	01	04	04	05	04	05	05	02	00	03	00
5	270	360	300	000	000	000	000	360	000	230	200	040	020	020	020	020	020	015	020	360	300	000	020	
	03	03	00	00	00	00	00	04	00	03	03	05	07	10	10	10	10	07	08	06	04	03	00	03
6	020	010	360	010	360	010	360	000	000	000	000	000	050	090	090	130	090	090	070	360	360	360	360	270
	03	03	03	05	04	04	03	00	00	00	00	00	03	02	03	02	04	03	03	05	05	06	02	03
7	040	015	030	360	015	360	020	020	360	330	030	040	090	150	100	100	060	360	360	360	360	000	000	000
	02	03	05	05	06	04	03	03	03	02	03	04	02	04	03	02	02	03	04	05	03	00	00	00
8	110	250	350	010	360	020	360	330	300	000	315	015	360	030	015	015	015	360	000	360	015	000	015	030
	02	05	05	10	07	08	05	04	00	00	07	05	03	08	08	07	06	07	00	04	02	06	04	06
9	360	270	270	270	350	360	360	030	030	020	030	090	180	050	010	045	040	025	010	355	030	010	005	005
	06	02	03	03	05	05	04	02	07	10	06	04	07	06	05	08	08	08	06	03	03	05	02	02
10	005	010	355	025	005	020	010	010	010	020	010	045	070	230	265	325	015	020	005	005	355	005	005	360
	05	06	05	05	05	06	05	05	04	05	04	03	02	02	02	02	05	05	05	03	03	03	05	04
11	360	000	205	265	000	015	010	025	025	020	015	025	010	360	030	005	360	330	005	000	240	230	000	000
	02	00	03	01	00	03	08	08	09	08	08	07	08	08	06	09	05	05	05	00	03	04	00	00
12	315	265	205	225	000	270	130	160	230	265	265	275	270	260	230	265	255	315	025	270	030	265	360	000
	03	02	05	11	04	07	02	05	09	08	15	14	05	05	08	08	09	05	03	05	03	06	03	00
13	185	355	325	360	355	000	175	205	000	000	000	000	030	000		000	015	005	005	355	260	245	355	000
	03	05	02	02	03	01	01	03	00	00	00	00	03	00		00	05	05	05	04	05	04	02	00
14	170	000	000	000	000	000	000	000	225	355	005	015	025	020	020	025	025	025	005	355	000	010	350	210
	02	00	00	00	00	00	00	00	03	02	05	09	10	11	11	11	12	10	06	04	00	03	04	02
15	185	000	005	000	355	360	240	345	000	000	000	000	245	215	245	000	010	010	005	010	005	255	220	360
	02	00	03	01	03	03	01	03	00	00	00	00	02	04	03	00	06	05	07	07	05	01	03	03
16	330	000	355	350	240	230	355	000	000	350	245	000	000	235	220	010	005	325	275	275	275	275	275	275
	01	00	01	01	02	01	04	00	00	03	02	00	00	01	04	07	08	01	13	14	17	15	14	14
17	270	310	335	275	275	330	345	225	000	000	000	000	190	225	240	190	210	000	355	000	000	350	005	360
	15	08	04	13	13	04	05	03	00	00	00	00	03	02	01	04	01	00	03	00	00	01	02	06
18	355	360	195	000	260	230	305	010	000	200	155	285	285	035	255	265	270	260	260	260	275	270	275	270
	07	04	01	00	01	01	01	03	00	01	01	06	03	08	15	12	15	10	10	13	13	07	05	08
19	270	325	355	350	355	355	350	010	000	090	185	000	015	000	125	020	015	010	005	355	265	000	205	285
	10	04	04	05	05	04	01	01	00	01	02	03	01	00	01	08	09	08	07	05	05	00	01	02
20	350	340	000	340	345	000	290	000	000	000	000	180	175	170	000	095	015	360	345	350	315	350	290	340
	05	03	00	03	03	00	01	00	00	00	00	02	03	04	00	01	03	07	05	08	04	03	03	03
21	000	000	000	120	030	240	120	030	340	265	300	120	210	180	180	180	045	030	015	015	030	360	360	015
	00	00	00	02	03	05	02	03	05	02	03	02	03	05	02	02	03	05	08	05	02	07	06	10
22	360	340	210	285	000	285	270	300	345	220	195	120	180	110	300	315	015	015	350	015	330	000	000	000
	06	05	04	03	00	06	02	03	06	04	05	03	04	04	01	04	05	06	07	07	06	00	00	00
23	340	360	360	360	350	340	330	000	000	190	210	120	045	090	120	030	030	015	000	015	360	360	360	350
	08	06	07	06	06	06	06	00	00	03	04	03	02	03	03	04	04	04	00	05	07	05	04	03
24	220	260	260	320	280	240	015	015	015	330	310	030	360	030	030	020	030	015	020	360	330	030	360	360
	05	03	05	04	04	03	06	07	08	07	07	08	06	07	06	08	08	07	04	08	06	07	05	04
25	360	320	360	000	000	030	360	360	360	360	360	015	150	270	210	045	030	000	360	360	360	360	290	030
	03	03	04	00	00	05	05	05	04	03	04	04	03	02	07	01	02	00	06	07	08	06	03	02
26	330	330	300	000	000	000	000	000	000	000	000	150	120	120	150	120	330	290	340	360	020	360	360	360
	04	04	00	00	00	00	00	00	00	00	00	04	05	04	02	03	02	04	05	07	08	07	05	06
27	360	000	000	000	000	000	360	315	000	000	000	150	210	200	360	020	015	015	020	015	360	360	360	315
	04	00	00	00	00	00	03	06	00	00	00	04	06	05	04	12	15	10	09	07	07	05	06	05
28	000	000	320	000	120	000	000	220	120	280	250	150	280	000	295	270	020	000	015	015	360	360	000	000
	00	00	03	00	02	00	00	04	03	05	04	04	03	00	05	10	11	00	10	06	07	05	00	00

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, MARCH 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	000	000	000	360	315	360	350	015	360	165	240	100	120	350	265	315	315	320	320	330	360	360	350	360
	00	00	00	05	05	06	05	05	04	03	05	04	05	05	05	11	11	10	14	10	06	06	06	07
2	360	000	260	000	000	000	315	315	240	195	225	240	240	260	260	255	255	250	250	260	270	270	260	260
	04	00	05	00	04	00	06	03	01	07	15	16	15	23	18	17	18	20	18	21	20	18	18	18
3	260	260	265	260	265	260	265	300	350	060	030	020	030	030	320	075	020	315	315	315	015	330	350	280
	13	20	20	18		15	15	10	03	04	06	10	08	06	06	05	07	10	10	07		05	05	04
4	360	315	315	360	020	030	030	360	030	020	010	030	030	020	030	330	030	330	030	030	030	030	030	090
	04	03	03	03	10	07	10	05	10	07	10	12	10	10	10	11	10	09	11	05	07	04	05	04
5	330	240	240	220	225	210	230	225	230	220	225	225	240	225	240	240	255	255	240	230	240	220	260	240
	05	12	10	12	10	09	13	10	14	12	15	15	18	20		15			15	10	10	08	08	07
6	255	270	330	240	195	265	270	265	180	165	170	180	150	165	180	315	360	010	015	040	020	020	010	020
	15	06	03	07	05	06	08	03	06	05	06	06		10	06	07	07	08	06	07	08	06	06	06
7	360	015	315	020	030	030	020	030	030	010	360	010	030	015	030	310	020	020	000	270	300	280	270	260
	06	06	04	06	08	10			12			10	11	07	06	05	08	04	06	06	05	06	05	07
8	360	225	240	330	340	360	360	360	210	030	120	340	090	030	040	030	015	030	315	315	000	000	000	000
	06	04	07	04	04		03		04	04	03	04	04	07	06	10	08	06	07	05	00	00	00	00
9	000	000	000	000	000	000	260	280	360	110	120	150	080	030	015	340	300	255	265	250	270	270	240	270
	00	00	00	00	00	00	04	05	02	03	05	04	04	06	07	05	11	10	08	06	05	06	01	06
10	270	265	270	270	250	250	240	250	255	270	240	265	265	190	220	225	260	180	210	190	210	270	260	060
	11	14	13						13		05	05	08	09	13	15	07	08	05	07	05	06	08	06
11	310	360	180	300	210	015	015	350	310	020	030	015	360	360	360	135	140	150	140	020	015	360	360	360
	07	01	07	04					05	08	07	09	05	08	09	08	10	12	13	10	06	08	07	11
12	315	030	015	020	020	020	360	350	360	030	015	360	360	010	175	150	160	160	180	190	195	190	180	225
	10	12		11	14			04		11	11		10	08	06	06	06	05	05	05				
13	230	240	240	240	240	240	240	240	230	195	180	180	180	225	225	210	240	225	255	240	240	255	255	255
											10	11	10	13	06	12	13	13	07	10	12	11	10	10
14	240	255	250	255	255	250	255	255	350	015	030	030	030	270	270	250	255	260	270	260	255	255	260	260
	06	10	15	16					07	07	05	02	04	04	05	10	14	13	14	15	15	15	15	15
15	260	260	270	260	270	270	260	255	255	255	255	255	250	255	255	255	255	260	260	260	255	260	270	300
	17	16			15		15			10		17	14	13	13	15	15	17	20	17	18	16	15	13
16	350	240	230	270	270	330	360	090	090	120	150	190	180	180	270	180	165	150	300	270	345	340	000	260
		07	05		04			02	02	04	04	04	04	04	05	06	05	03	04	09	05	05	00	04
17	240	360	000	000	000	000	320	360	315	120	090	210	030	315	320	360	040	015	330	180	330	000	270	190
	04	00	00	00	00	00					06	05	04	04	05	05	10	04	04	02	06	00	07	09
18	240	260	045	285	015	045	270	060	255	250	240	255	255	240	255	255	260	260	260	260	260	260	260	270
	12	11	06	07	06	02	04		13	10	11	08	20	20	18	22	18	18	20	15	14	15	15	11
19	270	270	330	290	315	300	260	360	030	090	090	100	120	090	090	100	080	090	045	045	030	315	330	345
	11	11								04		06	04	06	06	09	07	06	05	01	03	03	03	04
20	300	315	360	330	015	045	090	040	120	150	225	030	135	100	130	090	190	240	270	240	330	120	210	210
	05	04	04	03	03			08			05		20	13	10	13	22	08	05	04	05	03	06	03
21	195	135	180	150	165	165	170	135	165	165	150	180	165	285	270	255	135	230	240	210	220	190	240	250
	05	07	08	13	13	14	17	10	20								06			10	11	07	02	04
22	210	375	100	270	250	255	255	195	120	210	195	120	135	090	110	100	260	210	210	020	030	350	330	330
	03	03	04	07	03	03	02	03	03	05	05	03	04	02	11		10	06	05	06	07		04	03
23	320	060	195	270	265	270	270	255	255	330	015	015	010	015	015	010	340	315	330	010	010	360	360	360
	06	03	05	10	12	15	15	08													15		17	20
24	360	360																						
	13												015	010	015	010	240	005	010	290	325	005	005	005
													20	16	12	12	01	06	01	10	07	14	10	14
25	005	005	315	250	220	315	310	250	225	075	035	360	190	080	180	180	135	190	130	115	265	265	270	310
	10	10	04	09	05	08	05	06	03	03	05	05	05	06	05	04	06	05	05	02	06	08	09	08
26	265	300	340	340	260	010	330	035	045	060	360	150	135	130	120	150	120	105	070	285	300	270	260	270
	04	04	04	02	05	02	03	02	01	02	04	04	04	05	03	07	05	08	06	13	11	09	08	01
27	250	290	170	245	260	330	260	325	190	225	225	240	225	225	220	250	240	240	240	240	255	275	225	245
	06	02	03	03	06	04	06	06	06	09	09	11	15	15	13	18	14	13	15	13	19	09	06	11
28	250	145	150	240	260	250	255	255	280	360	110	065	245	280	050	020	005	030	255	270	065	360	295	230
	08	03	05	07	13	08	13	12	03	03	05	04	11	06	06	01	08	05	08	03	05	04	03	08
29	240	240	260	350	065	280	280	330	060	025	010	010	240	250	260	255	260	250	255	250	250	250	250	265
	08	06	09	05	11	06	02	02	04	06	07	02	11	14	19		24	20	17	10	14	15	16	20
30	260	260	260	255	265	260	265	265	260	255	240	270	245	225	230	230	240	240	255	260	270	230	210	210
	21	21	19	15	13	17	16	09	15	14	14	06	11	14	15	15	17	19	17	13	11	05	09	06
31	240	245	260	235	210	225	265	245	235	220	270	255	240	220	270	270	250	250	200	225	255	265	240	260
	12	04	05	06	10				10	11	09	12	14	16	18	11	14	15	06	08	08	08	09	07

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, APRIL 1975

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	275	350	330	290	245	300	315	040	005	030	240	290	250	240	240	240	050	335	360	340	280	060	270	255
			04	04	08	04	05	02	05	02	08	10	14	14	09	12	04	04	06	04		02	02	11
2	270	255	260	315	270	045	255	250	325	005	005	010	010	010	005	005	005	005	005	005	005	005	005	005
	11	14	10	05	11	02	02	08	11	18			26	28	28		30	22	24	35	28	34	28	
3	005	005	005	005	360	005	360	005	010	010	010	010	015	010	015	010	210	190	330	015	005	270	030	090
	21	15	21		23	24	21		25	26	23	19	19	16	15	14	10	11	06	19	21	02	03	02
4	065	010	335	005	005	360	335	005	005	010	015	035	030	015	050	255	270	200	235	260	260	265	260	270
	02	07	09					17	24	22	16	11	13	10	09	04	03	06	10	14	11	11	14	14
5	265	265	265	265	260	295	320	315	030	045	100	105	165	165	135	180	230	240	245	250	260	270	030	030
			14	12	15	10	06	04	06	06	03	04	06	06	06	04	09	11	14	15	11	09		
6	220	245	310	340	255	205	315	315	230	220	250	255	270	260	255	260	270	260	040	250	240	250	250	285
	04	05	05	06	06	10	03	03	12	09	10	15	19	16	22	24		24		07	10		15	
7	275	230	225	240	235	260	255	260	280	275	280	285	300	310	300	300	010	330	030	025	015	015	015	015
	06	04	14	16	16	21	26	21	32	28	34	31	28	30	26	25		15	13	12	26	20	18	10
8	015	325	350	355	330	155	320	240	250	250	225	255	300	250	240	255	255	260	260	250	250	245	230	230
	13	06	09	06	06	03	03	12	19	14	08	10	09	20		20	20	20	17	19	12	12	11	09
9	225	235	240	240	240	235	250	240	230	240	260	260	285	310	300	315	250	270	275	270	240	255	260	290
	03	06	11	11	10	07	09	13	14		18	15	15	21	15	17	19	14	07	05	05	02	07	04
10	245	265	290	330	030	020	000	025	060	210	225	230	240	290	270	280	270	250	240	245	270	290	265	000
	06	09	05	05	03	03	00	02	03	03		12	14		11	12	13	12	10	09	13	06	07	00
11	240	260	275	235	240	000	330	000	200	165	165	285	340	020	360	315	240	240	260	320	275	260	290	330
	03	06	07	05	07	00		00	07	07	05	06	08	14	09	03	15	12	09	05	04	08	03	02
12	270	270	320	310	000	000	015	190	115	120	165	120	360	180		075	165	210	340	150	315	025	315	010
	05	03	04	04	00	00	01	04	03	04	09		04	04		03	06	13	05	07	04	04	06	01
13	310	300	265	340	330	290	255	090	060	120	175	200	255	245	235	230	230	230	235	240	250	255	260	255
	03	01	02	05	03	01	02	02	04	03	06	10	09	26	20	26	28	23	17	13	11	17	14	12
14	215	215	215	225	255	235	225	165	150	200	205	225	240	235	240	285	290	290	285	300	300	300	320	300
	12	10	11	06	11	10	01	02	10	14	13	13	26	24	23	24	23	20	16	16	18	14	10	14
15	295	295	300	305	300	290	285	270	285	315	300	285	285	285	295	295	285	300	300	310	285	305	315	315
	14	16	18	18	12	11	09	13	11	12	15	21	18	14	11	22	14	14	17	11	10	09	07	10
16	320	330	310	015	030	340	345	230	180	140	270	285	300	285	285	240	295	250	280	240	250	200	235	260
	04	04	07	03	02	01	01	02	01	03	13	10	12	16	16	15	13	08	11	07	06	08	07	10
17	240	265	160	210	180	255	225	210	215	295	180	285	320	295	285	170	170	215	215	240	250	300	270	295
	03	11	02	03	04	05	05	01	04	09	04	16	09	19	10	06	13	17	18	14	28	18	17	23
18	295	275	300	295	300	290	300	295	295	290	290	315	300	295	305	280	290	300	335	345	300	330	300	310
	24	23	19	15	15	17	17	19	20	25	22	17	16	23	21	21	21	17	14	11	11	12	13	17
19	310	310	315	315	315	315	295	305	315	305	295	305	300	300	315	300	290	310	280	245	110	270	265	250
	22	27	28	23	15	14	10	14	25	22	23	23	21	23	18	18	20	20	11	08	03	10	08	10
20	270	265	275	290	285	295	295	270	275	295	300	290	275	275	265	280	280	290	295	265	275	280	290	275
	10	13	13	17	21	14	12	13	15	17	17	20	20	15	14	15	16	18	15	09	13	11	13	11
21	295	295	295	285	285	280	275	280	275	280	285	300	210	270	275	300	290	300	300	300	300	300	300	300
	11	14	12	11	15	15	12	12	12	13	12	10	07	08	13	13	15	19	17	16	15	15	14	15
22	300	295	300	005	320	000	040	255	275	210	280	180	195	170	170	170	315	305	300	295	280	270	300	315
	15	11	05	05	04	05	02	03	06	05	06	07	05	06	05	07	11	13	13	12	07	05	06	02
23	340	315	360	240	360	280	330	270	150	090	150	180	245	210	170	240	315	295	300	300	300	310	300	300
	04	02	04	01	01	01	05	02	01	02	04	04	06	05	13	20	30	13	12	08	09	06	11	05
24	320	290	290	310	270	195	045	015	075	190	150	210	240	280	025	090	290	300	330	315	285	285	275	270
	13	11	09	10	02	03	02	07	01	05	12	06	05	08	13	06	15	13	15	15	06	04	08	05
25	270	280	285	335	315	285	310	250	265	280	275	300	330	310	300	300	300	300	295	310	360	015	040	055
	06	01	12	08	03	01	04	03	05	14	16	13	12	18	17	15	18	18	20	11	06	10	06	07
26	045	005	330	050	025	045	000	240	090	335	150	030	180	285	195	155	120	120	190	325	240	300	315	315
	10	10	03	12	06	03	00	03	02	08	06	03	05	06	05	05	05	02	04	02	05	03	09	10
27	330	345	320	015	015	030	340	095	000	130	160	210	165	190	180	165	195	165	190	185	290	315	315	030
	03	06	03	04	01	00	03	01	00	02	04	06	07	06	08	12	13	13	12	07	07	06	10	05
28	265	285	180	255	260	230	165	150	150	270	270	260	315	275	315	315	330	290	290	315	300	300	290	280
	03	06	02	02	03	02	01	02	09	10	16	25	17	20	13	15	17	11	11	15	13	21	28	10
29	300	300	285	300	310	340	305	030	180	235	215	255	270	270	270	275	315	300	290	290	285	295	330	295
	13	12	10	03	02	07	08	02	03	10	12	25	24	25	25	17	19	13	17	13	13	16	16	14
30	290	295	310	130	090	060	060	100	075	030	045	120	150	300	300	270	240	280	270	060	060	280	285	285
	17	13	14	08	08	06	07	07	05	04	03	08	10	17	08	10	11	09	12	08	03	07	10	13

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, MAY 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	235	330	300	285	300	300	280	090	300	235	300	285	300	270	300	300	300	285	300	330	330	150	000	000
	13	15	10	08	10	07	10	04	15	11	16	23	15	17	11	20	22	11	10	27	23	05	00	00
2	300	285	255	000	200	095	300	290	135	110	045	045	210	210	240	170	180	165	190	170	170	250	310	040
	07	06	05	00	01	06	00	05	01	05	04	04	06	05	08	05	06	09	11	06	07	01	03	01
3	300	295	290	015	040	020	260	000	110	140	125	215	180	205	195	120	170	155	150	150	195	305	300	330
	00	05	02	01	01	02	11	00	02	04	09	07	07	10	10	11	09	13	09	05	01	06	00	04
4	060	110	020	060	000	285	270	270	255	195	210	225	210	225	220	220	230	225	195	225	225	250	290	090
	01	01	03	03	00	06	08	07	06	13	13	16	24	20	19	23	21	25	26	16	16	13	03	04
5	260	240	250	250	220	250	270	090	175	175	160	140	165	150	150	165	190	200	205	340	075	255	180	015
	17	05	13	03	05	03	07	02	10	15	12	10	18	14	13	25	12	11	07	10	04	04	01	03
6	280	215	265	210	130	155	145	180	120	160	095	280	290	330	310	300	300	300	300	315	300	265	330	315
	01	06	05	01	05	04	04	01	03	03	05	12	22	21	18	20	18	10	15	01	05	01	03	05
7	300	315	300	285	265	285	285	270	300	295	300	285	285	315	315	360	360	345	280	285	295	315	320	280
	00	09	08	12	04	14	08	05	14	11	10	05	13	13	13	07	10	09	09	09	05	05	05	09
8	270	300	300	290	285	290	300	330	150	180	195	280	270	285	270	285	270	180	315	290	315	315	300	300
	03	03	03	10	11	10	11	02	05	07	08	23	21	20	17	17	11	03	11	06	06	06	09	10
9	330	315	330	315	230	015	000	180	150	120	270	270	270	270	270	270	330	300	255	240	240	225	300	000
	08	05	10	08	13	03	00	06	05	04	20	23	25	25	23	22	15	10	07	06	05	06	07	00
10	245	280	310	300	270	315	315	315	270	270	285	285	280	270	270	300	285	315	315	330	330	090	315	360
	06	06	08	06	06	07	08	10	13	16	17	20	18	23	16	13	20	13	10	07	11	02	10	05
11	345	150	015	360	360	000	345	330	180	180	180	180	120	210	330	330	315	315	300	315	270	285	300	315
	08	04	06	05	05	00	05	02	03	03	05	08	10	13	10	11	10	12	07	07	10	10	07	10
12	310	330	030	090	060	000	300	000	000	030	120	120	270	180	135	265	240	300	345	315	300	300	300	090
	07	06	03	02	02	00	02	00	00	02	02	06	05	10	10	10	05	00	27	05	07	09	05	03
13	315	030	030	015	000	300	015	000	000	075	090	135	240	315	120	060	060	345	345	030	345	030	060	045
	07	02	04	05	00	05	05	00	00	07	03	08	03	05	04	05	10	10	10	08	10	10	10	20
14	060	060	060	060	360	210	015	240	075	075	090	090	060	210	210	120	060	060	090	150	170	315	300	360
	17	12	12	12	07	02	03	03	15	13	07	07	05	06	05	05	07	07	03	06	08	05	07	04
15	345	330	320	270	300	040	315	180	120	210	225	180	090	285	180	105	120	180	180	150	315	270	240	320
	03	06	05	02	02	05	03	03	03	03	05	07	03	04	07	04	05	02	05	15	04	07	05	10
16	305	080	040	030	100	000	010	070	070	085	075	080	015	360	075	090	090	075	050	000	325	305	165	030
	06	06	06	05	02	00	04	05	03	03	10	15	07	05	14	08	10	05	01	00	10	10	02	03
17	300	360	240	300	275	305	305	070	145	135	130	225	270	250	345	345	315	345	320	315	320	310	295	300
	10	02	02	03	09	10	10	02	01	03	03	04	05	03	10	08	11	13	10	10	08	11	06	11
18	330	300	285	310	330	310	315	315	300	090	110	180	180	300	300	340	320	340	305	330	325	235	240	030
	11	12	10	13	03	12	07	13	11	01	04	02	05	05	03	05	10	12	11	11	08	06	04	05
19	120	290	345	280	300	305	360	000	260	275	250	210	290	150	180	120	090	340	165	135	285	340	050	325
	01	07	04	06	08	06	03	00	05	06	06	16	10	08	06	06	08	24	11	06	07	10	03	05
20	350	315	340	340	270	270	320	200	130	240	200	160	210	285	250	240	240	265	270	315	310	315	315	320
	03	03	07	01	03	02	05	00	02	03	07	07	08	15	16	21	20	22	13	21	25	23	20	22
21	315	250	240	105	270	330	000	000	060	150	150	210	230	190	255	295	280	315	320	300	310	330	040	310
	13	08	08	02	04	08	00	00	03	01	05	05	10	19	21	16	06	13	15	07	08	02	03	05
22	000	010	280	190	220	255	315	060	075	090	130	130	240	280	225	290	330	325	350	335	330	320	320	325
	00	02	07	01	03	02	07	03	04	03	04	04	06	03	06	13	13	12	10	12	10	05	10	08
23	325	320	310	090	110	345	050	060	070	140	140	015	130	160	225	240	270	210	230	300	315	320	255	270
	12	03	06	01	02	03	01	03	05	03	04	06	06	08	15	14	11	10	05	11	05	05	07	04
24	275	285	225	150	135	240	260																	
	05	05	04	01	02	03	04																	
25																								
26											335	320	315	325	320	315	330	325	325	330	330	340	345	285
											18	21	20	15	19	17	19	13	18	20	31	24	14	07
27	030	360	250	320	270	300	235	300	345	345	350	345	350	360	350	345	345	325	350	360	360	360	360	360
	07	02	01	05	03	06	03	05	18	19	18	16	15	17	18	11	14	16	13	08	09	13	10	03
28	360	330	210	000	030	030	255	300	305	230	060	180	325	180	250	275	345	345	315	320	325	330	325	325
	01	03	02	00	01	02	02	02	08	06	03	04	02	05	06	06	15	15	16	12	09	06	08	10
29	325	330	210	105	090	090	000	075	270	270	240	270	270	300	330	250	300	330	360	350	360	360	360	330
	10	13	01	03	01	01	00	01	05	05	02	09	15	16	13	12	08	10	13	11	07	12	12	11
30	330	330	330	030	075	060	360	100	090	090	090	090	090	030	090	360	030	360	060	030	090	270	280	315
	13	08	13	05	05	13	03	01	12	12	11	07	05	07	03	08	07	08	08	08	03	04	04	08
31	010	000	300	030	000	280	030	180	220	150	180	120	270	150	150	270	315	270	240	315	330	300	300	280
	01	00	08	03	00	02	02	01	02	02	03	[illegible]	05	05	05	23	20	14	01	04	08	11	16	11

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, JUNE 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	220	210	330	320	300	180	170	150	180	200	160	120	015	210	300	240	000	240	360	330	300	270	360	090
	11	07	11	06	10	06	03	03	08	06	01	01	02	07	03	04	00	08	04	04	11	07	04	05
2	330	280	300	300	300	300	300	270	280	300	300	330	360	315	330	330	300	300	360	330	300	270	315	240
	01	07	12	11	12	11	11	08	08	12	10	15	10	17	13	16	12	10	05	10	04	06	05	01
3	315	030	330	350	360	220	240	250	180	180	270	330	315	320	270	240	300	270	300	300	300	300	315	315
	06	02	01	02	03	08	02	03	03	05	13	19	23	08	14	13	14	12	13	11	14	09	14	10
4	315	330	320	330	330	360	250	315	300	300	315	300	330	300	315	330	330	330	300	330	360	360	330	090
	13	12	10	09	10	03	11	10	05	10	10	08	15	16	16	14	11	13	14	10	05	09	03	01
5	330	330	315	330	030	300	330	090	090	120	090	180	030	180	120	180	150	210	180	190	240	300	315	330
	05	05	03	08	04	06	05	03	05	04	03	03	02	03	02	05	09	07	09	06	03	04	05	09
6	300	330	360	000	315	000	000	000	000	090	090	210	090	210	150	300	260	315	320	345	360	360	220	300
	06	05	04	00	05	00	00	00	00	02	02	04	03	05	03	05	10	10	10	10	09	06	04	12
7	330	345	330	315	360	030	270	000	120	090	210	210	210	300	280	330	330	330	330	330	360	330	270	330
	09	06	04	03	03	02	03	03	01	02	02	02	08	06	11	13	08	12	13	09	08	10	03	08
8	320	345	360	360	300	315	300	060	045	060	180	130	090	200	270	210	250	210	180	180	330	330	330	330
	08	04	00	03	01	02	02	05	04	04	03	02	03	07	06	05	05	04	05	03	09	02	09	07
9	270	270	315	330	030	320	315	300	000	190	180	075	300	270	270	270	300	300	300	300	315	300	300	300
	01	05	02	05	02	05	01	00	00	03	03	06	08	15	12	15	13	15	13	13	13	13	14	09
10	300	240	290	210	240	150	270	210	150	150	150	330	270	300	300	300	315	300	300	300	330	300	300	300
	11	05	05	07	03	03	03	02	02	10	12	06	17	09	13	12	10	07	07	08	08	08	03	09
11	270	300	210	210	190	180	000	240	240	240	270	300	300	300	315	270	270	300	300					
	04	00	02	05	07	04	00	03	07	17	16	16	14	08	13	09	15	13	17					
12																								
13																								
14																		265	260	265	265	300	300	310
																		13	18	22	13	06	08	13
15	270	270	250	300	330	330	295	000	290	280	285	310	285	285	300	300	315	300	270	305	320	290	105	360
	06	03	05	08	05	04	05	00	06	13	18	19	16	21	16	21	11	09	10	11	14	10	01	04
16	290	300	305	265	255	085	295	000	250	130	180	155	150	130	225	130	270	330	330	000	325	315	315	260
	10	10	10	01	05	01	10	00	02	02	06	06	08	08	04	05	03	03	02	00	05	11	11	06
17	310	315	320	315	305	310	015	235	180	195	295	285	280	285	260	275	280	310	285	320	315	315	295	195
	07	09	09	08	07	08	02	01	03	06	15	20	17	27	27	24	21	18	18	24	23	27	13	07
18	255	255	290	265	290	295	285	270	270	330	350	300	285	285	315	305	300	330	330	335	015	015	015	360
	12	12	10	08	13	08	10	10	08	05	15	08	15	12	16	20	13	23	18	18	08	10	10	12
19	315	300	325	010	325	225	330	340	045	100	090	105	150	215	150	090	160	285	280	275	310	330	315	305
	05	00	04	03	08	02	02	03	03	03	04	02	01	05	05	06	05	04	11	10	10	13	14	13
20	310	010	305	325	350	030	195	330	090	050	060	060	060	090	030	330	360	355	025	035	030	190	320	345
	13	07	08	11	06	04	02	04	04	05	08	05	05	04	08	05	05	03	05	06	07	07	10	04
21	345	340	025	030	275	000	320	330	235	120	150	120	135	120	090	330	360	360	210	210	240	165	320	000
	05	04	01	01	05	00	03	03	02	03	07	04	07	06	03	06	02	02	05	05	04	02	12	00
22	300	330	345	345	000	300	295	050	090	240	150	180	180	195	200	240	285	300	270	300	330	280	140	165
	02	03	02	03	00	03	07	04	03	03	03	06	07	11	11	13	16	15	12	10	11	04	06	03
23	300	315	340	270	285	000	000	000	000	180	180	240	200	210	180	180	270	270	260	280	300	300	300	270
	07	10	11	03	03	00	00	00	00	05	07	15	17	15	11	10	12	07	10	12	11	11	12	05
24	265	290	280	260	260	240	240	210	285	300	300	285	270	285	290	285	300	285	300	300	300	315	290	320
	06	10	10	05	05	05	06	07	08	10	10	10	17	16	15	15	10	11	07	10	07	10	08	11
25	315	050	315	210	180	195	225	300	270	300	300	285	315	300	300	330	300	330	320	330	360	120	015	000
	10	05	02	03	02	04	07	08	08	11	14	15	16	17	17	15	12	15	15	16	05	06	07	00
26	315	360	360	000	285	360	270	040	080	070	090	315	180	360	300	300	300	345	360	360	340	330	070	300
	11	06	04	00	07	07	05	05	06	08	06	07	04	07	17	12	12	11	12	11	10	12	07	07
27	150	330	330	360	360	330	360	060	000	135	090	060	060	180	045	045	270	300	230	280	330	330	345	330
	02	05	05	05	04	06	03	05	00	07	14	10	10	02	06	05	12	08	16	10	06	15	17	10
28	300	300	315	285	030	320	165	015	045	075	070	045	330	330	075	045	120	360	075	090	320	090	290	330
	10	12	11	10	03	07	03	03	06	10	15	11	05	08	13	10	10	17	15	08	07	05	05	02
29	330	340	300	010	315	045	330	000	220	300	100	360	090	210	150	330	295	270	300	270	270	320	290	270
	07	08	10	07	05	05	03	00	03	02	03	03	05	11	05	07	15		15	11	07	12	11	06
30	265	210	190	220	210	240	280	270	190	150	180	180	210	210	270	270	280	150	260	285	300	285	300	270
	06	05	05	06	05	10	06	05	05	06	07	12	15	10	16	10	20	16	15	10	15	14	10	06

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, JULY 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	315	300	300	300	300	060	240	045	060	250	300	300	330	330	360	315	315	310	300	330	310	300	270	050
	11	11	07	06	05	03	08	05	03	11	15	12	12	06	07	12	13	14	15	13	10	11	10	05
2	360	180	360	300	360	015	360	240	045	180	105	195	060	060	270	150	150	285	300	330	315	260	315	360
	07	05	03	11	05	06	05	03	04	02	04	07	04	05	07	07	03	10	12	08	05	03	06	07
3	345	015	330	000	300	060	360	000	090	120	190	060	360	210	360	060	210	120	330	000	345	020	330	330
	07	06	05	06	05	05	03	00	02	02	05	05	04	07	03	06	03	05	05	06	13	07	10	06
4	360	360	060	060	015	350	285	000	015	090	150	150	270	150	240	270	330	310	315	330	350	320	360	000
	02	03	03	02	06	08	05	00	02	02	07	02	03	05	11	15	05	07	11	12	12	10	07	00
5	300	360	060	015	360	050	000	045	135	090	150	120	195	090	120	120	180	150	180	165	170	320	330	250
	00	02	02	07	06	04	00	02	02	03	05	05	07	05	05	10	12	06	07	08	08	12	12	06
6	290	300	300	300	270	270	315	270	105	150	120	255	270	240	300	270	270	300	300	285	255	300	310	300
	08	11	10	08	07	07	12	01	02	04	03	16	18	30	15	15	22	23	23	17	07	07	07	10
7	245	280	225	280	255	230	190	240	270	300	300	300	315	300	165	160	120	225	270	240	340	330	315	330
	10	07	06	12	10	07	07	08	07	07	11	15	08	10	07	25	06	10	05	06	07	10	08	05
8	315	315	300	015	015	090	000	090	360	120	150	180	270	270	270	260	240	260	240	120	045	230	300	330
	07	06	06	06	08	05	00	05	03	03	04	07	16	05	10	14	15	07	10	05	04	06	03	06
9	060	240	270	270	015	270	360	330	120	120	135	180	075	060	150	090	090	060	045	040	030	030	060	000
	06	03	03	06	07	08	06	05	02	03	02	03	06	07	07	13	10	07	10	08	13	06	10	00
10	330	300	130	060	330	330	120	345	060	060	060	030	090	180	285	360	360	120	270	150	170	240	330	320
	00	00	05	02	03	04	04	07	04	06	08	07	07	12	07	05	04	05	06	05	04	05	11	11
11	330	015	350	330	240	330	270	285	090	270	120	160	150	225	300	300	230	300	310	310	315	300	300	300
	06	04	07	06	07	07	04	06	02	03	12	12	10	07	08	07	07	16	12	07	12	06	15	10
12	300	300	300	300	340	345	180	340	060	140	075	090	120	150	160	120	330	270	300	320	315	315	320	330
	14	05	10	17	07	05	10	16	06	06	12	05	05	07	04	02	04	05	15	15	18	18	14	10
13	310	315	330	315	315	330	320	315	300	300	315	120	260	300	060	060	050	060	060	165	195	330	330	010
	20	17	20	17	17	16	13	07	14	10	08	04	10	10	13	05	20	16	15	10	12	10	08	14
14	300	360	015	330	060	075	045	040	360	120	090	180	180	240	240	210	180	240	360	060	060	050	050	075
	05	00	00	04	12	07	05	03	02	03	03	05	05	07	07	15	05	05	10	20	16	17	15	11
15	040	000	225	300	015	315	360	000	000	165	120	120	120	210	300	200	330	330	330	315	345	020	075	135
	10	00	05	08	07	05	03	00	00	02	05	03	04	07	12	13	12	12	10	05	10	07	06	10
16	330	300	285	270	030	015	345	000	000	105	180	270	315	270	330	300	330	300	315	300	345	015	045	315
	03	06	06	07	07	05	03	00	00	05	03	05	11	07	13	11	14	08	10	10	08	07	10	10
17	040	015	330	270	360	360	310	050	060	090	075	060	180	040	060	330	300	290	345	360	210	150	330	320
	07	07	07	04	03	03	07	06	06	06	07	07	04	16	15	07	08	07	06	03	03	04	05	07
18	040	300	300	360	060	330	300	330	100	120	060	060	070	080	105	270	285	300	240	300	255	255	300	030
	06	02	07	04	03	05	03	05	05	06	05	06	07	07	06	17	16	08	07	00	08	05	10	07
19	050	250	240	300							240	220	270	290	300	300	250	250	270	270	305	270	240	290
	07	05	06	08							06	06	04	06	08	08	05	07	05	06	05	05	05	10
20	300	010	210	190	305	300	260	120	210	300	200	200	180	120	100	130	100	330	320	070	050	050	330	060
	11	12	06	03	04	05	03	02	03	00	04	04	05	05	08	06	06	06	11	10	07	08	06	06
21	350	300	310	300	060	000	000	000	300	090	240	280	210	090	200	180	180	060	060	300	340	310	000	300
	06	05	05	02	02	00	00	00	00	02	02	02	02	03	06	08	05	03	03	05	06	07	00	05
22	000	280	330	000	300	300	310	010	080	090	060	060	200	270	245	270	280	300	310	310	330	330	300	020
	00	03	05	00	00	03	04	05	04	03	05	05	06	03	06	08	07	08	07	07	07	07	04	04
23	010	090	010	310	210	300	040	000	000	000	300	000	000	000	180	120	120	120	060	070	050	080	310	300
	03	03	04	05	04	05	03	00	00	00	00	00	00	00	03	02	03	05	02	05	07	06	04	06
24	330	340	000	000	000	000	240	300	000	000	300	000	170	270	300	330	330	330	330	350	340	340	330	340
	03	03	00	00	00	00	02	00	00	00	00	00	04	02	07	08	08	10	08	08	06	04	02	05
25	170	300	280	300	340	300	000	000	000	070	070	100	060	090	070	070	070	300	290	340	330	330	120	000
	02	00	05	05	03	03	00	00	00	06	06	05	04	03	04	03	03	05	06	05	04	03	02	00
26	300	310	300	330	300	330	340	310	310	100	180	060	130	150	290	300	330	300	280	300	320	290	320	330
	00	05	03	03	03	04	04	02	02	02	02	02	02	05	05	08	06	05	07	05	05	05	02	03
27	330	300	320	320	310	010	020	290	070	000	300	040	060	270	300	270	230	050	300	060	090	000	320	300
	03	06	07	05	04	04	03	02	03	00	00	03	06	06	05	05	06	10	08	06	03	00	05	03
28	300	310	300	270	030	260	000	000	360	090	090	070	040	340	320	340	330	310	330	300	310	310	300	300
	03	03	02	02	03	02	00	00	01	03	04	03	05	08	07	07	04	03	06	03	04	07	06	03
29	310	330	300	300	330	010	000	000	000	300	300	130	130	330	110	330	240	160	060	280	300	250	270	310
	05	04	06	03	03	03	00	00	00	00	00	03	03	15	08	03	06	02	07	06	11	07	05	03
30	300	330	300	040	320	320	310	060	090	120	060	100	080	060	120	060	050	060	050	050	030	050	050	030
	05	07	04	04	03	06	04	02	03	02	02	04	03	03	02	04	06	05	05	05	06	05	06	05
31	035	300	320	010	010	300	040	010	180	160	090	120	090	080	030	150	030	330	040	060	010	330	300	230
	05	03	03	02	03	03	03	02	02	02	~~01~~	~~02~~	04	05	08	03	00	03	05	05	04	04	03	04

WIND DIRECTION AND SPEED (MPH), HOURLY AVERAGES, AT EMERY, UT, AUGUST 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	330	300	310	020	310	030	300	300	300	000	300	300	070	040	120	330	020	330	320	340	020	310	310	270
	00	00	03	03	03	03	00	00	00	00	00	00	03	03	03	03	00	07	03	03	04	04	02	05
2	280	330	020	030	060	330	310	030	270	130	110	130	170	150	250	210	040	000	340	340	060	040	330	270
	03	05	03	03	03	04	03	02	02	02	02	02	02	02	02	02	02	00	05	03	03	06	02	05
3	320	101	310	040	020	260	270	160	100	240	020	270	020	070	210	260	310	300	280	280	310	300	290	300
	05	02	07	03	03	03	03	03	03	03	02	03	03	03	05	09	06	06	06	06	06	05	06	03
4	330	190	330	300	270	300	301	280	010	000	030	290	180	180	180	320	320	240	240	300	300	300	300	310
	04	04	04	06	02	02	06	05	03	00	02	02	06	07	05	10	06	03	02	10	07	08	11	09
5	300	250	240	290	280	290	280	070	080	110	300	270	210	210	240	240	180	210	210	250	310	320	300	270
	08	06	05	04	05	05	06	02	03	15	02	10	07	07	05	03	06	07	05	02	03	03	04	05
6	300	270	270	090	310	040	030	280	150	000				240	300	350	290	250	290	320	300	340	040	050
	03	03	02	03	03	03	03	03	03	00				07	04	03	05	04	08	05	06	05	03	03
7	270	250	210	301	050	020	020	140	070	010	150	150	200	060	120	150	250	210	050	330	330	320	300	310
	02	03	05	02	04	02	02	04	05	02	02	03	03	06	07	03	03	03	03	03	05	05	05	05
8	330	070	040	040	000	000	000	300	000	000	150	100	040	060	180	310	300	310	310	340	340	300	310	190
	05	03	03	02	00	00	00	00	00	00	02	03	06	04	03	06	06	06	05	05	06	05	06	02
9	320	340	340	180	310	310	030	300	100	360	060	180	210	210	270	210	180	190	190	160	020	300	040	290
	03	03	03	03	03	03	04	03	02	02	02	02	03	03	05	02	04	04	04	02	02	04	03	05
10	260	330	300	210	270	060	180	030	120	100	120	150	180	240	270	240	290	280	300	290	300	300	270	280
	03	04	04	03	03	03	04	03	02	02	02	04	02	10	08	04	07	08	07	06	05	06	05	06
11	290	340	300	300	290	210	270	240	320	320	310	300	310	290	270	330	310	300	310	330	330	310	120	050
	07	02	03	03	03	03	03	03	06	06	04	07	06	05	05	06	06	05	05	05	05	03	02	05
12	330	000	000	020	330	330	310	040	090	070	130	170	060	310	060	150	210	220	210	240	330	310	330	300
	14	00	00	03	05	03	03	03	02	02	03	03	04	03	03	05	05	04	03	02	02	05	04	05
13	310	020	020	010	040	040	010	220	010	090	070	070	100	210	220	150	090	150	150	270	330	310	310	300
	05	02	02	02	02	02	00	03	02	04	04	04	03	06	08	03	04	06	03	03	06	06	06	02
14	250	250	250	180	270	240	000	060	060	230	280	250	280	300	310	240	230	060	120	340	030	030	040	000
	02	02	02	02	02	05	00	02	02	02	07	05	07	07	04	09	07	02	02	06	06	04	03	00
15	150	060	000	020	290	130	050	030	230	000	180	060	070	300	150	130	090	240	240	150	230	280	300	310
	12	12	00	02	02	04	03	02	02	00	03	03	04	03	04	05	05	04	06	07	06	05	06	07
16	160	280	100	330	000	040	210	180	080	075	165	135	120	315	265	300	300	295	295	290	130	250	280	270
	02	04	02	04	03	02	02	02	02	03	03	03	02	03	04	07	08	07	07	06	05	06	05	03
17	210	240	350	210	020	030	000	000	105	360	000	120	125	105	255	235	240	230	210	185	000	315	205	300
	05	03	03	03	04	03	00	00	03	02	00	02	02	03	07	07	02	03	04	04	00	02	02	03
18	320	275	040	075	025	240	255	045	120	240	235	190	210	255	330	270	210	205	195	235	045	305	315	295
	05	03	03	03	05	03	02	02	02	02	02	03	04	04	03	04	06	07	07	04	03	03	03	05
19	245	301	270	070	040	300	355	360	180	225	180	045	180	210	240	275	260	310	225	275	310	290	315	285
	05	06	05	04	04	03	02	02	01	01	01	01	02	03	04	01	06	04	03	02	05	03	05	03
20	330	315	135	030	215	010	305	020	195	075	170	120	170	150	155	180	265	150	195	300	180	190	350	120
	06	02	02	04	01	03	05	03	02	03	03	02	04	05	05	04	02	04	02	02	10	10	04	04
21	355	030	000	060	315	030	320	095	000	080	165	150	180	155	360	330	210	320	265	250	045	270	000	000
	02	02	03	01	04	02	02	01	00	01	02	02	03	05	05	02	01	03	05	05	04	01	00	00
22	040	320	060	315	030	005	330	150	000	075	165	075	165	225	270	225	250	245	190	325	305	310	330	030
	01	01	01	02	01	02	02	01	00	02	01	01	02	04	03	06	03	03	02	01	03	02	02	01

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) NOVBR, 1972

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1																								
2																								
																		275	275	280	255	270	280	260
																		11	10	01	07	10	11	04
3	280	315	345	350	350	275	340	355	000	010	065	165	165	165	155	185	160	145	120	345	290	295	000	015
	08	05	04	03	02	01	03	02	00	01	02	02	03	04	04	06	05	04	02	03	04	04	03	02
4	315	360	000	000	000	310	360	340	265	360	025	055	100	110	085	045	035	305	310	040	010	360	315	350
	02	01	00	00	00	02	03	04	01	01	05	04	05	05	04	14	05	06	04	03	07	05	03	04
5	120	270	020	170	205	205	230	230	260	250	250	240	250	250	240	255	245	245	250	245	270	245	300	110
	02	03	02	02	03	08	11	09	10	12	14	18	21	14	16	16	14	17	17	14	08	06	05	05
6	300	285	295	330	255	260	270	305	305	270	260	300	110	110	155	140	095	090	140	250	275	320	350	280
	02	09	06	05	12	15	13	08	06	08	04	03	05	05	06	05	03	02	02	05	07	04	04	02
7	210	000	000	000	000	000	310	270	320	350	360	310	030	015	010	015	050	345	020	355	345	355	345	355
	01	00	00	00	02	00	01	02	01	01	02	03	06	06	08	07	05	05	03	05	05	05	05	04
8	340	355	335	320	230	300	250	000	230	355	160	170	050	070	160	080	140	255	260	250	300	250	260	200
	04	03	04	02	01	01	02	00	02	03	02	05	03	06	07	06	05	10	07	04	06	14	09	05
9	290	275	285	240	290	280	270	265	285	260	260	265	125	130	160	115	140	115	120	260	280	300	330	310
	10	10	08	09	06	07	06	10	09	12	09	05	05	05	05	05	03	02	06	08	05	05	05	
10	320	015	270	315	000	345	015	360	350	005	020	035	050	030	080	115	115	060	310	015	020	015	350	010
	05	03	02	02	00	04	05	05	05	04	06	09	05	05	06	04	04	05	08	07	08	06	05	03
11	350	350	330	030	330	170	010	040	035	355	050	060	110	115	170	155	155	160	090	015	025	030	020	015
	05	04	04	03	04	01	05	03	03	02	02	01	03	04	02	07	06	07	05	07	06	08	10	13
12	010	005	010	010	010	355	335	265	270	245	265	285	060	270	270	030	270	270	270	250	260	255	255	290
	14	12	11	14	13	10	03	03	04	03	03	03	04	07	09	06	10	10	11	10	10	10	08	05
13	350	355	360	015	350	030	000	245	300	120	150	120	125	210	210	140	160	240	270	000	350	190	000	000
	05	03	03	04	04	01	00	02	01	03	02	05	08	05	03	04	04	02	01	00	02	02	00	00
14	000	060	100	100	010	005	020	025	030	030	015	045	065	095	120	130	195	260	020	010	360	310	315	005
	03	01	01	02	02	04	04	07	08	08	07	04	04	04	07	06	04	02	02	04	03	06	07	07
15	025	360	000	190	195	190	200	195	200	210	295	190	180	165	190	195	215	210	210	190	210	250	000	240
	04	02	00	03	02	02	03	03	01	02	03	04	04	04	06	04	03	03	05	04	03	01	00	01
16	270	320	000	360	040	350	270	350	180	270	000	100	125	180	225	150	350	330	035	010	010	040	060	020
	03	02	00	01	01	05	01	04	02	02	00	01	06	07	05	02	04	04	04	05	05	06	04	06
17	310	015	025	030	025	020	320	025	030	030	020	030	035	040	030	025	055	020	350	330	290	330	360	360
	07	07	10	10	08	11	11	09	08	05	07	06	08	08	07	06	04	03	03	03	03	02	02	01
18	360	350	010	010	350	005	340	280	270	250	250	260	265	255	250	250	265	255	230	235	015	280	280	240
	04	02	03	03	04	03	04	07	10	08	11	13	13	14	13	11	09	09	06	02	06	03	03	03
19	240	020	360	360	345	260	240	030	030	250	245	070	125	255	210	330	020	005	010	035	035	330	350	330
	04	01	01	04	01	02	01	01	00	02	01	02	04	03	01	01	04	06	07	05	07	03	02	03
20	010	045	050	315	275	315	290	265	255	260	275	270	280	270	275	275	275	275	275	270	270	265	270	265
	03	02	03	05	14	06	12	13	10	10	09	14	10	13	17	16	13	13	14	09	08	08	07	11
21	270	275	270	270	285	305	300	295	005	045	290	280	215	300	030	290	325	300	285	280	330	330	305	260
	11	11	12	12	14	10	08	08	03	03	04	05	04	03	04	05	05	04	07	06	06	04	02	02
22	265	360	000	355	335	340	015	360	135	180	195	170	040	030	040	060	345	345	305	280	240	315	320	320
	04	03	00	01	02	03	02	02	01	01	03	03	03	05	02	02	01	01	05	04	05	02	02	01
23	290	295	330	030	270	360	000	000	000	000	195	195	200	190	165	210	220	340	000	245	275	000	300	345
	02	03	02	02	02	01	00	00	00	00	02	03	03	03	03	03	02	01	00	02	02	00	01	05
24	335	265	315	280	270	270	330	285	280	235	275	265	260	260	270	255	265	280	295	350	015	360	030	270
	07	07	07	08	16	19	06	20	21	16	15	16	11	10	10	12	13	16	14	06	05	06	04	05
25	280	265	255	270	265	275	030	045	090	020		045	285	270	330	265	245	260	260	265	265	265	270	265
	09	16	16	07	13	10	05	03	02	04		05	10	14	06	08	13	19	16	19	22	20	21	16
26	295	340	145	205	280	010	015	005	010	015	015	005	275	275	295	270	270	280	285	270	265	275	275	265
	10	08	09	14	08	05	05	08	06	07	06	05	15	17	15	25	23	21	23	20	17	30	30	23
27	265	275	290	295	290	275	280	280	290	285	275	285	305	265	285	275	280	265	260	265	285	355	005	025
	15	15	15	37	40	45	43	40	28	20	20	19	14	10	08	16	15	09	08	10	08	09	09	05
28	345	355	355	090	325	360	355	030	360	085	185	145	130	125	175	195	085	100	025	010	015	320	025	035
	05	05	05	01	04	02	02	00	03	01	03	03	05	05	05	04	05	06	06	11	10	05	05	
29	145	255	260	275	275	260	260	265	270	270	265	260	235	245	245	235	020	025	010	010	355	350	010	010
	05	07	12	13	13	15	18	17	18	15	20	17	12	10	12	10	10	09	09	07	08	11	10	06
30	360	005	330	255	270	255	255	305	010	025	055	345	240	235	240	035	340	360	285	010	060	005	030	010
	04	05	04	15	12	15	15	13	07	07	05	06	17	14	17	05	05	06	08	07	04	04	04	04

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) DECEMBER 1972

DATE	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	360	355	355	010	005	355	360	005	015	025	185	045	090	100	105	005	025	310	360	355	355	240	005	340
	05	06	05	08	09	10	08	08	06	05	05	06	05	04	04	04	07	05	05	05	03	01	04	03
2	000	225	235	150	355	310	235	340	265	215	050	045	035	055	035	055	025	005	360	355	355	360	005	330
	00	03	03	03	05	03	02	04	02	04	06	05	05	05	05	04	06	05	06	07	05	06	06	05
3	360	355	005	355	305	070	005	245	260	060	040	175	145	095	120	105	120	040	360	355	355	315	220	255
	04	05	05	05	02	03	02	02	01	01	01	05	04	07	05	06	04	04	07	08	07	04	04	05
4	250	020	295	060	310	045	025	025	265	175	200	235	235	265	255	265	265	265	270	250	225	260	270	270
	06	04	05	03	04	02	03	01	18	17	11	08	12	18	15	14	14	15	16	10	10	14	10	14
5	280	270	295	295	285	270	265	290	270	265	255	255	250	260	260	255	290	285	265	295	305	305	345	320
	13	15	10	11	13	13	15	15	16	15	13	13	17	15	18	16	15	09	09	10	08	06	04	02
6	270	275	025	350	355	360	010	010	360	030	155	205	195	310	305	310	340	015	005	355	355	260	150	020
	02	02	04	05	05	04	05	06	05	05	03	06	05	05	05	05	07	07	08	05	05	05	04	05
7	360	020	265	270	250	255	280	250	015	180	190	190	255	265	270	265	265	275	265	295	330	010	025	020
	05	03	03	01	04	03	02	02	03	03	04	12	20	17	20	15	14	14	06	08	03	08	13	09
8	360	025	325	255	025	360	360	030	360	170	175	245	205	215	240	175	185	210	210	175	225	335	320	270
	06	05	04	03	02	03	05	04	02	05	06	23	23	21	14	16	14	08	03	06	05	02	02	10
9	285	300	290	265	255	235	245	255	275	275	280	270	270	265	270	270	275	275	275	280	280	330	340	355
	10	11	13	19	20	17	14	19	28	26	24	25	24	22	21	20	17	17	16	14	13	05	05	03
10	345	250	355	355	000	025	260	300	000	025	025	025	025	025	025	025	035	025	030	025	025	060	000	275
	03	03	04	01	00	01	01	01	00	01	05	05	03	10	10	11	10	10	07	05	03	00	00	02
11	000	000	000	000	000	000	000	000	000	180	000	265	265	265	265	265	270	270	270	270	270	275	275	275
	00	00	00	00	00	00	00	00	00	01	03	09	11	14	15	18	19	23	23	23	22	20	21	18
12	335	015	355	355	360	360	010	355	010	001	050	045	035	025	025	025	025	025	020	025	020	360	020	360
	11	07	08	06	02	04	02	05	02	00	03	04	05	06	05	07	08	07	06	05	05	03	05	05
13	005	355	355	305	000	360	000	045	000	185	005	025	020	030	075	045	345	280	275	265	270	265	300	245
	04	05	04	04	00	04	00	01	00	03	01	05	10	05	02	04	04	10	15	15	15	15	13	07
14	325	335	350	310	310	260	345	025	235	135	125	050	085	065	055	025	015	355	360	025	010	360	335	210
	06	06	05	05	05	04	02	02	03	01	02	04	03	05	05	05	08	05	01	04	05	05	03	05
15	210	340	000	010	360	000	000	260	000	000	175	170	155	155	160	175	115	300	355	355	360	250	000	010
	02	03	00	03	01	00	00	01	00	00	02	03	05	05	03	05	04	05	06	04	04	03	00	01
16	225	225	340	000	010	020	000	255	190	150	100	135	115	090	030	020	010	300	355	000	250	000	235	025
	02	01	00	00	02	01	00	02	02	01	01	02	03	04	05	06	05	05	03	00	02	00	01	02
17	005	000	000	240	360	240	240	000	000	000	145	120	095	080	075	030	010	355	345	125	010	355	130	320
	04	00	00	03	01	01	01	00	00	00	01	02	02	02	03	04	03	03	02	01	01	02	02	02
18	270	020	355	340	055	325	010	325	215	200	135	040	025	015	010	360	355	005	350	010	355	000	175	355
	01	03	02	02	02	02	02	01	02	02	04	08	12	13	10	05	05	02	03	04	05	00	02	06
19	355	005	005	350	295	255	140	015	320	020	055	045	040	030	015	000	010	360	360	010	025	025	095	035
	03	06	04	05	02	05	05	07	06	04	03	05	04	05	05	00	07	06	05	05	05	06	04	07
20	020	130	300	295	305	320	330	320	355	220	275	255	255	250	265	260	265	260	260	265	260	260	270	255
	08	10	17	29	22	18	10	10	08	06	12	15	13	17	18	17	10	10	13	09	12	18	15	07
21	295	025	005	015	010	010	235			070	025	025	085	070	115	035	335	010	360	010	355	285	055	350
	05	05	06	07	07	04	01			02	05	05	03	03	03	03	07	07	07	07	05	03	05	03
22	355	250	265	130	325	235	000	345	010			060	030	035	040	045	055	060	040	040	355	040	050	325	270
	02	03	01	01	04	01	00	01	00			01	05	07	08	09	07	05	06	08	05	05	06	03	06
23	160	280	295	300	295	290	285	280	275	175	040	010	105	110	150	175	120	310	300	040	000	000	000	145
	07	21	15	20	18	15	20	08	08	04	02	02	02	02	05	04	05	07	05	04	00	00	00	05
24	310	015	015	015	360	015	025	360	010	025	020	030	025	025	055	060	055	020	015	245	345	305	250	250
	05	07	04	06	04	05	01	02	03	04	04	02	06	05	04	03	03	03	02	02	03	07	07	09
25	250	220	250	275	265	325	310	295	310	175	170	130	115	115	165	235	260	335	315	295	265	280	305	335
	08	09	06	13	04	06	07	06	07	04	03	04	05	02	04	07	10	05	08	14	16	12	08	05
26	235	325	335	145	005	000	340	220	265	300	140	160	175	175	175	145	120	085	360	355	355	000	000	000
	02	05	05	04	01	00	01	01	02	00	02	02	03	05	04	02	03	03	05	04	04	00	00	00
27	000	220	000	000	000	000	000	000	000	000	000	000	175	175	130	095	035	005	360	350	355	345	070	305
	00	01	00	00	00	00	00	00	00	00	00	00	03	02	03	02	07	07	06	05	04	02	01	03
28	370	355	000	045	305	360	355	010	010	015	025	000	215	210	000	030	035	010	030	340	010	345	340	285
	02	04	00	01	03	02	03	05	04	03	01	00	02	02	00	04	06	08	09	03	03	03	03	17
29	285	275	285	280	280	280	280	265	285	280	275	275	280	270	280	280	275	280	280	285	290	290	290	280
	20	21	23	21	22	22	23	20	24	25	24	23	22	22	24	25	25	24	19	20	25	25	24	20
30	280	260	275	280	270	270	265	270	280	295	260	270	270	265	270	280	280	285	285	285	275	280	275	290
	20	15	18	16	15	16	15	13	11	14	16	18	19	20	23	27	23	22	22	17	15	15	13	12
31	295	295	275	280	240	325	360	010	325	055	170	055	035	030	010	115	290	245	290	295	285	285	340	295
	12	11	09	07	05	05	07	10	03	03	04	08	07	08	03	05	08	05	11	09	11	10	04	05

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) JANRY, 1973

HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DATE																								
1	265	295	040	160	265	255	255	255	255	240	250	095	053	030	020	340	025	015	325	325	310	340	355	205
	10	08	04	02	05	04	03	03	03	05	03	03	08	10	06	05	05	05	07	08	06	05	03	01
2	260	340	355	245	240	185	000	020	245	215	195	125	145	150	160	130	105	025	005	005	005	005	360	360
	02	03	01	01	02	02	00	01	03	01	02	03	03	04	03	04	05	07	06	06	06	04	01	02
3	000	015	000	000	175	055	355	350	015	025	060	130	100	100	100	130	035	030	025	015	020	010	360	005
	00	01	00	00	03	02	00	02	01	02	02	02	04	04	04	02	07	10	08	05	04	04	04	05
4	340	360	235	255	345	360	310	245	100	020	115	180	000	360	025	015	350	320	290	275	275	265	300	285
	04	02	03	01	02	03	01	03	01	02	01	02	00	01	06	05	05	07	09	13	14	12	10	10
5	275	235	235	265	305	290	330	335	315	360	355	155	205	110	145	125	115	100	010	355	355	010	355	355
	10	06	06	10	07	02	03	03	04	03	03	03	03	03	05	05	04	01	05	05	05	03	04	03
6	300	025	335	285	295	240	000	000	195	345	050	030	065	105	125	215	240	255	260	285	285	285	000	215
	03	03	02	03	02	01	00	00	02	05	03	03	04	02	03	02	04	03	03	02	01	01	00	01
7	225	190	360	000	000	000	005	235	355	000	255	205	165	140	175	205	145	065	360	360	345	270	185	040
	01	01	02	00	00	00	03	02	01	03	02	03	04	02	04	03	03	02	04	05	03	01	01	02
8	310	245	270	005	000	000	030	000	000	000	245	330	035	025	030	035	030	010	010	360	325	360	025	355
	03	03	01	03	00	00	01	00	00	00	02	02	07	10	05	06	07	06	03	04	01	02	01	03
9	340	000	015	000	000	195	270	000	000	000	220	115	045	025	030	025	015	005	350	265	000	000	335	330
	01	00	01	00	00	02	02	00	00	00	01	01	05	06	05	06	04	03	03	02	00	00	01	02
10	330	000	000	000	295	265	345	270	355	150	235	240	100	155	315	275	275	275	280	225	265	360	265	010
	01	00	00	00	01	02	01	01	01	01	01	01	02	03	05	15	13	13	12	08	11	08	06	05
11	315	325	355	000	025	000	000	000	000	000	000	180	205	190	185	185	175	135	000	000	010	005	005	040	000
	03	03	02	00	01	00	00	00	00	00	01	04	04	06	05	05	04	03	00	00	03	03	02	01	00
12	025	025	005	010	000	345	010	005	005	000	070	130	080	130	120	090	025	010	025	030	190	000	075	360
	03	03	03	01	03	01	03	02	02	00	01	02	02	04	04	05	05	05	04	03	01	00	05	02
13	320	005	000	330	265	265	235	265	030	240	215	200	130	090	040	250	175	000	215	230	185	165	000	330
	02	03	00	03	01	02	01	01	02	02	02	05	05	04	06	01	01	00	04	02	01	04	00	04
14	165	335	300	145	065	250	235	320	010	090	220	210	185	125	115	185	275	000	335	260	250	000	360	135
	04	04	03	02	01	01	03	02	02	01	03	03	03	02	02	03	01	00	02	01	02	00	02	01
15	340	245	220	355	340	010	000	220	000	000		000	190	165	185	110	055	080	030	005	360	000	235	275
	02	04	02	01	01	01	00	01	00	00		00	03	02	05	03	03	03	03	04	02	00	01	01
16	000	245	015	355	340	235	000	185	000	000	135	130	200	165	150	135	110	095	100	055	025	025	015	010
	00	02	03	01	01	01	00	01	00	00	01	02	02	02	03	03	03	02	02	04	05	05	05	03
17	310	025	025	025	015	025	015	010	350	265	225	245	055	065	225	115	100	015	190	170	265	235	245	215
	03	03	04	05	04	03	03	03	03	01	01	01	02	02	02	01	03	04	05	05	07	12	09	08
18	260	235	205	015	240	090	010	265	305	355	005	035	025	035	040	035	025	025	030	010	360	010	010	005
	04	05	04	02	02	03	04	03	02	03	04	05	05	10	08	09	10	12	08	05	03	04	04	05
19	005	315	015	005	360	350	010	330	015	005	025	030	035	020	025	035	035	045	045	325	275	270	275	280
	05	05	07	05	06	04	04	03	03	04	06	07	10	09	08	10	07	02	03	07	14	14	14	17
20	280	275	285	285	275	275	265	270	270	270	275	275	280	280	275	275	275	275	275	275	280	275	280	280
	17	14	18	17	18	20	19	20	21	21	25	27	25	28	27	25	26	27	28	28	29	27	24	20
21	275	275	280	280	315	355	355	340	290	325	325	325	270	270	270	270	280	280	275	270	270	270	270	275
	17	24	21	19	13	06	07	06	12	08	09	09	15	18	20	22	17	15	15	16	17	16	20	23
22	275	275	280	280	280	275	275	270	270	270	265	025	020	030	030	030	025	355	295	285	280	280	275	275
	24	24	24	22	21	19	15	14	14	11	05	10	18	16	17	16	14	04	09	13	15	14	15	17
23	275	295	270	270	295	315	245	015	355	265	010	050	100	140	105	060	025	015	360	350	000	360	125	000
	14	11	13	13	09	06	04	05	04	02	04	04	02	04	03	03	04	03	03	07	00	03	02	00
24	105	000	085	230	340	080	335	000	000	225	185	175	170	170	145	135	100	090	010	360	005	325	335	235
	01	00	01	03	01	02	01	00	00	01	01	03	03	03	04	06	05	04	05	05	03	01	01	01
25	355	000	015	005	190	000	180	070	000	000	145	150	130	115	085	025	025	010	005	360	355	005	005	355
	02	00	01	02	01	00	01	01	00	00	01	03	03	03	03	08	08	06	04	05	05	02	02	03
26	345	360	340	265	010	010	310	000	340	325	145	025	040	350	165	265	265	265	265	265	265	265	265	270
	02	02	01	03	03	03	02	00	02	01	01	01	03	03	06	22	17	25	22	20	17	19	22	20
27	265	265	265	275	265	280	280	280	275	270	265	335	035	325	025	015	035	015	360	350	335	295	325	275
	19	21	16	15	12	17	15	14	13	14	11	05	11	12	15	15	13	10	06	05	04	03	03	05
28	250	315	360	000	160	240	270	315	000	000	000	170	175	170	160	145	110	065	360	360	360	355	355	000
	01	01	05	00	02	02	01	02	00	00	00	03	05	05	05	05	08	05	05	05	05	03	01	00
29	000	000	000	000	245	000	340	000	000	180	200	160	145	100	090	050	030	020	005	355	325	000	000	340
	00	00	00	00	01	00	01	00	00	01	02	02	02	04	05	05	06	06	05	05	02	00	00	01
30	330	000	235	285	010	000	000	000	000	000	115	075	025	040	025	025	020	005	005	360	355	355	355	350
	01	00	01	01	01	00	00	00	00	00	02	03	03	03	05	05	05	05	03	03	03	03	04	03
31	290	295	245	015	025	035	005	015	020	215	265	265	265	250	265	275	265	265	265	265	270	270	270	265
	02	02	02	03	03	03	04	04	01	07	10	10	12	15	13	12	11	13	10	09	11	10	11	13

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) FEDRY, 1973

DATE / HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	275	290	280	280	275	270	260	270	270	270	260	260	270	255	265	270	270	280	280	285	295	295	325	335
	11	15	15	16	17	15	14	14	15	13	14	14	12	10	12	14	15	17	16	13	14	13	09	06
2	340	040	340	340	090	330	000	000	220	220	150	150	130	150	130	130	060	020	010	010	360	000	360	300
	06	03	04	02	02	01	00	00	01	02	02	03	04	03	04	03	06	07	07	05	03	00	02	02
3	000	330	000	010	230	140	120	360	230	080	130	150	120	160	130	110	100	100	040	010	020	020	360	360
	00	00	00	02	02	02	02	02	02	01	02	03	04	04	05	05	03	03	02	02	04	05	04	04
4	360	340	030	210	060	000	000	000	000	080	020	050	030	360	090	350	360	020	015	360	320	015	260	230
	04	01	02	01	00	00	00	00	00	02	05	05	05	05	02	04	04	05	05	06	03	04	02	01
5	240	330	360	000	000	000	010	330	360	230	220	100	020	020	020	020	020	020	315	010	015	010	290	000	015
	03	02	02	00	00	00	00	02	02	03	02	03	05	10	10	11	11	07	07	06	05	03	00	02
6	315	315	010	015	015	360	340	000	000	000	000	000	050	360	030	120	090	100	060	030	015	360	360	330
	03	03	04	04	03	04	03	00	00	00	00	00	04	03	05	03	05	04	03	04	04	06	03	03
7	360	015	340	015	015	360	020	020	010	360	030	030	060	130	100	090	080	030	360	360	360	360	000	290
	02	03	04	05	05	04	03	03	03	02	02	05	03	03	03	02	02	02	04	05	04	03	00	02
8	220	200	360	360	015	015	020	350	270	000	015	015	010	050	030	015	015	360	360	015	015	050	360	030
	03	03	05	08	08	07	07	05	04	06	07	06	04	06	08	08	05	08	05	03	02	02	03	04
9	360	360	250	270	350	360	360	020	015	330	030	040	150	130	010	035	035	025	025	005	015	010	005	010
	06	03	02	03	04	05	04	03	06	08	08	05	05	07	06	06	04	08	07	04	03	03	03	02
10	310	010	005	020	010	015	015	010	020	025	010	040	051	185	240	310	015	315	010	005	005	005	005	010
	04	05	06	05	05	06	06	05	04	04	04	03	02	01	02	02	05	06	04	04	03	03	04	03
11	045	035	235	235	000	010	020	015	025	020	015	020	020	015	020	010	005	035	015	005	245	235	255	245
	02	01	02	02	00	03	07	08	09	09	08	07	09	08	06	08	07	03	07	01	02	03	01	01
12	235	265	225	220	210	255	175	140	265	245	275	275	290	210	240	250	260	305	275	265	250	235	360	325
	03	02	04	05	09	07	05	05	06	05	13	14	10	05	10	09	07	08	05	07	03	04	04	01
13	270	295	005	330	360	000	360	210	000	000	000	000	035	010		015	030	005	005	360	295	245	210	010
	03	03	01	01	03	00	01	02	00	00	00	00	02	02		01	03	05	05	05	04	04	01	02
14	000	000	295	350	230	360	000	000	220	360	005	015	020	025	025	020	025	025	025	360	255	010	355	305
	00	00	01	01	01	01	00	00	01	01	04	08	09	11	11	10	11	11	07	05	04	03	04	02
15	200	000	350	360	355	355	330	330	000	000	000	000	225	220	260	000	020	020	010	010	360	330	250	355
	02	00	01	03	03	03	01	01	00	00	00	00	01	02	03	00	05	06	07	07	06	02	05	04
16	350	000	285	360	180	230	350	275	000	355	255	255	000	235	000	020	005	010	280	275	275	275	275	275
	02	00	01	02	01	02	02	02	00	04	01	01	03	01	00	07	07	03	03	13	16	15	13	14
17	270	320	320	275	275	280	330	310	000	000	000	210	195	215	240	230	180	030	350	360	000	350	005	360
	14	13	07	13	13	09	06	03	00	00	00	01	02	02	02	03	02	00	02	01	00	01	02	06
18	155	355	290	000	285	230	000	360	000	250	000	220	260	035	220	265	270	265	260	255	275	280	275	270
	07	05	01	00	01	01	00	01	00	01	00	03	10	07	08	14	12	13	11	10	12	06	10	08
19	270	330	360	360	355	355	130	335	205	000	105	000	000	000	000	000	020	015	010	015	355	275	250	000	000
	11	05	03	04	05	06	01	01	01	00	01	00	00	00	00	00	07	09	09	07	06	04	01	00	00
20	345	350	005	340	005	360	255	000	000	000	000	000	195	185	175	195	360	015	010	360	340	330	340	315	030
	03	02	01	01	01	01	01	00	00	00	00	00	01	03	03	01	01	06	05	06	07	05	05	03	04
21	300	000	000	120	180	220	210	240	345	220	180	120	190	190	240	240	360	045	360	030	345	360	360	360
	04	00	00	02	03	04	03	04	05	03	02	03	03	04	02	02	02	04	05	06	05	06	08	08
22	015	360	270	270	000	290	255	240	360	240	200	150	190	120	180	315	030	015	360	360	340	330	240	000
	10	04	04	05	00	05	03	03	05	03	04	04	04	04	02	04	04	06	06	08	06	05	04	00
23	015	360	360	360	345	360	330	000	000	060	200	180	090	360	100	045	030	015	000	360	020	360	360	360
	06	06	06	07	07	06	06	00	00	03	03	03	03	04	03	04	04	03	03	06	07	06	05	05
24	240	240	225	270	290	270	360	015	015	020	015	030	360	315	030	030	015	020	015	015	015	030	015	360
	06	04	05	03	06	03	04	07	07	07	08	08	07	06	05	06	08	08	06	06	07	07	06	05
25	360	360	270	300	000	030	350	360	360	360	360	030	270	160	210	210	345	000	015	360	360	360	315	230
	04	04	04	04	00	04	05	05	05	04	05	05	03	03	06	04	02	00	04	06	07	06	05	03
26	360	340	000	000	000	000	000	000	000	360	000	165	120	120	150	150	240	300	360	345	015	360	360	360
	03	04	00	00	00	00	00	00	00	00	00	05	05	03	03	05	03	03	04	07	07	07	06	05
27	360	270	330	000	000	000	360	360	000	000	150	150	210	180	045	015	015	015	015	015	360	360	360	330
	05	03	05	00	00	00	04	04	00	00	02	05	05	05	03	07	13	12	10	07	07	06	07	06
28	000	000	360	000	360	000	010	360	180	270	225	180	210	000	270	285	075	020	015	015	015	350	000	000
	00	00	03	00	03	00	00	03	05	04	05	04	03	00	05	06	06	07	07	08	07	07	00	00

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) MARCH, 1973

DATE / HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	000	000	000	330	330	020	360	015	360	240	230	150	100	240	330	360	015	015	030	320	030	350	350	360
	00	00	00	03	06	05	05	05	05	04	04	04	05	04	05	07	10	11	12	11	08	06	06	06
2	360	000	260	240	310	000	330	360	090	195	195	225	240	260	260	255	255	250	250	260	270	270	260	260
	05	00	03	04	00	00	05	04	03	04	10	15	15	20	22	17	17	20	20	23	20	17	17	20
3	260	260	260	260	260	265	265	270	360	360	060	030	030	320	030	060	030	030	360	020	010	350	360	330
	18	20	20	20		17	17	13	03	03	05	09	10	07	07	15	07	09	08	07		06	06	02
4	360	015	360	360	015	015	020	015	045	020	015	015	030	015	030	030	030	030	030	030	030	015	330	270
	03	04	04	04	07	08	10	07	07	10	09	11	10	10	09	10	11	10	08	07	08	05	05	05
5	060	300	240	240	225	210	225	225	230	225	225	230	230	240	240	240	250	255	250	230	240	230	250	250
	03	06	10	12	10	10	08	10	12	14	13	16	15	18		12			16	11	10	09	07	06
6	240	260	270	240	210	240	270	270	210	180	165	150	165	150	170	270	360	360	020	030	030	020	020	015
	12	10	06	06	04	06	06	04	07	06	05	06		10	08	05	06	08	08	08	08	07	07	07
7	010	360	015	015	030	030	030	040	030	020	010	010	030	030	030	020	030	030	000	260	270	315	260	270
	07	06	07	07	07	09			12			11	11	08	09	09	08	06	00	04	06	05	06	05
8	300	270	250	315	315	330	360	360	120	210	075	110	045	360	030	020	030	020	030	015	000	000	000	000
	06	05	06	05	05		04		03	05	04	03	04	04	05	09	09	08	07	06	00	00	00	00
9	000	000	000	000	360	000	360	280	360	180	120	120	060	080	015	045	300	280	265	260	260	250	270	270
	00	00	00	00	00	00	05	04	04	04	04	04	04	04	05	14	09	10	09	07	05	05	02	05
10	265	260	270	270	265	250	255	240	255	260	090	100	265	180	210	240	250	230	175	210	255	210	270	270
	09	13	10						10		04	04	05	08	10	15	12	08	08	07	06	04	08	07
11	270	330	240	120	270	360	360	015	010	015	015	015	350	010	015	135	150	140	140	020	030	350	015	010
	04	03	15	04					05	06	06	08	08	05	10	10	10	12	11	10	07	05	06	09
12	015	020	020	015	015	020	190	350	350	330	010	015	015	010	040	150	150	165	240	210	160	210	210	210
	16	12		14	15			04		09	14			09	09	04	07	04	06	04	05			
13	225	230	250	230	230	240	240	240	230	210	180	180	180	225	225	230	240	240	240	240	240	255	255	260
											07	10	10	11	07	10	14	14	07	11	09	12	10	13
14	240	255	250	255	255	250	255	260	350	015	030	045	030	270	270	270	255	260	260	270	255	255	260	260
	10	10	13	15					06	07	06	04	04	04	04	05	11	14	15	15	15	14	15	15
15	260	260	270	260	270	270	270	260	255	255	255	255	255	255	255	255	255	260	260	255	255	260	260	285
	16	17			15		17			11			14	15	14	13	14	15	17	19	16	18	17	16	14
16	280	315	255	360	300	270	360	090	090	110	120	170	210	180	210	140	165	150	000	270	300	330	000	360
		06	16		04			01	02	03	04	04	04	05	04	05	05	04	00	08	06	04	00	03
17	360	000	000	000	000	000	360	010	360	360	090	150	180	315	315	015	040	015	240	270	330	090	210	255
	03	00	00	00	00	00					05	05	04	04	07	05	10	06	05	04	05	09	05	08
18	225	250	270	270	270	330	360	180	255	255	225	240	255	250	255	255	260	260	260	260	260	260	260	260
	10	11	06	05	05	04	03		10	11	08	10	13	17	20	20	22	18	18	16	14	14	16	13
19	270	270	270	290	290	300	260	360	045	030	100	100	120	090	090	090	090	090	090	030	045	330	300	360
	11	10							04			06	05	05	05	08	07	07	06	03	03	04	02	03
20	315	360	330	360	015	045	045	365	050	135	150	285	100	110	120	120	115	250	220	285	270	180	180	180
	04	03	05	02	04			05			07			17	13	12	15	08	08	06	04	10	06	05
21	195	140	130	165	165	165	170	160	165	165	165	180	165	285	030	255	240	210	225	225	210	210	240	240
	05	08	11	12	13	15	16	14	15								05			12	10	10	03	04
22	225	360	090	150	250	300	270	195	180	150	180	150	180	100	110	100	240	270	210	360	020	360	330	345
	04	02	05	05	04	04	05	03	04	05	06	04	05	04	07		04	08	04	05	06		03	03
23	330	270	150	270	265	270	270	255	255	350	350	015	010	010	015	010	360	360	315	015	010	360	360	360
	05	05	04	08	12	15	16	11													13			20
24	360	350																						
	15											015	015	010	015	330	015	040	295	295	345	350	305	
												23	17	14	12	04	04	04	08	08	12	11	13	
25	005	005	350	265	235	270	310	270	265	120	060	045	120	070	180	030	180	195	165	160	265	265	270	275
	13	10	06	06	06	08	05	05	05	03	04	04	04	05	05	04	05	04	04	02	05	07	09	08
26	235	235	335	330	010	295	000	275	060	330	055	095	130	175	175	135	120	155	080	295	280	265	265	350
	07	04	05	03	02	06	00	02	02	02	03	05	05	06	04	06	05	07	07	08	10	08	10	01
27	270	330	210	150	265	260	260	310	230	210	220	260	235	225	230	245	240	235	235	240	245	260	260	230
	03	02	03	02	05	10	06	08	07	07	09	07	14	13	12	20	13	12	12	18	18	17	07	08
28	245	235	330	245	245	260	260	250	265	270	105	075	150	240	045	050	300	030	240	270	065	005	350	240
	09	05	04	11	12	08	16	12	13	06	05	05	08	08	06	03	07	07	09	04	04	04	02	08
29	245	220	275	330	060	280	275	345	345	050	015	010	300	250	255	255	240	250	255	250	250	255	245	260
	09	03	07	05	01	07	05	03	03	06	03	02	04	12	17		22	22	17	11	14	14	16	19
30	260	260	260	265	260	260	260	265	260	260	250	245	225	230	230	230	235	240	250	255	270	245	210	210
	21	20	19	16	14	15	16	09	15	15	14	07	11	12	15	15	17	19	17	15	08	06	09	10
31	235	240	260	245	215	215	120	250	180	220	225	250	255	225	275	295	235	245	235	215	235	265	245	250
	09	09	05	06	09				13	11	08	11	13	16	12	16	13	14	11	08	08	07		08

WIND DIRECTION AND VELOCITY, EMERY, UTAH (PERIOD AVERAGES) APRIL, 1973

DATE / HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	275	350	335	280	255	305	355	180	360	015	095	260	285	240	255	240	270	080	045	350	315	295	270	250
	05		04	04	06	05	05	04	04	02	06	12	07	15	13	12	05	04	06	04		06	02	08
2	260	265	255	270	265	350	000	255	325	360	005	010	010	010	010	035	035	305	005	005	005	005	005	005
	14	08	12	11	12	03	00	04	09	17	16	20	24	27	28	28		24	24	31	31	29	28	24
3	005	005	005	005	360	360	005	005	005	010	010	015	010	010	015	015	280	200	190	020	010	330	080	100
	21	16	16		23	24	20		26	26	24	20	13	16	15	17	16	11	06	08	21	03	03	02
4	100	015	335	345	010	005	350	350	010	010	015	015	025	330	040	015	330	200	230	255	265	265	260	270
	02	06	07					10	21	23	17	13	13	09	08	16	04	06	08	12	12	11	13	14
5	265	265	255	270	265	275	310	360	020	035	100	105	140	150	150	150	230	240	250	245	255	270	270	020
	16		14	10	14	14	07	04	05	07	04	05	03	06	06	05	08	09	14	15	12	09	10	
6	120	240	025	360	245	235	290	285	240	220	235	245	260	265	255	255	260	260	330	270	200	250	255	255
	04	05	02	04	07	11	04	02	11	10	09	15	17	16	20	22		18	08		10		16	09
7	285	230	225	245	245	245	260	255	280	270	280	230	300	315	310	295	305	005	030	025	020	015	015	010
	05	05	12	16	18	16	22	24	30	29	32	29	28	29	27	26	23	19	15	16	22	21	19	12
8	010	005	345	355	330	155	360	175	256	250	225	205	240	260	240	240	260	255	250	255	250	245	235	230
	11	10	06	06	05	01	02	06	16	17	08	09	12	18	23	20	19	20	19	17	15	10	12	10
9	235	240	240	240	240	235	255	240	230	230	240	260	275	285	300	315	265	270	275	270	255	245	255	295
	05	05	09	11	11	07	06	11	14	14		15	14	17	16		14	13	10	06	07	02	07	04
10	250	260	250	300	005	030	000	100	070	120	200	230	240	275	270	245	275	245	245	245	245	280	275	280
	06	07	06	04	03	01	00	01	02	04		12	11		11	12	13	13	11	08	08	07	07	01
11	165	265	265	180	240	235	360	360	215	185	340	160	300	330	005	315	260	230	245	305	310	265	255	290
	04	04	06	04	05	07		02	07	08	05	05	11	14	13	10	13	12	10	07	03	07	07	07
12	310	290	315	340	030	220	340	175	120	150	145	135	200	135		050	150	190	320	210	240	060	330	360
	04	04	03	03	02	02	02	02	02	04	08	07		06		11	05	07	10	06	03	03	05	02
13	315	345	140	195	105	140	250	090	070	135	165	160	210	230	220	225	230	230	235	240	240	250	260	260
	03	01	01	02	02	03	02	02	03	03	06	08	09	16	21	21	27	23	20	14	11	14	15	14
14	225	200	220	215	235	275	135	250	180	180	200	210	215	240	245	270	290	290	285	300	300	295	315	300
	11	10	11	08	10	10	04	03	04	11	11	14	21	26	23	26	23	19	17	16	18	14	13	13
15	295	290	300	300	295	295	285	275	280	315	315	290	285	285	300	280	285	285	300	305	285	315	305	310
	14	10	10	09	16	12	11	11	10	12	15	20	19	18	13	18	15	16	15	12	10	09	08	08
16	315	300	105	350	030	040	060	215	165	195	240	270	300	285	280	255	265	270	275	265	240	225	225	250
	05	03	04	05	02	02	01	01	01	02	04	12	11	14	15	14	15	11	09	10	08	07	07	09
17	255	240	210	195	210	225	250	210	240	225	240	225	280	295	290	250	180	200	215	225	240	285	295	255
	02	06	06	04	06	04	05	03	03	07	05	09	16	13	15	11	11	13	18	17	17	21	15	21
18	295	290	300	285	295	295	295	295	295	290	290	295	295	300	315	330	290	300	315	345	315	295	315	310
	22	21	17	17	17	16	15	18	19	23	22	19	18	20	15	18	20	18	17	13	11	10	08	10
19	315	315	315	310	315	310	300	300	310	305	305	305	295	300	300	310	300	300	295	280	230	240	250	220
	20	26	25	22	20	12	15	12	23	20	23	21	21	22	21	21	18	19	16	10	05	08	07	08
20	270	275	275	280	280	290	290	285	285	285	290	285	280	290	275	260	285	285	290	280	270	290	285	280
	11	12	12	12	14	13	12	13	15	15	16	20	19	17	18	15	14	17	15	11	10	11	14	13
21	275	295	290	290	285	285	280	275	280	265	280	300	285	290	285	290	290	295	300	300	300	300	300	300
	11	14	15	11	14	13	13	10	13	13	10	10	05	07	13	13	15	19	17	17	15	15	13	14
22	300	290	300	330	360	020	060	315	270	255	270	225	200	150	150	190	290	305	300	295	290	245	260	300
	14	11	08	07	03	03	01	02	05	06	05	05	05	06	06	09	10	13	13	14	09	05	04	05
23	015	345	330	345	255	290	180	045	105	120	140	160	195	200	200	210	235	325	300	300	305	305	300	255
	03	04	03	02	01	01	01	02	01	02	04	05	06	07	12	15	22	20	13	09	09	09	07	05
24	310	310	310	315	060	200	145	035	050	180	170	190	240	260	295	075	315	285	315	315	310	285	280	280
	10	09	07	07	05	02	01	06	06	03	11	08	05	08	11	13	15	13	13	14	14	05	05	07
25	280	270	285	300	350	260	315	290	270	275	280	300	315	300	300	300	300	300	305	310	340	010	360	040
	07	03	11	08	03	01	04	03	04	08	15	14	13	18	20	18	18	18	18	13	06	08	06	08
26	300	010	150	035	050	045	315	275	225	075	130	060	135	180	195	170	150	135	170	210	240	260	310	315
	07	08	05	09	09	05	01	03	03	06	06	04	05	04	05	05	05	04	03	03	02	03	07	09
27	300	340	330	330	025	000	310	045	135	180	195	170	165	165	165	170	180	185	190	190	250	270	315	330
	06	14	05	06	03	00	02	01	01	02	05	06	07	07	08	09	12	13	13	08	06	06	09	09
28	030	300	210	180	240	250	150	195	140	225	275	260	310	290	300	300	340	295	300	310	300	300	295	295
	04	09	02	02	03	03	02	02	05	08	13	24	23	18	17	16	21	14	15	18	15	20	21	18
29	310	310	270	290	015	330	330	040	120	180	195	255	270	280	280	290	290	300	290	290	285	285	300	300
	13	14	07	06	02	07	06	02	03	14	17	23	25	23	23	20	18	15	15	15	15	13	16	18
30	290	290	300	300	345	090	060	075	075	075	060	090	120	240	285	290	270	300	280	300	345	090	290	285
	18	16	14	10	08	07	07	07	05	05	05	03	05	15	15	11	08	07	13	10	04	03	10	13

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) MAY, 1973

DATE / HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	285	330	300	285	285	300	300	315	300	300	300	285	315	270	315	300	300	270	300	330	330	360	120	000
	12	13	13	10	10	09	07	05	10	11	14	15	13	14	12	15	17	10	15	25	25	10	05	00
2	300	290	270	240	160	030	285	240	255	120	070	120	090	195	185	160	195	165	170	180	165	270	275	335
	04	07	07	05	02	06	01	03	03	04	05	05	05	06	06	06	06	13	10	08	06	02	03	05
3	035	310	295	345	030	300	285	030	120	135	150	180	210	195	195	150	170	165	150	150	165	290	270	330
	01	03	04	03	03	00	02	00	01	03	05	07	06	12	11	10	10	11	10	08	03	05	06	01
4	030	300	300	030	360	285	285	270	260	210	200	225	210	215	225	230	225	225	220	210	225	240	135	240
	03	00	02	03	03	02	10	08	06	11	13	17	21	25	19	20	23	23	22	18	15	13	05	02
5	250	260	245	260	240	270	260	285	155	165	170	140	150	160	150	150	185	195	265	315	090	165	245	315
	11	10	10	05	06	05	05	03	06	13	15	12	15	15	15	16	15	09	10	06	04	03	03	03
6	340	255	215	195	170	130	140	150	130	155	120	045	300	320	330	300	300	300	315	310	320	300	300	335
	01	02	05	05	05	05	05	03	03	03	05	06	22	22	21	19	16	14	13	08	04	01	05	04
7	270	310	290	290	285	285	285	270	300	285	285	300	290	300	315	330	360	330	300	300	300	290	290	285
	02	06	09	10	07	07	12	05	13	12	08	07	11	11	13	11	08	11	10	08	07	06	05	08
8	300	180	030	300	285	285	300	270	120	180	135	270	270	285	285	285	270	240	270	300	330	315	300	300
	05	02	01	08	10	10	11	03	03	06	07	18	20	18	18	16	13	04	10	08	06	06	08	10
9	300	300	300	315	300	345	090	210	150	150	270	270	270	270	270	270	270	285	270	255	250	225	285	285
	10	07	05	07	10	06	02	05	04	05	18	20	21	23	23	20	20	13	08	08	07	05	07	07
10	285	300	285	300	300	285	315	315	300	270	285	285	285	270	270	285	285	300	315	315	330	315	315	300
	05	07	07	08	06	06	08	08	10	15	18	20	15	18	20	16	18	13	13	08	09	07	08	10
11	360	300	360	030	030	360	040	360	240	180	190	180	150	210	280	330	315	315	340	315	280	360	290	330
	06	09	04	04	03	02	05	03	03	03	05	06	07	08	14	14	12	10	08	07	07	06	09	08
12	315	315	030	075	060	045	360	315	000	345	120	090	120	240	150	240	255	230	045	030	315	300	315	300
	07	03	04	02	03	03	03	05	00	02	03	04	05	18	15	18	05	08	25	08	06	08	07	07
13	300	090	015	030	030	030	060	300	000	075	075	060	135	090	060	060	060	060	045	045	045	040	045	060
	06	04	03	04	04	05	04	05	00	05	07	08	05	05	06	07	08	07	08	10	10	08	08	12
14	045	000	360	060	360	360	360	180	075	075	090	075	060	150	180	150	300	300	060	090	165	180	300	315
	20	17	06	12	05	04	03	03	12	14	10	06	05	06	04	05	06	05	05	05	09	07	06	06
15	045	330	360	300	360	360	360	240	135	180	210	180	150	180	180	120	105	090	210	150	140	180	270	270
	03	05	03	04	02	03	03	02	02	03	03	06	04	06	06	07	05	07	03	10	05	04	07	09
16	300	040	070	035	000	050	030	060	090	100	075	075	050	050	090	045	075	105	345	300	305	315	030	300
	05	05	06	06	00	05	03	03	04	03	03	09	15	10	08	08	06	06	04	02	00	08	10	05	02
17	315	020	270	290	290	300	310	050	135	150	105	150	240	240	320	355	345	330	330	310	315	320	300	300
	07	02	05	03	08	10	11	03	01	02	05	07	07	05	08	08	10	12	11	11	10	11	07	10
18	310	300	285	300	300	315	315	310	300	310	300	285	150	255	150	300	325	335	315	320	330	225	255	335
	11	12	11	12	07	12	10	12	12	05	03	03	05	07	03	03	09	11	11	10	09	05	04	05
19	300	300	315	315	295	300	240	040	255	285	290	210	210	170	150	125	085	010	240	150	210	335	150	030
	04	06	05	07	07	07	05	03	02	06	05	09	11	08	07	06	06	14	09	10	05	07	04	07
20	030	295	050	285	345	270	270	045	120	180	195	180	180	270	270	250	255	250	290	300	315	315	315	315
	03	02	07	03	03	03	03	01	01	02	07	07	10	15	14	18	20	18	15	19	23	23	18	16
21	315	240	260	210	110	335	060	165	160	195	120	230	240	220	240	285	280	315	315	300	285	015	015	320
	13	07	12	03	04	06	03	01	02	02	04	04	11	14	22	16	10	13	15	09	08	05	05	05
22	280	300	270	255	210	245	310	020	060	090	150	170	160	200	170	270	300	320	330	335	330	320	315	320
	04	00	05	03	03	03	05	03	05	03	03	03	03	04	05	10	13	13	11	10	10	06	08	09
23	320	285	340	060	080	345	125	060	090	100	195	120	100	195	225	225	255	210	255	270	315	315	270	270
	09	05	07	03	03	03	03	03	04	04	03	08	08	10	13	15	10	11	08	08	05	07	05	04
24	275	285	300	150	120	230	260																	
	05	05	05	01	03	03	05																	
25																								
26																		325	320	320	310	320	315	330
																		15	20	22	17	17	17	20
27	330	060	285	300	295	290	285	270	325	345	350	345	345	350	360	345	345	340	345	350	360	360	360	360
	09	03	03	04	04	06	03	03	10	20	18	15	17	16	16	11	12	15	12	11	09	12	11	08
28	285	000	360	045	040	060	315	245	345	240	140	240	160	210	180	255	345	345	330	320	325	330	325	325
	02	00	04	01	02	02	05	05	09	04	03	03	03	05	06	08	15	17	16	15	10	08	08	08
29	325	330	330	090	090	090	000	090	105	270	260	260	270	280	315	330	340	330	345	350	345	350	360	345
	10	11	10	02	02	01	00	01	02	06	04	06	14	17	15	12	13	10	12	13	09	11	13	11
30	330	330	330	315	060	060	060	030	090	090	090	090	075	060	060	045	060	045	045	045	030	240	280	300
	12	10	12	13	05	10	06	02	14	13	11	08	05	05	06	08	06	06	09	08	06	01	05	07
31	330	045	150	330	000	260	045	060	180	240	150	150	210	150	160	230	280	300	270	240	330	330	300	300
	06	01	03	02	00	02	02	01	01	02	03	03	05	05	07	11	13	17	06	11	10	10	16	11

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) JUNE, 1973

DATE	HOURS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	250	210	330	320	315	215	140	150	180	190	180	150	211	180	230	300		270	330	330	315	320	315	090
	12	06	10	10	08	06	06	03	08	07	02	03	01	04	05	02	02	05	08	05	08	07	05	04
2	045	280	280	300	300	300	300	330	280	300	300	330	330	315	330	330	320	330	345	330	315	280	280	240
	01	05	07	11	10	11	11	08	08	11	11	15	13	13	11	14	14	12	08	07	06	05	05	01
3	300	330	030	330	270	240	240	250	180	180	240	330	315	320	270	270	280	280	300	300	300	315	315	300
	02	02	02	02	03	06	05	03	02	05	08	14	20	11	07	16	12	15	14	13	13	11	14	13
4	315	315	320	330	330	320	270	315	315	300	315	320	315	315	315	330	315	330	330	330	330	360	330	120
	11	13	12	09	10	08	04	10	06	08	12	10	12	16	16	14	13	13	12	11	08	08	03	01
5	270	330	120	330	315	315	030	075	075	100	090	160	150	120	060	150	150	180	210	190	210	280	315	330
	03	04	03	07	06	04	05	03	05	03	04	03	04	03	03	04	05	07	06	08	06	03	04	08
6	315	330	030	060	210	150	270	000	000	090	130	180	165	150	150	240	330	330	330	330	330	350	350	300	300
	04	04	04	04	03	01	01	00	00	02	01	02	03	05	03	05	07	10	09	10	09	08	07	09
7	300	345	330	360	345	030	330	280	150	075	130	210	150	330	320	330	330	330	330	330	345	345	210	310
	07	07	05	02	03	02	02	01	01	03	01	02	05	09	16	11	10	10	12	10	06	10	02	09
8	340	330	015	345	360	030	330	030	060	060	060	180	210	180	210	210	210	270	190	210	315	330	330	330
	07	03	02	02	03	03	01	03	06	04	03	03	03	05	07	06	05	03	04	02	07	07	06	07
9	360	330	330	330	360	300	300	000	000	220	210	100	301	280	270	280	300	300	300	300	300	315	300	300
	03	03	03	03	03	03	03	00	00	02	03	05	05	15	13	10	12	12	13	13	15	14	13	10
10	300	290	270	270	240	300	210	300	120	180	150	180	300	300	300	315	300	300	315	300	315	300	300	300
	11	07	07	05	06	05	02	05	02	03	11	06	13	10	13	12	10	08	06	08	08	06	06	08
11	300	210	210	210	210	210	210	210	265	220	270	300	300	315	315	270	300	300	300					
	06	01	05	04	05	06	01	03	07	10	17	15	14	13	10	10	13	14	15					
12																								
13																								
14																				280	255	265	280	320	310
																				16	23	15	06	08	14
15	290	255	255	310	305	320	300	170	225	280	290	300	300	280	300	330	300	295	290	300	305	275	330	240
	05	05	05	07	06	04	04	02	03	14	17	20	17	18	15	23	15	11	10	13	13	08	05	03
16	290	290	300	300	270	360	285	275	260	210	170	180	190	160	210	140	210	360	360	000	340	315	315	280
	08	10	10	07	05	03	05	03	02	03	05	05	05	08	06	06	06	03	02	00	03	09	11	08
17	310	310	315	315	315	315	150	275	210	195	225	270	270	285	280	270	270	300	285	310	320	315	310	270
	08	08	09	09	04	07	02	03	02	05	10	16	18	23	25	23	25	21	20	20	24	28	23	07
18	255	255	280	275	285	295	285	280	260	315	330	330	280	285	305	305	315	320	325	330	355	015	010	355
	08	14	10	09	12	10	09	10	08	07	11	09	16	15	14	18	19	20	19	18	12	12	10	12
19	320	075	315	345	320	285	050	040	045	090	120	180	105	195	150	145	160	270	285	280	300	330	315	310
	05	02	04	03	05	03	03	03	03	04	04	03	03	03	04	05	05	05	08	11	10	13	13	12
20	310	360	320	325	340	035	345	350	075	360	070	070	060	075	030	075	030	030	035	030	030	340	295	320
	12	07	08	10	08	06	02	04	04	05	07	07	05	05	06	06	05	04	04	05	07	06	08	08
21	330	335	040	030	270	290	350	040	180	180	130	120	120	060	100	330	045	030	180	225	240	280	320	090
	06	07	03	02	02	03	03	02	02	03	05	06	07	07	05	05	05	03	05	04	04	03	10	03
22	360	300	330	030	030	360	285	040	045	120	180	150	210	150	170	210	240	280	280	290	310	270	150	210
	02	02	05	03	04	02	07	05	05	02	02	06	06	07	12	11	07	12	11	15	11	05	05	03
23	210	320	330	360	270	340	000	000	045	135	165	210	240	200	195	190	235	270	270	280	290	310	300	270
	06	08	7	05	05	00	00	00	02	03	07	10	17	14	12	12	13	11	12	11	11	11	11	07
24	225	280	290	270	270	250	240	225	270	290	300	300	270	285	290	285	330	300	300	300	300	300	270	315
	04	10	13	06	08	06	06	06	08	10	10	08	13	15	17	15	15	12	11	10	08	08	06	11
25	360	050	030	270	150	150	180	290	285	300	300	300	300	300	330	300	320	330	340	320	330	120	360	180
	07	05	02	05	02	02	06	07	10	11	12	12	16	17	17	14	14	16	15	15	10	05	05	03
26	360	315	360	015	270	030	360	030	070	070	075	090	090	090	300	330	300	345	340	360	345	340	330	300
	07	06	05	07	07	05	07	05	05	08	07	06	05	05	15	15	12	11	12	12	12	11	10	05
27	300	330	330	360	360	330	330	075	060	180	090	080	040	120	060	060	270	300	230	270	300	320	345	210
	08	06	07	05	05	06	03	03	03	04	12	10	07	04	05	06	10	12	20	10	07	12		10
28	300	300	300	315	045	030	300	090	030	060	060	060	045	180	060	070	070	080	075	075	360	320	180	320
	08	07	08	08	05	03	06	03	03	10	14	13	07	03	12	11	12	15	14	15	07	06	04	06
29	330	330	315	360	330	360	360	000	200	240	150	150	360	150	165	315	270	280	285	285	270	320	300	285
	03	07	07	05	03	05	03	00	03	02	03	03	05	10	07	10	12		15	12	10	10	11	10
30	270	240	210	230	210	230	210	270	230	180	150	180	210	240	260	270	270	180	250	260	290	285	290	300
	05	06	07	07	07	08	05	07	05	05	05	07	15	15	17	15	17	17	17	15	12	13	12	08

WIND DIRECTION AND VELOCITY, EMERY, UTAH (PERIOD AVERAGES) JULY, 1973

DATE / HOUR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	300	300	330	280	300	060	240	270	360	180	300	330	330	330	330	330	315	340	310	310	320	310	290	270
	10	11	08	06	07	03	05	06	05	05	14	14	12	08	07	10	13	15	15	13	12	10	11	05
2	010	320	360	315	300	360	310	240	180	135	180	150	180	360	180	165	190	195	340	340	330	280	300	360
	06	11	05	11	07	05	05	03	03	03	03	05	05	05	05	07	07	07	12	10	06	05	05	07
3	345	340	315	030	270	060	015	000	030	060	090	075	090	210	180	120	180	180	060	045	360	350	330	330
	07	07	05	03	03	03	04	00	02	03	03	05	05	05	05	06	06	05	04	03	07	12	10	04
4	360	340	350	015	360	360	330	300	045	060	120	150	090	180	230	270	300	300	315	320	340	345	330	315
	02	05	06	05	05	07	06	02	02	02	05	05	03	05	08	12	07	07	12	12	12	12	07	05
5	075	150	320	360	360	030	030	060	090	330	120	140	165	180	060	150	165	150	150	140	165	300	330	270
	02	02	06	07	05	05	02	03	02	02	05	05	07	05	07	10	10	08	08	10	10	10	12	07
6	280	300	310	300	285	240	345	270	360	120	160	270	270	240	270	270	280	300	310	285	270	285	300	300
	10	10	11	07	07	06	05	10	03	03	04	17	17	22	23	20	20	20	20	20	13	07	05	06
7	290	290	260	270	270	240	210	240	260	330	300	300	300	300	030	140	150	210	330	300	270	360	300	330
	10	10	12	09	10	10	07	08	08	07	10	15	12	10	07	17	12	10	06	06	05	07	08	07
8	300	315	300	360	030	360	360	075	020	120	140	150	225	240	255	270	240	250	240	180	120	360	300	320
	08	05	07	04	07	03	05	03	05	03	03	07	12	10	10	08	14	11	06	06	04	03	03	06
9	345	360	240	315	060	330	300	030	030	120	150	120	045	060	100	090	090	080	060	040	030	030	050	045
	08	04	03	05	05	06	06	05	02	02	02	03	05	07	07	10	11	11	07	10	10	10	08	08
10	000	300	030	120	300	330	360	330	180	050	060	040	090	180	180	360	220	170	210	240	170	255	340	330
	00	03	03	03	03	03	04	06	04	04	08	07	07	07	07	06	05	05	05	04	07	07	07	11
11	320	330	360	360	340	340	300	300	330	060	090	140	150	170	240	250	270	270	310	310	315	330	300	300
	10	07	07	04	05	10	05	07	05	04	07	12	12	08	08	10	07	10	15	10	10	07	12	07
12	310	315	300	300	330	360	315	270	180	360	090	090	105	135	120	140	315	290	285	300	315	315	315	315
	13	08	12	17	10	07	09	11	06	07	14	07	05	07	04	03	04	03	12	15	17	18	15	11
13	315	315	330	315	315	315	320	315	300	310	330	210	180	240	360	050	050	060	060	090	165	240	300	345
	15	17	20	18	17	18	15	10	10	12	10	05	06	10	10	08	15	17	15	12	12	11	07	10
14	240	310	030	330	070	075	060	060	360	360	150	135	210	220	210	210	180	180	315	340	060	050	050	060
	05	07	08	06	10	08	05	05	02	02	03	05	05	07	06	10	07	04	07	12	17	17	16	12
15	040	360	300	300	360	340	320	030	000	165	135	180	150	140	260	290	310	315	330	330	330	360	020	090
	10	03	06	08	07	06	05	00	00	02	04	05	04	05	10	12	12	14	10	08	08	08	06	10
16	070	340	285	280	300	030	270	360	000	120	150	130	300	270	315	300	300	315	330	310	315	345	030	045
	05	04	04	07	06	05	03	03	00	03	03	03	10	13	10	12	12	10	11	10	08	10	10	08
17	340	030	360	300	290	270	320	050	060	080	075	060	100	030	100	060	270	300	315	090	360	165	030	320
	06	07	05	05	02	03	05	05	06	07	06	06	07	17	15	11	11	07	07	05	03	03	05	06
18	360	360	315	360	360	330	360	110	090	120	100	060	070	060	075	180	285	315	280	170	360	240	270	360
	07	04	05	05	03	04	05	04	03	05	05	06	07	07	08	17	15	10	10	05	06	06	05	07
19	030	330	250	260							180	240	270	290	290	310	260	250	260	270	285	290	275	305
	06	06	05	06							05	05	03	06	07	08	06	06	06	06	05	05	05	06
20	290	270	200	200	270	310	270	220	180	030	210	230	180	150	120	130	120	180	330	070	050	070	200	230
	09	11	08	04	04	05	04	02	03	00	03	04	05	04	05	06	10	04	10	11	11	08	08	07
21	060	140	310	300	040	000	000	000	000	100	180	180	180	200	150	210	190	200	240	300	340	330	000	220
	05	04	05	03	03	00	00	00	00	02	02	02	02	03	05	06	06	04	04	04	06	06	00	03
22	000	190	300	300	000	320	310	250	060	080	070	060	090	290	270	270	280	300	300	310	330	330	240	250
	00	02	03	00	00	03	04	05	03	03	05	05	05	06	03	06	08	09	08	08	06	07	03	05
23	250	040	320	320	250	290	180	090	000	300	000	000	000	000	180	140	120	130	070	040	060	070	270	300
	05	03	04	05	04	05	04	00	00	00	00	00	00	02	03	04	05	03	05	06	07	05	05	
24	270	340	000	000	000	000	270	000	000	000	000	000	150	180	290	320	330	330	330	330	340	340	330	340
	04	13	00	00	00	00	02	00	00	00	00	00	02	03	06	07	08	10	08	08	07	05	03	05
25	270	000	280	280	100	280	030	000	000	100	070	080	060	090	070	070	120	210	290	320	330	330	200	000
	04	10	03	04	04	03	00	00	00	04	06	05	04	03	03	03	03	04	06	05	04	03	03	00
26	000	310	300	330	300	300	320	330	310	160	120	060	130	210	210	290	320	300	280	300	310	280	320	270
	00	03	02	04	03	05	04	02	02	02	02	02	02	03	03	07	06	05	06	05	05	05	02	03
27	270	300	300	310	310	010	020	160	200	000	000	180	060	180	280	250	220	120	050	060	070	000	310	300
	03	06	06	06	04	04	03	02	02	00	00	05	06	05	06	03	07	08	09	07	04	00	04	04
28	300	310	300	270	030	130	000	000	050	030	090	090	090	250	330	300	340	310	340	320	310	300	300	300
	03	03	03	02	03	02	00	00	02	02	04	03	03	06	08	07	05	03	06	03	04	06	06	03
29	320	330	305	300	330	230	000	000	330	300	060	130	130	160	180	330	270	180	060	270	300	275	150	310
	03	03	05	03	03	04	00	00	00	00	00	03	03	10	08	04	04	03	06	07	09	07	05	03
30	300	270	280	150	180	180	310	180	080	100	110	090	090	090	120	090	060	060	060	060	030	050	050	030
	05	05	04	03	02	05	04	03	03	02	02	04	03	03	02	03	05	05	05	05	06	05	06	05
31	010	300	310	180	020	180	180	030	150	120	150	120	100	090	040	100	000	100	040	060	310	180	310	260
	05	03	03	03	03	03	03	02	02	02	02	02	04	05	07	05	00	02	06	05	04	04	04	04

WIND DIRECTION AND VELOCITY: EMERY, UTAH (PERIOD AVERAGES) AUGST, 1973

DATE \ HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	000	330	180	020	310	030	030	000	000	000	000	000	180	080	060	060	030	180	300	030	030	310	310	270
	00	00	03	04	03	03	00	00	00	00	00	00	02	03	03	03	04	07	04	03	03	05	02	04
2	280	330	180	030	040	180	270	040	270	180	130	120	170	150	280	210	150	000	070	120	050	180	220	300
	03	05	04	03	03	03	03	02	02	02	02	02	02	02	02	02	02	00	04	04	04	05	04	04
3	300	130	300	060	060	210	280	180	050	130	180	140	180	070	210	250	300	300	290	275	310	300	290	180
	04	03	05	04	03	03	03	03	03	03	02	03	03	03	06	10	07	06	06	06	06	06	06	03
4	330	270	240	310	270	270	310	290	180	000	100	200	210	180	180	220	330	210	240	230	330	320	300	300
	04	04	04	06	03	02	06	05	03	00	02	02	04	06	05	10	06	03	03	06	08	07	11	08
5	300	280	250	260	280	280	280	050	060	100	210	280	270	190	240	210	200	210	240	230	300	290	300	280
	08	06	05	03	05	05	06	03	03	03	02	07	06	06	06	03	05	07	05	03	03	03	04	05
6	280	270	270	180	180	140	030	180	240	030					270	180	270	270	270	300	300	320	040	030
	03	03	02	03	03	03	03	03	03	00					06	05	06	05	06	05	06	06	04	03
7	180	270	240	200	040	020	180	050	060	060	130	120	180	150	090	130	200	210	150	180	330	320	310	300
	02	03	04	03	03	02	02	03	04	03	02	02	03	05	08	05	03	03	03	03	05	05	05	05
8	330	180	050	060	000	000	000	000	000	000	130	120	120	060	180	300	300	300	300	320	340	320	310	270
	05	03	03	02	00	00	00	00	00	00	02	03	04	04	02	06	06	06	05	05	06	05	06	04
9	270	340	340	180	310	310	020	270	200	090	100	180	180	200	210	180	150	190	190	160	020	290	090	180
	03	03	03	03	03	03	04	03	02	02	02	02	03	03	04	03	03	03	03	02	02	04	03	03
10	290	300	300	230	250	070	180	150	090	100	130	150	180	230	270	240	280	280	280	290	290	300	270	280
	05	03	05	03	03	03	03	03	02	02	02	04	02	07	08	05	05	08	07	06	05	05	05	05
11	290	340	300	300	280	230	180	180	220	320	310	300	310	290	260	320	300	310	310	320	330	320	170	060
	07	05	03	03	04	03	03	03	05	07	08	07	05	05	05	07	06	06	05	05	06	04	02	04
12	160	060	000	180	330	330	300	180	070	090	120	180	150	180	060	120	210	210	210	210	300	320	240	300
	03	00	00	03	03	02	03	03	02	02	03	03	03	03	03	05	05	04	03	02	02	04	03	04
13	310	180	020	020	040	090	000	240	180	070	070	070	100	180	220	140	160	150	150	260	330	320	300	200
	04	02	02	02	02	02	00	03	02	04	04	04	03	05	07	05	05	08	04	03	06	06	06	03
14	240	270	280	240	270	180	000	060	060	270	270	270	270	280	270	240	240	090	130	150	030	040	050	000
	02	02	02	02	03	03	00	02	02	03	06	06	07	08	06	09	08	03	03	03	06	04	03	00
15	180	060	000	180	180	270	060	040	190	000	090	090	060	250	180	150	150	190	270	240	180	290	310	310
	02	02	00	03	02	04	03	03	02	00	02	03	03	03	03	04	04	05	06	06	07	05	06	07
16	270	250	190	250	050	040	120	180	075	085	155	150	120	300	330	255	300	295	300	295	240	255	290	300
	04	03	04	03	03	02	02	02	02	03	03	03	03	03	03	07	07	07	10	06	04	06	06	05
17	220	270	315	240	150	035	360	090	075	060	015	125	235	190	270	250	240	260	210	190	200	315	300	255
	05	04	04	03	03	03	02	02	02	02	01	02	02	02	05	07	06	03	04	04	01	01	03	02
18	315	015	030	060	345	015	270	060	090	135	210	270	210	240	240	235	210	210	210	195	240	045	310	325
	05	03	02	03	05	04	03	02	02	02	02	02	04	03	03	03	06	06	07	06	03	03	01	03
19	290	285	275	045	045	270	300	020	090	180	225	245	100	180	225	270	235	285	265	235	300	300	315	300
	04	06	05	05	04	02	02	02	01	01	01	01	02	03	03	02	04	04	03	02	04	04	04	02
20	305	030	260	090	180	040	290	090	040	360	130	135	150	150	150	165	150	140	170	270	140	165	270	300
	05	04	02	03	03	03	04	02	02	03	03	02	03	05	05	05	03	03	03	02	06	12	07	05
21	260	060	035	030	300	080	180	150	135	165	105	150	180	180	300	315	300	240	060	060	055	030	090	030
	02	02	02	01	02	02	02	01	01	01	01	02	02	04	05	02	01	03	04	04	04	02	01	01
22	345	015	060	020	170	010	320	355	255	090	090	120	150	210	250	215	240	255	315	315	315	335	360	040
	01	01	01	01	02	02	02	02	01	02	02	01	02	03	03	04	04	03	02	01	02	03	02	01

HOURLY TEMPERATURE RECORD (RUN NOV 30, 19781 CJ — EMERY EAST DATA TAPE 1972/1973 TEMPERATURES — DEC 1972

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	SH	MN	SD
1																									0.0	0.0	0.0	0.0	0.
2																									0.0	0.0	0.0	0.0	0.
3																									0.0	0.0	0.0	0.0	0.
4																									0.0	0.0	0.0	0.0	0.
5																									0.0	0.0	0.0	0.0	0.
6																									0.0	0.0	0.0	0.0	0.
7																									0.0	0.0	0.0	0.0	0.
8																									0.0	0.0	0.0	0.0	0.
9																									0.0	0.0	0.0	0.0	0.
10																									0.0	0.0	0.0	0.0	0.
11																									0.0	0.0	0.0	0.0	0.
12																									0.0	0.0	0.0	0.0	0.
13																									0.0	0.0	0.0	0.0	0.
14																									0.0	0.0	0.0	0.0	0.
15																									0.0	0.0	0.0	0.0	0.
16																									0.0	0.0	0.0	0.0	0.
17																									0.0	0.0	0.0	0.0	0.
18																									0.0	0.0	0.0	0.0	0.
19																									0.0	0.0	0.0	0.0	0.
20																									0.0	0.0	0.0	0.0	0.
21																									0.0	0.0	0.0	0.0	0.
22																									0.0	0.0	0.0	0.0	0.
23																									0.0	0.0	0.0	0.0	0.
24																									0.0	0.0	0.0	0.0	0.
25																									0.0	0.0	0.0	0.0	0.
26	24	22	24	20	20	19	18	18	18	22	28	32	34	36	36	38	38	32	28	26	24	23	21	20	20.0	28.0	25.5	25.9	6.6
27	20	18	16	16	16	14	14	14	14	18	24	30	34	36	36	36	34	30	23	22	22	22	20	22	22.0	25.0	23.5	23.0	7.6
28	22	22	24	24	24	24	23	23	23	23	24	25	26	28	30	29	28	26	26	26	25	24	24	28	8.0	26.0	25.2	25.3	2.2
29	28	26	26	26	26	26	25	24	24	25	26	28	29	30	28	26	24	23	22	22	22	20	20	20	10.0	25.0	24.7	24.8	2.8
30	20	19	19	20	18	18	18	18	18	22	24	26	28	28	28	26	24	20	18	18	18	18	18	18	10.0	23.0	20.5	20.3	3.7
31	18	18	19	20	18	14	12	12	12	18	20	24	24	27	27	28	26	24	22	20	19	18	18	18	16.0	20.0	19.2	19.7	4.7
MN	22.0	20.9	21.4	21.6	20.0	19.2	18.4	18.2	18.2	21.4	24.4	27.5	29.2	32.2	32.2	32.2	30.6	27.0	24.5	23.5	22.9	22.0	21.3		14.8	25.6	23.2	24.7	5.1
SD	3.3	2.9	3.5	3.2	3.8	4.6	4.0	4.3	4.3	2.6	2.4	2.8	3.8	4.7	4.7	6.8	6.2	4.8	4.3	3.8	3.7	3.0	2.8	3.8	5.1	4.0	2.5	4.2	
IV*	4.4	4.0	5.0	4.0	4.8	5.8	5.0	5.2	5.2	3.6	2.4	2.8	3.2	2.8	2.2	3.0	3.0	3.0	4.0	3.7	3.2	2.3	2.7	4.2	4.5	2.6	2.8	3.8	1.6
N*	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	24
N	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	24

HOURLY TEMPERATURE FREQUENCIES (RUN NOV 30, 19781- CJ — EMERY EAST DATA TAPE 1972/1973 TEMPERATURES — DEC 1972

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

HOURS / TEMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
42																1									0	0	1	0	1
41																									0	0	1	0	1
40														1	1		1								0	0	1	0	1
39																1	1								0	0	1	0	1
38														2	2	1									0	0	2	0	2
37													2				1	1							0	0	3	0	3
36												1						1	1						0	0	3	0	3
35												1		1	1			1		1	1				0	0	4	0	4
34	1										1	1	1	2	2	1	1		1			1		1	0	0	6	0	6
33		1	1	1	1	1					1	1	1	1	1	2	1	1	1	2			1		0	0	7	0	7
32	1		2	1	1	1	1	1	1	1	3	1	1				2	1			1	1	1	1	0	0	8	0	8
31	1	2					1	1	1	2								1	2	2	2	1		1	0	0	8	0	8
30	2		3	1							1							1		1		1	2	2	0	0	9	0	9
29	1	1	2			1	2	2	2	2									1	1	1	2	2	1	0	0	10	0	10
28			1	1	2														1	1				1	0	0	5	0	5
27						2	1	1	1																0	0	4	0	4
26							1	1	1																0	0	3	0	3
25																									0	0	0	0	0
24																									0	0	0	0	0
23																									0	0	0	0	0
22																									0	0	0	0	0

HOURLY TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- CJ

EMERY EAST DATA TAPE 1972/1973 TEMPERATURES JAN 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

HOURS TEMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
37													1												0	0	1	0	1
36														1		2	1	1							0	0	6	0	6
35												1			1	1									0	0	8	0	9
34															3		1								0	1	12	0	13
33																									0	1	12	0	13
32														4	1	2	1	1							0	1	21	0	22
31													2												0	1	23	0	24
30											1		1	1	2	2	3	2	1	1					0	2	34	2	38
29													1	2			1								0	2	38	2	42
28												4	4	5	5	3	2	2			1	1			0	6	59	5	69
27													2	1	2	1	2	1	1				1		0	6	68	6	80
26										1	1	2	6	5	6	7	1	3	4						0	10	96	10	116
25															1	1	3			2					0	10	101	13	124
24											2	6	4	2		2	4	1	2	2	1	2			0	18	114	21	153
23												2						2							0	20	116	23	159
22	2		1	1	1					1	4	3	3	4	1	1	2	4	2	1	1	2	2	1	1	29	131	33	197
21		1				1	1			1				1	1				1					2	2	7	30	134	34	205
20	1	1	2	1	1			1	3	3	6	6	1		5	3	4	4	5	5	2	2	1	1	13	44	151	56	263
19	2	1	1	2	2	2	1	1		1			1		1			1			2	2	1	1	13	52	154	56	285
18	2	2	1				2	2	1	1	5	1	1	3		2	1		3	6	3	3	2	2	28	64	161	75	328
17			1						1		1	2				1	1				2	1			29	69	163	78	338
16	6	2	5	4	1	2	3	2	2	4	3		1				1	2	2	1	3	1	5	6	44	52	197	96	389
15	1	5	2	1	1	1	1	2	1	1	1				1	1	1	1	1	1	1	2	2	1	52	88	171	105	416
14	2	5	2	2	5	3	2	1	2	5	2	1	1	1			1	4	3	3	2	1	2	1	71	101	173	119	468
13						2		1	1	1		1							1	2	1	1	2		75	105	178	125	483
12	3	1		3	1	1		1	1	4							1	1		2	4	3	2	3	84	111	180	139	514
11	1		1		2	3	1												1		1			2	91	113	180	143	527
10	4	6	6	5	5	3	5	4	3	2	1								2	1	2	5	4	3	120	128	180	160	588
9	2	2	1	1				1											1				1	2	126	129	180	164	599
8	4		1	3	3	2	3	1	3	2							1	1	2	1	1	3	4		139	138	181	176	634
7		2	1	1		1		1	2		1								1						144	142	181	177	644
6	1	2	4	2	3	1	3	4	4	1									1						157	154	181	178	670
5		1	1	3		3	1	1													1				165	155	181	179	680
4		1			3	3	3	3	2												1	2	1		172	163	181	183	699
3								1																	172	163	181	183	699
2					1	1	3	1	2															1	174	169	181	184	708
1								1															1		174	170	181	185	710
0	1			1			1	1		2														1	176	174	181	186	717
-1	1	1																							178	174	181	186	719
-2		1	1			1																			181	174	181	186	722
-3																									181	174	181	186	722
-4			1	1	2	1		1																	186	175	181	186	728
-5							1		1																186	177	181	186	730
-6							1																		186	178	181	186	731

HOURLY TEMPERATURE RECORD (RUN NOV 30, 1978)- CJ

EMERY EAST DATA TAPE 1972/1973 TEMPERATURES

JAN 1973

HOURS DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	SD
1	14	14	14	12	11	11	10	10	10	10							28	20	16	14	12	12	12	10	18.0	19.0	0.0	13.3	
2	08	06	06	05	04	05	02	04	06	14	20	20	24	24	25	24	22	14	11	10	10	10	08	08	23.0	13.5	11.5	12.1	
3	06	06	06	06	02	02	04	04	07	14	17	22	22	22	20	18	15	14	13	12	12	12	10	08	20.0	12.0	12.5	11.4	5.3
4	10	10	10	10	11	11	12	13	16	18	20	24	21	20	20	17	14	14	13	12	10	09	08		16.0	16.0	14.0	13.7	4.4
5	08	04	06	08	06	04	00	00	02	12	16	20	24	22	20	20	18	14	10	08	10	10	08	09	24.0	12.0	10.5	10.8	5.3
6	09	07	06	06	06	05	06	06	08	12	15	17	19	18	20	17	14	12	09	06	05	04	04	02	18.0	11.0	9.5	9.7	5.4
7	-01	-02	-02	00	-04	-04	-05	-04	-05	00	07	13	16	18	20	21	20	16	10	07	04	04	01	00	26.0	8.0	5.3	5.4	5.9
8	00	-01	-04	-04	-04	-02	-06			00	10	14	14	14	15	15	12	08	08	08	08	08	09		21.0	4.5	5.6	5.9	7.0
9	09	10	10	10	10	10	10	10	11	12	16	18	18	18	19	18	16	15	14	12	11	10	10	08	11.0	13.5	12.5	12.7	3.5
10	03	05	07	07	06	04	02	06	06	08	14	22	27	30	32	32	30	28	26	24	24	22	16	11	33.0	17.0	20.0	16.5	10.3
11	10	09	08	05	04	06	02	01	02	06	16	17	22	26	26	26	20	16	15	14	14	15	16	16	25.0	13.5	14.0	13.0	7.6
12	16	15	15	15	14	15	14	13	14	18	24	24	26	28	26	26	24	20	14	14	12	10	10	10	18.0	19.4	16.5	17.4	5.7
13	10	09	10	09	10	10	08	09	10	16	20	26	28	28	30	28	30	30	26	20	18	18	15	14	22.0	19.0	18.0	18.1	3.1
14	12	10	10	10	08	08	08	06	06	10	18	22	27	32	34	35	36	36	30	24	20	20	14	16	30.0	21.0	20.0	18.8	10.3
15	14	14	10	10	10	12	10	10	08			28	31	32	28	28	28	26	20	20	18	14	12	12	24.0	20.0	19.5	18.0	3.0
16	12	10	13	14	14	16	16	16	16	16	18	20	20	22	21	20	20	19	18	18	18	17	16	16	12.0	16.0	13.5	16.9	2.9
17	16	16	16	16	16	16	16	16	16	19	22	24	26	29	30	30	26	22	25	30	28	28	27	18	14.0	23.0	25.2	22.0	5.5
18	18	14	14	12	10	08	06	04	08	16	18	20	22	22	22	22	20	20	20	20	19	19	19	19	18.0	13.0	16.5	16.3	5.4
19	19	19	19	19	19	19	19	19	20	21	22	23	24	26	24	26	24	23	22	22	22	22	22	22	7.0	22.5	22.2	21.5	2.2
20	22	20	22	22	22	21	21	20	20	22	22	24	26	24	26	26	24	22	18	18	17	18	18	18	3.0	21.5	19.7	21.4	2.7
21	18	18	20	19	19	14	18	18	20	20	20	24	28	29	28	26	24	22	20	20	19	19	18	16	15.0	21.5	21.2	20.7	3.8
22	16	15	15	14	14	14	14	14	15	26	26	26	26	26	26	25	24	20	18	16	15	15	16		12.0	20.0	18.0	18.7	5.1
23	16	14	16	16	14	13	10	07	12	13	18	23	28	28	28	30	27	26	20	18	16	15	14	11	23.0	18.5	17.5	18.0	6.5
24	10	10	10	08	08	07	08	06	07	14	22	28	31	32	34	32	30	28	22	18	17	18	16	16	29.0	20.0	14.5	18.0	3.3
25	12	12	11	10	12	10	06	08	06	14	20	28	28	28	27	25	22	20	18	18	16	16	16	15	22.0	17.0	16.5	16.6	5.8
26	15	14	13	12	10	11	10	10	10	20	20	24	29	32	34	36	32	30	26	25	24	24	22	22	26.0	23.0	22.5	21.0	8.3
27	22	21	20	20	20	19	18	18	18	20	24	28	30	27	27	27	27	27	24	16	15	14	13	12	13.0	21.0	18.7	21.1	5.1
28	11	10	09	08	08	05	04	05	04	08	14	20	26	26	25	28	29	26	24	15	14	13	13	12	25.0	16.5	14.5	15.0	8.4
29	20	16	17	16	15	14	15	15	15	14			26	26	26	25	22	16	13	13	12	10	10		16.0	18.0	16.7	17.0	5.0
30	08	07	05	05	04	04	04	02	04	12	20	24	26	28	28	26	25	23	21	20	20	20	20		26.0	15.0	18.0	15.7	9.1
31	19	18	18	16	14	13	16	15	17	26	30	35	37	36	35	36	34	32	27	25	25	24	23	23	24.0	25.0	25.5	24.7	7.8
MN	12.5	11.3	10.1	9.0	10.2	18.3	25.2	26.1	24.0	18.7	15.8	14.1		20.1		16.7		6.7											
		11.3	10.9	9.8	9.4	14.0	22.6	25.8	25.6	21.6	16.8	15.3	13.2		17.2		16.2												
SD	5.6	6.0	6.2	6.7	6.0	4.6	4.7	5.0	5.8	5.8	5.6	5.6		6.0		5.6													
		5.6	5.7	5.9	6.1	5.8	4.5	4.3	5.4	6.4	5.7	5.7	5.4		4.7		4.6												
V*	4.4	4.7	5.5	6.4	6.1	3.8	3.5	4.0	5.0	5.0	4.4	4.1	3.8		6.5		3.2		2.4										
		4.8	5.2	5.6	6.4	4.5	3.6	3.5	4.5	4.6	4.1	4.4	3.6		3.7		2.8												
I					1		3	2	1																				
					1	1	2	1	1																				
I*					2		5	3	1																				
					2	2	3	1	1																				

LY TEMPERATURE RECORD (RUN NOV 30, 1978) - C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES FEB 1973

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MX	3H	MN	SD
1	22	22	22	21	21	21	20	20	21	25	29	31	34	36	37	37	36	33	27	25	24	23	22	21	17.0	28.5	26.0	26.2	6.0
2	17	15	14	13	14	10	11	10	10	15	21	26	30	30	31	32	32	29	23	18	18	15	16	15	22.0	21.0	19.2	19.5	7.5
3		14	14	14	14	12	11	11	12	16	23	28	30	30	29	29	28	29	26	25	24	23	21	20	19.0	20.5	22.2	20.7	6.9
4		19	17	18	16	16	17	17	17	18	23	28	29	32	32	31	30	28	26	24	23	19	20	17	16.0	24.0	23.7	22.4	5.6
5		15	14	11	12	11	09	08	06				28	28	29	28	28	26	23	23	23	23	22	22	23.0	17.5	20.7	19.4	7.4
6	22	22	22	22	22	22	22	22	22	23	24	24	28	28	28	29	29	28	27	27	26	25	25	24	7.0	25.5	25.5	24.7	2.6
7	25	25	25	24	24	24	24	24	24	24	26	27	28	29	30	29	29	28	27	27	26	26	26	26	6.0	27.0	26.2	26.1	1.9
8	25	25	25	25	25	24	24	24	22	28	30	28	29	32	34	32	32	30	28	25	25	24	23	20	14.0	27.0	26.5	26.6	3.5
9	19	17	16	16	16	14	14	16	17	20	21	22	25	30	32	29	28	26	22	22	21	20	20	20	18.0	23.0	21.5	21.0	5.0
10	20	20	20	20	20	20	20	20	20	20	22	23	25	26	26	27	26	25	22	22	21	21	21	21	7.0	23.5	22.0	22.0	2.4
11	21	21	21	21	20	21	21	21	21	22	24	25	26	26	26	26	27	26	26	26	26	20	26	24	7.0	23.5	24.7	23.7	2.4
12	24	22	20	20	18	22	30	30	28	30		35	36	36	36	36	34	34	29	24	22	20	20	17	19.0	26.5	27.5	27.1	6.0
13	17	16	10	12	14	13	13	11	12	16	22	28	35	36	34										26.0	23.0	0.0	19.3	9.0
14																									0.0	0.0	0.0	0.0	0.0
15																									0.0	0.0	0.0	0.0	0.0
16																									0.0	0.0	0.0	0.0	0.0
17																									0.0	0.0	0.0	0.0	0.0
18																									0.0	0.0	0.0	0.0	0.0
19											24	28	31	34	32	30	29	27	22	20	16	15	15	12	22.0	23.0	0.0	23.9	7.0
20	12	12	09	10	10	05	05	05	05	14	19	26	30	31	35	32	29	26	21	21	18	18	16	12	30.0	28.0	18.0	17.6	9.3
21	11	11	09	08	06	06	04	04	12	14	18	24	33	33	32	34	34	32	28	27	27	26	25	25	30.0	19.0	22.7	20.1	10.6
22	25	24	24	24	24	24	25	24	25	28	36	38	42	40	42	40	38	34	30	28	26	26	26	25	18.0	33.0	29.2	29.9	6.6
23	25	24	24	24	24	24	24	24	24	28	30	32	33	33	33	34	34	33	32	28	28	23	28	28	10.0	29.0	28.2	28.3	3.8
24	23	23	27	26	26	26	26	25	25	25	26	27	29	30	32	32	32	30	29	28	28	28	28	26	7.0	28.5	28.0	27.8	2.1
25	26	26	24	23	25	25	24	24	24	25	25	26	27	29	32	34	36	37	37	32	27	26	26	26	14.0	30.0	26.7	27.7	4.3
26	23	22	23	22	20	20	20	22	23	24		36	36	36	36	36	38	36	32	31	30	30	30	30	18.0	29.0	29.0	28.5	6.3
27	30	29	28	28	28	28	28	28	28	32	34	40	42	43	43	42	36	36	32	30	30	30	29	30	15.0	35.5	32.7	32.7	5.3
28	30	29	28	28	28	28	28	28	30	32	34	34	34	35	35	34	36	35	30	30	30	28	28	28	8.0	32.0	30.7	30.8	2.9
N	21.6	20.9	19.9	19.6	19.5	19.0	19.1	19.0	19.5	22.8	25.6	29.0	31.4	32.4	32.9	32.5	31.9	30.4	27.3	25.6	24.5	23.8	23.5	22.3	16.3	25.7	25.4	24.7	6.0
D	5.1	5.2	5.9	5.8	5.9	6.8	7.4	7.5	7.0	5.6	5.0	4.8	4.6	4.2	4.2	4.0	3.7	3.7	4.0	3.6	3.9	4.1	4.1	5.2	7.2	4.6	3.8	4.2	
	3.4	3.9	3.9	4.4	4.3	5.0	5.9	5.7	5.5	4.1	4.0	4.5	3.5	3.5	4.0	3.3	2.6	2.3	2.6	2.1	2.3	2.9	2.8	3.1	6.2	3.5	2.7	3.1	2.0
	6	6	6	6	6	6	6	6	6	7	8	6	5	5	5	6	6	6	6	6	6	6	6	6	5	5	7	5	5
		7	7	7	7	7	7	7	7	9	12	8	6	6	6	7	7	7	7	7	7	7	7	7	6	6	8	6	6

Y TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES FEB 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
													1	1										0	0	2	0	2
												2		1	1									0	0	6	0	6
																								0	0	6	0	6
											1		1		1									0	1	8	0	9
																								0	1	8	0	9
											1					2								0	2	10	0	12
														1	1		1	1						0	2	13	1	16
										1	1	2	4	2	2	4	2							0	4	29	1	34
											1	1	1	2			1							0	5	34	1	40
										2	1	2	1	2	4	3	2							0	8	48	1	57
												2	2	1			2							0	8	55	1	64
									2		1		2	6	4	3	1	3	1					0	11	71	5	87
											1	1	1	1	1				1					0	12	75	6	93
2						1	1	1	1	2		3	4	1	1	1	2	2	2	3	2	1	2	2	18	87	18	125
	2									1		3	2	2	4	4	2	2				1		4	19	104	21	148
1	1	2	2	2	2	2	2	2	3		5	3	2	1	1	3	3	2	3	2	3	3	2	14	33	117	36	200
		1									2	1			1	1	1	3	3	2				15	35	121	44	215
1	1		1	1	1	1				2	3	1	2	2	1	1	4	3	1	4	5	4	3	20	41	132	64	257
4	2	2	1	2	1	1	1	2	2	1	1	2					1		3	1	1	2	2	32	49	135	73	289
1	2	3	3	3	4	4	5	3	3	3	2								2	2	1		2	48	69	135	80	332
1		1	1					1	1	2	1							2	1	2	3	1		51	74	135	89	349
2	4	2	2	1	2	1	2	2	1	2	1							3	2	1		2	1	64	83	135	98	380
1	1	1	2	1	2	1	1	2		2								1	1	2	1	2	2	72	89	135	107	403
2	1	2	2	3	2	3	2	1	2										1		2	3	3	84	97	135	116	432
1	1									1											1			86	98	135	117	436
1			1	1					1	1									1	2	2	1		89	100	135	123	447
2	1	1				1	1	2															2	93	104	135	125	457
	1	1	1	2	1		1		2											1		1		99	107	135	127	468
1	2								1												1	1	1	102	108	135	130	475
	1	3	1	3	1	1			2															111	111	135	130	487
			1		1	1																		113	112	135	130	490
1	1		1	1	1			3															2	118	115	135	132	500
1	1		1		1	2	2																	122	119	135	132	508
		1	1	1	1		1	1																126	121	135	132	514
		2				1																		128	122	135	132	517
			1				1																	129	123	135	132	519
																								129	123	135	132	519
				1	1			1																131	124	135	132	522
					1	1	1	1																132	127	135	132	526
						1	1																	132	129	135	132	528

URLY TEMPERATURE RECORD (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES MAR 1973

URS TE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	JH	MN	SD
1	28	28	30	27	28	26	26	27	30	36	40	42	43	46	46	47	44	40	35	34	34	32	32	32	21.0	36.5	35.0	34.7	6.9
2	32	32	31	30	30	30	30	30	30	35	40	42	40	42	44	42	38	32	31	30	29	28	27	27	17.0	35.5	33.0	34.3	5.4
3	26	26	25	24	24	23	22	22	26	30	33	35	36	37	38	40	40	38	34	30	28	28	28	26	18.0	31.0	28.7	30.0	
4	26	26	26	26	26	26	26	26	26	25	27	28	28	29	29	30	30	28	27	26	26	25	24	24	6.0	27.0	26.7	26.7	
5	24	24	26	28	28	28	26	26	30	30	32	34	36	37	38	38	38	36	31	29	28	37	36	35	14.0	31.0	29.7	31.5	
6	25	25	24	24	23	22	22	24	26	30	34	35	38	38	38	35	33	31	30	28	27	26	25	25	16.0	30.0	28.5	28.7	5.2
7	25	24	25	25	25	25	26	26	28	29	32	32	32	32	32	32	32	32	32	32	32	24	24	24	8.0	28.0	30.5	28.4	3.5
8	23	22	22	20	20	20	22	23	24	25	28	32	34	35	36	35	32	32	31	29	28	28	28	28	16.0	28.0	28.2	27.4	5.1
9	27	27	26	27	26	26	26	24	28	34	36	38	40	40	40	40	40	42	40	34	31	31	30	30	18.0	33.0	32.0	32.7	5.8
10	28	28	28	26	29	30	29	30	34	37	40	42	44	45	46	48	47	46	46	40	35	33	34	30	22.0	37.0	36.0	36.5	7.3
11	29	27	28	26	26	24	26	26	28	30	32	32	32	32	34	34	38	39	39	38	37	32	31	30	15.0	31.5	33.0	31.2	4.5
12	31	30	30	30	30	30	30	30	30	32		34	32	32	32	32	30	30	30	28	28	26	27	26	8.0	30.0	29.5	30.0	1.9
13	26	26	27	24	23	23	23	24	27	31	35	38	36	36	38	34	34	32	29	27	25	25	26	25	15.0	30.5	27.2	29.3	5.0
14	24	24	24	24	25	24	24	26	28	30	31	32	34	36	38	38	35	32	30	30	28	28	28	27	14.0	31.0	29.0	28.2	4.5
15	27	26	26	26	26	26	26	28	30	33	36	40	40	41	43	43	42	40	34	32	31	30	30	30	17.0	34.5	32.2	32.7	5.1
16	29	28	26	25	24	24	23	26	30	36	39	40	43	45	46	49	49	48	45	40	35	33	32	32	26.0	36.0	34.5	35.2	3.6
17	32	30	29	29	29	28	28	30	32	34	40	40	40	44	45	46	46	46	42	40	40	38	36	38	19.0	37.0	38.0	36.7	5.3
18	38	36	36	35	36	34	32	32	33	38	42	46	46	48	46	46	45	42	39	34	32	32	31	30	18.0	39.0	36.0	37.9	5.7
19	33	31	28	28	26	25	24	26	28	32		40	40	42	44	44	44	44	42	41	40	38	36	32	29.0	34.0	35.5	35.1	7.0
20	30	33	30	30	30	30	28	30	32	39	40	42	44	44	46	46	46	46	45	36	36	34	34	32	31	18.0	37.0	35.0	36.1	4.3
21	32	31	30	28	28	27	26	26	28	29	30	32	30	32	32	32	32	32	32	30	28	29	30	30	30	6.0	29.0	29.0	29.8	1.8
22	28	28	28	27	26	24	22	23	28	30	34	36	36	36	36	36	34	36	34	31	30	28	27	26	14.0	29.0	29.5	30.2	4.5
23	26	26	25	24	22	23	24	26	29	36	38	40	40	42	42	42	42	40	38	36	32	32	32	31	20.0	32.0	32.5	32.8	6.9
24	30	30	30	28	27	26	25	25	32	35	36	37	40	40	42	42	42	42	42	42	42	36	34	34	31	17.0	33.5	34.2	34.5	5.9
25	31	23	26	26	24	23	22	22	25	32	36	38	40	44	44	47	48	50	48	46	42	34	32	30	28.0	36.0	37.5	34.9	9.3
26	29	29	27	26	28	27	26	26	26	32			48	49	48	47	48	46	45	42	40	37	36	33	23.0	37.5	38.7	36.1	8.8
27	31	28	29	28	28	28	29	30	36	43	47	48	50	54	54	50	50	49	45	38	38	34	34	34	26.0	41.0	39.7	39.8	9.2
28	34	34	34	32	32	32	30	28	34	38	38	38	34	30	34	36	36	33	30	28	28	28	28	28	10.0	33.0	29.0	32.4	3.4
29	23	27	27	26	25	26	26	26	26	28	32	36	35	38	38	36	39	38	37	32	30	30	29	28	14.0	32.0	31.0	31.0	4.7
30	28	28	28	27	27	26	26	27	30	33	36	39	40	42	42	44	44	42	37	34	32	32	32	33	18.0	35.0	33.0	33.7	6.0
31	32	32	31	29	28	30	30	30	34	39	42	46	44	46	45	45	46	48	46	41	35	33	32	31	20.0	38.0	36.5	37.3	6.9
MN	28.7	27.9	26.8	25.4	29.3	35.9	38.6	40.5	40.3	36.7	32.3	30.5													16.9		32.6		6.0
	28.1	27.0	26.4	26.7	33.0	37.8	39.9	40.6	39.3	34.1	31.0	29.6														33.4		32.8	
SD	3.2	2.9	3.1	2.8	2.9	4.5	5.2	5.6	6.0	6.0	4.5	3.4													5.4		3.6		
	3.0	2.8	3.1	2.6	4.1	4.7	6.0	5.8	6.2	5.3	3.8	3.3														3.6		3.3	
DV*	2.6	2.7	3.6	3.4	3.2	4.5	5.1	5.1	4.8	4.7	3.9	3.5													5.9		2.8		2.0
	2.6	2.9	3.9	3.1	4.2	4.5	5.6	5.0	5.1	4.4	3.6	3.1														2.9		2.6	
HI						3																							
						1																							
HI*						6																							
						2																							

URLY TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES MAR 1973
A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

URS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
49														1	1										0	0	2	0	2
48																									0	0	2	0	2
47																									0	0	2	0	2
46																									0	0	2	0	2
45													1			1	1	1							0	0	6	0	6
44														1		1	1	1							0	0	10	6	16
43												1	1	1	1	1	2	2	1						0	0	18	1	20
42											1					3	1								0	2	22	1	25
41												2	1	2	2	3	3	3	2	1					0	4	39	4	47
40															2	3	3	1	3						0	4	48	7	59
39													3	2	1	3	3	1							0	4	51	7	62
38										1			2			1									0	5	65	7	77
37											2	4		4	4	2	4	4	3	2	1				0	11	83	13	107
36														1		4	2	4		2					0	11	84	15	110
35											5	5	9	2	1	2	2	3	1	3	3				0	21	103	22	146
34										2		1					1	1	2						0	24	105	24	153
33	1									2	3	4	1	2	6	2	2	3	1	2	1	2		1	1	33	121	31	186
32										1		1		2					2		1	2			1	35	123	36	195
31		1	1		1				1	3	5	2	4	3	2	3	1	2	1	2	1		4		4	46	138	44	232
30				1						2	1	2	1	1		2	1		1		1			1	5	51	143	49	248
29	1	1	1			1			3	2	2	2	3		2	2	2		3	4	2	4	3	1	3	50	152	66	287
28									1	2	1						1	1				3		2	3	64	154	71	292
27	6	2		1	1	1	1	1	3	4	4	5	3	4	3	3	3	5	2	3	4	5	7	5	18	82	175	95	370
26	4	5	2							6	1					1	2	1	5	2	2	2	2	4	23	64	176	108	391
25	6	5	5	1	3	5	4	7	7	6	1		1	1					1	2	3	3	3	7	68	109	182	131	490
24	4		2	2					1	2				1	1				1	1	2	1	1		56	114	184	137	491
23	2	8	2	5	6	3	2	3	7	1	1	1	1					1		4	6	5	5	3	90	129	186	150	565
22	2	5	3	4	6	2		2	5		1								1	1	1		2	2	106	133	185	167	592
21	2	5	5	7	6	7	11	10													1	2	1	3	140	159	186	175	660
20	2	1	3	2	3	2	1	1	1	2											1	2	2	2	153	164	186	181	684
19	2	3	2	5	3	4	3	3	1													1	2	2	172	171	186	186	715
18	1				2	4	2	2																	179	175	186	186	726
17		1	1		1	1	5	2																	183	182	186	186	737
16				1	1	1																			183	182	186	186	737
15																									186	182	186	186	740

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	SD
1	30	30	28	28	28	26	25	26	29	35	38	37	34	35	29	30	29	31	31	30	28	28	28	29	13.0	31.5	29.0	30.1	3.3
2	28	28	28	27	28	27	28	27	27	29	30	30	36	38	40	40	40	38	36	35	34	33	33	32	13.0	33.5	33.5	32.2	4.6
3	32	31	31	31	31	30	30	33	34	35	37	38	40	41	42	40	34	36	34	30	27	26	25	24	18.0	33.0	31.2	33.0	4.9
4	24	22	23	25	25	24	24	29	31	33	35	37	39	40	42	43	44	45	42	35	34	32	32	32	23.0	33.5	33.0	33.0	7.2
5	32	31	31	29	30	30	28	33	38	42	45	46	49	52	55	56	58	57	52	45	44	42	40	38	30.0	43.0	42.0	41.8	9.7
6	38	40	39	38	40	41	42	40	42	52	55	58	59	55	60	60	58	57	50	46	46	47	47	45	22.0	49.0	47.2	48.1	7.7
7	44	44	43	40	36	30	27	26	30	31	34	35	36	37	37	36	36	32	31	27	24	23	22	20	24.0	32.0	25.0	32.5	6.7
8	[illegible]	18	17	17	16	15	14	17	25	30	33	37	38	41	43	43	43	42	40	37	35	34	32	31	29.0	28.5	31.2	29.9	10.3
9	[illegible]	30	30	29	30	30	30	32	39	43	46	50	54	56	56	54	53	54	50	44	41	40	41	38	27.0	42.5	42.0	41.7	9.7
10	[illegible]	35	33	32	32	32	32	34	39	46	52	56	56	56	56	58	56	54	50	46	44	43	42	42	26.0	45.0	44.0	44.3	9.3
11	44	40	40	38	38	38	38	40	45	48	49	52	44	48	47	50	53	52	43	44	42	40	34	34	19.0	43.5	42.5	43.4	5.5
12	34	33	32	32	31	28	30	39	45	48	52	54	56	56	56	58	58	52	53	46	43	41	41	39	30.0	43.0	43.0	44.0	9.9
13	39	38	36	36	36	34	34	38	47	52	53	55	56	59	64	63	64	63	61	54	51	51	48	48	30.0	49.0	48.7	49.2	10.3
14	47	46	44	43	43	39	37	42	46	48	49	50	54	56	56	54	50	50	49	46	42	40	38	37	19.0	46.5	44.2	46.1	5.6
15	36	35	34	34	34	33	33	34	36	40	46	47	48	49	51	53	52	51	48	44	40	39	36	35	20.0	43.0	40.5	41.2	7.0
16	34	33	32	29	29	30	29	30	35	42	48	51				57	58	56	55	50	48	45	45	45	29.0	43.5	0.0	42.0	10.2
17	44	48	46	46	44	44	44	44	48	50	51	54	53	53	52	53	54	53	52	50	48	45	43	40	14.0	47.0	48.2	48.3	4.1
18	38	36	36	35	34	34	33	34	34	35	36				44	42	41	36	34	31	29	30	29	29	15.0	36.5	0.0	34.8	4.0
19	29	28	28	26	26	26	27	30	33	35	37	38	39	41	41	40	40	38	36	30	31	30	30	30	15.0	33.5	32.5	32.9	5.2
20	30	28	28	28	28	28	30	34	36	38	40	38	41	40	37	38	38	35	34	32	32	32	32	31	13.0	34.5	33.5	33.7	4.2
21	31	31	31	30	31	31	31	35	38	42	42	44	45	47	47	50	50	49	45	41	37	36	36	35	20.0	40.0	38.0	39.0	6.8
22	35	34	33	30	30	28	28	33	40	44	47	52	52	56	56	59	59	60	58	54	49	45	42	39	32.0	44.0	45.5	44.3	10.6
23	36	36	36	34	34	32	31	35	40	50				57	58	57	49	45	48	44	41	38	38	37	27.0	44.5	42.5	41.7	8.3
24	37	38	38	39	39	39	39	41	41	41	41	44	51	55	56	51	48	52	50	46	44	40	38	38	19.0	46.5	45.5	43.6	5.9
25	39	38	37	36	36	37	36	44	48	51	52	56	56	57	58	58	57	56	55	50	47	48	44	40	22.0	47.0	46.7	47.3	5.1
26	39	40	36	35	33	33	33	36	41	46	47	51	53	57	59	60	60	60	60	57	51	46	42	40	27.0	46.5	48.0	46.5	9.7
27	37	34	37	34	35	35	34	38	43	51	56	57	61	63	66	67	67	68	66	64	59	55	49	46	34.0	51.0	53.7	50.9	12.6
28	44	49	52	48	48	45	45	49	54	60	66	68	67	67	66	69	67	64	64	60	54	52	50	50	25.0	56.5	55.0	56.6	8.5
29	47	46	45	42	40	38	39	43	51	58	60	64	64	65	64	65	64	63	60	56	50	45	43	42	27.0	51.5	51.0	52.2	3.7
30	41	40	40	40	40	37	35	35	38	40	44	47	40	40	40	42	42	40	38	36	36	36	38	37	12.0	41.0	36.7	39.2	2.8
MN	35.9	35.4	34.8	33.7	33.5	32.5	32.2	35.1	39.1	43.2	45.6	48.1	49.0	50.7	51.0	51.6	50.8	49.7	47.5	43.7	41.1	39.5	38.0	36.8	22.5	42.0	41.4	41.5	7.9
SD	6.5	7.1	7.1	6.6	6.4	6.2	6.2	6.5	7.0	8.0	8.5	9.1	9.1	8.9	9.7	9.8	10.0	10.1	10.0	9.6	8.5	7.8	7.0	6.7	6.4	6.9	7.5	7.0	
IV*	5.8	6.5	6.2	6.0	6.0	6.2	6.2	5.7	5.3	6.4	6.6	7.0	7.3	6.1	7.2	7.3	7.7	8.1	7.7	6.8	6.6	6.4	6.3	6.0	5.7	4.4	4.9	4.8	2.5
MI											1	2	3	2	1												2		
MI*											2	4	6	4	2												4		

HOURL[illegible]PERATURE FREQUENCIES (RUN NOV 30, 1978)- G3

EMERY EAST DATA TAPE 1972/1973 TEMPERATURES APR 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

HOURS / TEMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
69																1									0	0	1	0	1
68												1						1							0	1	2	0	3
67													1	1		1	2								0	1	7	0	8
66											1				2				1						0	2	9	1	12
65														1		1									0	2	11	1	14
64												1	1		2		2	1	1	1					0	3	17	3	23
63														1		1		2							0	3	21	3	27
62																									0	3	21	3	27
61													1						1						0	3	22	4	29
60										1	1				1	2	1	2	2	1					0	5	28	7	40
59													1	1	1	1	1				1				0	5	33	8	46
58										1		1			2	3	4		1						0	7	42	9	58
57												1		3		2	1	2		1					0	8	50	10	68
56											1	2	4	5	6	1	1	2		1					0	11	69	11	91
55											1	1		2	1				2			1			0	13	72	14	99
54									1			2	2			2	1	2		2	1				0	16	79	17	112
53											1		2	1		2	2	1	1						0	17	87	18	122
52			1							2	3	2	1	1	1		1	3	2			1			1	24	94	21	140
51									1	2	1	2	1		1	1		1			2	1			1	30	98	24	153
50										2		2				2	2	1	4	3	1		1	1	1	34	103	34	172
49		1						1			2		1	1			1	1	1		1		1		2	37	107	37	183
48		1		1	1				2	3	1		1	1			1		2		2	1	1	1	5	43	110	44	202
47	2								1		2	2		1	2						1	1	1		7	48	113	47	215
46		2	1	1					1	2	2	1								5	1	1		1	11	54	113	55	233
45			1			1	1		2		1		1					2	1	1		4	1	2	13	58	116	64	251
44	4	1	1		1	1	1	2		1	1	2	1		1		1			4	3		1		21	65	119	72	277
43			1	1	1			1	1	1					1	2	1		1		1	1	2		24	68	123	77	292
42				1			1	1	1	3	1				2	2	1	1	1		2	1	3	2	25	75	129	86	315
41	1					1		1	2	1	1		1	3	1		1			1	2	1	2		27	80	135	92	334
40		4	2	2	3			2	2	2	1		2	3	2	3	2	1	1		1	4	1	3	38	87	148	102	375
39	3		1	1	1	2	2	1	2				2									1		2	46	92	150	105	393
38	2	3	1	2	1	2	1	2	3	1	1	3	1	1		1	1	2	1			1	4	3	57	103	156	114	430
37	3		2			2	1				2	3		1	2					1	1			3	64	109	159	119	451
36	2	2	4	2	3		1	1	2		1		2			1	1	2	2	1	1	2	2		77	114	165	127	483
35	1	2		2	1	1	1	3	1	4	1	1		1				1		2	1			2	84	125	167	132	508
34	2	2	1	3	3	2	2	4	2		1		1				1		3		2	1	1	1	97	134	169	140	540
33		2	2		1	2	3	3	1	1	1											1	1		104	143	169	142	558
32	2		2	2	1	2	1	1										1		1	1	2	3	2	113	145	170	151	579
31	1	3	3	1	3	1	2		1	1								1	2	1	1			2	125	149	171	157	602
30	3	2	1	2	3	5	4	2	1	1	1	1				1				3		2	1	1	141	159	172	164	636
29	1			3	1		1	1	1	1					1		1				1		1	2	146	163	174	168	651
28	1	3	4	2	3	3	3														1	1	1		162	166	174	171	673
27				1		1	2	1	1											1	1				164	170	174	173	681
26				1	1	2		2														1			168	172	174	174	688
25				1	1		1		1														1		170	174	174	175	693
24	1					1	1														1			1	172	175	174	177	698
23			1																			1			173	175	174	178	700
22		1																					1		174	175	174	179	702
21																									174	175	174	179	702
20																								1	174	175	174	180	703
19	1																								175	175	174	180	704
18		1																							176	175	174	180	705
17			1	1				1																	178	176	174	180	708
16					1																				179	176	174	180	709
15						1																			180	176	174	180	710
14							1																		180	177	174	180	711

HOURLY TEMPERATURE RECORD (RUN NOV 30, 1978)- CJ EMERY EAST DATA TAPE 1972/1973 TEMPERATURES MAY 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	SD
1	38	38	36	35	36	36	36	40	40	44	44	46	44	43	48	50	48	42	44	42	42	39	37	35	15.0	42.5	40.7	40.3	4.3
2	32	32	31	30	32	30	32	40	44	46	48	50	52	56	56	58	58	56	55	50	46	43	41	38	28.0	44.0	45.0	44.3	3.8
3	33	34	32	32	32	32	30	38	46	52	54	56	60	60	62	64	62	63	62	58	54	48	48	46	34.0	47.0	49.5	48.5	11.8
4	44	42	42	40	40	42	44	46	54	60	60	62	65	66	66	64	67	68	64	62	58	56	54	50	28.0	54.0	56.5	54.[illegible]	[illegible]
5	52	52	50	47	48	48	46	48	53	56	58	58	58	58	58	56	52	47	42	38	38	38	38	38	20.0	48.0	45.6	49.	[illegible]
6	36	34	34	35	35	35	34	35	38	40	44	48	56	56	56	58	58	58	55	56	50	48	48	46	24.3	46.0	47.5	45.[illegible]	[illegible]
7	46	44	42	43	43	42	42	45	50	52	56	58	60	60	60	60	60	60	59	51	48	52	48	48	18.0	51.0	49.5	51.2	6.9
8	44	44	42	42	42	42	43	48	54	58	64	64	64	68	70	64	62	64	62	56	54	52	48	48	28.0	56.0	54.7	54.1	9.4
9	48	48	46	46	44	44	44	50	58	64	66	68	70	71	72	72	72	72	68	62	58	52	50	50	28.0	58.0	57.7	58.1	10.6
10	48	48	48	46	47	48	54	62	66	70	72	73	75	75	76	76	76	74	72	66	60	57	57	56	30.0	61.0	62.2	62.6	11.0
11	50	50	48	50	48	46	48	56	60	66	70	72	74	78	78	78	76	76	74	68	61	58	56	56	32.0	62.0	62.6	62.4	11.3
12	54	54	53	52	52	50	50	50	56	66	72	75	78	70	70	70	70	68	66	62	58	58	56	56	28.0	64.0	59.0	61.1	8.7
13	52	52	50	52	50	48	46	48	54	62	66	68	70	70	72	74	74	73	70	66	62	60	56	52	28.0	64.0	60.0	60.3	3.4
14	56	54	48	44	44	43	42	46	52	58				70	70	72	70	68	62	60	54	50	50	50	30.0	57.0	0.0	55.7	9.9
15	48	46	44	43	42	42	48	56	60	62	66	68	70	72	70	64	70	68	64	60	58	54	52	52	30.0	57.0	59.0	57.5	9.9
16	50	50	48	47	46	46	50	56	64	68	72	74	74	76	76	76	76	76	76	72	62	60	62	60	30.0	61.0	62.5	63.2	11.3
17	52	52	50	52	50	54	56	60	68	74	76	78	80	80	80	78	78	78	76	72	66	64	62	62	30.0	65.0	67.0	66.6	10.9
18	60	60	58	58	56	58	60	66	70	76	78	80	82	84	84	80	82	80	80	74	70	70	66	66	28.0	70.0	71.0	70.8	3.5
19	62	60	60	58	58	58	56	60	66	70	76	74	64	66	68	70	70	70	68	66	62	56	54	54	22.0	65.0	61.5	63.6	5.2
20	52	52	52	50	50	46	46	52	57	64	66	68	70	74	72	72	72	72	74	70	66	60	60	58	28.0	60.0	61.0	61.5	3.4
21	58	54	52	52	50	48	48	50	56	62	64	64	58	56	54	45	47	49	49	49	48	46	44	46	20.0	54.0	50.0	52.0	5.7
22	46	45	45	44	44	44	44	46	49	56	59	62	64	66	68	70	71	70	68	65	59	57	55	51	27.0	57.5	57.0	56.2	9.8
23	50	48	48	46	45	46	46	52	59	65	69	67	68	66	70	70	70	67	66	64	62	56	55	54	25.0	57.5	59.0	58.7	9.8
24	54	56	53	56	51	53	54	57	64	69	72	74	76	74	72	77	76	72	74	70	66	64	62	60	26.3	64.0	65.6	64.8	8.7
25	58	59	59	58	56	54	53	54	58	58	54	53	55	56	56	57	49	47	48	47	46	45	44	42	17.0	50.5	50.2	52.7	5.2
26	42	41	40	38	38	38	38	43	45	43	45	51	51	54	53	54	54	52	51	49	47	46	46	46	15.0	46.0	46.5	46.0	3.5
27	44	43	42	39	38	36	36	41	46	51	52	55	56	57	59	59	59	59	60	59	57	53	51	50	24.0	48.0	51.7	50.1	8.1
28	50	47	45	44	44	40	38	43	48	55	66	67	69	70	73	71	69	68	66	60	56	53	52	49	35.0	55.5	55.0	56.0	11.1
29	50	51	47	46	47	48	57	66	70	72	74	74	76	77	76	75	73	70	64	60	58	55	55	54	31.0	51.5	62.5	62.3	10.8
30	54	53	52	46	42	44	49	54	56	58	61	64	65	67	68	70	71	70	68	62	58	54	52	50	29.0	56.5	58.0	57.8	8.5
31	50	49	45	45	46	41	46	54	60	64	68	72	73	75	73	70	71	68	67	62	60	60	58	55	34.0	58.0	60.2	59.8	10.4
MN	49.0	48.2	46.6	45.7	45.1	44.6	45.7	50.4	55.6	60.1	63.1	64.8	66.0	66.8	67.3	66.3	66.7	65.4	63.9	60.0	56.5	53.9	52.2	51.0	26.6	56.1	56.3	56.4	9.2
SD	6.9	7.2	7.1	7.2	6.5	6.8	7.5	7.8	8.3	9.0	9.7	9.3	9.3	9.2	8.7	8.8	9.4	9.7	9.5	8.7	7.4	7.1	6.9	7.0	5.3	6.9	7.2	7.0	
LV*	5.4	5.1	5.0	4.6	4.6	4.7	5.5	5.7	6.1	6.7	6.6	6.1	6.9	6.9	6.3	6.8	6.9	7.2	7.6	6.9	5.7	5.5	5.4	5.0	4.5	4.0	5.0	4.4	1.9
HI											1	1	1														1		
HI*											2	2	2	2	2												2		

HOURLY TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- CJ EMERY EAST DATA TAPE 1972/1973 TEMPERATURES MAY 1973
A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

HOURS / TEMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
84														1	1										0	0	2	0	2
83													1				1								0	0	2	0	2
82																									0	0	4	0	4
81												1	1	1	1	1		1	1						0	1	9	1	11
80																									0	1	9	1	11
79											1	1	1	1	1	2	1	1							0	3	16	1	20
78														1	1	2									0	3	18	1	22
77										1	2		2	1	3	2	4	2	2						0	6	32	3	41
76												1	2	2		1									0	7	36	3	46
75										1	1	4	2			1	1	1	3	1					0	13	43	7	63
74												1		2			1	1							0	14	48	7	69
73										1	4	2		1	4	2	3	3	1	2					0	21	61	10	92
72														1	3	1	3								0	21	66	10	97
71										2	2	1		3	5	7	4	5	1	2	1	1			0	26	94	15	135
70										2	1		4	1			1								0	28	96	15	139
69										1	1	4	1	1	3			5	5	1					0	35	106	21	162
68												2		1			1	1	1						0	37	109	22	168
67									2	2	2	5		1	1				3	3	3			1	1	48	114	33	195
66										1			2							1					0	43	116	34	193
65									2	1	2	3	3			4		1	3	1		2			0	59	124	40	223
64										3								1							0	56	125	46	224
63																	2		2	6	4			3	1	55	128	56	250
62	1							1		3		2			1						1				1	66	128	57	252
61											1										3	3	4	1	2	74	136	71	283
60	1	2	1				1	2	3	1	1		2	2	1	1	1	1	1	3	1	1			5	76	140	74	297
59		1	1						2		1				1	2	2	1		1	6	2	1	2	7	85	149	86	336
58	2		1	3	1	2			2	4	1	2	2	1	1	1					1	2			16	88	151	90	345
57							1	1	1							2				2	1	3	3	3	21	100	162	102	385
56	1	1		1	2		2	3	3	2	1	1	2	4	3	1		1			1	1	3	3	21	102	163	108	394
55										1		1	1						2			2	2	2	29	114	167	118	426
54	3	3				2	2	3	3		2			1	1	1	1				2	3	2	3	33	115	168	120	436
53		1	2			1	1		1			1			1							3	3	2	44	121	171	128	464
52	4	4	3	4	1			2	1	2	1		1	1				1	1	1	1		1	1	51	123	172	132	478
51		1			1					1			1				1			1		1		2	69	130	173	141	513
50	6	2	3	2	4	1	2	3	1						1			1	1	2				1	70	132	175	145	522
49		1					1		1								1	1	1		2	2	4	2	88	141	177	156	562
48	3	3	5		2	5	3	3	1		1	1					1	2		1	1				94	141	180	158	573
47		1	1	2	2																2	2	1	4	109	152	180	147	588
46	2	1	1	5	2	4	5	3	2	1						1						1			115	155	181	150	619
45		1	3	1	1			1	1		1								1				2		131	153	182	171	647
44	3	2	1	3	4	3	3			1		2	1	1								1			136	157	183	172	658
43		1		2	1	1	1	2		1	1				1										150	169	184	176	679
42	1	1	4	1	3	4	2											1	1	1	1		1	1	152	170	184	177	683
41		1				1		1																	156	174	184	177	691
40			1	1	1	1		2	1	1												1			157	174	184	178	693
39				1																	1	1	1	2	164	178	184	184	710
38	2	1		1	2	1	2	1	1														1	1	164	179	184	185	711
37																									164	180	184	185	713
36	1		1		1	2	2																	1	173	181	184	186	724
35				2	1	1		1																	176	182	184	186	728
34		2	1				1																		176	182	184	186	728
33																									183	183	184	186	736
32	1	1	1	1	2	1	1																		184	183	184	186	737
31			1																						186	184	184	186	740
30				1		1	1																						

HOURLY TEMPERATURE RECORD (RUN NOV 30, 1978): C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES JUN 1973

HOURS / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	S
1	57	56	54	52	51	52	50	52	52	52	54	48	48	52	50	52	52	52	49	49	48	46	46	46	11.0	51.5	49.5	50.9	2
2	46	45	46	46	46	46	46	48	52	55	57	58	59	62	63	61	61	62	60	60	54	52	49	46	18.0	54.0	54.0	53.3	5
3	46	44	44	44	44	43	44	45	48	54	57	57	58	51	59	60	60	58	60	54	51	48	46	43	17.0	51.5	49.2	50.7	6
4	42	42	41	40	39	40	38	43	55	54	59	59	61	62	63	60	61	60	59	53	52	48	45	43	25.0	50.5	51.0	50.9	8
5	40	38	40	38	40	47	53	57	60	63	66	67	69	70	71	72	71	72	69	63	58	57	51	48	34.0	55.0	59.7	57.5	11
6	47	48	49	48	43	46	50	58	64	69	72	75	76	80	81	80	81	80	76	68	65	62	60	57	38.0	62.0	65.0	64.3	12
7	54	52	53	52	53	52	53	64	69	75	79	82	85	82	84	84	85	82	80	75	69	62	61	59	33.0	68.5	68.3	58.6	12
8	58	58	56	57	53	55	56	64	72	78	80	83	84	86	87	87	88	89	86	85	77	70	67	63	36.0	71.0	74.0	72.5	12
9	60	59	56	58	56	52	55	63	70	76	80	84	87	88	89	91	90	87	87	83	79	76	74	73	39.0	71.5	75.3	73.9	13
10	70	70	69	67	68	69	66	66	69	74	78	80	85	85	87	87	87	87	86	84	79	72	69	69	21.0	76.5	77.3	76.0	8
11	69	66	64	65	64	65	64	65	70	71	73	75	76	78	79	79	78	73	70	68	66	64	62	61	18.0	70.0	68.5	63.4	5
12	60	60	58	56	55	50	52	58	64	70	73	75	76	77	78	78	78	78	72	70	62	62	60	60	28.0	64.0	63.2	65.3	9
13	57	54	54	51	54	52	53	56	64	68	72	72	75	73	70	72	71	68	66	60	56	57	55	54	24.0	63.0	59.5	61.8	9
14	52	51	50	50	51	52	53	51	51	50	52	54	59	57	58	57	58	59	56	54	51	50	49	47	12.0	53.0	53.0	53.0	3
15	43	42	41	40	39	40	40	43	47	51	54	52	54	52	51	48	46	46	44	43	40	36	37	37	18.0	45.0	43.0	44.4	5
16	35	35	34	34	31	31	37	42	47	50	52	54	57	59	61	59	60	63	66	64	54	50	47	44	35.0	48.5	51.0	48.6	11
17	42	42	42	38	39	38	43	49	56	61	64	65	67	67	65	66	66	64	61	54	51	49	45	44	29.0	52.5	53.0	53.2	10
18	40	37	35	34	33	34	37	43	47	52	53	55	56	57	58	58	57	56	54	52	49	46	44	44	25.0	45.5	48.0	47.1	8
19	42	40	35	32	35	30	32	39	47	52	54	58	60	62	65	67	67	69	69	65	62	56	54	50	39.0	49.5	54.5	51.7	12.
20	50	46	45	45	42	43	46	51	58	62	66	69	71	72	73	74	75	75	74	72	62	56	56	51	33.0	58.5	60.5	59.7	11.
21	49	50	49	49	42	45	52	58	64	70	73	75	77	79	81	82	81	81	80	78	68	66	58	57	40.0	62.0	66.8	65.2	13.
22	56	52	54	53	51	48	52	57	66	74	76	78	82	82	82	84	85	80	78	72	69	67	65	63	37.0	66.5	68.0	67.8	12
23	60	54	55	52	52	52	55	58	68	75	79	81	81	80	80	81	81	79	78	75	71	67	65	66	29.0	66.5	69.3	68.5	11.
24	64	62	61	61	62	63	68	71	70	73	74	80	82	84	84	84	83	82	79	73	70	67	64	60	24.0	72.0	73.0	71.7	9
25	60	58	61	57	58	63	66	72	76	80	82	84	84	85	87	86	86	84	83	81	74	72	70	66	30.0	72.0	74.8	74.0	10.
26	62	62	60	60	56	57	60	66	72	78	84	86	88	90	90	90	90	88	86	84	77	72	71	68	34.0	73.0	76.0	74.3	12
27	64	62	62	60	60	58	61	66	74	80	84	86	86	88	90	92	92	88	82	80	78	78	74	72	34.0	75.0	76.3	75.7	11.
28	67	68	64	66	66	64	61	65	70	78	83	80	77	78	76	76	78	76	78	76	73	68	65	65	22.0	72.0	71.3	71.6	6.
29	64	60	58	58	57	56	58	60	66	72	78	82	85	88	89	91	90	90	88	86	80	76	70	70	35.0	73.5	76.5	73.8	12.
30	70	68	70	68	68	69	70	70	74	80	83	85	87	89	90	90	90	90	90	88	84	78	74	70	22.0	79.0	81.8	79.0	3.
MN	54.2	52.7	52.0	51.1	50.3	50.5	52.4	56.7	62.1	66.6	69.8	71.4	73.1	73.9	74.8	75.0	75.0	74.0	72.3	69.0	64.4	61.0	58.5	56.6	28.0	62.5	63.7	63.2	10.
SD	10.0	9.3	9.9	10.1	10.3	10.3	9.7	9.4	9.4	10.6	11.1	11.9	11.9	12.4	12.4	12.9	12.9	12.3	12.2	12.4	11.5	11.0	10.4	10.4	9.3	10.2	10.8	10.3	
IV*	4.8	5.3	5.0	5.2	5.4	6.1	5.3	4.5	4.4	4.7	4.9	5.4	6.0	6.7	6.4	6.7	6.7	6.7	6.5	7.1	5.1	5.4	4.9	4.7	7.8	4.1	4.7	4.2	2.
MI																													

HOURLY TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES JUN 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
92																1	1								0	0	2	0	2
91																2									0	0	4	0	4
90														1	3	2	4	2	1						0	0	16	1	17
89														1	2			1							0	0	20	1	21
88													1	3			1	2	1	1					0	0	27	3	30
87													2		3	2	1	2	1						0	0	37	4	41
86												2	1	1		1	1		3	1					0	2	41	8	51
85												1	3	2			2			1					0	3	48	9	60
84											2	2	2	1	2	3		1		2	1				0	7	57	12	76
83											2	1					1		1	1					0	10	58	14	82
82											1	2	2	2	1	1		2	1						0	13	66	15	94
81												1	1		2	1	3	1		1					0	14	74	16	104
80										3	2	3		2	1	1		2	2	1	1				0	22	80	20	122
79											2			1	1	1		1	1		2				0	24	84	23	131
78										3	2	1		2	1	1	3	1	3	1	1	2			0	30	92	30	152
77													2	1							2				0	30	95	32	157
76									1	1	1		3		1	1		1	1	1		2			0	33	101	36	170
75										2		4	1				1	1		2					0	39	104	38	181
74									2	2	1					1			1		1		3		0	44	105	43	192
73										1	3			1	1			1		1	1			1	0	48	108	46	202
72								1	2	1	2	1		1		2		1	1	2		3		1	0	55	112	53	220
71								1		1			1		1		2				1		1		0	57	116	55	228
70	2	1	1				1	1	4	2				1	1				1	1	1	1	2	2	4	65	118	63	250
69	1		1			2			2	1		1	1					1	2		2		1	1	8	69	120	69	266
68		2		1	2		1		1	1								1		2	1	1		1	13	72	121	74	280
67	1			1								1	1	1		1	1					3	1		15	73	125	78	291
66		1		1	1		2	3	2		2					1	1		2		1	1		2	18	82	127	84	311
65				1		1		2				1			2					1	1		3	1	20	85	129	90	324
64	3		2		1	1	1	2	4		1							1		1		1	1		27	93	130	93	343
63						2		1		1					2			1		1				2	29	95	133	96	353
62	1	3	1		1					1				3				1			3	3	1		35	96	137	103	371
61			2	1			2			1			1		1	1	2		1				1	1	38	99	142	106	385
60	4	2	1	2	1		1	1	1				1			2	2	1	2	2			2	2	48	102	148	114	412
59		1									1	1	2	1	1	1		1	1					1	49	104	154	116	423
58	1	2	2	2	1	1	1	4	1			2	1		2	1	1	1			1		1		58	112	160	118	448
57	2			2	1	1		2			2	1	1	2		1	1					2		2	64	117	165	122	468
56	1	1	2	1	2	1	1	1	1				1					1	1		1	2	1		72	120	167	127	486
55			1		1	1	2		1	1		1											1		75	125	167	128	495
54	1	2	3		1					2	3	2	1						1	3	2		1	1	82	132	168	136	518
53			1	1	2		4				1									1					86	137	168	137	528
52	1	2		3	1	6	3	1	2	3	2	1		2		1	1	1		1	1	1			99	149	173	140	561
51		1		1	3			2	1	1				1	1						3		1	1	104	153	175	145	577
50	1	1	1	1		1	2			2					1							2		1	109	157	176	148	590
49	1		2	1				1											1	1	1	1	2		113	158	176	154	601
48		1		1		1		1	1			1	1			1					1	2		1	116	161	178	158	613
47	1					1			4														1	1	118	165	178	160	621
46	2	1	1	1	1	2	2										1	1				2	2	2	126	167	180	166	639
45		1	1	1		1		1															2		130	168	180	168	646
44		1	1	1	1		1												1				1	3	134	169	180	173	656
43	1				1	2	1	3												1				2	138	173	180	176	667
42	3	3	1		2			1																	147	174	180	176	677
41			2																						149	174	180	176	679
40	2	1	1	2	1	2	1														1				158	175	180	177	690
39					3			1																	161	176	180	177	694
38		1		2		1	1																		165	177	180	177	699
37		1					2																1	1	166	179	180	179	704
36																						1			166	179	180	180	705
35	1	1	2		1																				171	179	180	180	710
34			1	2		1																			175	179	180	180	714
33					1																				176	179	180	180	715
32				1			1																		177	180	180	180	717
31					1	1																			179	180	180	180	719
30						1																			180	180	180	180	720

Y TEMPERATURE RECORD (RUN NOV 30, 1978): C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES JLY 1973

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	SH	MN	SD
68	66	66	66	66	63	64	65	69	76	79	79	80	82	86	88	88	87	85	83	80	76	70	68	25.0	75.5	76.5	75.0	8.5
66	63	62	60	62	58	56	56	58	76	84	86	87	90	90	88	90	86	82	78	75	72	68	66	34.0	73.0	74.0	73.3	12.1
64	64	62	60	56	58	60	66	84	83	88	90	93	90	88	96	88	88	88	86	78	76	72	68	37.0	74.5	76.5	76.7	[illegible]
67	61	64	64	60	60	51	68	74	84	87	91	92	94	94	94	94	90	88	85	78	74	70	70	34.0	77.0	77.8	77.7	12.
66	63	58	60	60	60	63	66	73	78	86	90	94	95	95	95	94	94	92	88	83	78	76	76	37.0	76.5	81.0	78.5	13.6
74	70	70	73	72	70	68	69	75	86	90	88	88	92	92	92	92	90	85	84	80	75	76	72	24.0	80.0	80.0	80.1	8.7
72	70	71	70	68	69	70	74	76	80	83	84	87	88	87	82	77	80	77	75	75	71	66	64	24.0	76.0	77.0	75.7	6.8
63	63	60	58	56	58	58	58	65	70	74	79	78	70	70	68	74	76	80	74	75	71	68	65	24.0	58.0	69.5	67.7	7.5
62	60	61	60	56	54	52	54	62	70	84	86	90	90	90	92	90	86	82	80	74	70	58	68	40.0	72.0	72.5	72.5	13.5
66	66	64	62	58	58	58	68	74	83	85	87	89	90	90	92	90	90	90	84	80	76	70	68	34.0	75.0	77.0	76.6	11.9
64	64	61	60	62	62	63	70	78	80	82	84	84	82	80	82	80	76	74	72	70	68	70	68	24.0	72.0	71.3	72.3	8.0
68	68	68	68	66	66	66	60	62	66	68	72	72	72	78	78	76	76	72	71	68	68	68	66	18.0	59.0	68.5	69.3	4.5
66	65	64	64	64	64	64	64	64	66	76	78	78	80	80	82	80	78	78	72	68	60	58	58	24.0	70.0	70.0	69.6	7.7
56	56	58	56	54	54	58	60	65	68	72	75	76	76	78	78	80	80	82	78	70	66	66	54	28.0	58.0	69.5	67.3	9.7
53	52	52	52	52	52	52	58	63	68	70	74	77	76	81	82	84	84	82	80	75	72	68	64	32.0	68.0	69.5	67.6	11.8
66	63	60	56	56	56	56	56	59	74	78	80	82	84	84	84	84	82	80	77	72	70	66	66	29.0	70.0	71.0	70.5	10.6
63	64	60	58	57	56	60	68	72	78	80	84	65	68	72	70	70	70	70	68	66	63	62	60	28.0	70.0	65.0	66.8	7.0
59	57	56	55	55	56	54	64	68	70	73	76	78	76	66	58	60	60	50	60	58	58	58	58	24.0	66.0	61.5	62.2	7.2
57	57	57	57	56	55	57	60	67	68	61	58	65	70	65	62	64	66	69	65	62	58	58	58	15.0	62.5	52.7	61.3	4.5
52	56	54	52	50	48	50	56	60	66	68	71	73	72	72	72	73	71	68	56	58	55	55	54	25.0	60.5	59.5	60.9	8.7
55	52	50	48	48	48	46	54	59	64	68	70	73	76	77	72	76	76	78	75	65	62	63	58	32.0	62.0	63.0	63.0	10.7
58	58	54	50	51	50	50	56	62	68	70	72	70	60	70	76	72	72	71	69	64	62	60	56	26.0	63.0	59.5	62.5	8.1
56	54	52	51	50	48	48	52	58	64	69						76	77	76	70	64	61	60	58	29.0	62.5	0.0	60.2	9.6
58	56	55	52	52	50	53	60	69	72	75	78	81	84	82	82	80	80	77	74	71	68	66	62	34.0	67.0	63.8	68.3	11.2
60	58	55	55																					5.0	57.5	0.0	57.0	2.1
							63	70	75	78	80	82	84	86	84	84	84	80	74	68	68	64	62	24.0	74.0	0.0	75.6	8.1
62	64	64	61	62	62	62	62	67	72	78	78	76	74	82	76	71	72	72	69	62	62	58	56	25.0	69.0	65.0	67.7	7.1
55	54	52	53	54	54	53	56	62	70	75	80	82	82	75	76	78	82	80	74	70	64	62	60	30.0	67.0	68.8	66.3	11.0
59	59	59	56	57	55	56	59	64	70	75	80	82	80	66	76	82	76	83	72	63	57	56	56	23.0	69.0	65.5	66.6	10.1
55	54	55	53	54	53	54	56	60	66	73	75	87	79	82	84	82	82	77	80	84	68	68	64	34.0	70.0	75.3	68.5	12.0
62	59	58	56	58	58	56	56	58	64	72	76	81	84	84	80	80	85	82	78	78	71	68	66	29.0	70.5	74.0	69.6	10.5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	SH	MN	SD
61.7	60.5	59.5	58.2	57.7	57.1	57.6	61.2	66.6	72.6	75.8	79.4	80.8	80.7	80.8	80.6	80.4	79.9	78.7	75.1	71.2	67.4	65.3	63.0	27.7	69.6	70.4	69.3	9.7
5.5	5.0	5.4	5.9	5.7	5.8	5.9	5.6	6.7	6.4	7.0	7.1	7.6	8.4	8.4	9.1	8.3	7.6	7.0	7.3	7.1	6.3	5.5	5.5	6.9	5.3	6.0	5.3	
4.1	4.1	4.3	4.1	3.9	3.5	4.6	5.1	5.9	4.3	4.5	4.6	5.9	6.7	5.9	5.6	5.1	5.3	5.5	5.3	4.8	4.1	3.9	3.6	6.5	3.1	3.3	3.6	2.5
1	1	1	1	2	2	2	1	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1			3		
2	2	2	2	3	3	3	2	2	2	2	4	4	4	4	4	2	2	2	2	2	2	2	2			5		

TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES JLY 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
													1	1	1									0	0	3	0	3
												1	1	1	1	2	1							0	0	10	0	10
												1												0	0	11	0	11
												1	1	1	3	1		1						0	0	18	1	19
											1													0	1	18	1	20
										1	2	1	4	3	1	3	3	1						0	4	33	2	39
												1												0	4	34	2	40
										1	1	1	1	1	2	2	1	2	1					0	6	42	5	53
										1	1	3		1			1							0	8	47	5	60
									1	1	2			2			2		1					0	12	51	6	69
										1							1	2	1					0	13	52	9	74
								1	1	2	3	1	4	2	3	3	2		2	1				0	20	67	12	99
									2	1								1	1	1				0	23	67	15	105
										1		4	3	3	5	2	3	5						0	24	87	20	131
												2		1										0	24	90	20	134
									2	1	4	1	2	2	1	5	3	4	3	3				0	31	104	30	165
										1	2		1											0	34	105	30	169
								1	2	3	3	3		2	2	1	1	2	3	3	1			0	43	114	39	196
												1		1		1	1	3	1					0	43	118	43	204
								1	2	3	2	2	4		4	3	5	1			3	2	1	0	51	136	50	237
								1	1	1	2			1					2	4	1			0	56	137	57	250
1							1	2	1	1	1		1			1		1	4	1	1			1	62	139	64	266
			1					1		2		2				1								2	65	142	64	273
1				1				1	2	2	2	1	2	2	2	1	2	2	3	1	2	1	1	4	72	152	74	302
		1									1					1	1	1	1	1	3			5	73	154	80	312
	2	1	1		1	1	1	1	5	2	1	1	2	2	1	1	1	1	1	3	2	4	1	10	84	162	92	348
					1		1	2		1								1	2					11	88	162	95	356
2	1	1	1	1		1	3	1	4	3			1		1			1	1	3	5	7	5	17	100	164	117	398
1								2																18	102	164	117	401
5	2	1	1	2	1	1	2		4					2			1			1	1	4	4	30	109	167	127	433
	1						1	2				2		1					1	1			1	31	112	170	130	443
2	4	4	2	1	1	2	2	2	3							1				2	1	1	3	45	121	171	137	474
1	3				1	2	1	1												1	1	1		50	125	171	140	486
3		2	1	3	2	1	1	4							1					2	3	2	2	61	131	172	149	513
	1	2	1			1				1											1			65	133	172	150	520
2	2	3	5	2	2	2	4	2					1			1	1	1	1		1	2	2	81	141	175	157	554
2	2	1					1	2																86	144	175	157	562
2	2	3	2	2	5	3	2	3			1				1					2	2	4	5	102	153	176	170	601
1	2	1	1	2		1															1			109	154	176	171	610
2	3	1	4	5	3	4	7												1			1	3	127	165	176	176	644
3		3	2	1	2																1	1		138	165	176	178	657
	3	2		3	3	2	2																2	149	169	176	180	674
1			2		1	2																		153	171	176	180	680
1	2	3	3	2	1	2	1																	165	174	176	180	695
			1	1																				167	174	176	180	697
		1	1	2	2	2																		173	176	176	180	705
																								173	176	176	180	705
			1	1	3	1																		178	177	176	180	711
																								178	177	176	180	711
						1																		178	178	176	180	712

HOURLY TEMPERATURE RECORD (RUN NOV 30, 1978): C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES AUG 1973

HOURS DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	SD
1	62	58	60	56	59	57	55	54	62	68	74	80	84	86	87	88	84	86	79	84	82	74	69	67	34.0	71.0	76.3	71.5	11.
2	62	60	58	60	60	58	60	56	56	62	70	78	83	85	88	90	89	92	88	83	82	79	73	67	36.0	74.0	77.3	72.5	12.
3	68	54	62	60	59	60	59	60	60	66	74	74	78	82	85	86	81	76	76	77	74	72	70	68	27.0	72.5	72.3	70.5	8.
4	68	54	64	63	60	60	62	63	65	64	66	58	71	74	76	77	79	58	68	69	70	64	64	64	21.0	68.5	69.0	66.7	5.
5	63	60	58	58	58	59	58	57	57	60	64	68	73	74	72	68	65	70	70	68	67	68	64	60	17.0	65.5	66.5	64.1	5.
6	63	62	60	58	57	56	56	57	66	70	73	74	74	76	74	78	75	72	67	64	64	60	62	60	22.0	67.0	65.0	65.6	7.
7	58	56	56	56	56	55	56	62	66	70	72	78	76	66	77	79	80	80	76	70	66	60	59	60	25.0	67.5	63.5	66.3	9.
8	58	58	58	62	65	65	56	64	68	77	82	82	86	86	85	85	84	82	78	70	70	64	62	60	30.0	71.0	70.5	71.1	10.
9	56	58	56	57	56	56	56	65	70	76	82	84	87	88	88	89	89	87	81	78	70	66	68	65	33.0	72.5	71.0	72.0	12.
10	65	65	64	65	66	64	63	68	75	80	86	80	92	89	92	90	89	88	85	80	75	74	72	72	29.0	77.5	75.5	76.6	10.1
11	70	68	66	65	64	64	56	72	75	76	80	85	86	88	90	89	88	87	84	81	74	72	71	66	26.0	77.0	75.5	76.1	9.0
12	66	65	62	60	62	56	54	58	66	73	80	86	87	88	90	89	90	90	87	83	80	76	70	67	36.0	72.0	75.5	74.4	12.2
13	65	65	67	65	64	63	62	59	70	76	83	84	88	88	87	86	84	82	80	76	72	71	72	72	29.0	73.5	73.5	74.2	9.2
14	66	66	65	64	62	63	63	66	70	79	82	86	88	87	86	81	79	79	80	74	71	67	60	63	26.0	75.0	73.0	73.0	8.8
15	63	64	62	58	59	56	58	66	69	76	82	84	85	87	87	87	88	80	80	74	69	66	62	63	32.0	72.0	70.8	71.3	10.8
16	62	59	56	57	55	55	53	60	70	76	76	80	76	72	70	67	68	69	67	67	68	66	64	64	27.0	66.5	65.3	65.7	7.3
17	60	59	56	56	56	55	53	57	63	65	69	71	77	79	79	69	67	72	74	73	69	67	64	61	26.0	66.0	67.5	65.5	7.8
18	60	59	59	60	56	55	52	53	60	65	70	73	74	71	76	78	78	80	76	73	69	66	65	62	28.0	66.0	65.3	66.3	5.4
19	65	63	60	58	56	56	53	53	59	66	73	77	80	82	83	84	86	77	80	81	84	70	65	66	33.0	69.5	75.8	69.3	10.9
20	63	70	65	64	61	60	59	57	64	78	81	83	84	83	83	83	86	78	74	73	60	57	59	58	29.0	71.5	65.5	70.1	10.3
21	57	57	55	54	54	55	55	58	63	68	71	72	75	59	60	67	60	61	60	57	55	54	54	52	23.0	63.5	56.0	53.7	6.3
22	51	49	50	50	50	49	51	58	63	67	71	72	70	76	73	76	74	75	71	68	66	63	60	61	27.0	62.5	64.8	63.1	9.7

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	RG	MR	3H	MN	SD
MN	62.2	61.4	60.0	59.4	58.9	58.1	57.3	60.2	65.4	70.9	75.6	78.2	80.7	80.3	81.3	81.2	80.2	78.3	76.5	73.8	70.8	67.1	65.3	63.6	28.0	70.1	69.8	69.4	9.5
SD	4.4	4.6	4.2	3.9	3.9	3.9	4.0	4.9	5.1	5.9	6.0	5.7	6.3	8.1	7.9	7.6	8.5	8.6	6.9	6.7	6.9	6.0	4.9	4.5	4.8	4.1	5.4	4.4	
IV*	2.9	3.4	3.6	3.5	3.1	3.4	3.3	3.3	3.5	4.2	4.0	3.8	3.9	6.1	5.4	6.0	7.3	6.5	5.6	5.0	4.9	4.4	3.0	3.4	4.6	2.5	3.8	2.4	2.8
MI																													

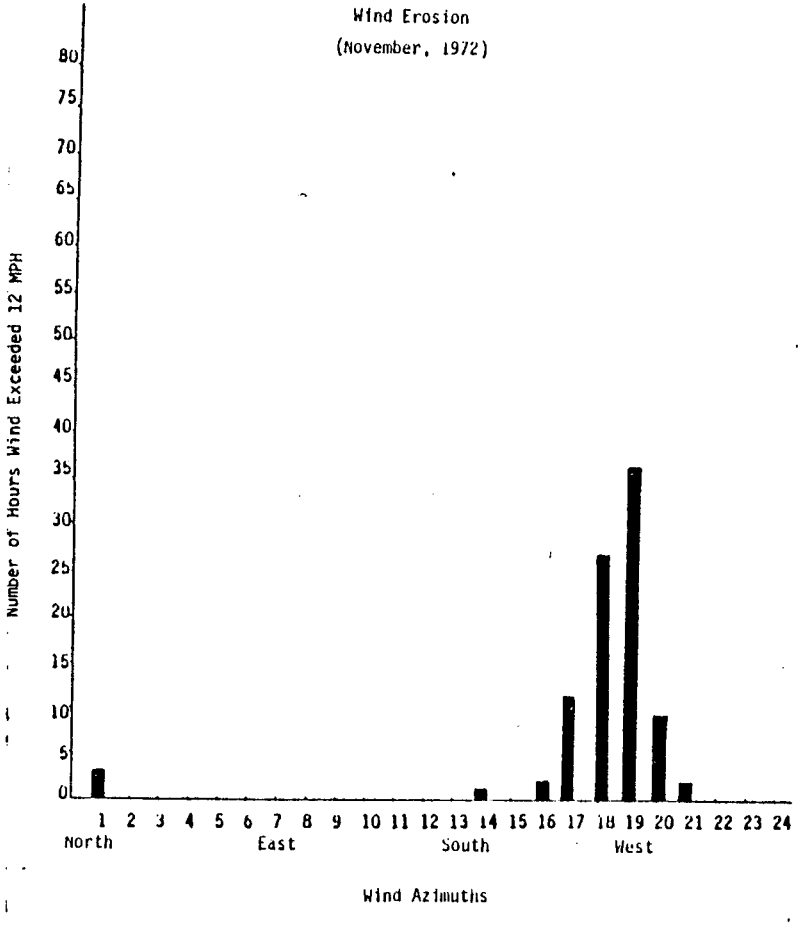
HOURLY TEMPERATURE FREQUENCIES (RUN NOV 30, 1978)- C3 EMERY EAST DATA TAPE 1972/1973 TEMPERATURES AUG 1973

A= 0100-0600, B= 0700-1200, C= 1300-1800, D= 1900-2400

HRS TEMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	B	C	D	TOT
92													1		1			1							0	0	3	0	3
91																									0	0	3	0	3
90															2	2	1	1							0	0	9	0	9
89														1		3	3								0	0	16	0	16
88													2	4	2	1	2	1	1						0	0	28	1	29
87													2	2	3	1		2	1						0	0	38	2	40
86											1	2	2	2	1	2	2	1							0	3	48	2	53
85												1	1	1	2	1			1						0	4	53	3	60
84												3	2			1	3		1	1	1				0	7	59	6	72
83											1	1	1	1	2	1				2					0	9	64	8	81
82											4	1		2				2			2				0	14	68	10	92
81											1					1	1		1	2					0	15	70	13	98
80										1	2	3	1				1	3	4	1	1				0	21	75	19	115
79										1				1	1	1	2	1	1			1			0	22	81	21	124
78										1		2	1			2	1	1	1	1					0	25	86	23	134
77										1		1	1		1	1		1		1					0	27	90	24	141
76										5	1		2	2	2	1		1	3	1		1			0	33	98	29	160
75									2				1				1	1			1				0	35	101	30	166
74											2	2	2	2	1		1		2	2	2	2			0	39	107	38	184
73										1	2	1	1		1					3			1		0	43	109	42	194
72								1			1	2		1	1			2			1	2	2	2	0	47	113	49	209
71											2	1	1	1					1		1	1	1		0	50	115	53	219
70	1	1							4	2	2		1		1			1	1	2	3	1	2		2	58	118	62	240
69									1		1					1		1		1	3		1		2	60	120	67	249
68	2	1						1	1	2		2				1	1		1	2	1	1	1	1	5	66	122	74	267
67			1							1						2	1		2	1	1	2		3	6	67	125	83	281
66	2	1	1		1		1	2	3	2	1			1							2	4	1	2	11	76	126	92	305
65	3	3	2	3	1	1		1	1	2							1						2	1	24	80	127	95	326
64		3	2	2	2	2		1	1	1	1									1	1	2	4	2	35	84	127	105	351
63	3	1		1		2	2	1	3													1		2	42	90	127	108	367
62	3	1	3	1	2		2	1	1	1													3	1	52	95	127	112	386
61					1													1						2	53	95	128	114	390
60	3	2	3	4	2	3	1	2	2	1					1		1		1		1	2	2	4	70	101	130	123	424
59		3	1		3	1	2	1	1														2		78	105	131	125	439
58	2	3	3	4	1	1	2	3										1						1	92	110	132	126	460
57	1	1		2	1	1		4	1											1		1			98	115	132	128	473
56	1	1	4	3	5	5	4	1	1																117	121	132	128	498
55			1		1	5	2														1				124	123	132	129	508
54				1	1		1	1														1	1		126	125	132	131	514
53							3	2																	126	130	132	131	519
52							1																	1	126	131	132	132	521
51	1						1																		127	132	132	132	523
50			1	1	1																				130	132	132	132	526
49		1				1																			132	132	132	132	528

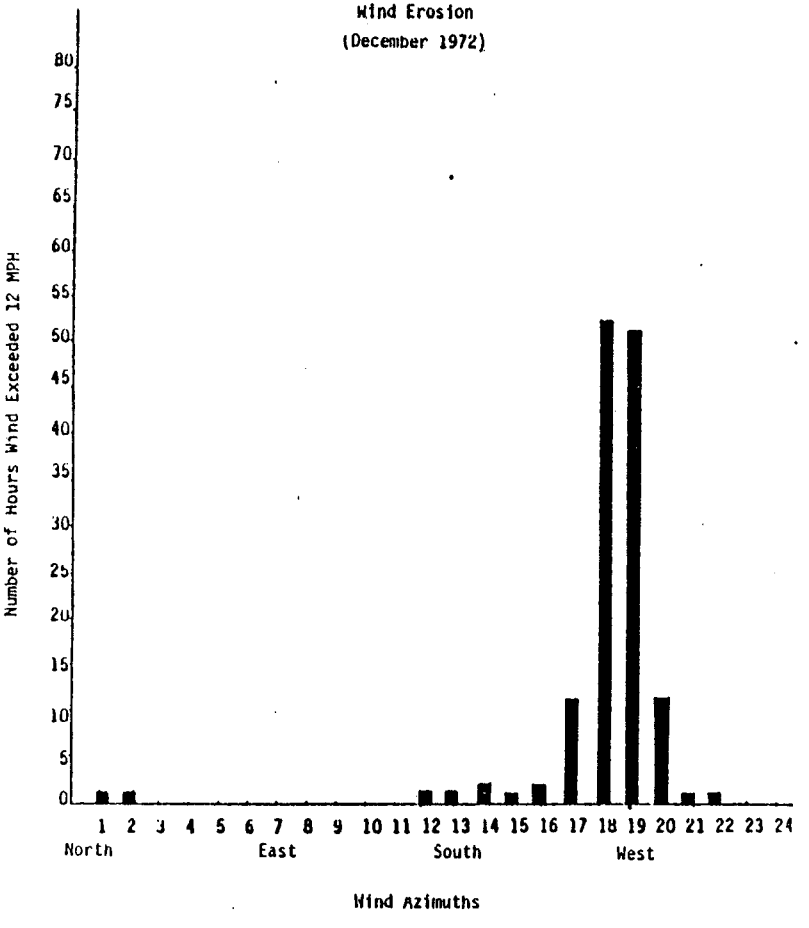
APPENDIX 6

Wind Erosion



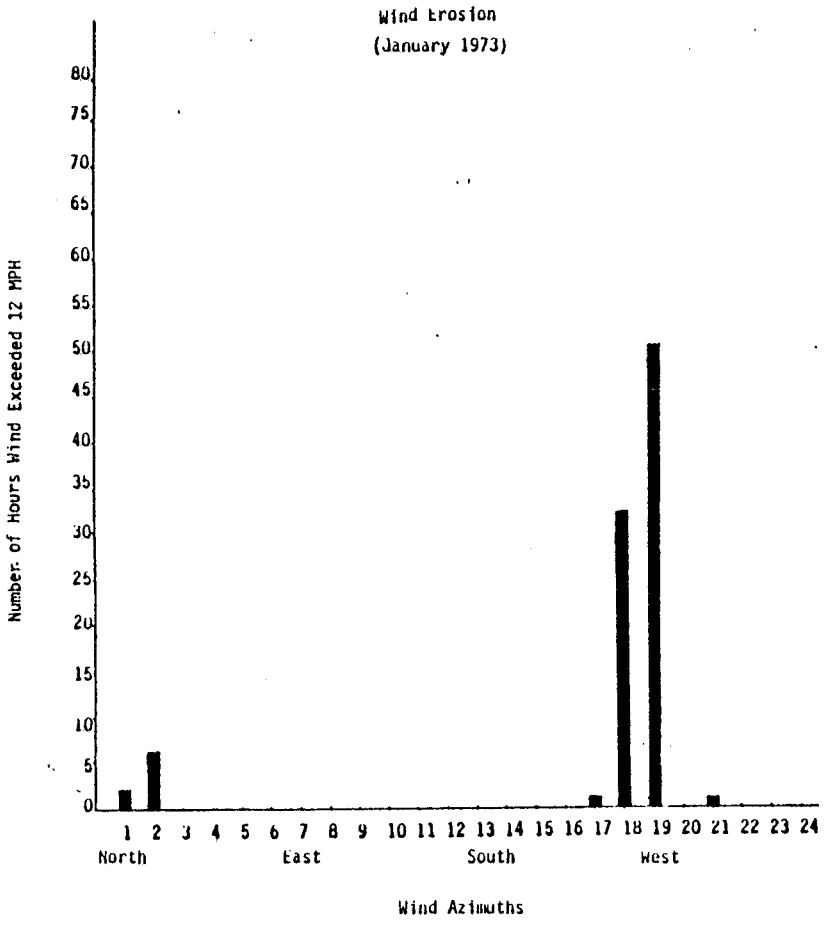
Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
4 = 45-60	12 = 165-180	20 = 285-300
5 = 60-75	13 = 180-195	21 = 300-315
6 = 75-90	14 = 195-210	22 = 315-330
7 = 90-105	15 = 210-225	23 = 330-345
8 = 105-120	16 = 225-240	24 = 345-360



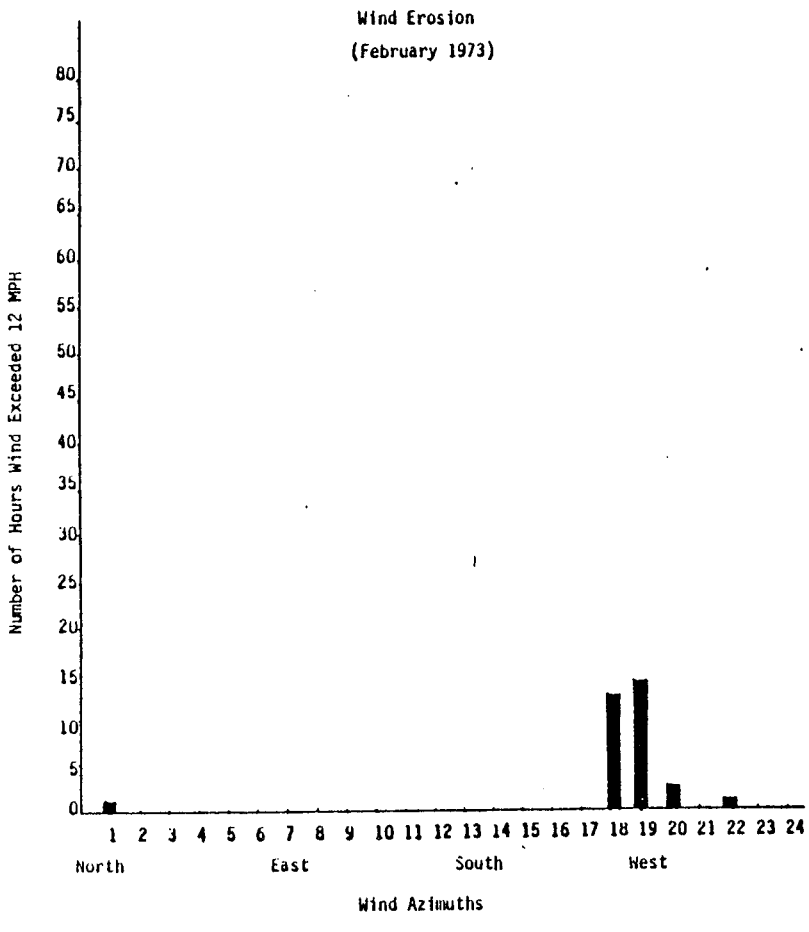
Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
4 = 45-60	12 = 165-180	20 = 285-300
5 = 60-75	13 = 180-195	21 = 300-315
6 = 75-90	14 = 195-210	22 = 315-330
7 = 90-105	15 = 210-225	23 = 330-345
8 = 105-120	16 = 225-240	24 = 345-360



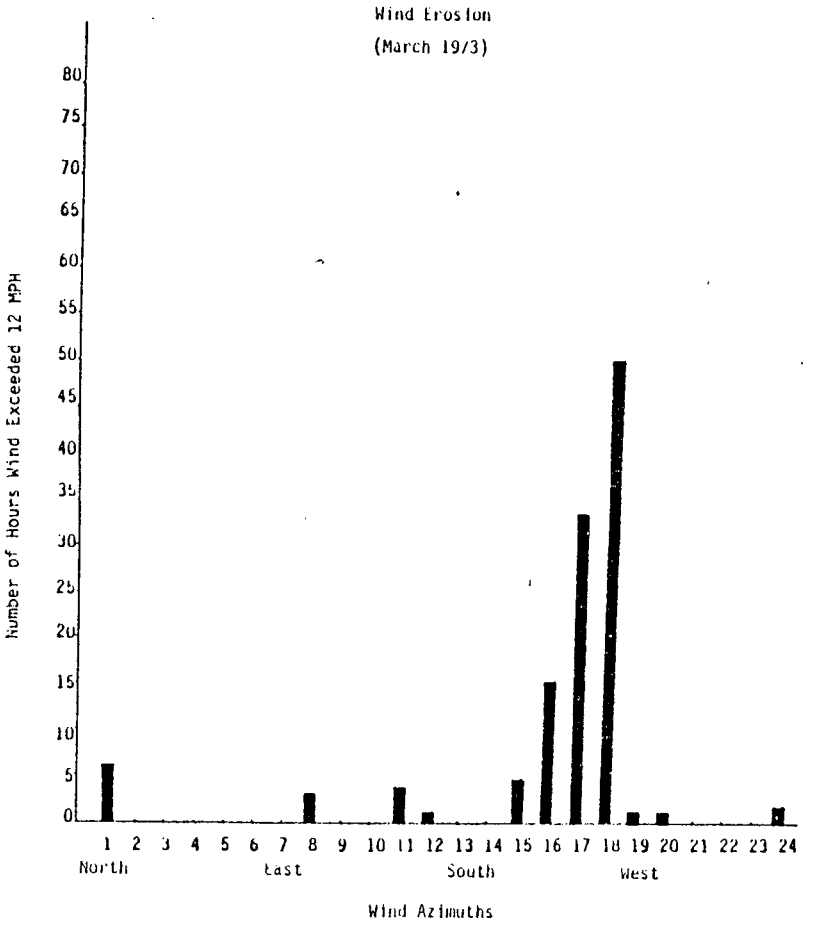
Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
4 = 45-60	12 = 165-180	20 = 285-300
5 = 60-75	13 = 180-195	21 = 300-315
6 = 75-90	14 = 195-210	22 = 315-330
7 = 90-105	15 = 210-225	23 = 330-345
8 = 105-120	16 = 225-240	24 = 345-360



Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
4 = 45-60	12 = 165-180	20 = 285-300
5 = 60-75	13 = 180-195	21 = 300-315
6 = 75-90	14 = 195-210	22 = 315-330
7 = 90-105	15 = 210-225	23 = 330-345
8 = 105-120	16 = 225-240	24 = 345-360



Azimuth Intervals:

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2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
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7 = 90-105	15 = 210-225	23 = 330-345
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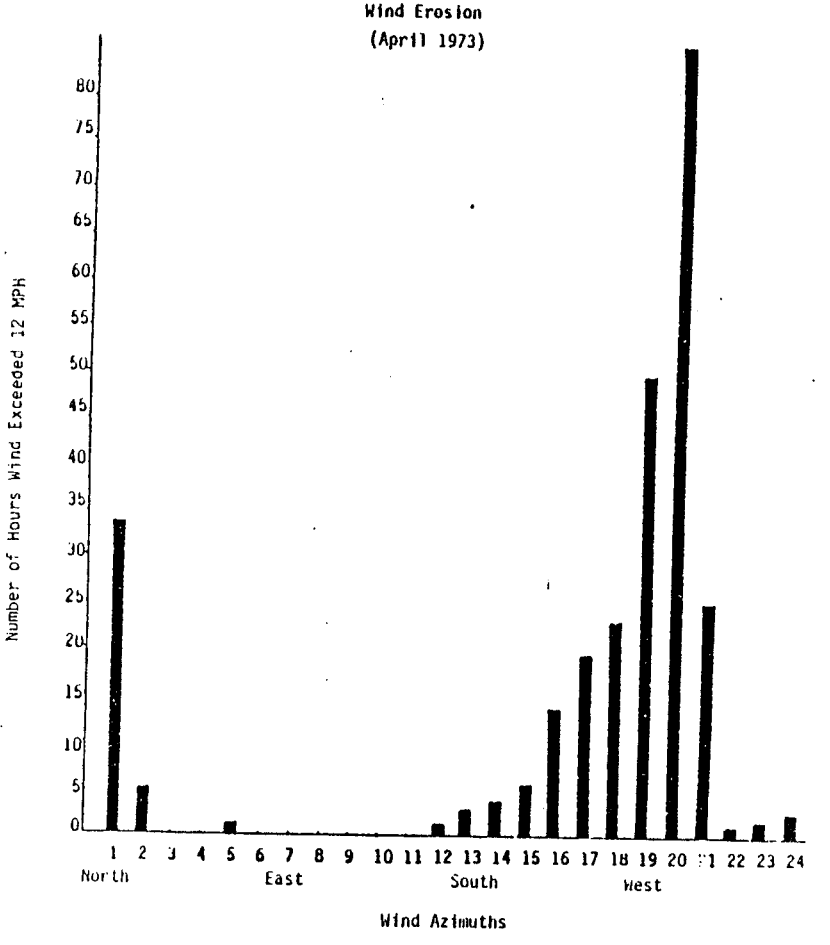

Azimuth Intervals:

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2 = 15-30	10 = 135-150	18 = 255-270
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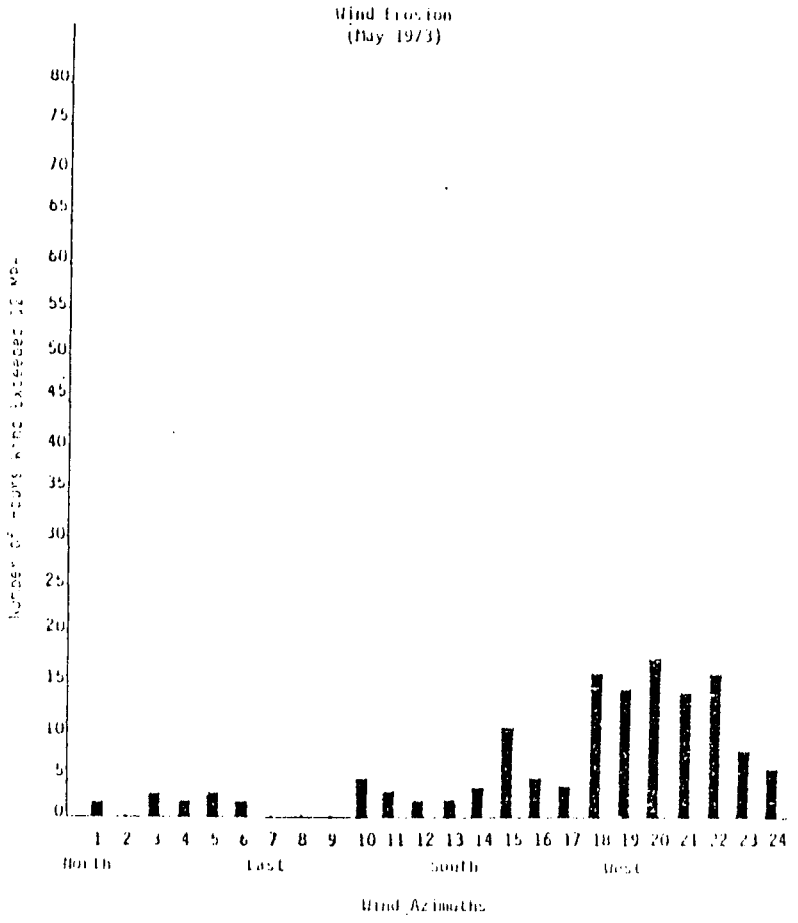

Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
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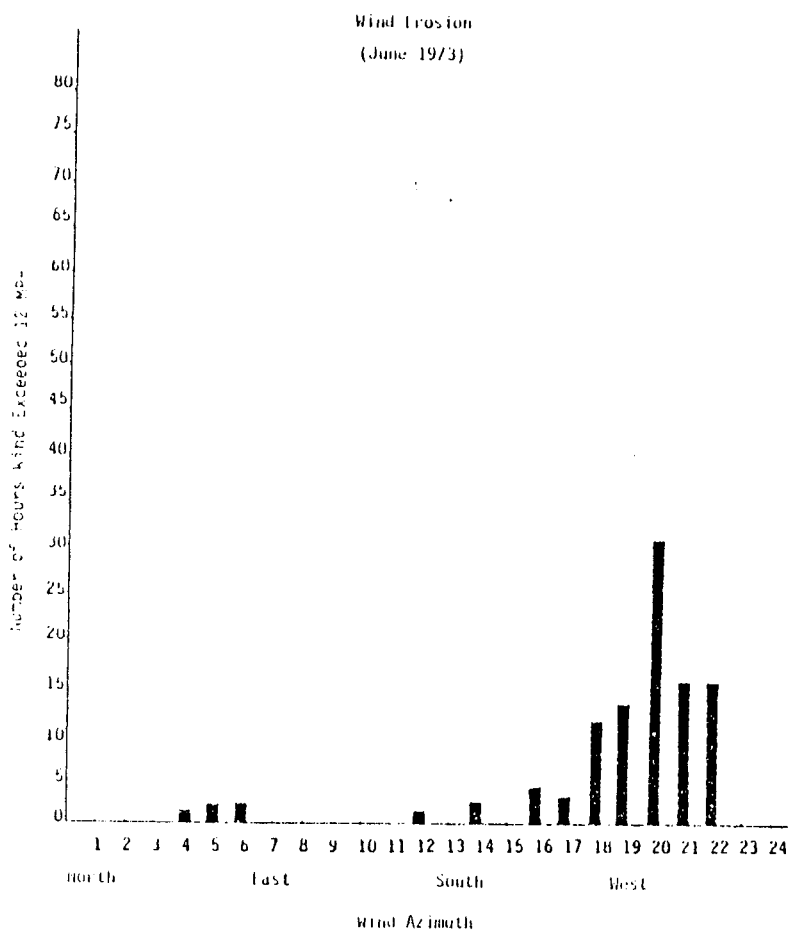

Azimuth Intervals:

1 = 0-15	9 = 120-135	17 = 240-255
2 = 15-30	10 = 135-150	18 = 255-270
3 = 30-45	11 = 150-165	19 = 270-285
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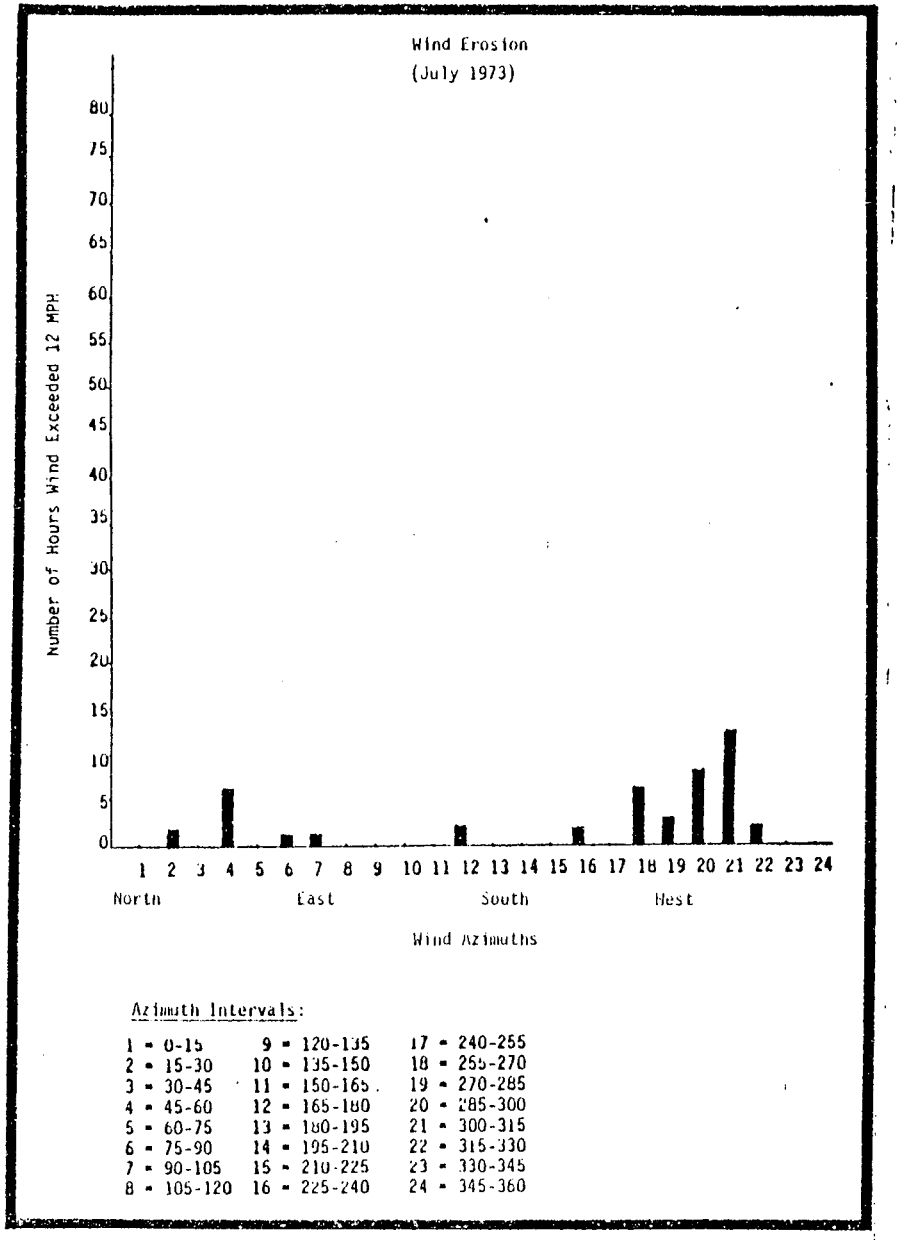
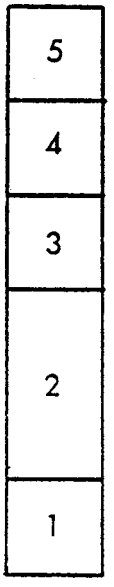

Wind Erosion
(July 1973)
Number of Hours Wind Exceeded 12 MPH
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
North
East
South
West
Wind Azimuths
Azimuth Intervals:
1 = 0-15
2 = 15-30
3 = 30-45
4 = 45-60
5 = 60-75
6 = 75-90
7 = 90-105
8 = 105-120
9 = 120-135
10 = 135-150
11 = 150-165
12 = 165-180
13 = 180-195
14 = 195-210
15 = 210-225
16 = 225-240
17 = 240-255
18 = 255-270
19 = 270-285
20 = 285-300
21 = 300-315
22 = 315-330
23 = 330-345
24 = 345-360

APPENDIX 7

Laboratory Analysis of Bore holes #3 Through #6

Key to Lithologic Correlations



5 — Ash - (burned coal) thickness exaggerated

4 — Delta Front / Marine Sequences - laterally continuous, primarily sandstone, minor siltstone, (clyst) claystone

3 — Coal (identified according to letter scheme of Lupton, 1916)

2 — Alluvial and Delta Plain - rocks undivided: sandstone, siltstone, (clyst) claystone; lateral variation great, unpredictable, particularly in alluvial rocks.

1 — Marine Sandstone

Abbreviations:

Sat. pH = Saturation Acidity - Alkalinity

Sat. Cond. = Saturation Conductivity

meq/l SAR = Sodium Absorption Ratio in millequivalents per liter

% O.M. = Percentage of Organic Matter

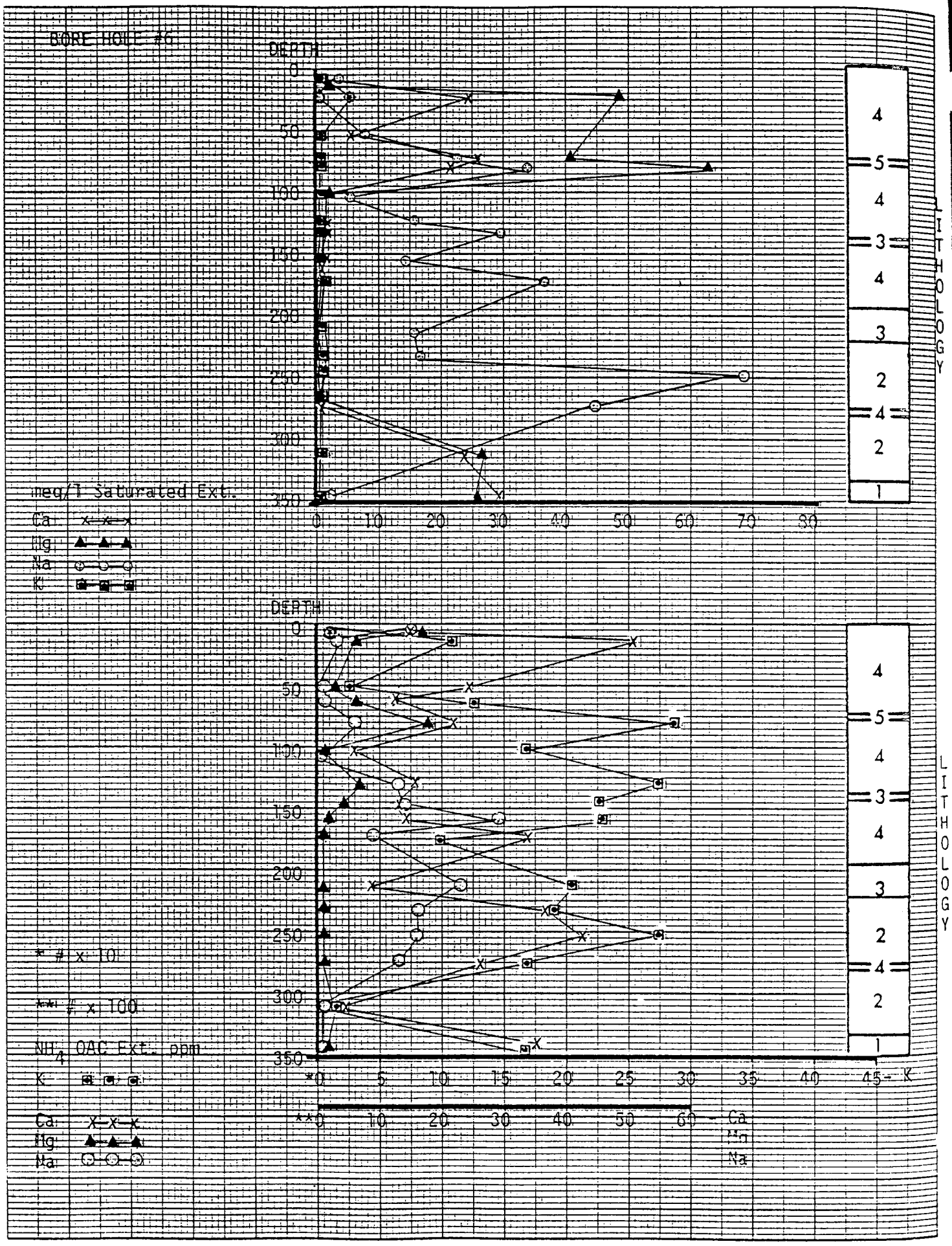
meq/100g C.E.C. = Cation Exchange Capacities in millequivalents per 100 grams

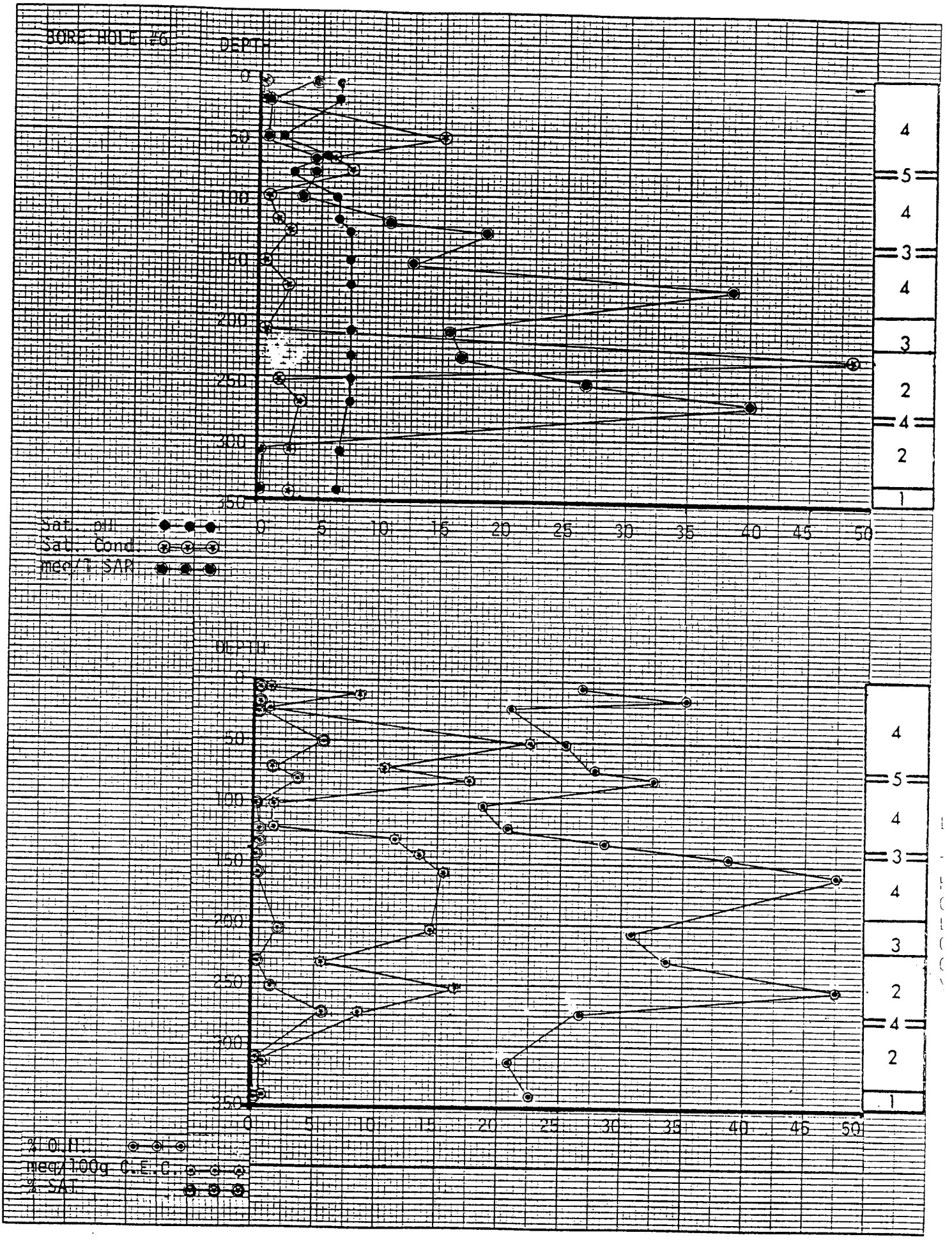
% Sat. = Percent Saturation

DTPA Ext. ppm = Diethylenetriamine pentaacetic acid extract in parts per million

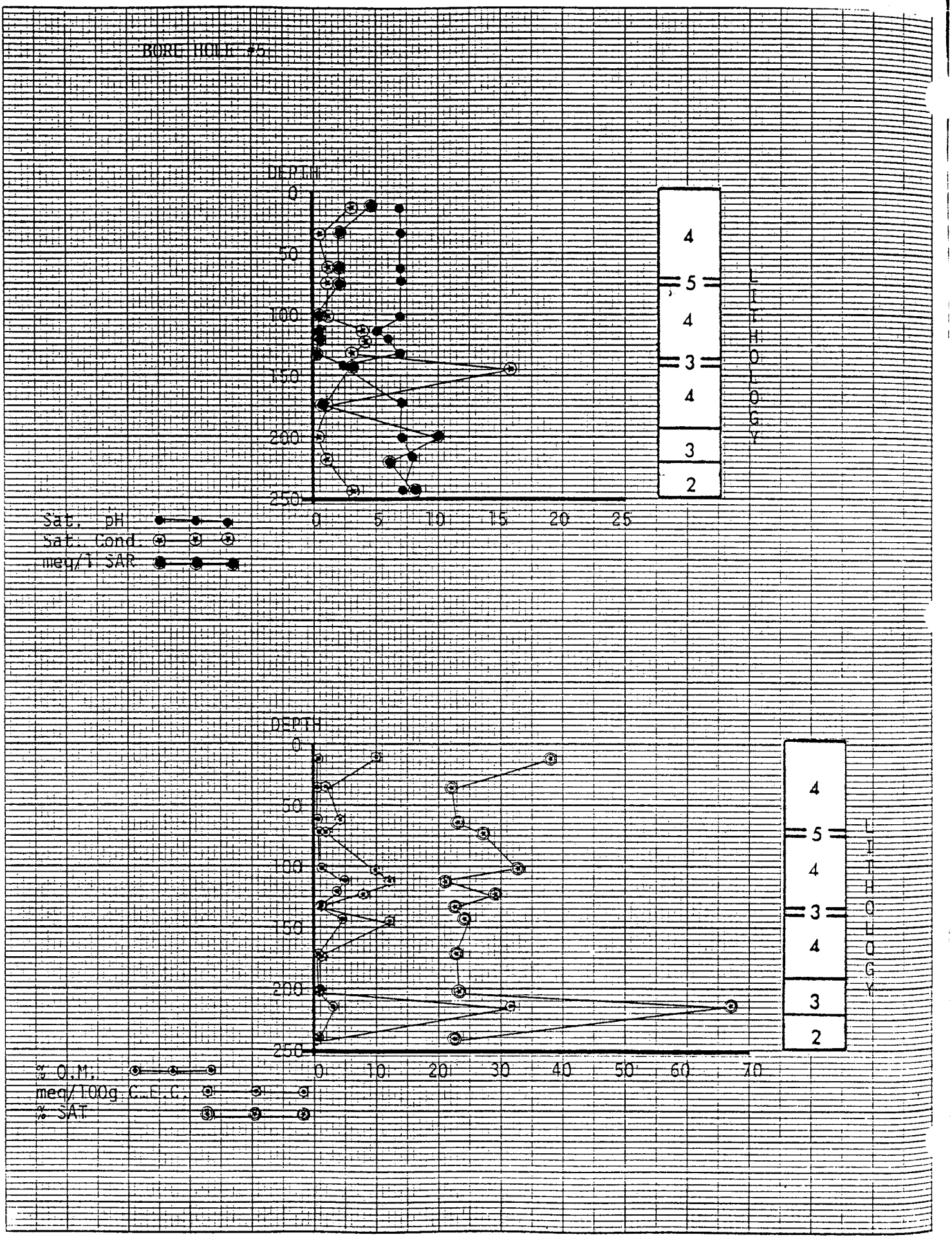
meq/l Sat. Ext. = Saturation Extract in millequivalents per liter

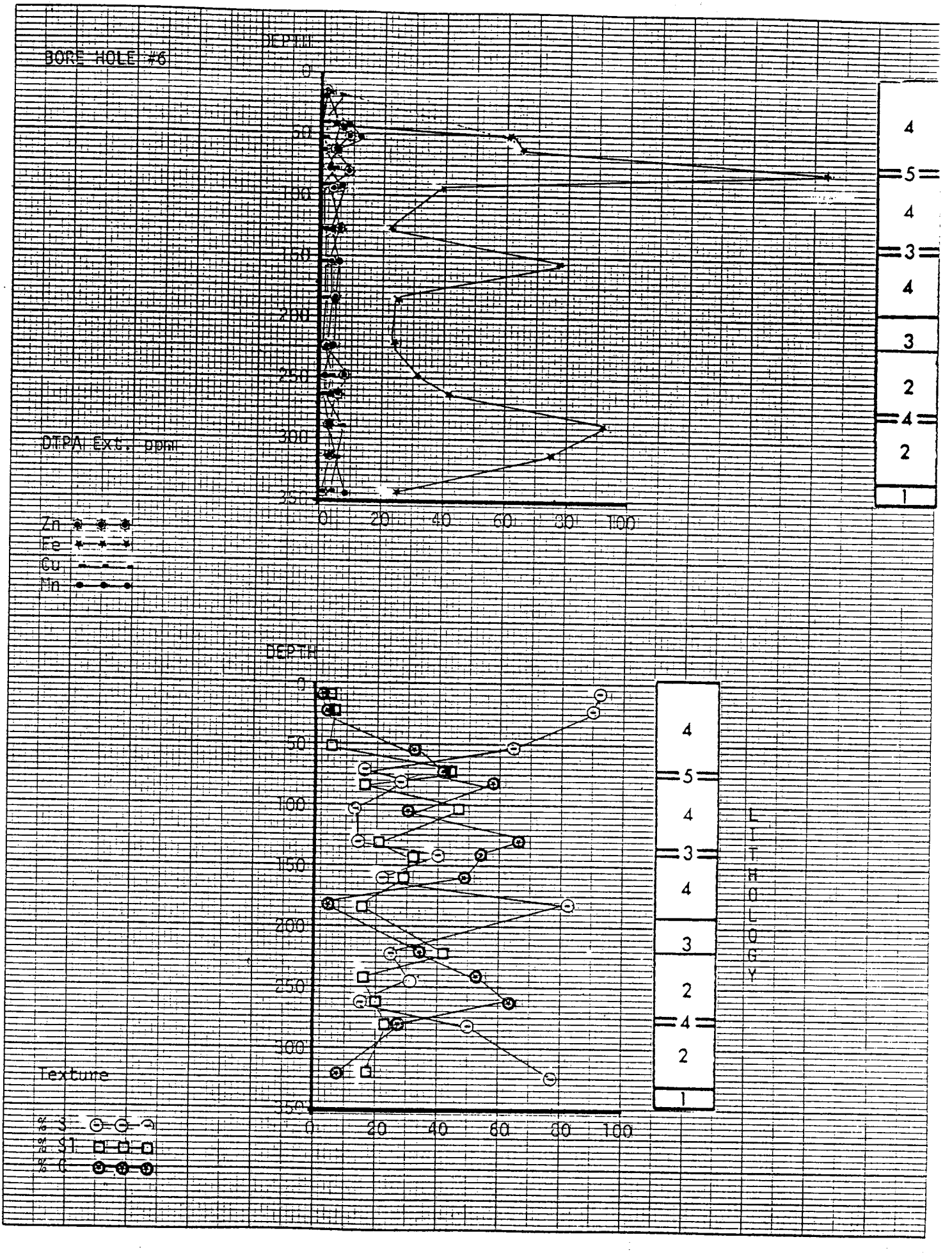
NH_4 OAC Ext. ppm = Ammonium Acetate extract in parts per million


BORE HOLE #6
DEPTH
0
50
100
150
200
250
300
350
meq/l Saturated Ext.
Ca
Mg
Na
K
0 10 20 30 40 50 60 70 80
4
5
4
3
4
3
2
4
2
1
LITHOLOGY
DEPTH
0
50
100
150
200
250
300
350
* # x 10
** # x 100
NH4 OAC Ext. ppm
K
*0 5 10 15 20 25 30 35 40 45 K
Ca
Mg
Na
**0 10 20 30 40 50 60 Ca
Mg
Na
4
5
4
3
4
3
2
4
2
1
LITHOLOGY

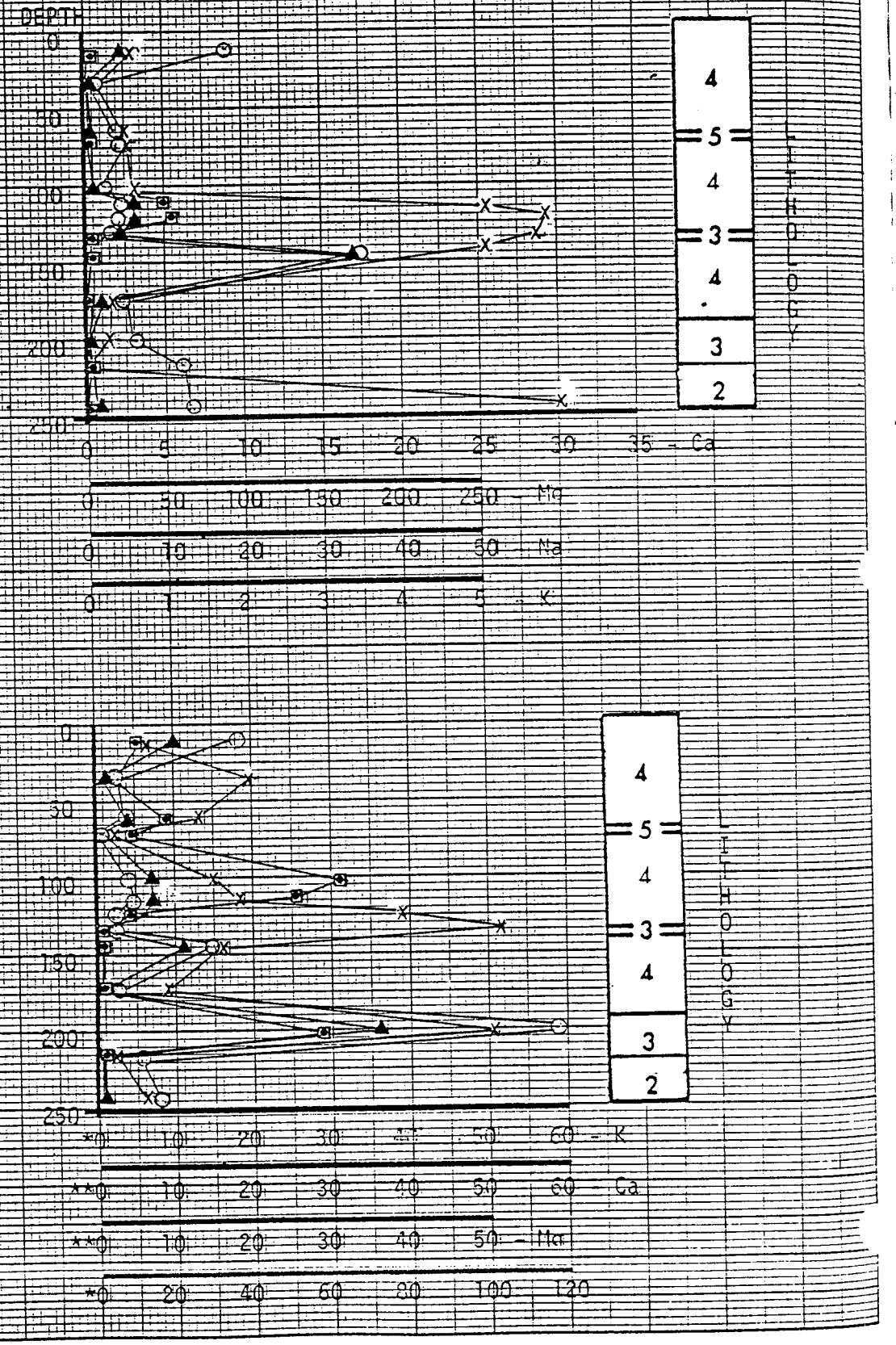

BORE HOLE #6
DEPTH
0
50
100
150
200
250
300
350
0
5
10
15
20
25
30
35
40
45
50
4
5
4
3
4
3
2
4
2
1
Sat. pH
Sat. Cond.
meq/l SAR
DEPTH
0
50
100
150
200
250
300
350
0
5
10
15
20
25
30
35
40
45
50
4
5
4
3
4
3
2
4
2
1
% O.M.
meq/100g C.E.C.
% SAT.

BORE HOLE #5


DEPTH
0
50
100
150
200
250
0
5
10
15
20
25
4
5
4
3
4
3
2
LITHOLOGY
Sat. pH
Sat. Cond.
meq/l SAR
DEPTH
0
50
100
150
200
250
0
10
20
30
40
50
60
70
4
5
4
3
4
3
2
LITHOLOGY
% O.M.
meq/100g C.E.C.
% SAT


BORE HOLE #6
DEPTH
0
50
100
150
200
250
300
350
0
20
40
60
80
100
DTPA Ext. ppm
Zn
Fe
Cu
Mn
4
5
4
3
4
3
2
4
2
1
LITHOLOGY
DEPTH
Texture
% S
% Si
% C

BORE HOLE #5


DEPTH
0
50
100
150
200
250
4
5
4
3
4
3
2
LITHOLOGY
meq/l Saturated Ext.
Ca X-X-X
Mg ▲-▲-▲
Na ○-○-○
K ■-■-■
0 5 10 15 20 25 30 35 - Ca
0 50 100 150 200 250 - Mg
0 10 20 30 40 50 - Na
0 1 2 3 4 5 - K
* # x 10
** # x 100
NH4 OAC Ext. ppm
K ■-■-■
Ca X-X-X
Mg ▲-▲-▲
Na ○-○-○
*0 10 20 30 40 50 60 - K
**0 10 20 30 40 50 60 Ca
**0 10 20 30 40 50 - Mg
*0 20 40 60 80 100 120