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FREE-FLOW VARIABILITY ON THE JESS AND SOUZA RANCHES, ALTAMONT PASS

prepared by

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NOTICE

PREFACE

Two wind turbine arrays, located in the Altamont Pass, east of San Francisco, were instrumented with anemometers and a central monitoring computer. Within each array, every other turbine was instrumented, in order to obtain a high spatial density of wind speed measurements. Wind speed data were collected over a period of four days during the summer high wind season with all turbines shut down. The resulting dataset was analyzed to determine the spatial variability of the wind resource in these two arrays. Since no turbine wakes were present, variation in the flow was due to interaction of the flow with the terrain, and not a function of turbine interaction.

The free-flow datasets can be used by other researchers to refine numerical free-flow computer models. The datasets will be used to fine-tune and/or validate these computer models. In addition, the free-flow data will be compared to results of a wake energy deficit study also being undertaken on these same ranches.

The success of this project is due to a number of people, who the author wishes to acknowledge. Mr. Gary Wayne and Mr. Tom Morton of Altamont Energy Corporation, conceived the idea. Mr. Morton and Mr. Brian Smith of Grant Line Energy Corporation managed the entire project. Mr. Richard Farrell and Mr. Kevin O'Keefe of Altamont Energy Corporation assisted in arranging funding. Mr. Dave Kresse, of Grant Line Energy, helped supervise the installation and operation of the data collection network. Mr. Philip Frame, a Consulting Meteorologist provided wind forecasts and hindcast discussions, and assisted in the installation of the network and in the data processing. Mr. Walter Sass, Ken Cohn and Mike Sacarny of Second Wind, Inc. designed and built the central monitoring computer, communications hardware and software, which operated flawlessly. Mr. Alan Miller and Mr. Dennis Elliott of Battelle, Pacific Northwest Laboratories assisted in the project planning, subsequent execution and review. Mr. Warren Bollmeier of SERI and Dr. Steve Sargent of DOE assisted in the management of this Project.

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SECTION 1.0

INTRODUCTION

Approximately 7000 wind turbines ranging in size from 20 kW to 750 kW have been installed in the Altamont Pass in the 1980's. Few wind developers had the opportunity to conduct detailed micro-siting studies. Many felt it was adequate to make wind measurements at one to five sites per square mile. Thus, wind turbine developers/operators have been amazed at the enormous variability in energy production within the Pass, both between turbine arrays but especially within arrays. The enormous variations could be due to 1) individual turbine operating characteristics, 2) free flow variability due to terrain and/or 3) wake effects. This Free-flow study was conducted to explain turbine production variability and in particular to address the second item above; free-flow variability. A second study was also conducted simultaneously to address the third item above; wake effects.

1.1 METEOROLOGICAL DISCUSSION OF THE ALTAMONT PASS

A word about the driving mechanism of the winds in the Altamont Pass is appropriate. The Altamont Pass is located in a gap in the California coastal range, approximately 45 miles east of San Francisco. To the east of the Pass lies the great Central Valley and to the west lies several ranges of coastal hills, the San Francisco Bay and the Pacific Ocean. During the spring and summer months, the high wind season, there is a large temperature gradient between the cool Pacific Ocean and the hot interior valleys. The coastal waters near San Francisco remain in the high 50s (15 degrees C), whereas the Central Valley temperatures rise to near 100 degrees (35 degrees C). As the interior temperatures rise, air density decreases, and the hot, low density air, rises. This creates a low pressure area over the interior, known as a thermal trough. The thermal trough can usually be found in the summer months, extending from the Coachella Valley in southeast California up through the Central (Sacramento - San Joaquin) Valley. Over the eastern Pacific, which is cool by comparison, the semi-permanent Pacific High Pressure Cell is nearly always present. Thus there is a pressure difference or gradient between the coast and the inland valleys. The result of this pressure difference is wind, which blows from areas of high pressure to low pressure.

A second important meteorological feature, is the subsidence inversion. An inversion occurs when a layer of warm air is found over a layer of cool air. Associated with the Pacific High is the west coast subsidence inversion, the culprit blamed for trapping California smog. This inversion is present along the California coast and over the eastern Pacific during most of the spring and summer months. The mean summer height of the inversion base, measured at the Oakland airport (about 35 miles west of the Pass) is 1350 feet (400 meters) above mean sea-level (MSL). Measurements of the inversion height, in the Pass itself, show it to be several hundred feet above ground level, which is slightly lower than it is in Oakland.

The significance of the inversion is that it acts as an invisible lid. Air flowing inland from high pressure to low pressure is accelerated through coastal gaps, like the Altamont Pass. The presence of the inversion enhances the venturi effect of the Pass by providing an additional constriction to the flow, from the top. Thus air flow is squeezed from the bottom and sides by the Pass itself, and from the top, by the inversion.

The inland pressure gradient and the inversion are the basic elements responsible for the persistent spring-summer winds in the Altamont. As mentioned earlier, the height of the inversion in the Pass is only several hundred feet above ground level. Wind speeds are higher below the inversion, and decrease with height above the inversion. At times, the inversion is very close to the ground and vertical wind shear during these episodes, is negative, i.e. wind speeds decrease with height.

The free-flow data were collected during typical spring-summer conditions. A detailed synoptic discussion of the meteorological conditions during the free-flow periods can be found in Appendix A.

SECTION 2.0

STUDY METHODOLOGY

The methodology for the Free-Flow study was to collect several days of 10-minute average wind data from the anemometer arrays. The data were collected during typical spring-summer (high wind) season flow regimes. All turbines were shut down during these data collection periods.

The 10-minute data were processed to hourly averages and analyzed on a mainframe computer. The analysis consisted of calculating correlation coefficients and speed ratios between a designated reference site, and all other sites. The values were then manually plotted and isoplethed.

2.1 STUDY AREAS

The Jess Ranch study area is in the eastern portion of the Altamont Pass. The Jess Ranch is on relatively flat terrain, by Altamont Pass standards with elevation dropping gently to the northeast. Elevations in the study area range from 600 feet MSL in the southwest corner to 400 feet MSL in the northeast corner. The study area is approximately one-half square mile, one mile long (in the north-south direction) and one-half mile wide. The northern half of the Jess Ranch has Nordtank turbines and the southern half of the Ranch has ESI turbines. Figure 2-1 is a topographic map of the Jess Ranch and surrounding terrain.

The Souza Ranch study area is in the northern portion of the Altamont Pass, about six miles north-northwest of the Jess Ranch. The Souza area terrain is more complex than the Jess area. The study area is on gently rolling hills. Immediately south of the study area is a canyon trending east-west, with an elevation of about 350 feet MSL. Elevations in the study area range from 440 feet MSL in the western portion to 300 feet MSL in the eastern portion. The Souza study area is about half the size of the Jess area. All turbines in the Souza Ranch study area are Nordtanks. Figure 2-2 is a topographic map of the Souza area and surrounding terrain.

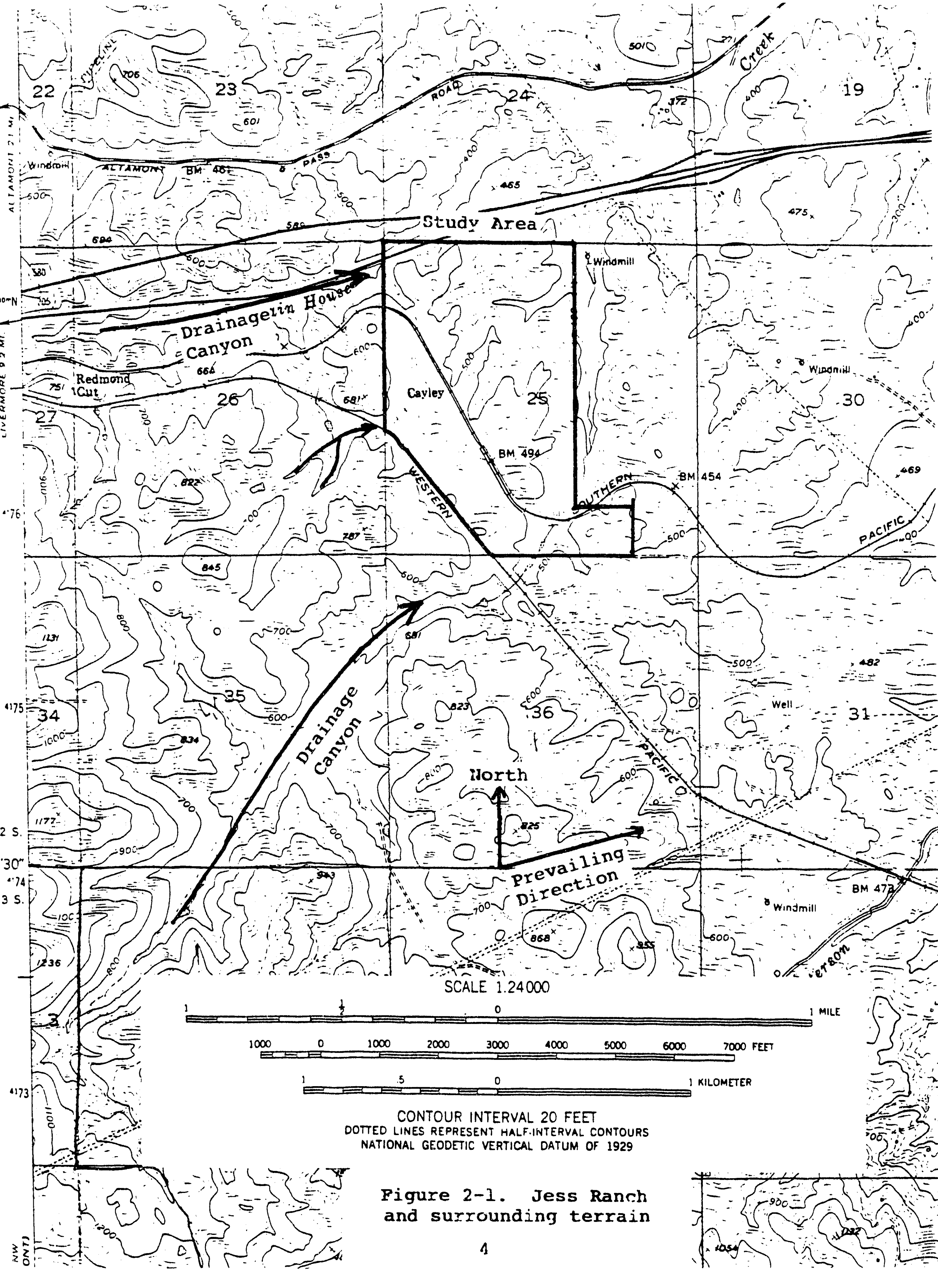


Figure 2-1. Jess Ranch and surrounding terrain

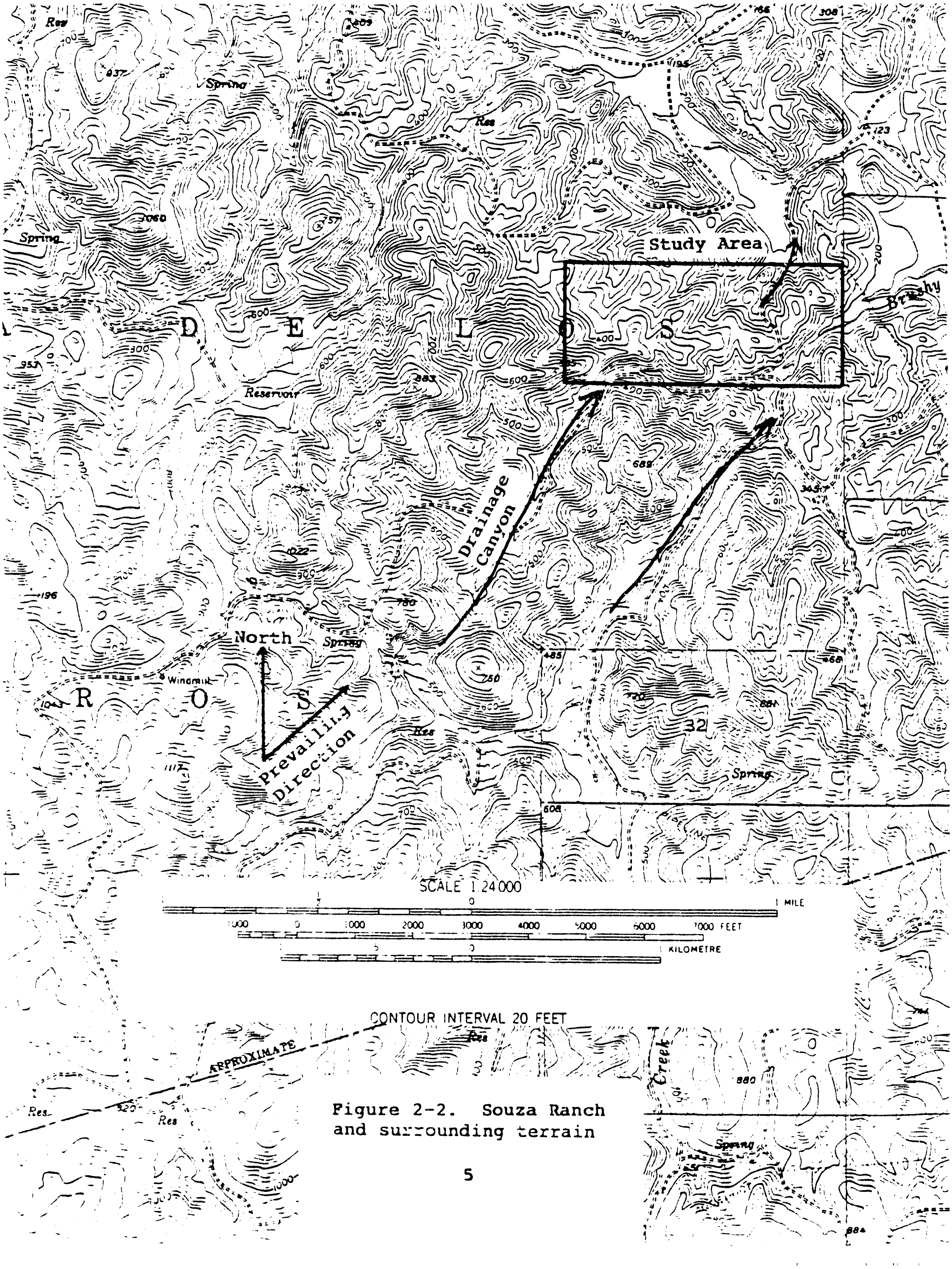


Figure 2-2. Souza Ranch and surrounding terrain

2.2 MONITORING EQUIPMENT

2.2.1 Anemometry

Due to the relatively flat terrain on the Jess Ranch, the turbines are laid out in straight rows, normal to the west-southwest flow. Spacing between turbines, within rows, is 100 feet (2 rotor diameters) and spacing between rows is about 500 feet (10 rotor diameters). Anemometers were installed on every other turbine, so the spacing between sensors is 200 feet, crosswind, by 500 feet downwind. Figure 2-3 is a topographic map of the Jess Ranch showing the locations of the turbines and anemometer towers. The large letters indicate the locations of groups of turbines. Individual turbines are plotted as small triangles, and only the end turbines in a given group are labelled. For example, in the upper left corner of Figure 2-3, in the row adjacent to the J-08 anemometer, there are six turbines, but only L1 and L6 are labelled.

77 anemometers were installed on the Jess Ranch on booms on every other turbine. The southern half of the Jess Ranch consists of ESI-54S turbines on 80-ft towers. On Figure 2-3, these are in the C, D, E, H, I and J groups. The northern half of the Ranch consists of Nordtank 65 kW turbines on 72-ft towers. These are in groups F, G, K, L, M and N. Anemometers were installed on the ESI-54S turbines on existing five-foot booms at 50 feet AGL. Anemometers were installed on the Nordtank turbines on 12-foot booms at 35 feet AGL. A longer boom was used on the Nordtanks due to the large tubular tower, vs. the open-lattice ESI tower. The anemometers were installed at the 35-ft level vs. 50 feet to keep them below the rotor. The boom orientation was north-northwest, which is normal to the flow, so there was no tower shadow. On the Nordtank turbines, 35 feet AGL is about 11 feet below the bottom of the rotor, and on the ESI turbines, 50 ft AGL is 3 feet below the rotor. Of course, the rotors were stationary during the free-flow data collection period, so no interference is expected.

In addition to the 77 anemometers installed on turbines, there were five additional meteorological towers. Table 2-1 lists the towers, location, measurement levels and sensor types. Note that two of the Jess Ranch towers were not integrated with the central monitoring computer (to be discussed below) and data collected at these towers were hourly averages, not 10-minute averages.

Table 2-1. Jess Ranch Meteorological Towers

Tower	Location	Sensor Ht (ft)	Sensor Type	Status
J-08	Upwind of Turbine L4	50	R.M. Young propvane	reference tower, integrated with central monitoring computer
J-17	Upwind of Turbine N3	35, 70	Maximum cup	integrated with central monitoring computer
J-18	Upwind of Turbine J3	35, 70	Maximum cup	integrated with central monitoring computer
J-04	Adjacent to Turbine C10	120	Maximum cup	not integrated with central computer. Separate data logger records hourly averages
J-19	Near A-12	40, 80	Maximum cup	not integrated with central computer. Separate data logger records hourly averages

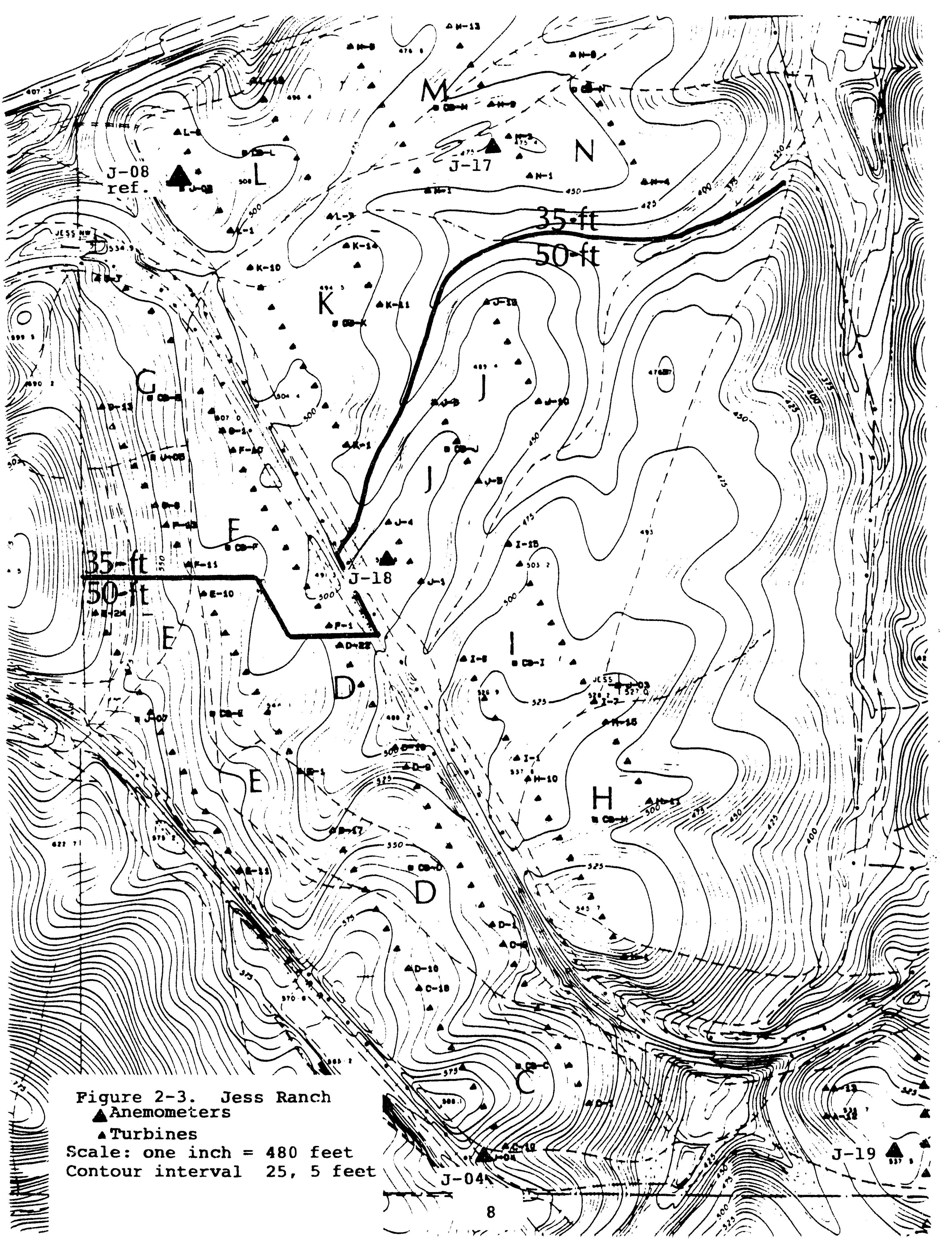


Figure 2-3. Jess Ranch
▲ Anemometers
▲ Turbines
Scale: one inch = 480 feet
Contour interval 25, 5 feet

The Souza Ranch terrain is slightly more complex than Jess and the turbine rows follow the local ridgelines to some extent. The turbine rows are not as straight, nor are they all parallel. Spacing between anemometers, and sensor height is the same as on Jess. However, the boom orientation is northwesterly, since the prevailing wind direction is southwesterly. Figure 2-4 is a topographic map showing the location of turbine anemometers and towers. 23 turbine anemometers were installed on Souza as well as three meteorological towers. Table 2-2 lists the characteristics of these towers. All three towers were connected to the central monitoring computer.

Table 2-2. Souza Ranch Meteorological Towers

Tower	Location	Sensor Ht(ft)	Sensor Type	Status
S-13	Upwind of Turbine G5	35, 70	35'=Maximum cup 70'=R.M. Young Propvane	reference tower
S-27	Adjacent to Turbine E7	45, 80	Maximum cup	
S-29	Upwind of Turbine D9	50	Maximum cup	

Except for the two reference towers, all sensors were Maximum type 40 cups. The sensors are molded lexan 3-cup anemometers. The transducer is an AC generator that produces a sine wave signal. The signal frequency is proportional to wind speed. The manufacturer specifies the accuracy to be ±2.5%, and the distance constant to be 9.7 feet.

The two reference towers; J-08 on Jess and S-13 on Souza had R.M. Young "Wind Monitor" Model #05103 propvanes. Wind direction is measured with a potentiometer and wind speed is measured with an AC Sine Wave generator. The Manufacturer specifies the distance constant to be 7.4 feet and the accuracy to be ±2.0%.

Approximately 60 of the Maximum cups and both propvanes were wind tunnel tested at the U.C. Davis wind tunnel. The wind tunnel test procedure called for approximately 30 samples for each sensor in wind speeds ranging from 10 to 60 mph. Almost all cups tested read one to two percent below tunnel speed, the mean speed of all cups tested was 98.7% of tunnel speed. The two propvanes read about 1% above tunnel speed. Appendix B lists the results of the wind tunnel tests and the location of sensors.

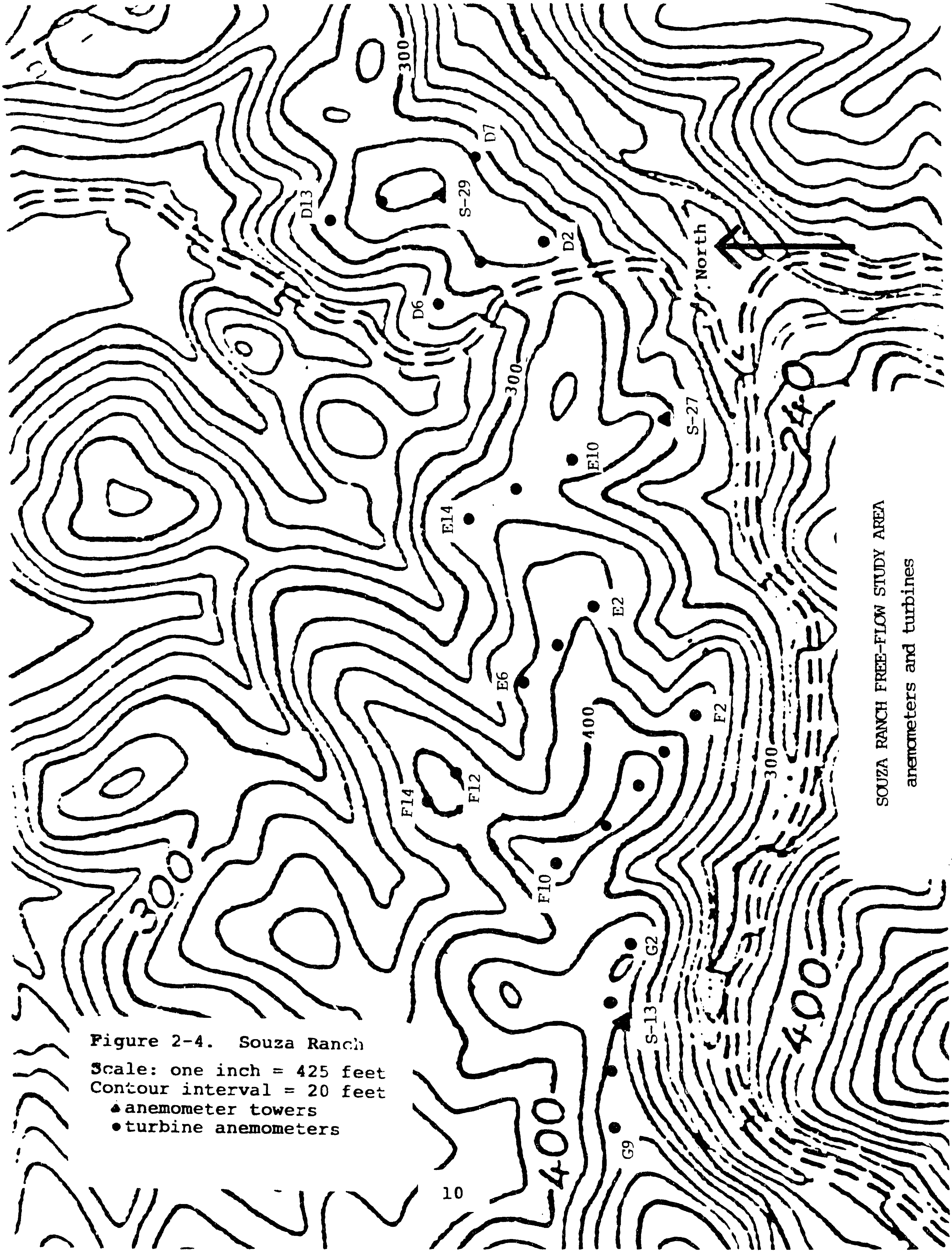


Figure 2-4. Souza Ranch

Scale: one inch = 425 feet
Contour interval = 20 feet
▲ anemometer towers
● turbine anemometers

2.2.2 Central Monitoring Computer and Communicating Turbine Monitors (CTM)

The Second Wind, Inc. monitoring system on each ranch has two main components; 1) the central computer and 2) the CTMs. Each individual turbine has a CTM which monitors turbine status, turbine power and wind speed and direction (if there are wind sensors installed). The CTMs operate on a one-second scan interval, and calculate and store ten-minute averages. The CTMs are connected via cable to the central computer, which interrogates all turbines once a minute. The central computer performs many functions, of particular importance to this study is the data archiving function. The 10-minute data are stored on a Bernoulli disk drive, which permits these data to be accessed by other computers.

Due to the electrical noise in a windfarm environment, the CTM has a threshold voltage for wind speed signals. This threshold is equivalent to roughly two mph for a Maximum cup, and slightly higher for an R.M. Young propvane. A one-second scan below this two mph threshold would be interpreted as a zero mph reading. Thus a 10-minute average of zero mph, could actually have been between zero and two mph. Furthermore, during any 10 minute period below about five mph, there could be excursions below two mph, which would be read as zero. Thus a true average wind speed of five mph could be archived as a 4.5 mph average. As the average wind speed increases, there are fewer excursions below two mph and this bias goes to zero. Almost all of the data collected were in winds well above 10 mph so this problem is trivial. However there are a few averages in the dataset in the 0-5 mph range that are negatively biased.

2.3 DATA PROCESSING

The Second Wind, Inc. field computer stores the 10-minute averages. These data are transferred to the office computer on a Bernoulli disk. The office computer has two programs that were used to access this data. One program is a Data Dump facility that allows the user to specify a start and end time and a range of parameters. It creates a file which can be printed out for review of the 10-minute records. A second program is the hourly program which computes hourly averages from the six 10-minute records. The program creates an hourly average for any hour when three or more, valid 10-minutes records were available. The hourly program was used on all sites to generate hourly data. The hourly averages were transferred from the office computer to a PRIME mainframe computer for QA and subsequent analysis.

2.3.1 QA Procedures

The hourly averages were loaded into a PRIME computer where an extensive wind energy database and software library resides. The

QA procedures required calculating correlation coefficients (r) and speed ratios and reviewing and plotting these. This was followed by scrutinizing any outlying data points that were revealed by these plots, and some subjective judgement as to the data points' validity.

Specifically the following steps were taken: 1) calculate correlation coefficients and speed ratios between the reference anemometer and all other sites on the ranch. 2) Calculate correlation coefficients and speed ratios between all adjacent pairs of anemometers. 3) Review these and investigate any sites that had correlations below .9 or peculiar speed ratios. 4) Scan both the hourly and 10-minute data listings to spot any suspect data points. (An example of a suspect data point might be a zero mph wind speed at one level of a tower, and a 20 mph speed at another level.) 5) If data appeared invalid it was deleted. 6) Re-calculate correlation coefficients without invalid data and verify that significant improvement in correlation was achieved. 7) Fill in gaps where data were deleted using surrogate data from closest adjacent site. Surrogate data points were created using linear regression equations.

Review of the Souza dataset revealed no spurious data. All correlations were between .94 and 1.00. A total of 2726 parameter-hours of data were collected with a data recovery of 100%.

Review of the Jess dataset revealed suspect data at six sites. In most cases the suspect data were 0.0 mph wind speeds, when other levels or adjacent sites had strong winds. It has not been determined if the cause was due to a sensor, sensor wire, CTM or communication failure. Table 2-3 below is a list of suspect data sites:

Table 2-3. Jess Ranch Suspect Data

Site	Number of invalid hours	Status
J-17 70 ft	23	spurious data deleted, replaced with surrogate data
E-13	2	" " " " "
F-12	13	" " " " "
K-01	17	" " " " "
F-05	all data	recorded zero wind speed, all data deleted
I-12	all data	" " " " "

Thus two sites were deleted altogether, and an additional 55 hours of data from four turbines were also deleted. A total of 8717 parameter-hours of valid data was collected out of a possible 8976 parameter-hours, for a net data recovery of 97.1%. The 55 hours of data were filled in at the four sites listed above, however no attempt was made to fill in data from turbines F5 and I12.

Data recovery for the entire study, including both areas, was 97.8%. This is an excellent rate of data recovery for a study of this scale.

2.3.2 Site J-08 Sensor Problems

Two problems were detected with the R.M. Young sensor at site J-08. This sensor was installed on September 7, 1987. Previous to this installation, three years of data had been collected at this site and at site J-04. The established speed ratio between these sites for the previous three Septembers was 98.8% (J-08 = 98.8% of J-04). After installation of the R.M. Young sensor, this ratio jumped 2.8%, to 101.6% of J-04. It was felt that the J-08 sensor might have a positive bias. To determine if this were true, in the field, a calibrated Maximum Cup was installed at J-08 at the same level, in January 1988. Three months of concurrent wind speed data were collected by these two sensors. Correlation of all concurrent wind data, in winds of 10 mph or greater showed that the R.M. Young sensor was reading 2% higher than the Maximum Cup. The correlation was perfect. As a result, all wind speeds at J-08 were reduced by 2%, to reflect this field calibration.

The other problem with J-08 was in orientation of the vane. It was discovered that the north point on the wind vane was oriented towards 22.5 degrees, or 22.5 degrees east of true north. With this orientation all wind direction data would be recorded 22.5 degrees too low. (For example, a north wind; 360 degrees, would read 337.5 degrees.) It was evident from the base plate and guy wires that the mast had not turned, but had been installed incorrectly. Therefore 22.5 degrees have been added to J-08 wind direction data.

These problems were not evident at the other R.M. Young sensor installed at site S-13 on the Souza Ranch.

SECTION 3.0

DATA ANALYSIS

3.1 DATASETS

Data collection took place on the Souza Ranch from September 10, 1987 at 1600 PDT through September 14, 1987 at 1400 PDT. The duration of the data collection phase was 94 hours, or 564 10-minute samples. Data collection on the Jess Ranch took place in two periods; October 1, 1987 at 1400 PDT through October 3 at 0500 and from October 7, 1987 at 0800 through October 10, 1987 at 0900. During the first period on the Jess Ranch, light and variable winds occurred during the middle of the day on October 2, and these data were not included in the final dataset. The duration of the Jess data collection phase was 102 hours or 612 10-minute samples. Although data collection took place in October on the Jess Ranch, the meteorological conditions were typical of summer, as shown in Appendix A.

A complete listing of the hourly data can be found in Appendix C. The Appendix lists up to 48 hours of data for 15 sites on each page. Data is listed synoptically, i.e., each line of data lists data for one hour, for 15 sites.

3.2 LINEAR CORRELATIONS

3.2.1 Souza Ranch

The first step in the data analysis was the correlation of all wind speed data to the reference towers. Table 3-1 is a list of all the linear correlation coefficients (r) to reference site S-13.

TABLE 3-1. Souza Hourly Correlation Coefficients (r) to S13 70'

SITE	r
S-13 35'	1.00
S-27 45'	.97
S-27 80'	.97
S-29 50'	.98
D02 35'	.98
D04	.97
D06	.95
D07	.97
D11	.97
D13	.95
E02	.97
E04	.98
E06	.99
E10	.94
E12	.96
E14	.97
F02	.96
F04	.98
F06	.99
F08	.98
F10	1.00
F12	.99
F14	.98
G02	.99
G04	1.00
G07	.98
G09	.95

The table shows that all sites on Souza had correlation coefficients (r) of .94 or better, which indicates excellent correlations. The data on Table 3-1 are plotted on Figure 3-1. Additional information can be found in Appendix D. This appendix lists the start and stop dates, the sample size, correlation coefficient (r), the mean speed and theoretical energy. In addition, the summary lists the linear-regression equation and the speed and theoretical energy ratios to the reference S-13. The speed ratios are accurate, however the energy ratios are approximations since the power curve in this computer program is a generic 65-kW power curve, not the Nordtank 65 kW curve.

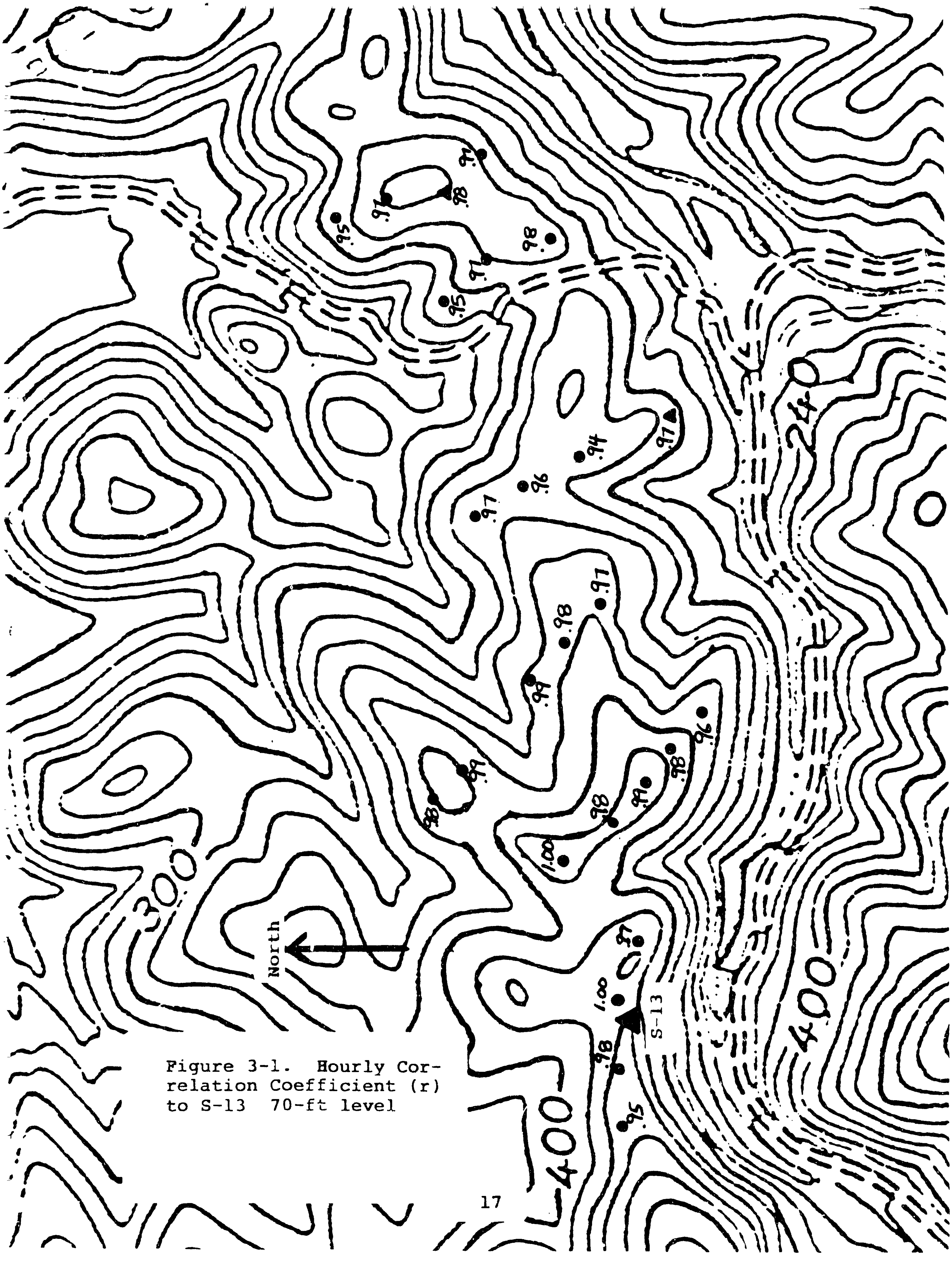


Figure 3-1. Hourly Correlation Coefficient (r) to S-13 70-ft level

3.2.2 Jess Ranch

Table 3-2 lists the correlation coefficients for the Jess Ranch. The correlations include the surrogate data points at the four sites discussed in Table 2-3. The correlations on Jess decreased as function of distance to the J-08 reference, so the Jess sites were also correlated to the J-04 120-ft tower. J-04 and J-08 are at opposite ends of the study area, and tower J-18 is roughly in the middle (see Figure 2-3). Further analysis of the data revealed that individual site correlations were inversely proportional to the distance between sites. Sites adjacent to each other were highly correlated, whereas sites 4000+ feet from each other showed only fair correlations; r = 0.85 or lower. A few sites in the middle of the ranch, showed only fair correlations to both J-04 and J-08 and thus were correlated to site J-18. Table 3-2 lists the correlation coefficients to these three sites. In addition, the table lists the correlation of all sites to their adjacent site. The table shows that the mean correlation coefficient to adjacent sites was .98, which is excellent. This analysis on Jess was done as part of the QA process. Poor or fair correlations may be indicative of invalid data points. Since the pattern of correlations on Jess was clearly a function of distance, and not random, it was concluded that the moderate correlations between distant sites did not indicate invalid data.

TABLE 3-2. Jess Ranch Hourly Correlation Coefficients to Reference Anemometers and Adjacent Sites

Location	J-08	J-04	J-18*	Adjacent Site
SITE J08 50-ft reference	--	.90		1.00
SITE J-04 120-ft level	.90	--		.99
SITE J-19 40-ft level	.87	.93		1.00
SITE J-17 35-ft level	.96	.83		1.00
SITE J-17 70-ft level	.95	.83		1.00
SITE J-18 35-ft level	.85	.84		1.00
SITE J-18 70-ft level	.85	.85		1.00

TABLE 3-2 (CONT.)

Location	J-08	J-04	J-18*	Adjacent Site
TURBINE C1 50-ft	.89	.98		.99
TURBINE C3 50-ft	.87	.98		.99
TURBINE C5 50-ft	.89	.98		.99
TURBINE C7 50-ft	.87	.96		.99
TURBINE C9 50-ft	.86	.95		.98
TURBINE C12 50-ft	.91	.99		.99
TURBINE C14 50-ft	.90	.99		.98
TURBINE C16 50-ft	.87	.97		.98
TURBINE C18 50-ft	.86	.95		.97
TURBINE D2 50-ft	.86	.94		.98
TURBINE D4 50-ft	.83	.90		.98
TURBINE D6 50-ft	.80	.87		.98
TURBINE D13 50-ft	.83	.90		.99
TURBINE D15 50-ft	.80	.87		.99
TURBINE D21 50-ft	.85	.90		.96
TURBINE E2 50-ft	.86	.91		.96
TURBINE E4 50-ft	.89	.93		.96
TURBINE E6 50-ft	.86	.90		.95
TURBINE E8 50-ft	.90	.88		.95
TURBINE E10 50-ft	.92	.93		.97
TURBINE E11 50-ft	.84	.89		.98
TURBINE E1 50-ft	.85	.91		.98
TURBINE E15 50-ft	.89	.93		.95
TURBINE E18 50-ft	.88	.92		.95
TURBINE E20 50-ft	.90	.90		.97
TURBINE E22 50-ft	.93	.94		.97
TURBINE F1 35-ft	.85	.87		.97
TURBINE F3 35-ft	.88	.88		.97
TURBINE F7 35-ft	.83	.88		.98
TURBINE F9 35-ft	.78	.84	.94	.98
TURBINE F12 35-ft	.76	.83	.93	.99
TURBINE G1 35-ft	.84	.86		.96
TURBINE G3 35-ft	.90	.86		.96
TURBINE G5 35-ft	.97	.87		.98
TURBINE G7 35-ft	.99	.87		.98
TURBINE G8 35-ft	.81	.81	.97	.95
TURBINE G10 35-ft	.88	.84		.97
TURBINE G12 35-ft	.94	.87		.97
TURBINE H1 50-ft	.85	.94		1.00
TURBINE H2 50-ft	.85	.95		1.00
TURBINE H7 50-ft	.86	.93		.97
TURBINE H10 50-ft	.83	.88		.97
TURBINE H12 50-ft	.83	.91		.94
TURBINE H15 50-ft	.83	.88		.94

TABLE 3-2 (CONT.)

Location		J-08	J-04	J-18*	Adjacent Site
TURBINE I1	50-ft	.83	.87		.99
TURBINE I3	50-ft	.82	.86	.90	.99
TURBINE I5	50-ft	.83	.87		.99
TURBINE I9	50-ft	.81	.86	.91	.96
TURBINE I14	50-ft	.82	.85		.96
TURBINE J6	50-ft	.87	.86		.97
TURBINE J8	50-ft	.86	.88		.97
TURBINE J11	50-ft	.86	.86		.98
TURBINE J13	50-ft	.84	.85	.94	.98
TURBINE K1	35-ft	.82	.84	.93	.95
TURBINE K3	35-ft	.84	.87		.96
TURBINE K5	35-ft	.90	.86		.96
TURBINE K7	35-ft	.95	.84		.97
TURBINE K9	35-ft	.97	.85		.97
TURBINE K12	35-ft	.94	.84		.98
TURBINE K14	35-ft	.96	.82		.98
TURBINE L1	35-ft	.99	.88		.99
TURBINE L3	35-ft	1.00	.90		1.00
TURBINE L5	35-ft	1.00	.91		.99
TURBINE L8	35-ft	.99	.88		.99
TURBINE L10	35-ft	1.00	.89		1.00
TURBINE L12	35-ft	.99	.89		1.00
TURBINE M2	35-ft	.97	.85		.99
TURBINE M4	35-ft	.98	.88		.99
TURBINE M6	35-ft	.99	.89		1.00
TURBINE M8	35-ft	.99	.89		1.00
TURBINE M9	35-ft	.96	.86		.99
TURBINE M11	35-ft	.96	.86		1.00
TURBINE M13	35-ft	.97	.87		1.00
TURBINE N1	35-ft	.94	.83		.97
TURBINE N4	35-ft	.89	.81		.97
TURBINE N6	35-ft	.90	.79		.99
TURBINE N8	35-ft	.93	.80		.99
	MEAN	.89	.89		.98

*Sites with correlation coefficients of .85 or lower to both reference sites, were correlated to J-18 to help determine validity of the data, and these coefficients are listed here.

The data listed on Table 3-2 are plotted on Figures 3-2 and 3-3. Figure 3-2 shows the correlations to J-08 and Figure 3-3 shows the correlations to J-04. Both figures shows the areas of high correlation in the vicinity of the reference tower used. Well exposed sites such as L3, L5, C10-14 show good correlations to both towers. Additional information such as linear-regression equations, and speed ratios can be found in Appendix E, which is the same format as Appendix D.

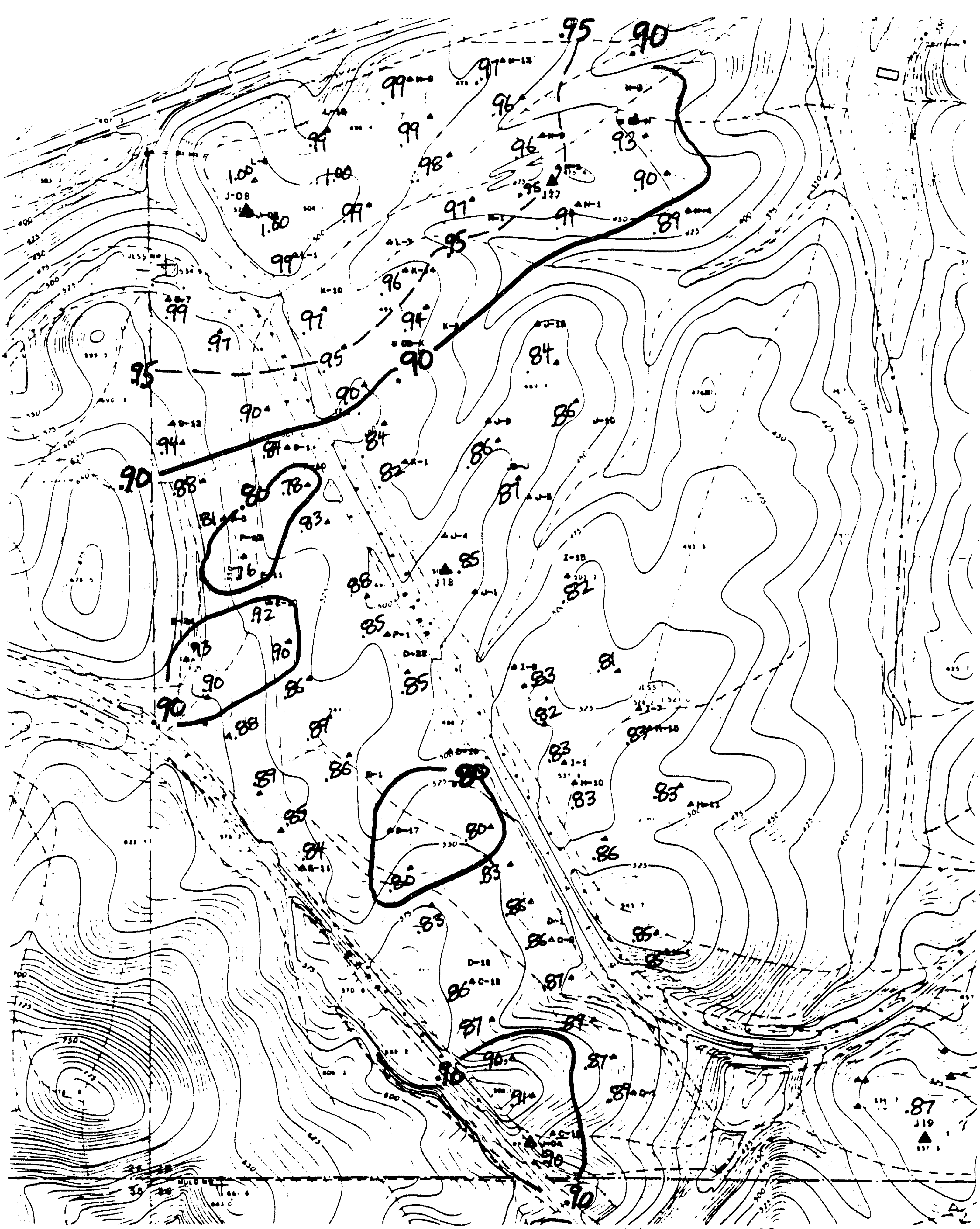


Figure 3-2. Hourly correlation coefficient (r) to Site J-08

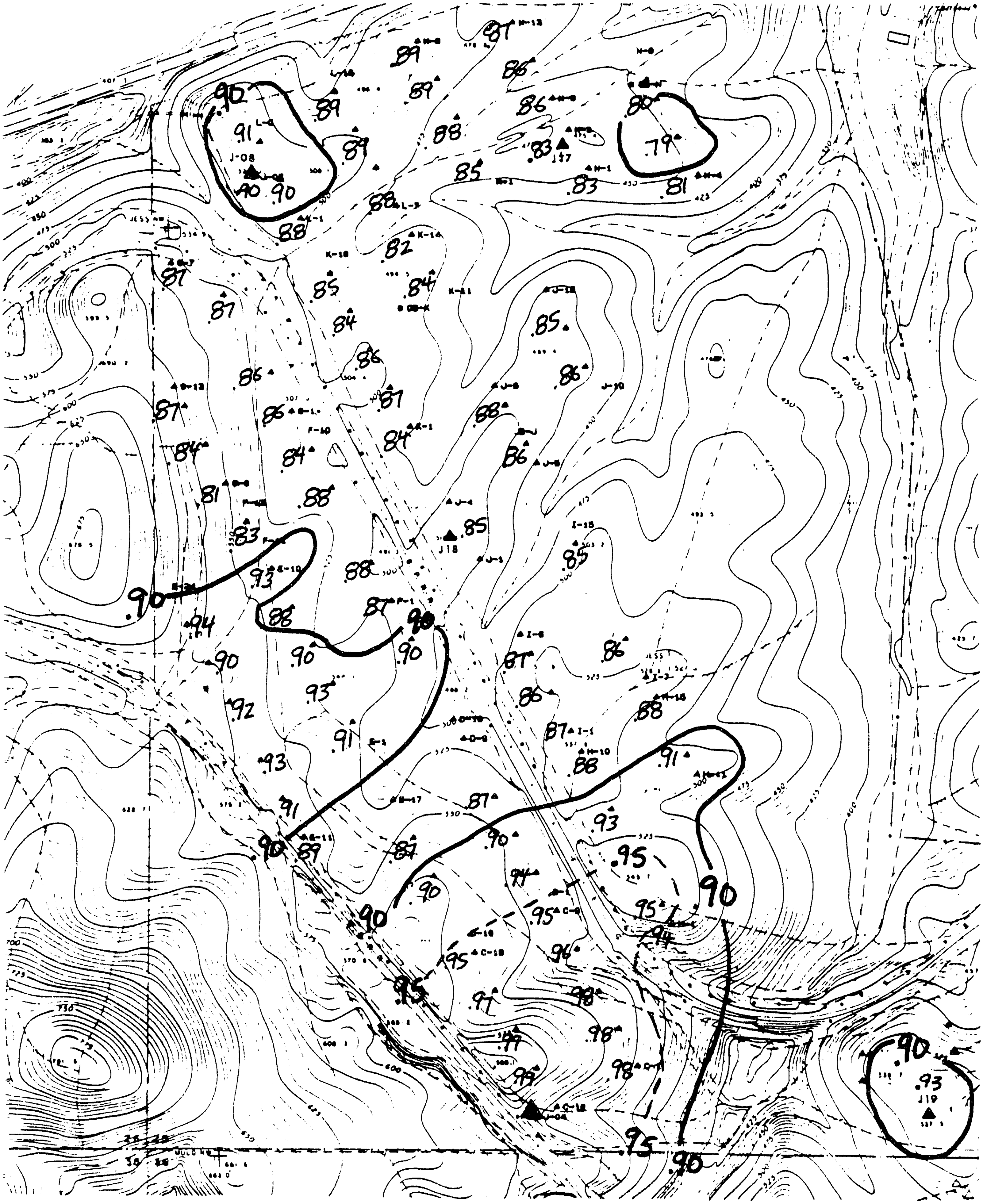


Figure 3-3. Hourly correlation coefficient (r) to Site J-04

3.3 WINDROSES

Tables 3-3 and 3-4 are joint-frequency distributions of wind speed and direction for site S-13 and J-08, respectively. The data is grouped in 5 mph speed bins and 5 degree direction bins. Table 3-3 shows that wind directions ranged from 210 degrees to 255 degrees, south-southwest through west-southwest. The table also shows that almost all the data falls in a 15 degree band from 220 to 235 degrees. This is typical of spring-summer flow at site S-13. The table also shows that most of the hourly mean speeds were between 20 and 30 mph.

Table 3-4 shows that there was a more narrow range of directions at J-08; from 235 to 260 degrees. Most of the hours fall in a 15-degree band from 240 to 255 degrees, or west-southwest. This is the normal spring-summer direction at this site. The table also shows that most of the speeds were between 20 and 30 mph.

TABLE 3-3. S-13 WINDROSE

JOINT FREQUENCY DISTRIBUTION - HOURS OF OCCURRENCE

09/10/87 - 09/14/87

PARAMETER 1: DOE FREE FLOW DATA - SOUZA RANCH
SITE S-13 70-ft reference (MPH)

PARAMETER 2: DOE FREE FLOW DATA - SOUZA RANCH
SITE S-13 70-ft (DEG)

	PARAMETER 1: MPH							
PARAMETER 2 DEG	10.0 TO 15.0	15.0 TO 20.0	20.0 TO 25.0	25.0 TO 30.0	30.0 TO 35.0	35.0 TO 40.0	40.0 TO 45.0	TOTAL
210.0 -215.0	-	-	2	-	-	-	-	2
215.0 -220.0	-	2	4	3	-	-	-	9
220.0 -225.0	1	4	8	7	2	-	-	22
225.0 -230.0	-	4	10	12	4	4	-	34
230.0 -235.0	-	4	2	4	4	4	1	19
235.0 -240.0	1	1	-	-	-	1	-	3
240.0 -245.0	1	-	-	-	-	-	-	1
245.0 -250.0	1	-	-	-	-	-	-	1
250.0 -255.0	3	-	-	-	-	-	-	3
TOTAL	7	15	26	26	10	9	1	94

NOTE: VALUES IN A CATEGORY ARE GREATER THAN OR EQUAL TO THE LOWER BOUND, AND LESS THAN THE UPPER BOUND OF THE CATEGORY

TABLE 3-4. J-08 WINDROSE

JOINT FREQUENCY DISTRIBUTION - HOURS OF OCCURRENCE

10/01/87 - 10/10/87

PARAMETER 1: DOE FREE FLOW DATA - JESS RANCH
SITE J-08 50-ft reference (MPH)

PARAMETER 2: DOE FREE FLOW DATA - JESS RANCH
SITE J-08 DIRECTION (DEG)

	PARAMETER 1: MPH						
PARAMETER 2 DEG	10.0 TO 15.0	15.0 TO 20.0	20.0 TO 25.0	25.0 TO 30.0	30.0 TO 35.0	35.0 TO 40.0	TOTAL
235.0 -240.0	-	1	-	2	1	-	4
240.0 -245.0	1	4	9	11	3	1	29
245.0 -250.0	2	2	7	12	4	4	31
250.0 -255.0	2	5	8	11	3	2	31
255.0 -260.0	2	3	1	1	-	-	7
TOTAL	7	15	25	37	11	7	102

NOTE: VALUES IN A CATEGORY ARE GREATER THAN OR EQUAL TO THE LOWER BOUND, AND LESS THAN THE UPPER BOUND OF THE CATEGORY

3.4 DIURNAL MEAN SPEEDS

Table 3-5 lists the diurnal (time-of-day) mean speeds for the Souza and Jess reference sites. Bear in mind that each hourly average has only four or five hours (days) of data in it so the typical diurnal pattern may not be reflected in the data. The data from S-13 shows the typical diurnal pattern of an Altamont site; highest winds just before midnight and lowest winds around noon. The data from the mid-day lull at J-08 on October 2, 3 and 10 was deleted from the dataset also. Thus, J-08 does not show this pattern.

Table 3-5. Diurnal Mean Wind Speeds (mph)

Hour	S-13	J-08
01	29.5	27.0
02	26.9	25.4
03	25.5	24.6
04	24.5	21.7
05	24.6	19.9
06	24.8	21.9
07	23.7	20.9
08	23.7	21.5
09	23.4	23.2
10	22.6	26.6
11	19.6	26.0
12	18.3	25.6
13	18.3	24.8
14	18.8	25.6
15	20.6	25.5
16	20.7	26.1
17	21.3	24.7
18	24.8	26.0
19	27.6	25.6
20	32.8	26.1
21	34.5	27.3
22	32.4	28.1
23	30.7	28.7
24	31.3	27.4
----	------	------
MEAN	25.1	25.0

A complete listing of the diurnal mean speeds at all sites can be found in Appendix F. These summaries are interesting because one can compare different sites' diurnal patterns and mean speeds.

3.5 VERTICAL SHEAR

There were a total of five two-level towers available for this study, three on Jess and two on Souza. Vertical wind shear is often expressed as an exponent; alpha. Normally, in areas of flat terrain, alpha is equal to 1/7th or about .14. Because of the inversion and the complex terrain, vertical shear in the Altamont varies considerably from this value, and is often less than .14. In the Altamont, alphas are generally very low on well-exposed ridges and higher at sheltered sites.

Alpha has been calculated for each hour of data at all five towers. Table 3-6 is a diurnal summary of these data. (Note that the units are, "100 or %", i.e. all values have been multiplied by 100. Thus an alpha of 14. in the table is actually .14.) The table shows that all five towers have alphas less than the normal .14. On the Jess Ranch, the mean of the alphas ranged from .114 at site J-18 to a low of .058 at J-19. Site J-19 is on a well-exposed knoll, which helps explain its lower shear.

There is no clear diurnal pattern shared by all sites. J-18 and J-19 show lower shear in the mid-day than at night. Shear often increases after sunset as the lack of thermal instability creates less downward mixing of momentum. This phenomena has been discussed quite extensively in meteorological and air-quality literature.

The Souza sites also have lower mean alphas than the normal .14. In fact, site S-27 has a mean shear close to zero, indicating wind speeds are the same at both levels. Site S-13 shear is larger, .075, which is about half the normal value.

As noted in Section 2.2.1, there were two turbine anemometer heights on the Jess Ranch; 35 and 50 feet AGL. The vertical shear measured at the three Jess two-levels towers suggests that the speed difference between 35 and 50 feet would be two to four percent.

TABLE 3-6. DIURNAL WIND SHEAR SUMMARY

DOE FREE-FLOW VERTICAL WIND SHEAR DATA
UNITS ARE SHEAR EXPONENT: (ALPHA *100)

	JESS RANCH SITES October 1-10, 1987			SOUZA RANCH Sept 10-14	
HOUR	J-17 (%)	J-18 (%)	J-19 (%)	S-13 (%)	S-27 (%)
1	9.3	11.0	6.0	7.5	-0.7
2	9.0	13.0	4.9	5.4	-0.9
3	10.3	13.8	5.6	5.7	-0.1
4	8.9	15.4	7.8	6.0	0.4
5	9.5	17.1	7.5	5.9	0.2
6	10.0	22.2	9.0	5.8	1.0
7	9.4	9.5	7.6	7.4	1.8
8	12.7	21.3	7.5	7.7	1.3
9	10.0	12.6	7.6	8.0	-0.2
10	6.0	9.2	3.3	8.1	-0.3
11	10.7	9.0	6.4	8.3	-1.6
12	10.8	7.6	2.6	7.5	-2.3
13	5.4	6.8	0.6	6.3	-1.4
14	11.4	6.5	1.9	7.2	-1.6
15	11.7	6.7	-0.5	10.8	0.1
16	11.3	6.1	2.1	8.9	-0.7
17	11.4	6.7	1.7	10.0	-0.1
18	11.4	8.3	4.8	9.7	-0.2
19	13.2	10.5	7.1	9.4	1.3
20	12.4	12.9	7.4	7.3	2.9
21	12.8	9.7	7.4	6.2	2.5
22	11.3	9.8	7.9	6.4	-0.1
23	10.6	10.0	8.6	6.9	-0.1
24	10.3	10.3	7.7	8.2	1.0
MEAN	10.5	11.4	5.8	7.5	0.1
VALID HRS	102	102	102	94	94

TOWER MEASUREMENT LEVELS:
JESS J-17 35/70'
JESS J-18 35/70'
JESS J-19 40/80'
SOUZA S-13 35/70'
SOUZA S-27 45/80'

3.6 WIND SPEED FREQUENCY DISTRIBUTION AND THEORETICAL ENERGY

Theoretical energy production is calculated by integrating the measured frequency distribution over a given time period, with a power curve. This calculation has been done for the two reference sites, with the Nordtank-65 power curve. In the calculation the power curve has been adjusted to 97% of sea-level density, which is a close approximation based on the altitude and temperature. Wind speed data at S-13 were collected at hub-height, so no shear adjustment is necessary. J-08 data were collected at 50 feet which is 22 feet below hub-height. However, based on the excellent exposure of J-08, on a bluff, the shear between 50 and 72 feet AGL is probably zero, so no correction has been made.

Table 3-7 and 3-8 are the distributions for S-13 and J-08, respectively. The tables show that theoretical energy at these sites during the free flow period was about 4,300 kWh at S-13 and about 4,700 kWh at J-08. Theoretical energy at J-08 is slightly higher, due in part to the longer integrating period, 102 vs. 94 hours. Thus the two periods were quite similar in energy content at these two sites. The mean wind speeds are nearly identical also.

TABLE 3-7. WIND SPEED FREQUENCY DISTRIBUTION FOR S-13

DOE FREE FLOW DATA - SOUZA RANCH
SITE S-13 70-ft reference

09/10/87 - 09/14/87

SPEED (MPH)	HOURS	NORDTANK 65 POWER KW(*)	ENERGY KWH
10	0	2.2	0.0
11	0	4.5	0.0
12	0	6.8	0.0
13	3	9.4	28.1
14	3	12.0	35.9
15	2	14.5	29.1
16	2	18.6	37.2
17	0	22.7	0.0
18	1	26.8	26.8
19	5	30.8	154.2
20	8	34.9	279.4
21	5	38.0	190.1
22	4	41.1	164.5
23	7	44.2	309.6
24	6	47.3	284.0
25	6	50.4	302.6
26	3	52.1	156.2
27	8	53.7	429.4
28	4	55.3	221.2
29	6	56.9	341.4
30	1	58.5	58.5
31	5	60.1	300.7
32	0	60.7	0.0
33	2	61.4	122.7
34	2	62.0	123.9
35	3	62.6	187.7
36	3	63.2	189.5
37	1	63.8	63.8
38	3	64.4	193.2
39	0	66.0	0.0
40-60	1	67.0	67.0
TOTAL	94		4,296.8 kWh

(*) CORRECTED TO 97.0% DENSITY

MEAN WIND SPEED = 25.1 MPH

TABLE 3-8. WIND SPEED FREQUENCY DISTRIBUTION FOR J-08

DOE FREE FLOW DATA - JESS RANCH
SITE J-08 50-ft reference

10/01/87 - 10/10/87

SPEED (MPH)	HOURS	NORDTANK 65 POWER KW(*)	ENERGY KWH
10	0	2.2	0.0
11	1	4.5	4.5
12	0	6.8	0.0
13	1	9.4	9.4
14	2	12.0	23.9
15	4	14.5	58.2
16	4	18.6	74.5
17	5	22.7	113.5
18	3	26.8	80.3
19	2	30.8	61.7
20	3	34.9	104.8
21	3	38.0	114.1
22	3	41.1	123.4
23	4	44.2	176.9
24	7	47.3	331.4
25	8	50.4	403.5
26	9	52.1	468.5
27	8	53.7	429.4
28	5	55.3	276.4
29	9	56.9	512.2
30	4	58.5	234.1
31	2	60.1	120.3
32	2	60.7	121.5
33	3	61.4	184.1
34	2	62.0	123.9
35	2	62.6	125.1
36	3	63.2	189.5
37	1	63.8	63.8
38	1	64.4	64.4
39	1	66.0	66.0
40-60	0	67.0	0.0
TOTAL	102		4,659.2 kWh

(*) CORRECTED TO 97.0% DENSITY

MEAN WIND SPEED = 25.0 MPH

3.7 SPEED AND ENERGY RATIOS

The principal analysis tool of this report was the calculation of speed ratios between the reference site and all other sites. Ratios have been calculated for the entire dataset and for a number of sub-sets. The sub-sets were based on stratification by a third parameter. The stratifications were done by:

1) Wind direction at reference site
2) Wind speed at reference site
3) Day vs. night hours
4) Data Period (at Jess only, where there were two periods)

Theoretical energy ratios were also calculated for the entire dataset, using the Nordtank-65 kW power curve.

After calculating these various ratios, the data were plotted on topographic maps and isoplethed. The maps are an excellent vehicle for presenting this large amount of data, as the wind speed ratio patterns are quite apparent, when plotted out. In some cases, the ratios of a particular stratification class did not reveal any difference in overall pattern, from the entire dataset. In these cases the maps are redundant and have not been included in this report.

3.7.1 Souza Ranch Ratios

Table 3-9 lists the speed ratios to S-13 for the various stratifications as well as the energy ratios for the entire dataset.

TABLE 3-9. Souza Ranch Ratios to S13 70' Reference Anemometer

SITE	---ALL DATA--- SPEED RATIO	ENERGY RATIO	-----------SPEED RATIOS BY STRATIFICATION----------- DAY	NIGHT	210-226 DEG	226-255 DEG	10-24.6 MPH	24.6-41 MPH
S-13 35'	.95	.94	.94	.95	.96	.95	.95	.96
S-27 45'	.94	.92	.94	.94	.96	.92	.95	.94
S-27 80'	.94	.93	.93	.94	.96	.93	.95	.94
S-29 50'	.96	.96	.96	.95	.97	.95	.98	.95
D02 35'	.96	.96	.97	.96	.98	.95	.98	.95
D04	.94	.93	.93	.94	.97	.92	.96	.93
D06	.93	.91	.91	.93	.96	.89	.93	.92
D07	.94	.93	.93	.94	.98	.91	.95	.93
D11	1.08	1.09	1.07	1.09	1.11	1.06	1.09	1.08
D13	1.10	1.10	1.08	1.10	1.15	1.05	1.11	1.09
E02	1.03	1.03	1.02	1.02	1.07	.99	1.04	1.02
E04	.95	.94	.95	.94	.98	.92	.96	.94
E06	.96	.95	.97	.94	.98	.94	.97	.95
E10	.99	.98	.97	.99	1.04	.94	.99	.99
E12	.93	.92	.92	.93	.97	.89	.94	.92
E14	.92	.91	.92	.91	.95	.89	.94	.91
F02	1.05	1.06	1.07	1.03	1.08	1.02	1.06	1.04
F04	1.06	1.07	1.08	1.04	1.07	1.05	1.08	1.05
F06	1.11	1.11	1.13	1.09	1.12	1.10	1.12	1.10
F08	1.06	1.07	1.08	1.05	1.09	1.04	1.07	1.06
F10	.98	.97	.99	.98	.99	.98	.98	.98
F12	1.02	1.01	1.01	1.02	1.02	1.01	1.01	1.02
F14	.98	.95	.95	.99	.98	.97	.96	.99
G02	1.05	1.05	1.06	1.03	1.06	1.03	1.06	1.05
G04	.98	.97	.97	.98	.99	.97	.98	.98
G07	.92	.88	.89	.93	.94	.89	.90	.93
G09	.77	.68	.75	.78	.80	.74	.76	.78
MEAN	.98	.97	.98	.98	1.01	.96	.99	.98

Review of Table 3-9 reveals that stratification by wind direction changes the ratios from the entire dataset, however stratification by speed and time-of-day show fewer changes. These are four ratio maps included in this section:

1) Speed ratios to S-13 for entire dataset
2) Energy ratios to S-13 for entire dataset
3) Speed ratios for wind direction band 210-226 degrees
4) Speed ratios for wind direction band 226-255 degrees

Before reviewing these figures it is useful to look at Figure 2-2, the topographic map of the Souza Ranch and surrounding terrain. Notice the location of the canyon aligned with the southwest flow that intersects the lower-left (southwest) corner of the study area.

Figure 3-4 is a plot of the speed ratios to S-13 for the entire data period. The wind speeds were quite uniform with the exception of G9. Almost all the site ratios were within a range of 90 - 110% of S-13. There are two high wind areas; in the west area near G2 and F2-F8, and in the east area around D11 and D13. The first area is on a ridge downwind of the principal canyon axis, mentioned above. The second area is a lower ridge jutting into a small drainage canyon (also aligned southwest). The areas with speed ratios of 100% or higher have been lightly shaded on the Souza maps. All sites with ratios above 100% are on ridges that intersect or jut into small drainage canyons, aligned with the prevailing flow. Turbine G9 is in a low wind area that appears to be sheltered by the terrain immediately west of it.

Figure 3-5 is a plot of the theoretical energy ratios for the entire data period. The pattern is the same as Figure 3-4. Note that no shear adjustments were made to correct the 35-ft data to hub-height (72 feet). Vertical shear data for the Souza sites were discussed in Section 3.5. As mentioned, site S-13 shear was about one-half the "normal" value of .14 (for flat terrain) and S-27 shear was about zero. At sites that are not on the tops of well exposed ridges, shear values may be close to .14. This is probably true at most of the "E" sites, which are on terrain that slopes gently down behind a ridge. Therefore the energy ratios on Figure 3-5 may be artifically low at these sites. However, trying to estimate wind shear at individual sites is difficult and the resulting errors could be larger than simply presenting the data as is.

Figure 3-6 is a plot of speed ratios for the more south-southwesterly winds (210-226 degrees). The ratios are about three percent higher overall, than on Figure 3-4, but the general pattern is the same.

Figure 3-7 is a plot of the speed ratios for the more west-southwesterly winds (226-255 degrees). The ratios are about two percent lower overall, than Figure 3-4 and five percent lower than Figure 3-6.

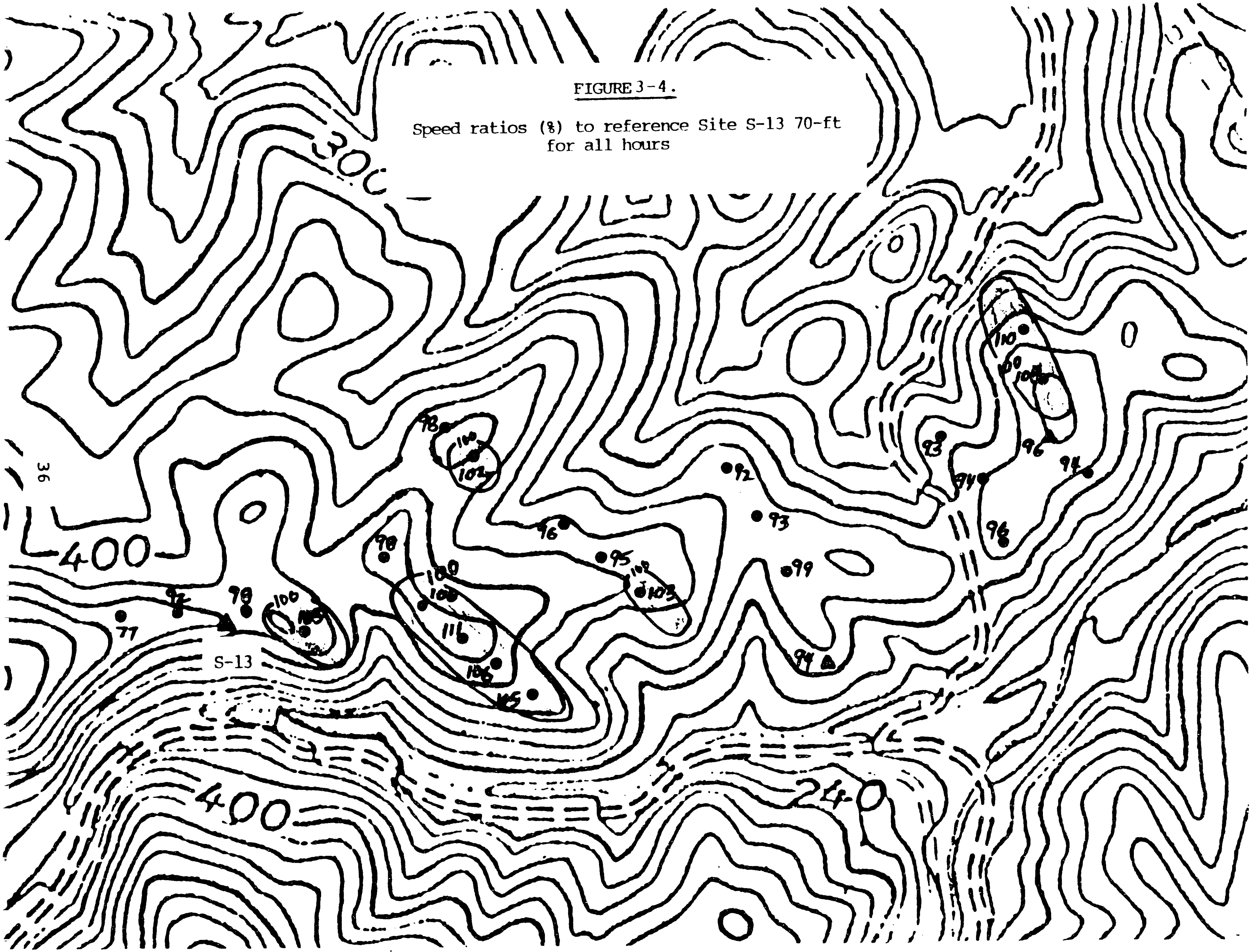


FIGURE 3-4.

Speed ratios (%) to reference Site S-13 70-ft
for all hours

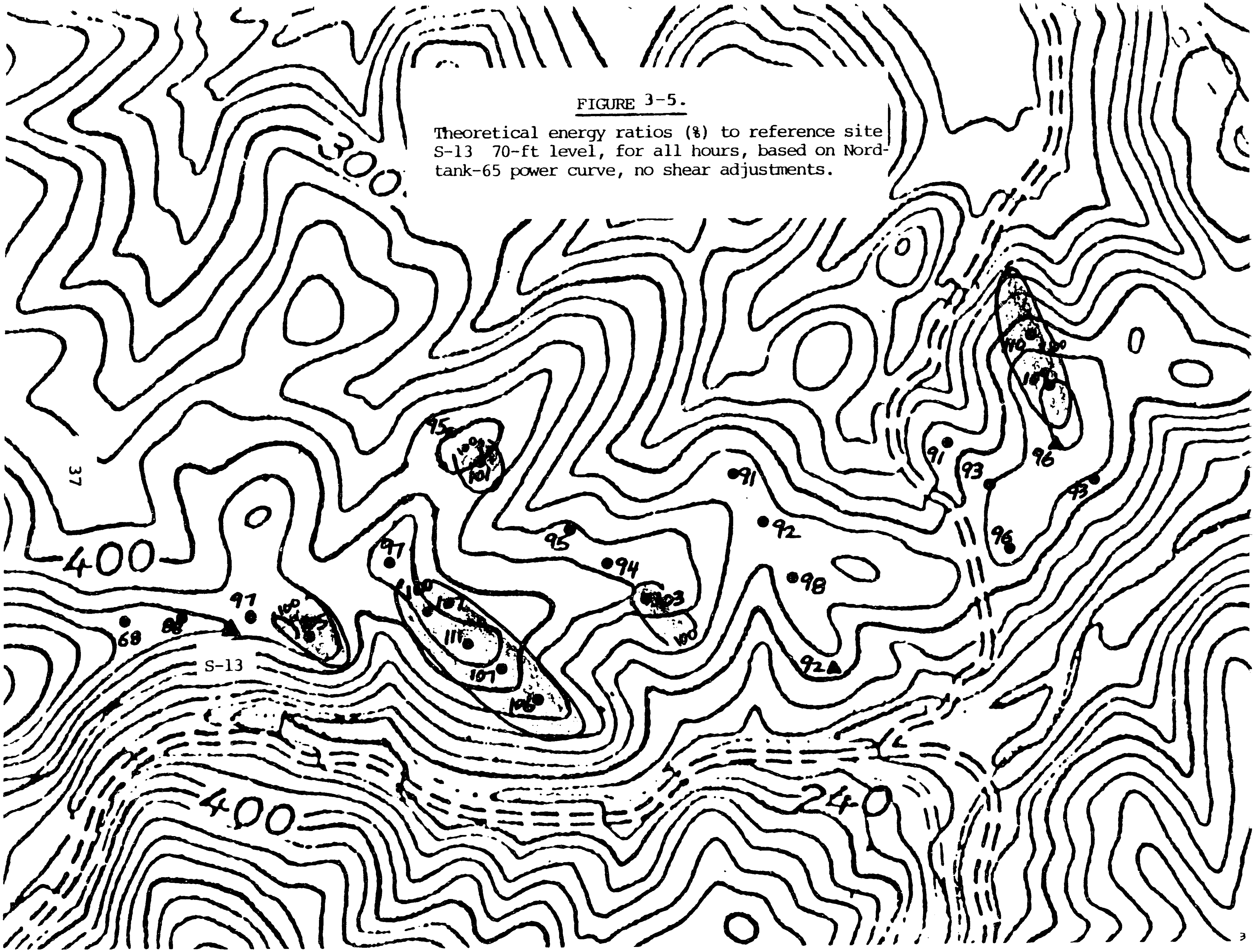


FIGURE 3-5.

Theoretical energy ratios (%) to reference site S-13 70-ft level, for all hours, based on Nordtank-65 power curve, no shear adjustments.

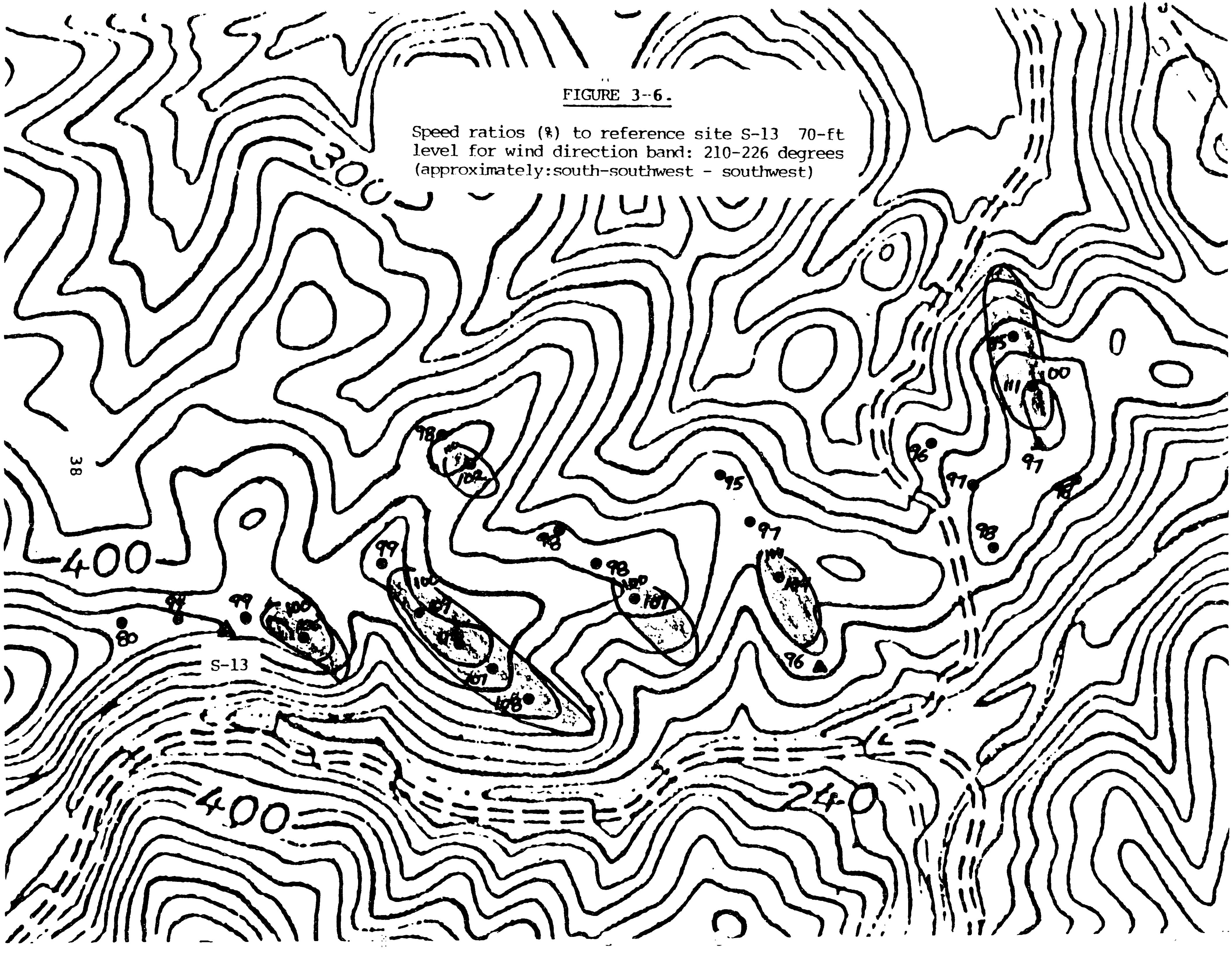


FIGURE 3-6.

Speed ratios (%) to reference site S-13 70-ft level for wind direction band: 210-226 degrees (approximately:south-southwest - southwest)

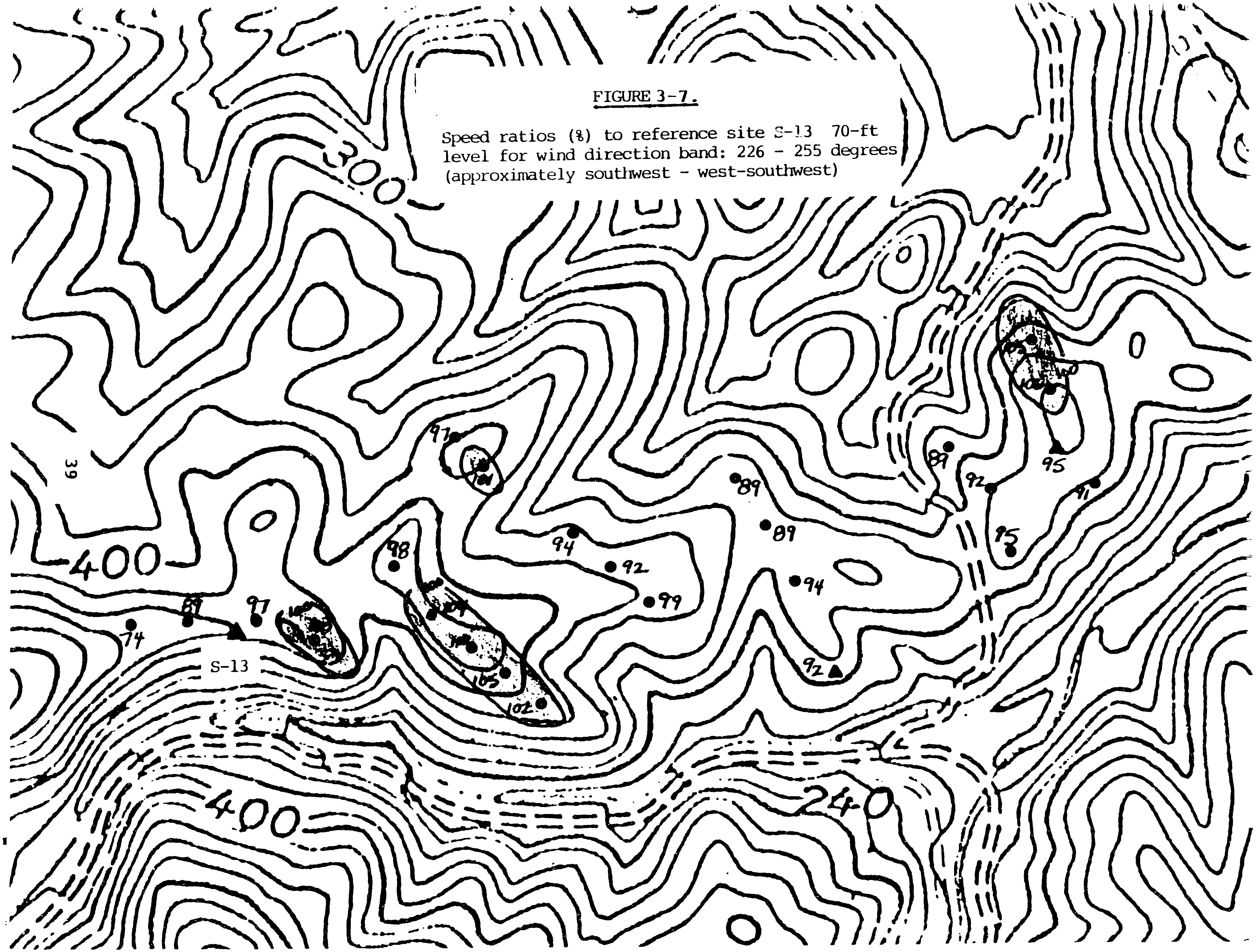


FIGURE 3-7.

Speed ratios (%) to reference site S-13 70-ft level for wind direction band: 226 - 255 degrees (approximately southwest - west-southwest)

3.7.2 Jess Ranch Ratios

Table 3-10 lists the speed ratios to J-08 for the various stratification classes as well as the energy ratios for the entire dataset. The speed ratios are for anemometer height and have not been normalized, except for J-04. The ratios from the four sites which had some invalid data points are calculated from the datasets that include the surrogate data. As with Souza, the stratification by wind direction, changes the ratios more than stratification by wind speed or time-of-day. The first data period; October 1-3, which was characterized by somewhat weaker flow also shows numerous changes in the speed ratios, relative to the entire dataset. Thus there are five ratio maps included in this section:

1) Speed ratios to J-08 for entire dataset
2) Energy ratios to J-08 for entire dataset
3) Speed ratios for wind direction band 210-247 degrees
4) Speed ratios for wind direction band 247-262 degrees
5) Speed ratios for October 1-3 data period.

Before reviewing the figures it is useful to refer back to Figure 2-1 to study the upwind terrain. Notice the locations of the canyons aligned with the southwest flow, upwind of the ranch. Two large and one small canyon should be noted. The largest canyon intersects the southern border of the study area and continues southwest for two miles through sections 35 and 2. A second large canyon, which contains the southern lanes of Interstate-580, is west of the northern part of the study area. A small, third canyon can be seen in the southeast portion of Section 26. The canyons are marked with arrows. One additional terrain feature to take not of is the 681-ft hill upwind of Jess just west of the area marked, "Cayley".

Table 3-10. Jess Ranch Free-Flow Data Analysis

Speed and Energy Ratios to Site J-08 for different stratification classes

site	all hours	232-247 degrees	247-262 degrees	10-25.6 mph	25.6-45 mph	Daytime hours	Night hours	Oct 1-3	Oct 7-10	ENERGY RATIOS
J04 e50'	0.91	0.95	0.86	0.92	0.90	0.91	0.91	0.87	0.92	0.93
J04 120'	0.99	1.04	0.94	1.00	0.98	0.99	0.99	0.95	1.00	0.99
J19 40'	0.96	1.01	0.91	0.98	0.95	0.92	0.99	0.95	0.97	1.03
J19 80'	1.00	1.06	0.94	1.01	1.00	0.95	1.04	0.99	1.01	0.99
J17 35'	0.80	0.79	0.81	0.80	0.80	0.79	0.80	0.81	0.80	0.82
J17 70'	0.86	0.86	0.87	0.86	0.87	0.85	0.87	0.87	0.86	0.82
J18 35'	0.72	0.76	0.67	0.70	0.74	0.75	0.70	0.60	0.76	0.71
J18 70'	0.78	0.82	0.72	0.76	0.79	0.80	0.76	0.65	0.81	0.70
C1 50'	0.94	0.97	0.90	0.96	0.92	0.93	0.94	0.91	0.94	0.97
C3 50'	0.92	0.96	0.88	0.94	0.90	0.89	0.93	0.90	0.92	0.93
C5 50'	0.83	0.86	0.80	0.84	0.83	0.80	0.85	0.82	0.84	0.81
C7 50'	0.76	0.80	0.72	0.78	0.76	0.74	0.78	0.74	0.77	0.71
C9 50'	0.78	0.82	0.74	0.78	0.78	0.74	0.81	0.75	0.79	0.72
C12 50'	0.93	0.97	0.88	0.93	0.92	0.92	0.93	0.89	0.94	0.94
C14 50'	1.02	1.07	0.97	1.02	1.02	1.00	1.04	1.00	1.03	1.04
C16 50'	0.82	0.87	0.77	0.82	0.83	0.79	0.84	0.77	0.84	0.79
C18 50'	0.80	0.84	0.75	0.79	0.80	0.75	0.83	0.77	0.81	0.74
D2 50'	0.77	0.81	0.72	0.77	0.77	0.73	0.80	0.77	0.77	0.71
D4 50'	0.75	0.79	0.71	0.76	0.75	0.72	0.78	0.77	0.75	0.68
D6 50'	0.73	0.75	0.70	0.73	0.72	0.69	0.75	0.77	0.72	0.64
D13 50'	0.76	0.78	0.73	0.76	0.76	0.71	0.79	0.81	0.74	0.69
D15 50'	0.73	0.74	0.71	0.73	0.73	0.69	0.76	0.78	0.71	0.65
D21 50'	0.70	0.74	0.65	0.70	0.70	0.70	0.70	0.64	0.72	0.61
E2 50'	0.73	0.75	0.70	0.72	0.73	0.70	0.74	0.74	0.72	0.65
E4 50'	0.70	0.74	0.67	0.69	0.71	0.70	0.70	0.66	0.72	0.62
E6 50'	0.63	0.67	0.59	0.62	0.64	0.65	0.62	0.55	0.66	0.50
E8 50'	0.71	0.73	0.67	0.68	0.72	0.73	0.69	0.62	0.73	0.62
E10 50'	0.76	0.80	0.73	0.74	0.78	0.76	0.76	0.70	0.78	0.72
E11 50'	0.68	0.69	0.68	0.68	0.68	0.66	0.70	0.73	0.67	0.57
E13 50'	0.72	0.73	0.70	0.71	0.72	0.69	0.73	0.73	0.71	0.63
E15 50'	0.71	0.72	0.69	0.69	0.71	0.69	0.72	0.71	0.70	0.62
E18 50'	0.70	0.74	0.67	0.69	0.71	0.71	0.70	0.65	0.72	0.61
E20 50'	0.75	0.77	0.72	0.73	0.76	0.77	0.73	0.67	0.77	0.69
E22 50'	0.84	0.86	0.81	0.81	0.85	0.83	0.83	0.80	0.84	0.82
F1 35'	0.68	0.72	0.63	0.67	0.69	0.71	0.66	0.57	0.71	0.63
F3 35'	0.64	0.67	0.59	0.60	0.66	0.66	0.61	0.52	0.67	0.56
F7 35'	0.71	0.77	0.65	0.70	0.72	0.71	0.70	0.62	0.74	0.68
F9 35'	0.62	0.68	0.56	0.62	0.62	0.63	0.61	0.53	0.65	0.53
F12 35'	0.63	0.70	0.56	0.62	0.64	0.64	0.62	0.50	0.67	0.55
G1 35'	0.58	0.63	0.53	0.57	0.59	0.60	0.57	0.50	0.61	0.45
G3 35'	0.56	0.59	0.53	0.55	0.57	0.58	0.55	0.51	0.58	0.40
G5 35'	0.74	0.75	0.74	0.72	0.76	0.76	0.73	0.71	0.75	0.71
G7 35'	0.84	0.84	0.84	0.81	0.86	0.85	0.83	0.82	0.85	0.87
G8 35'	0.58	0.62	0.53	0.56	0.59	0.61	0.56	0.46	0.61	0.46
G10 35'	0.63	0.67	0.59	0.60	0.65	0.65	0.61	0.52	0.66	0.54
G12 35'	0.70	0.72	0.68	0.68	0.72	0.72	0.68	0.64	0.72	0.65

Table 3-10. Jess Ranch Free-Flow Data Analysis

site	all hours	232-247 degrees	247-262 degrees	10-25.6 mph	25.6-45 mph	Daytime hours	Night hours	Oct 1-3	Oct 7-10	ENERGY RATIOS
H1 50´	1.02	1.06	0.98	1.03	1.01	0.95	1.07	1.03	1.01	1.04
H2 50´	0.98	1.02	0.93	0.98	0.97	0.91	1.01	0.97	0.97	0.98
H7 50´	0.84	0.88	0.79	0.84	0.83	0.80	0.87	0.84	0.84	0.82
H10 50´	0.82	0.86	0.78	0.83	0.82	0.80	0.83	0.83	0.82	0.80
H12 50´	0.84	0.88	0.79	0.85	0.83	0.78	0.87	0.84	0.84	0.82
H15 50´	0.79	0.83	0.74	0.80	0.79	0.78	0.80	0.78	0.79	0.76
I1 50´	0.80	0.84	0.76	0.81	0.80	0.79	0.81	0.80	0.80	0.78
I3 50´	0.82	0.85	0.78	0.82	0.81	0.81	0.82	0.81	0.82	0.79
I5 50´	0.80	0.84	0.76	0.81	0.80	0.80	0.80	0.77	0.81	0.78
I9 50´	0.77	0.82	0.71	0.76	0.77	0.77	0.77	0.73	0.78	0.73
I14 50´	0.84	0.89	0.78	0.84	0.84	0.85	0.83	0.75	0.87	0.84
J6 50´	0.80	0.85	0.75	0.79	0.81	0.82	0.79	0.71	0.83	0.78
J8 50´	0.80	0.86	0.72	0.77	0.81	0.80	0.78	0.66	0.84	0.78
J11 50´	0.82	0.87	0.76	0.81	0.82	0.83	0.81	0.73	0.84	0.80
J13 50´	0.81	0.87	0.73	0.79	0.81	0.81	0.80	0.69	0.84	0.79
K1 35´	0.68	0.72	0.63	0.69	0.68	0.68	0.69	0.60	0.71	0.62
K3 35´	0.72	0.77	0.65	0.71	0.71	0.73	0.70	0.62	0.74	0.68
K5 35´	0.71	0.73	0.68	0.71	0.70	0.73	0.69	0.66	0.72	0.66
K7 35´	0.67	0.67	0.68	0.66	0.68	0.69	0.66	0.65	0.68	0.59
K9 35´	0.76	0.75	0.77	0.75	0.76	0.76	0.75	0.77	0.75	0.74
K12 35´	0.72	0.71	0.72	0.72	0.71	0.73	0.70	0.70	0.72	0.67
K14 35´	0.82	0.80	0.83	0.81	0.82	0.82	0.81	0.82	0.81	0.83
L1 35´	0.86	0.85	0.87	0.85	0.87	0.86	0.86	0.87	0.86	0.90
L3 35´	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.98
L5 35´	0.96	0.96	0.95	0.95	0.96	0.96	0.95	0.94	0.96	1.03
L8 35´	0.86	0.86	0.87	0.85	0.87	0.86	0.86	0.87	0.86	0.90
L10 35´	0.92	0.91	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.98
L12 35´	0.96	0.96	0.97	0.97	0.96	0.96	0.96	0.97	0.96	1.04
M2 35´	0.84	0.82	0.85	0.83	0.84	0.83	0.84	0.84	0.83	0.87
M4 35´	0.84	0.84	0.85	0.85	0.84	0.84	0.85	0.85	0.84	0.88
M6 35´	0.91	0.91	0.91	0.92	0.91	0.91	0.91	0.91	0.91	0.98
M8 35´	0.96	0.96	0.96	0.97	0.95	0.95	0.96	0.97	0.95	1.04
M9 35´	0.86	0.85	0.86	0.86	0.85	0.85	0.86	0.86	0.85	0.90
M11 35´	0.88	0.87	0.88	0.89	0.87	0.86	0.88	0.89	0.87	0.93
M13 35´	0.96	0.95	0.96	0.97	0.95	0.94	0.96	0.98	0.95	1.03
N1 35´	0.85	0.85	0.86	0.86	0.85	0.85	0.85	0.84	0.85	0.88
N4 35´	0.80	0.81	0.79	0.81	0.80	0.80	0.80	0.78	0.81	0.82
N6 35´	0.78	0.77	0.78	0.79	0.77	0.77	0.78	0.78	0.77	0.78
N8 35´	0.78	0.77	0.78	0.78	0.78	0.76	0.78	0.78	0.78	0.78
MEAN:	0.79	0.82	0.76	0.79	0.80	0.79	0.80	0.76	0.80	0.77

Figure 3-8 is a plot of the speed ratios to J-08. All ratios are based on 35-ft or 50-ft level data with the following caveats:

1) J-04 is adjusted from 120 feet to 50 feet using an alpha of .10.
2) J-19 data is actually 40 feet (unadjusted)
3) J-08 data is actually 50 feet (unadjusted)
4) 35 foot turbine anemometer ratios are adjusted to the 50 foot level using an alpha of .10. Data collected on turbines on the northern half of the ranch were at 35 feet, vs. 50 feet on the southern half. It is possible that use of an alpha of .10 could yield a speed ratio error of plus or minus three percent based on the expected range of shear values at these sites. Use of an alpha of .10 is considered a good compromise based on data from J-17 and J-18.

Note that almost all ratios are less than 100%. This is due to site J-08's excellent exposure. J-08 is situated on a bluff which juts into the large canyon that Interstate 580 runs through. J-08 is exposed to this channel, which is oriented parallel to the west-southwest flow. There are three relatively high wind areas; one around J-08, extending downwind of it, one in the southern part of the study area at J-19 and another one in the southern part of the study area around H1, H2, C10, C12 and C14. These areas are aligned with the large canyons discussed above. A fourth smaller area of relatively high winds can be found near E10 and E22. This area is aligned with the third small canyon discussed above. A relatively low wind speed area can be found around G1, G3 and G8. This area appears to be blocked by the 681-ft hill to the immediate southwest.

It is interesting to note that the range of ratios on Jess is considerably larger than on Souza. The Jess Study area is larger than Souza, but due to its flatter terrain, more homogeneity was expected.

Figure 3-9 is a plot of the energy ratios to J-08. Note that all sites except J-08 have been normalized to hub-height (72 ft) using a vertical wind shear exponent of .10. Met towers J-17, J-18 and J-19 use their hub-height sensors for this map. Tower J-04 has been adjusted (down) from the 120-ft level. All turbines have been adjusted (up) from the 35-ft or 50-ft level. Vertical wind shear has been discussed in Sections 3.5 and 3.7.1. In Section 3.5 it was shown that sites J-17 and J-18 had shear exponents of about .10. These sites have exposure that is representative of many of the sites on Jess. They are in fairly flat areas, and not on highly exposed knolls like J-08 and J-19. Use of an alpha of .10 is a good compromise. Some sites like turbines L3 and L5 probably have less positive shear due to their similar exposure to J-08. Thus their theoretical energy production may be biased positively. Other sites, like G1, G3 and G8, downwind of a hill probably have higher shear than .10. Thus they may be negatively biased. As mentioned in Section 3.7.1 estimating individual sites' vertical shear is difficult and so the reader is cautioned that individual energy ratios on Table 3-10 and Figure 3-9 could be in error by as much as 10%. Figure 3-9 shows a similar pattern to Figure 3-8, except that there is wider range of ratios (the lows are lower).

Figure 3-10 is a plot of the normalized (to 50 foot level) speed ratios to J-08 for wind directions from 232 to 247 degrees. The pattern is similar to Figure 3-8, except many sites have higher ratios. This is especially true in the southern and central part of the study area. The ratios in the northern area around J-08 are unchanged.

Figure 3-11 is a plot of the normalized speed ratios to J-08 for wind directions from 247 to 262 degrees. On this figure many of the ratios are lower than on Figure 3-8. As in the previous figure, the largest swing occurs in the southern and central part of the study area, with the northern area unchanged. A possible explanation is that in winds with a more southerly component (Figure 3-10) the large canyon near the southern part of the study area (see Figure 2-1) is more aligned with the flow. Thus these areas get an additional boost, and the ratios increase. With more of a westerly component, this canyon is not as well aligned and the ratios fall.

Figure 3-12 is a plot of the normalized speed ratios to J-08 for the first study period. In this figure, the ratios in the center of the ranch drop considerably. This is especially noticeable around tower J-18 and the F, G, J and K turbines. Sites at the northern and southern ends of the study area show little change relative to Figure 3-8.

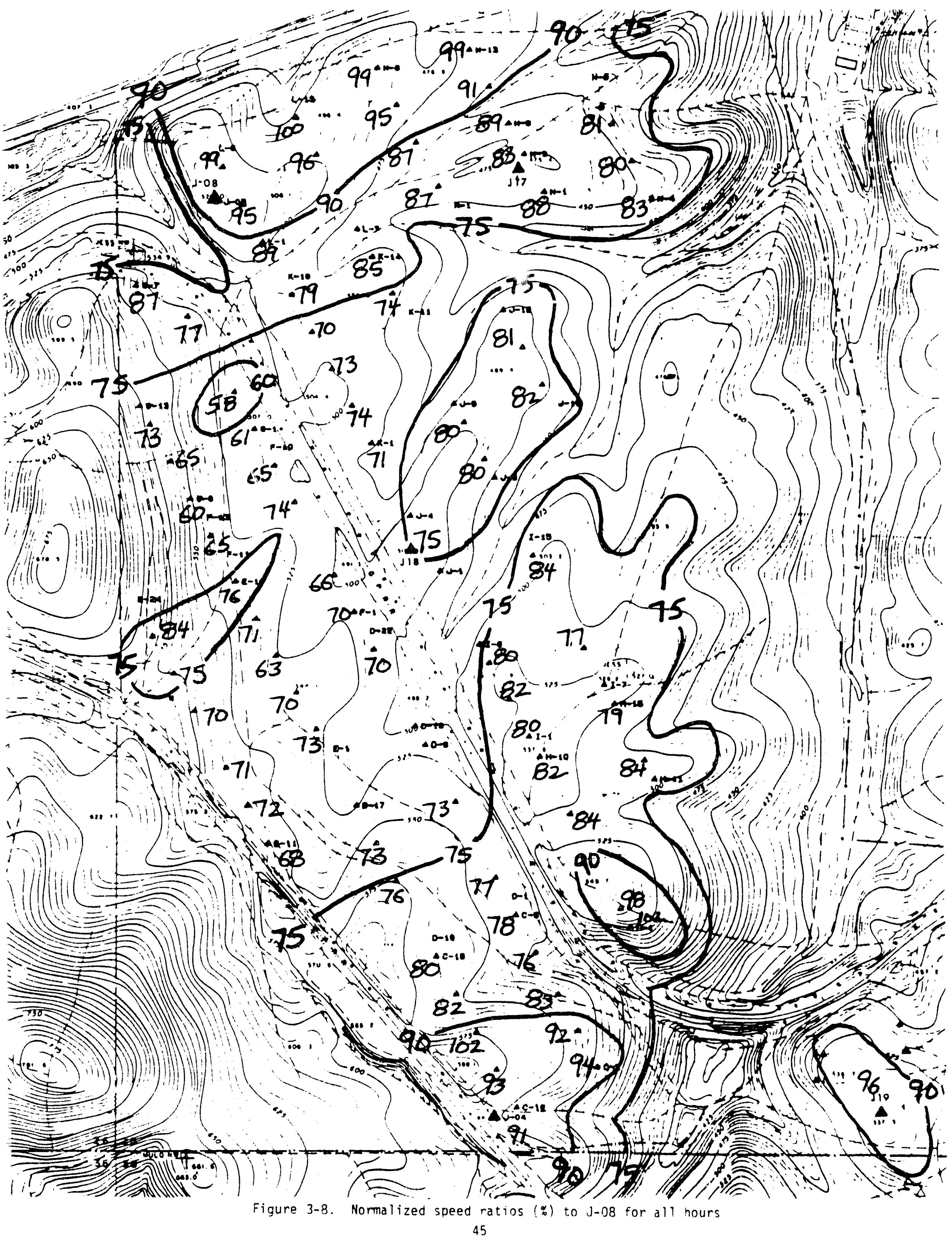


Figure 3-8. Normalized speed ratios (%) to J-08 for all hours

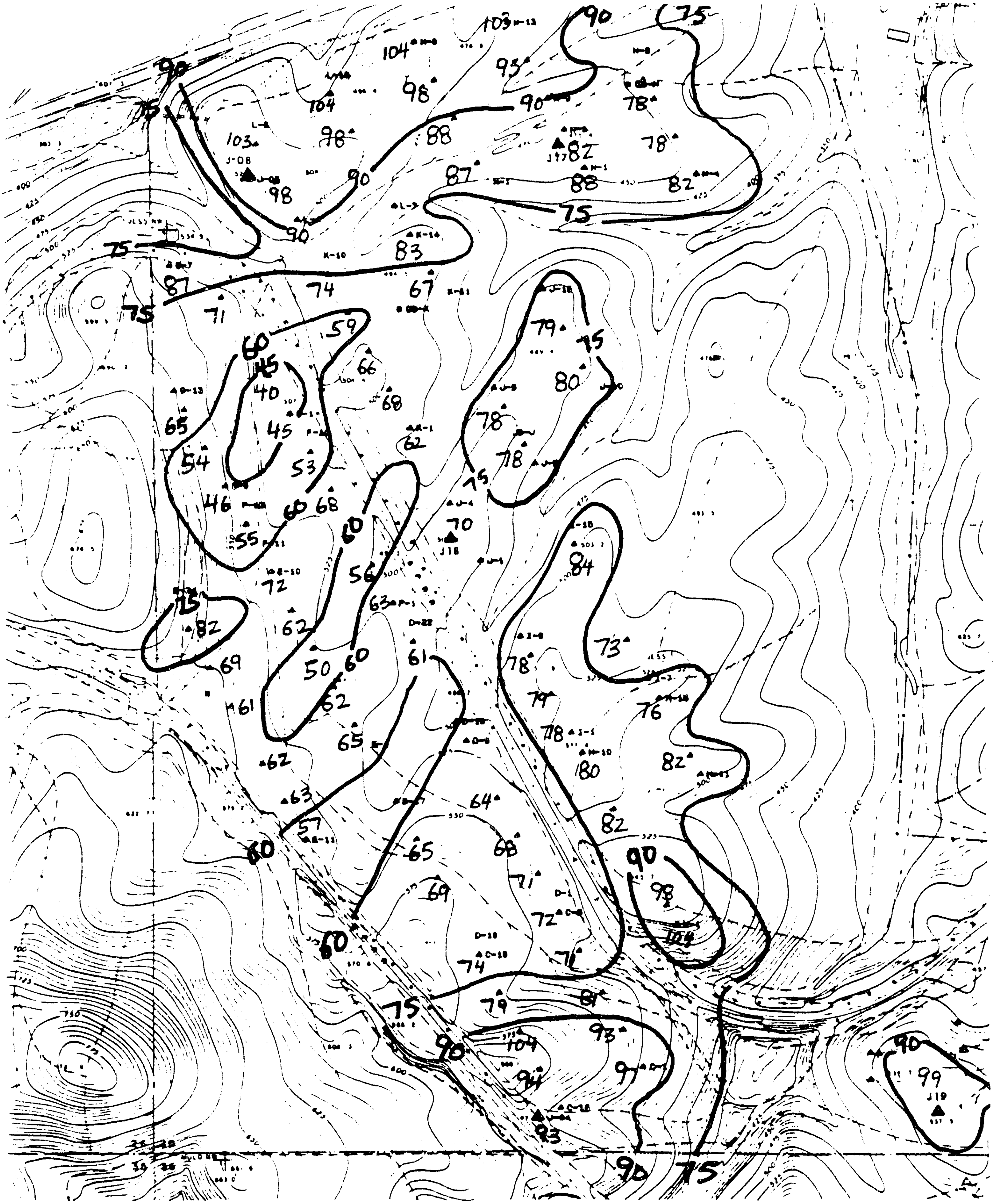


Figure 3-9. Theoretical energy ratios (%) to J-08, Nordtank 65 curve, assumed alpha = .10

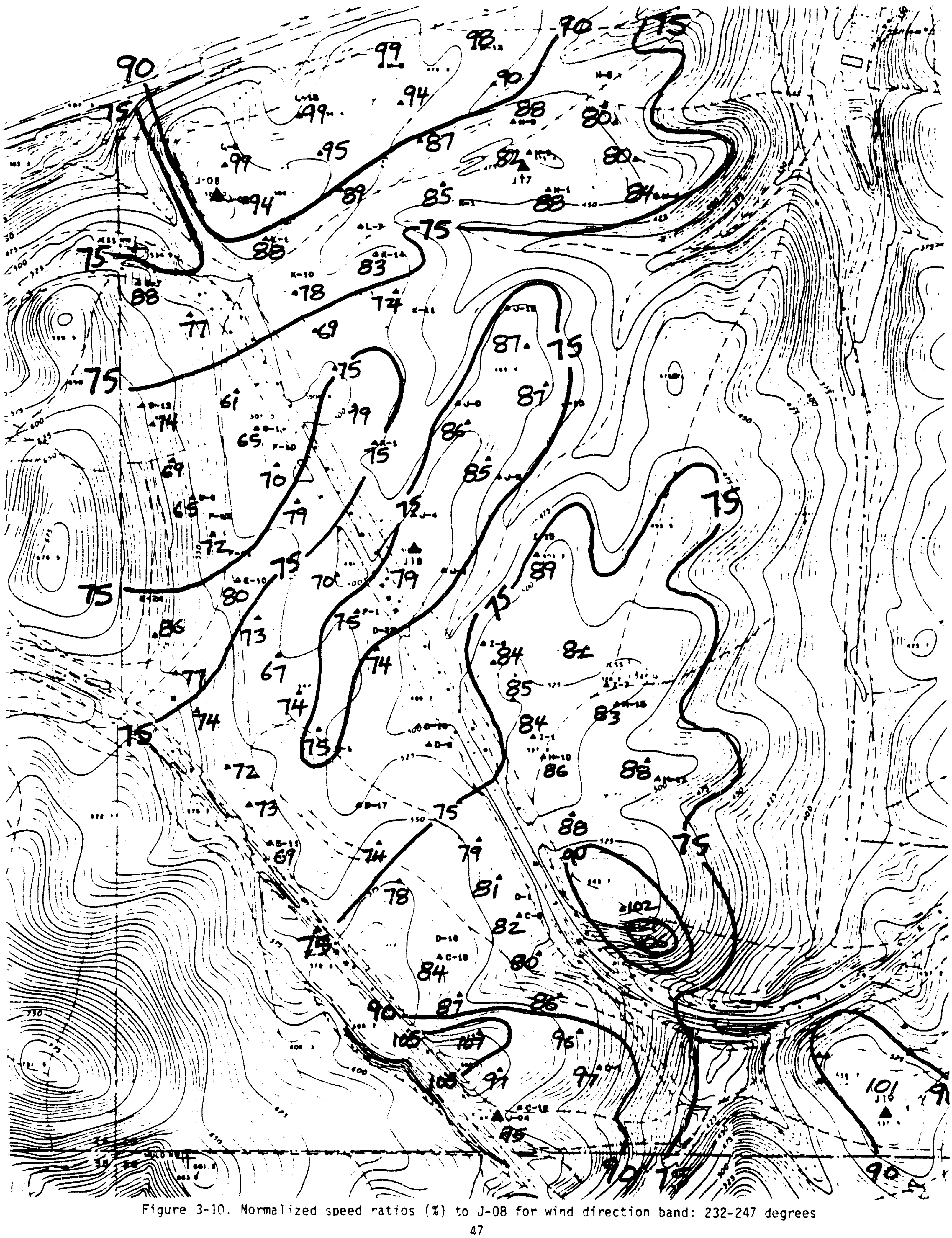


Figure 3-10. Normalized speed ratios (%) to J-08 for wind direction band: 232-247 degrees

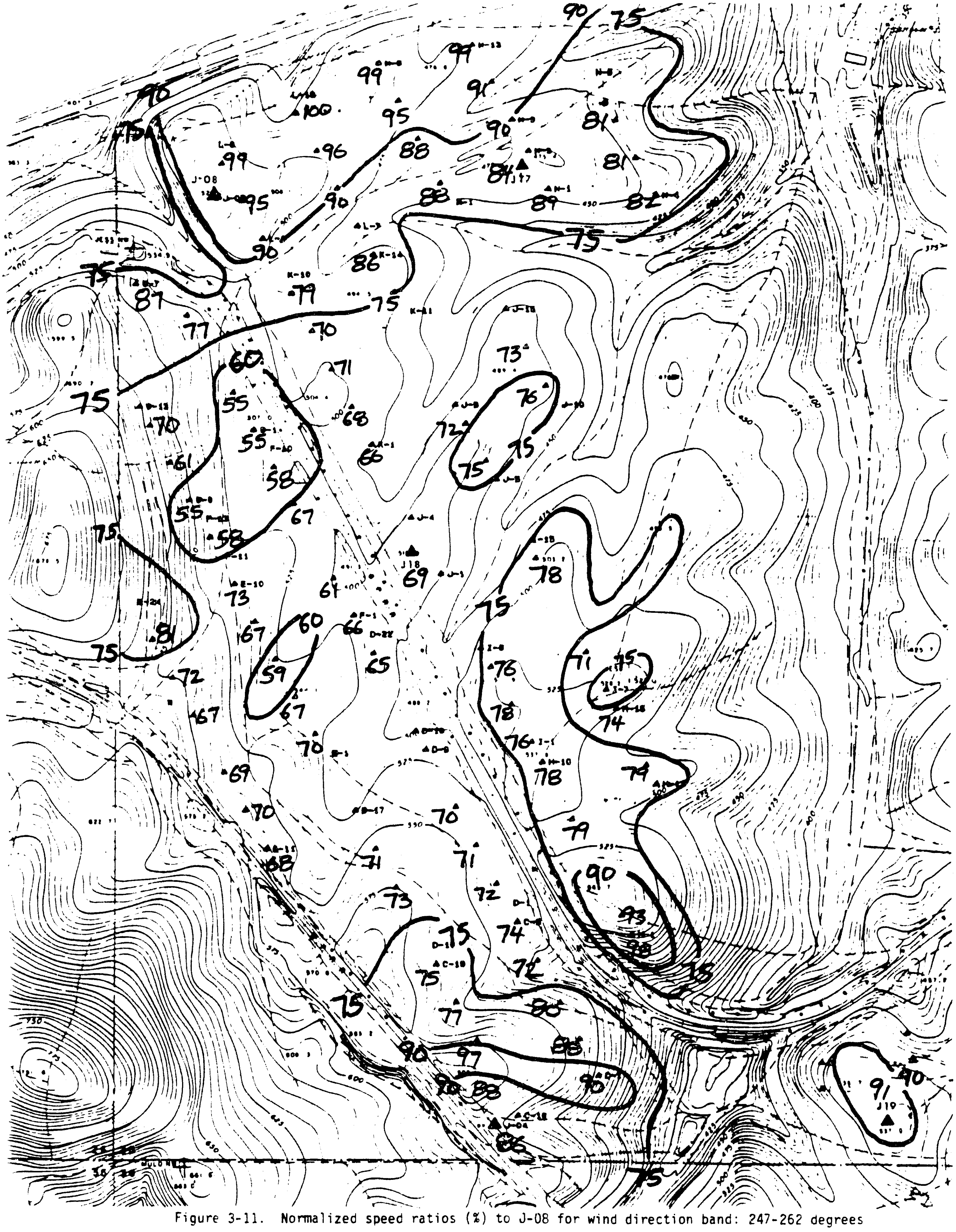


Figure 3-11. Normalized speed ratios (%) to J-08 for wind direction band: 247-262 degrees

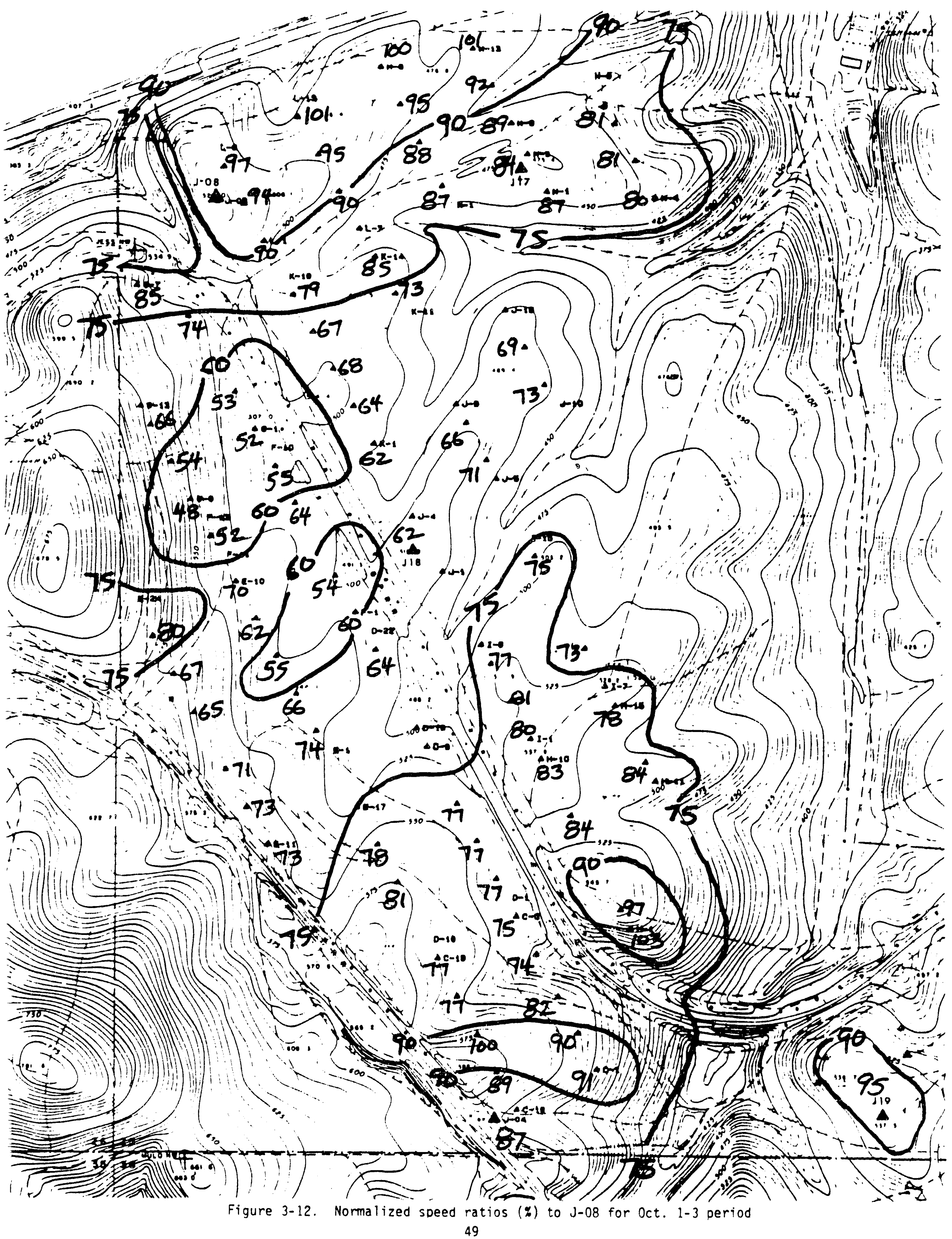


Figure 3-12. Normalized speed ratios (%) to J-08 for Oct. 1-3 period

SECTION 4.0

CONCLUSIONS

Wind speed data were collected from two dense networks on two windfarms in the Altamont Pass. The data were collected during typical spring-summer conditions, with no turbines operating in the study areas. Data were analyzed to determine variability of the wind resource. The principal method for doing this was to calculate wind speed ratios to a single reference location.

The smaller test area, the Souza Ranch, has moderately complex terrain. The topography is a gentle downslope punctuated with some small ridgelines which trend perpendicular to the flow. In spite of the complex terrain, the dataset revealed a fairly homogeneous resource. All sites were highly correlated to the reference tower and the mean speed ratio was 98%. The range of speed ratios was from 77% to 111%, however all but two sites had ratios within a band from 90% to 110% of the reference. Site elevation appears to enhance the flow. A topographic pattern at least as significant as elevation is a combination of ridges and canyons. Specifically, ridges normal to the flow that jut into drainage canyons parallel to the flow, appear to have the highest wind resource.

The Jess Ranch study area has slightly complex terrain. It is a gentle downslope with a few ridges and valleys oriented parallel to the terrain. The dataset was not as homogenious as the Souza dataset. The average correlation coefficient between the reference site and the other sites was .89. Speed ratios ranged from 56% to 102%, with a mean ratio of 79%. The range of theoretical energy ratios was from 40% to 104%. Thus the ratio between the best and worst turbine's theoretical energy production is 260%. These turbines are separated by about a half-mile and a difference in elevation of only 60 feet.

The low speed ratios to J-08 were due to the excellent exposure of the reference site, relative to the other sites. Site elevation does not appear to be a factor at this site. However, the topographic pattern observed at Souza was seen here as well. Sites on ridges that jut into drainage canyons, or that are downwind of drainage canyons have the best resource, conversely, a hill rising 150 feet above the surrounding terrain appears to disturb the flow for approximately ten hill-heights (1500 feet) downwind. Ten hill-heights is consistent with old meteorological rules-of-thumb. The strong positive effect of the drainage canyons parallel to the flow may not have universal application. It is true in the Altamont because of the shallow, stable flow under the inversion. In areas with deeper layers or higher instability these canyons might not have such a dramatic effect.

Appendix A

Synoptic Meteorological Summaries

SYNOPTIC SUMMARIES

FOR THE SOUZA FREE FLOW STUDY

SEPTEMBER 10 THROUGH SEPTEMBER 14, 1987

SEPTEMBER 10

On the afternoon of September 10, 1987 at 1600 PST, the semipermanent, subtropical Pacific surface high pressure area was centered southwest of San Francisco at 32°N 132°W, with a central pressure of 1026 mb. A thermal low pressure area, also a semipermanent feature, was centered over the southern tip of Nevada with a central pressure of 1006 mb. The axis of this trough extended into southeast British Columbia (see figure A1 where the important weather map features have been labled). The surface pressure gradient between the coast and the San Joaquin Valley was moderate at 3 mb. Aloft, southwest winds of 10 kts and a height of 585 decameters was reported at the 500 mb level over Oakland, as the upper winds circulated around a low pressure area with a central height of 574 decameters, located at 40°N 134°W (see figure A2). The height of the marine layer was at a typical summertime level of 400 meters. Winds at Souza were 20-30 mph at this time. Although the thermal trough axis was east of its usual position, and extended much farther north than it normally does, this was a more or less typical summertime weather pattern over the western United States.

SEPTEMBER 11

At 0400 PST on September 11, surface high pressure was centered at 33°N 137°W, with a central pressure of 1025 mb. The thermal low was centered over southwest Arizona with a central pressure of 1005 mb, and the axis continued east of its normal position extending through Nevada, Oregon, and into eastern Washington (see figure A3). The surface pressure gradient from the coast to the valley at this time had diminished to 2-2.5 mb. The 500 mb low moved eastward to 40°N 130°W. At Oakland, the wind at 500 mb had increased to 15 kts out of the southwest, and the height of the 500 mb surface had dropped 5 decameters (which is greater than the fall that normally occurs during that part of the day) to 580 decameters (see figure A4). The marine layer at this time continued at a depth of about 400 meters. Winds at Souza had increased slightly to 25-30 mph.

At 1600, the thermal low center had deepened to 1002 mb and moved into southeastern California, with the trough axis extending into eastern Washington. Along this axis, there was another low center of 1005 mb in central Nevada, and one of 1007 mb in northeast Oregon (see figure A5). These last two centers were probably due more to atmospheric dynamics rather than surface heating. The surface pressure gradient had increased to 3-3.5 mb. At 500 mb, the upper level low moved southeast toward the area and intensified slightly to 573 decameters at 38°N 128°W (see figure A6). This caused the winds at this level to back to the south and increase to 20 kts above Oakland, and the level of the 500 mb surface to drop to 577 decameters at a time of day when it normally rises. It also allowed the marine layer to deepen to 800 meters. The winds at Souza had increased to 25-35 mph in a weather pattern that is quite common in spring but occurs infrequently in the summertime.

SEPTEMBER 12

At 0400 PST on September 12, the Pacific High was centered at 35°N 150°W. The thermal low had a central pressure of 1003 mb and was centered over southern Nevada with the axis extending southward into extreme northwest Mexico, and northward into eastern Oregon (see figure A7). The surface pressure gradient had slackened to about 2 mb. The 500 mb low continued its southeast trek to a position at 35°N 125°W, and the central pressure dropped to 570 decameters. At Oakland, the 500 mb winds became southeast, and diminished to 5 kts, while the level of the 500 mb surface fell to 573 decameters (see figure A8). The marine layer was somewhat shallower at 650 meters. As the pressure gradient had diminished, and the marine layer had become thinner, the winds at Souza had decreased to about 25 mph.

At 1600, the Pacific High had a central pressure of 1025 mb, and was located at 34°N 143°W. The thermal low was centered over southeast California with a central pressure of 1002 mb, and a trough axis extending into the southern Sierra Nevada. A dynamic low pressure center of 1000 mb was located in northwest Nevada, and a secondary center of 1002 mb was centered over western Idaho (see figure A9). The pressure difference from the coast to the valley had increased to 3 mb. Aloft, the 500 mb disturbance intensified to 569 decameters, and moved to a position just off the California coast at Point Conception. In response, the winds at that level became east-northeast above Oakland (see figure A10). The marine layer continued at about the same depth at 700 meters. The winds at the site also were little changed at 25-35 mph, in a west coast weather pattern that is typical in the spring, but quite unusual in the summertime.

SEPTEMBER 13

On September 13, at 0400 PST, surface high pressure was centered at 32°N 141°W, with a central pressure of 1025 mb. The thermal low pressure system was gone, and dynamic low pressure centers of 1004 mb and 1003 mb, were located over southern Nevada and southwest Idaho, respectively (see figure A11). The surface pressure gradient between the coast and the valley was about 2 mb. Aloft, the upper low moved into southern California, and winds above Oakland were from the northeast at 10 kts, with the 500 mb surface measured at 574 decameters (see figure A12). With cyclonic curvature aloft, the layer of marine air deepened to 950 meters. At Souza, the winds had diminished to about 20-25 mph.

At 1600, surface high pressure continued well offshore. The low pressure center that had been over southern Nevada at 0400, was now centered over southern Arizona with a central pressure of 1009 mb. The low over southwest Idaho continued nearly stationary, with a central pressure of 1003 mb (see figure A13). The surface gradient between San Francisco and Sacramento had increased to 2.7 mb. At the 500 mb level, the upper low had moved into southern Nevada, and at Oakland, the 500 mb height had risen to 581 decameters, with the winds becoming north-northwest at 15 kts in response to the movement of the upper level low out of the area, and the upstream ridge that was moving in behind it (see figure A14). With the upper air flow becoming anticyclonic, and the marine layer becoming shallower at 600 meters, the winds at Souza decreased to 10-20 mph in the "springlike" weather pattern.

SEPTEMBER 14

At 0400 PST, September 14, high pressure at the surface was centered at 42°N 154°W, with a weak ridge extending into northern California and Oregon. Once again the thermal trough was absent, but the dynamic low pressure center over southwest Idaho continued, though weakening, with a central pressure of 1010 mb (see figure A15). The surface gradient between the coast and the Central Valley had diminished to 1-1.5 mb. The upper low was over southeast Utah at this time, and the ridge that had been upstream 12 hrs earlier had just passed Oakland. Heights continued to rise at Oakland, as the 500 mb surface was measured at 583 decameters and the upper winds at Oakland were out of the northwest at 15 kts (see figure A16). The marine layer had deepened a little to a depth of 750 meters. The winds at Souza increased slightly to 15-25 mph.

At 1600, the surface high pressure area was centered at 42°N 150°W, and a surface cold front extended from southeast British Columbia through eastern Washington, Oregon, and northwest California. The thermal low had reformed over southern California with a central pressure of 1010 mb (see figure A17). The surface gradient had increased to 2-2.5 mb. At 500 mb, heights continued to rise at Oakland to 587 decameters, and the upper winds were west-northwest at 20 kts (see figure A18). The marine layer quickly became very shallow with the base of the inversion reported at the surface at Oakland. The winds at Souza at 1300 PST when the study ended were 15-20 mph. Although the weather was in the process of returning to normal summertime conditions, it was still in a springtime weather pattern.

SYNOPTIC SUMMARIES

FOR THE JESS FREE FLOW STUDY

OCTOBER 1 THROUGH OCTOBER 3

AND

OCTOBER 7 THROUGH OCTOBER 10, 1987

OCTOBER 1

On the afternoon of October 1, 1987 at 1600 PST, the semipermanent, subtropical Pacific surface high pressure area was centered southwest of San Francisco at 29°N 130°W, with a central pressure of 1019 mb. A thermal low pressure area of 1008 mb was centered over the Imperial Valley, with a trough axis extending northward over the Central Valley, through western Oregon into western Washington (see figure A19). The surface pressure gradient between the California coast and the Central Valley at this time was rather large at 4 mb. Aloft, south-southeast winds of 15 kts with a 500 mb height of 586 decameters was reported at Oakland, as the result of the circulation around an upper level high pressure area with a central pressure of 588 decameters, located over southern Idaho (see figure A20). Because of the anticyclonic motion and high heights aloft, the layer of marine air was shallow at 300 meters. Although the surface pressure gradient was quite large, the winds at Jess Ranch were only 20-25 mph because of the influence of the shallow marine layer, in this typical summertime weather pattern.

OCTOBER 2

At 0400 PST on October 2, surface high pressure developed a center of 1022 mb at 41°N 128°W, and was starting to build inland over the Pacific Northwest behind a weak, diffuse, cold front. The thermal low had a central pressure of 1011 mb, and was located over the east coast of Baja California, with the trough axis extending northward through the San Joaquin Valley into the Sacramento Valley (see figure A21). The surface pressure gradient was still large at 2.5-3 mb. At the 500 mb level, heights continued high at Oakland with 585 decameters reported. The wind at that level was out of the southwest at 5 kts in the circulation around a strong upper level low pressure area centered in the Gulf of Alaska (see figure A22). As a result, the marine layer deepened to 500 meters. With the pressure gradient weakening, and surface high pressure building into the Pacific Northwest, the winds at Jess had diminished to 15-25 mph, and would continue to decline and even become northerly during the day.

At 1600, surface high pressure was centered at 37°N 133°W, with a central pressure of 1026 mb, and a weak ridge extending into the Pacific Northwest. The thermal low was centered over extreme northwest Mexico with a central pressure of 1010 mb, and the trough axis extended northward through southern California, the Central Valley, Oregon, and eastern Washington (see figure A23). The pressure gradient was a moderate 2.4 mb. Aloft, Oakland was sandwiched between a high pressure center of 589 decameters at 36°N 132°W, and one of 591 decameters over Utah. The level of the 500 mb surface at Oakland had risen to 589 decameters, greater than the normal daytime rise (see figure A24). Winds over Oakland were light and variable, and the marine layer became quite shallow at 100 meters, under the influence of the strong high pressure aloft. At Jess, the winds which had become light northerly earlier in the day, continued out of that direction, and would not become southwest again until 1700 PST, in the typical summertime weather pattern.

OCTOBER 3

At 0400 PST October 3, the Pacific high was centered at 38°N 135°W with a central pressure of 1030 mb, and a weak ridge over Washington and Oregon. The thermal low was centered in northern Baja California, with the trough extending northward off the southern California coast to Point Conception, then inland over the coast range through the Sacramento Valley (see figure A25). The pressure gradient between the central California coast and the Central Valley had slackened to 1.7 mb at this time. At 500 mb, high pressure was centered at 38°N and 129°W with a center of 592 decameters (see figure A26). In response to the movement of the upper high toward the coast, the winds above Oakland had become northerly at 10 kts, and the heights continued to rise to 590 decameters. The marine layer was very shallow at this time at less than 100 meters. The winds at Jess which had been about 15 mph at 0300, had stopped completely at this time, ending the study. The winds would later become northerly in a pattern that was starting to have the characteristics of a classic late summer/early fall coastal heat wave.

OCTOBER 7

On the morning of October 7, 1987 at 0400 PST, the semipermanent, subtropical eastern Pacific surface high pressure area was centered southwest of San Francisco at 27°N 130°W, with a central pressure of 1020 mb. The thermal low pressure area was located over the Mexico/Arizona border, and had a central pressure of 1008 mb, with a weak trough axis extending northwestward along the southern Sierra Nevada (see figure A27). The surface pressure gradient between the California coast and the Central Valley at this time was large at 3.5 mb. Aloft, a weak trough just offshore was spinning out of a deep upper level low pressure area centered at 38°N 145°W with a central pressure of 551 decameters. This caused west-southwest winds of 20 kts with a height of 581 decameters at the 500 mb level over Oakland (see figure A28). Because of the approaching upper level trough and the west-southwest winds aloft, the summertime layer of marine air was a little deeper than usual at 500 meters. With an ample marine layer, and a strong pressure gradient, the winds at the Jess Ranch were quite high at 30-35 mph.

At 1600 PST, the Pacific high had moved toward California and was centered at 30°N 127°W with a central pressure of 1021 mb. The thermal low was nearly unchanged with a weak trough over the southern Sierra Nevada (see figure A29). The surface pressure gradient between the coast and the San Joaquin Valley continued at about 3.5 mb. At the 500 mb level, the weak trough that was offshore at 0400 was now over the Sierra, while the upper low had filled to 561 decameters and was now located at 39°N 141°W (see figure A30). In response, the winds at Oakland had become west-northwest at 20 kts, and the height of the 500 mb surface had risen to 583 decameters. The depth of the marine layer continued at 500 meters. The winds at Jess ranch had decreased to 25-30 mph in the typical summertime weather pattern.

OCTOBER 8

At 0400 PST on October 8, surface high pressure was centered at 26°N 130°W, with a central pressure of 1019 mb. The thermal low was centered over southwest Arizona with a central pressure of 1008 mb, and the axis oriented along the southern Sierra, through the Sacramento Valley, through northwest California (see figure A31). The surface pressure gradient from the coast to the valley at this time was a moderate 2-2.5 mb. The 500 mb low moved eastward slightly to 39°N 140°W with a central pressure of 560 decameters. At Oakland, the wind at 500 mb was out of the west-northwest at 15 kts, and the height of the 500 mb surface remained at 583 decameters, in response to a weak upstream ridge just offshore (see figure A32). The marine layer deepened slightly to 700 meters. The winds at Jess were about 25 mph.

At 1600, the thermal low center had deepened to 1006 mb and moved into southeastern California, with the trough axis along the Sierra Nevada (see figure A33). The surface pressure gradient had increased rapidly to over 3.5 mb. At 500 mb, the upper level low moved to 38°N 136°W with a central pressure of 566 decameters. The axis of the weak ridge that had been offshore at 0400 had just passed Oakland, and was now approaching the Sierra, causing the upper winds at Oakland to back to the southwest at 10 kts (see figure A34). The winds at Jess continued at 25 mph in the typical summertime weather pattern.

OCTOBER 9

At 0400 PST on October 9, the Pacific High was centered at 25°N 133°W. The thermal low had a central pressure of 1008 mb and was centered over the California-Arizona border, with the axis extending northward along the west side of the Central Valley, into northwest California, and along the Oregon coast. A dynamic surface low (a reflection of the low in the upper atmosphere) with a central pressure of 1010 was centered at 36°N 135°W (see figure A35). The surface pressure gradient had slackened to 2-2.5 mb. The 500 mb low continued its slow eastward trek to a position at 37°N 135°W, with a central pressure of 565 decameters. At Oakland, the 500 mb winds continued out of the southwest, and increased to 20 kts while the level of the 500 surface fell to 578 decameters (see figure A36). The marine layer was deep at 700 meters. As the pressure gradient had diminished, the winds at Jess had decreased slightly to 20 mph.

At 1600, the Pacific High was ill defined while the thermal low was centered over southeastern California with a central pressure of 1008 mb, and the trough axis extending northward along the Sierra. A dynamic low pressure area was centered over the Pacific at 34°N 132°W, with a central pressure of 1010 mb (see figure A37). The pressure difference from the coast to the valley had increased to 2.5-3 mb. Aloft, the 500 mb low pressure area was now situated at 34°N 132°W, directly above the surface low, with a central pressure of 567 decameters. In response, the winds at that level became southerly at 25 kts above Oakland (see figure A38). The marine layer was somewhat shallower at a depth of 550 meters. The winds at Jess increased slightly to 25 mph, in a west coast weather pattern that is typical in the spring, but occurs infrequently in the summertime.

OCTOBER 10

On October 10, at 0400 PST, surface high pressure was centered at 30°N 122°W, with a central pressure of 1017 mb. Surface low pressure was centered at 34°N 131°W with a central pressure of 1010 mb. The thermal low was centered near Yuma Arizona, with a central pressure of 1012 mb. The thermal trough axis extended out of the low, up the southern Sierra, through the Sacramento Valley, into the California-Oregon border region (see figure A39).

The surface pressure gradient between the coast and the valley had decreased significantly to about 1.5 mb. Aloft, the upper low was directly above the surface low at 34°N 131°W, and Oakland had south-southeast winds of 30 kts, at 500 mb, with a height of 578 decameters reported (see figure A40). With cyclonic curvature aloft, the layer of marine air deepened to 750 meters. At Jess, the winds had diminished slightly to about 15-20 mph, in the "springlike" weather pattern.

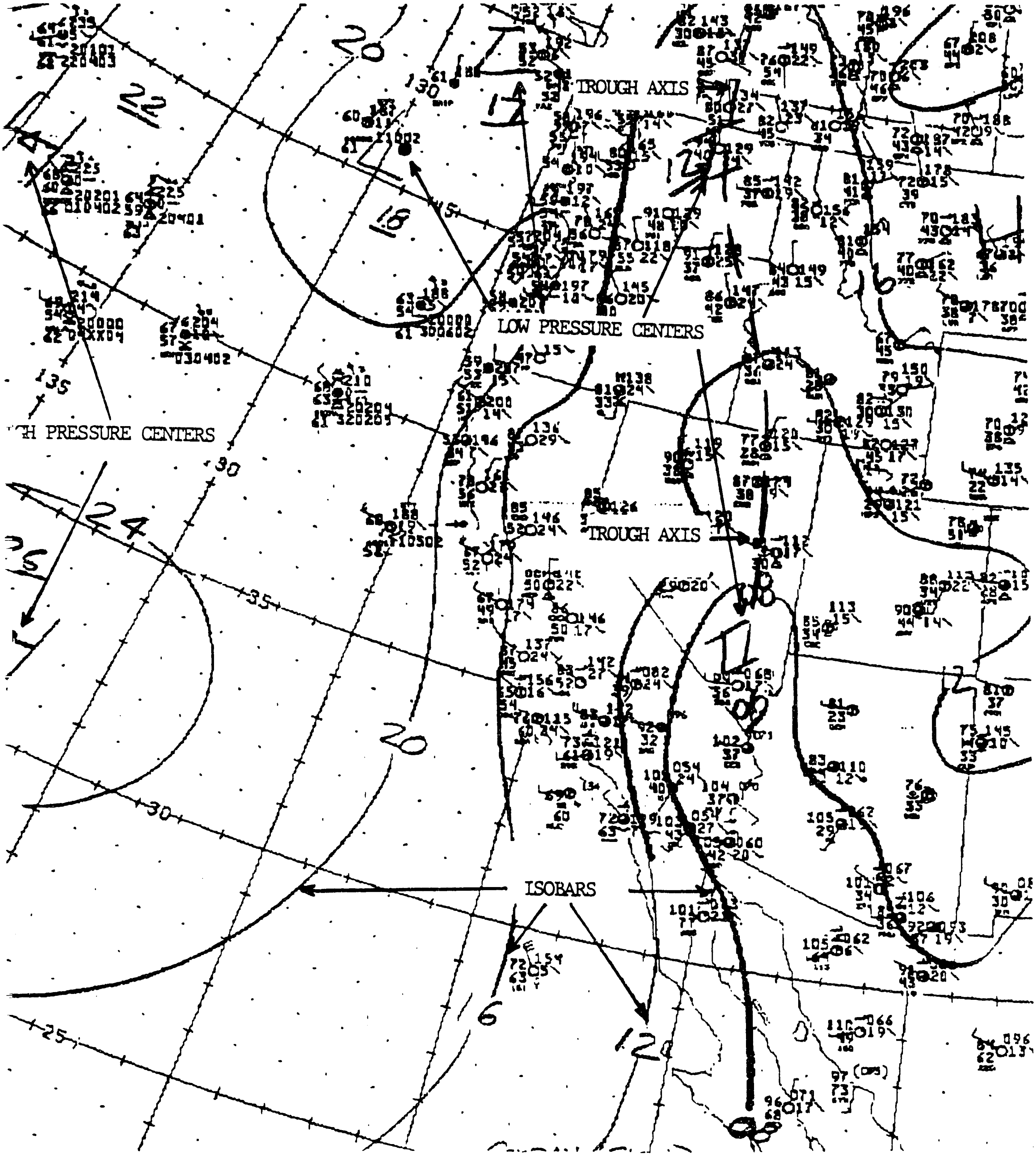
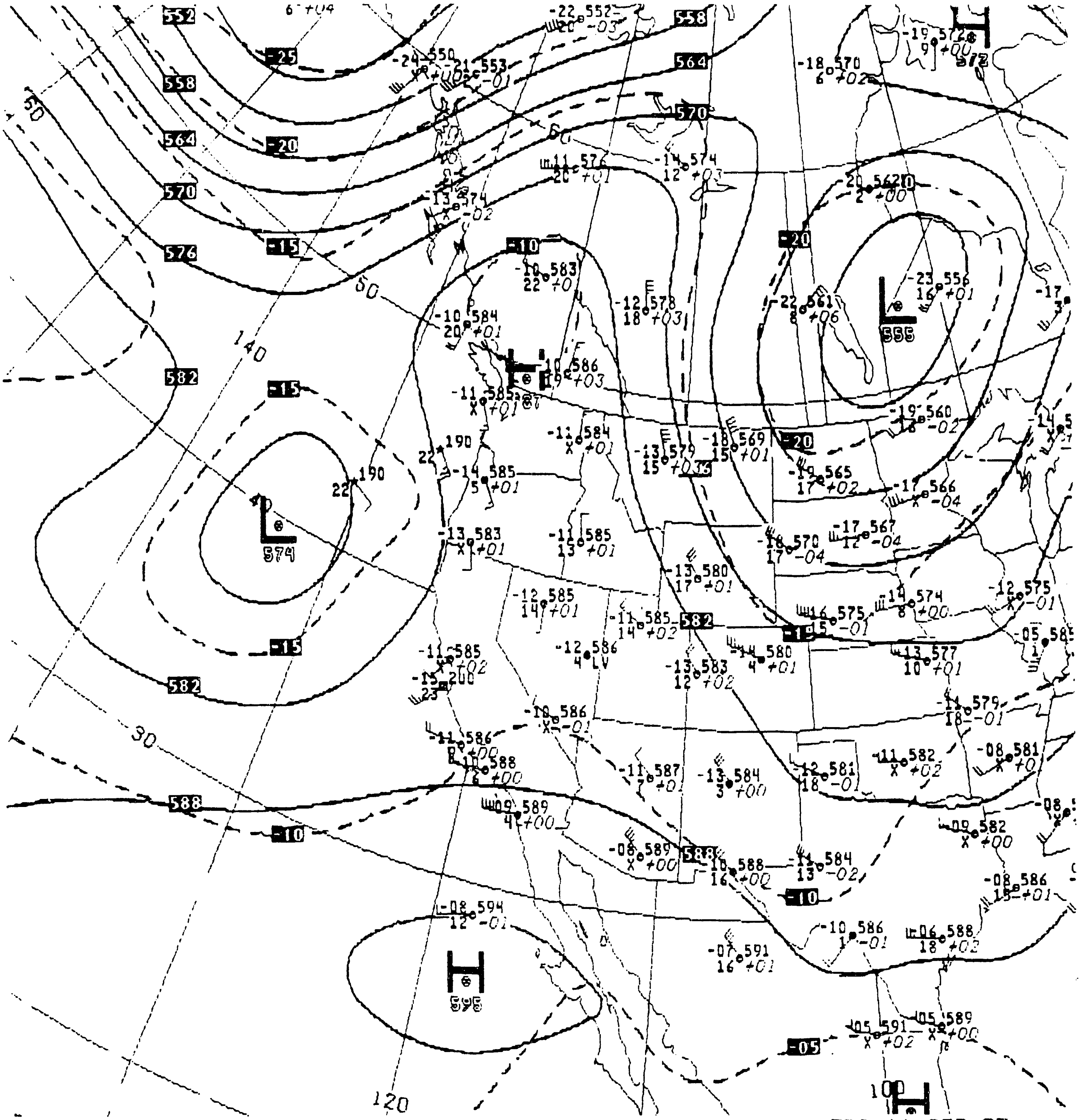


Figure A1. Surface map - Sept 10 1600 PST



D020 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 00Z FRI 11 SEP 87

Figure A2. 500 mb map - Sept 10 1600 PST

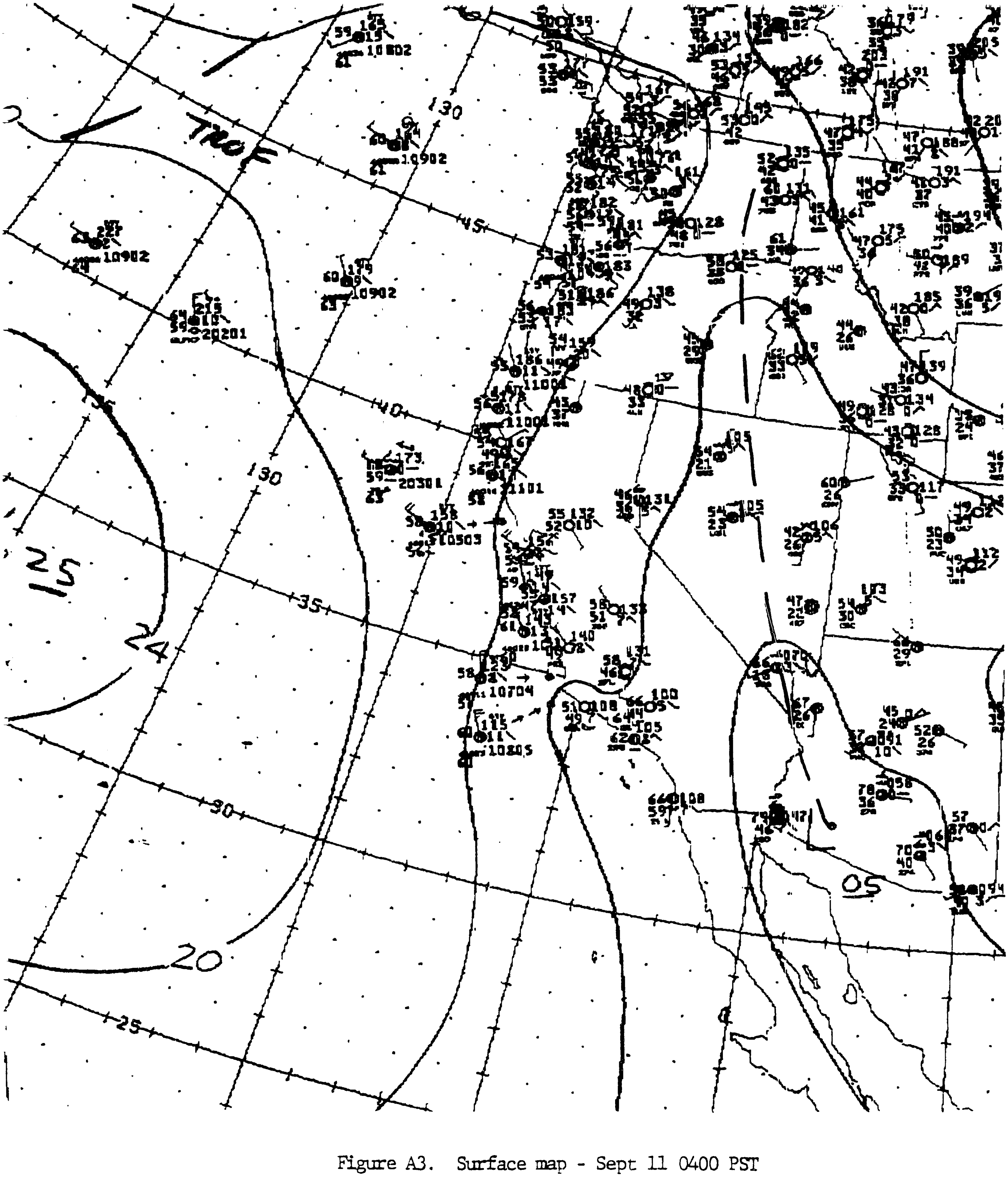
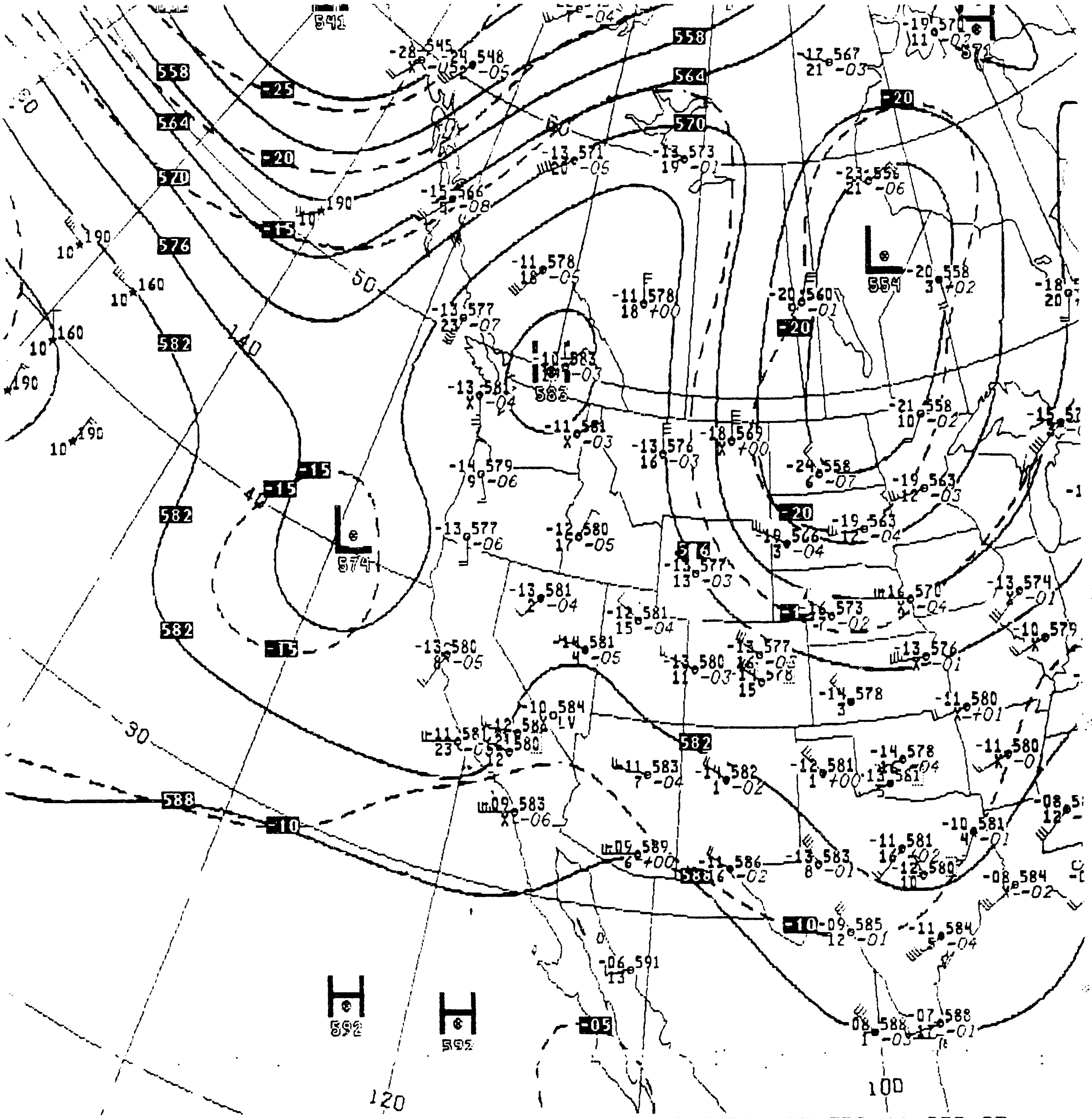


Figure A3. Surface map - Sept 11 0400 PST



D155 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 12Z FRI 11 SEP 87

Figure A4. 500 mb map - Sept 11 0400 PST

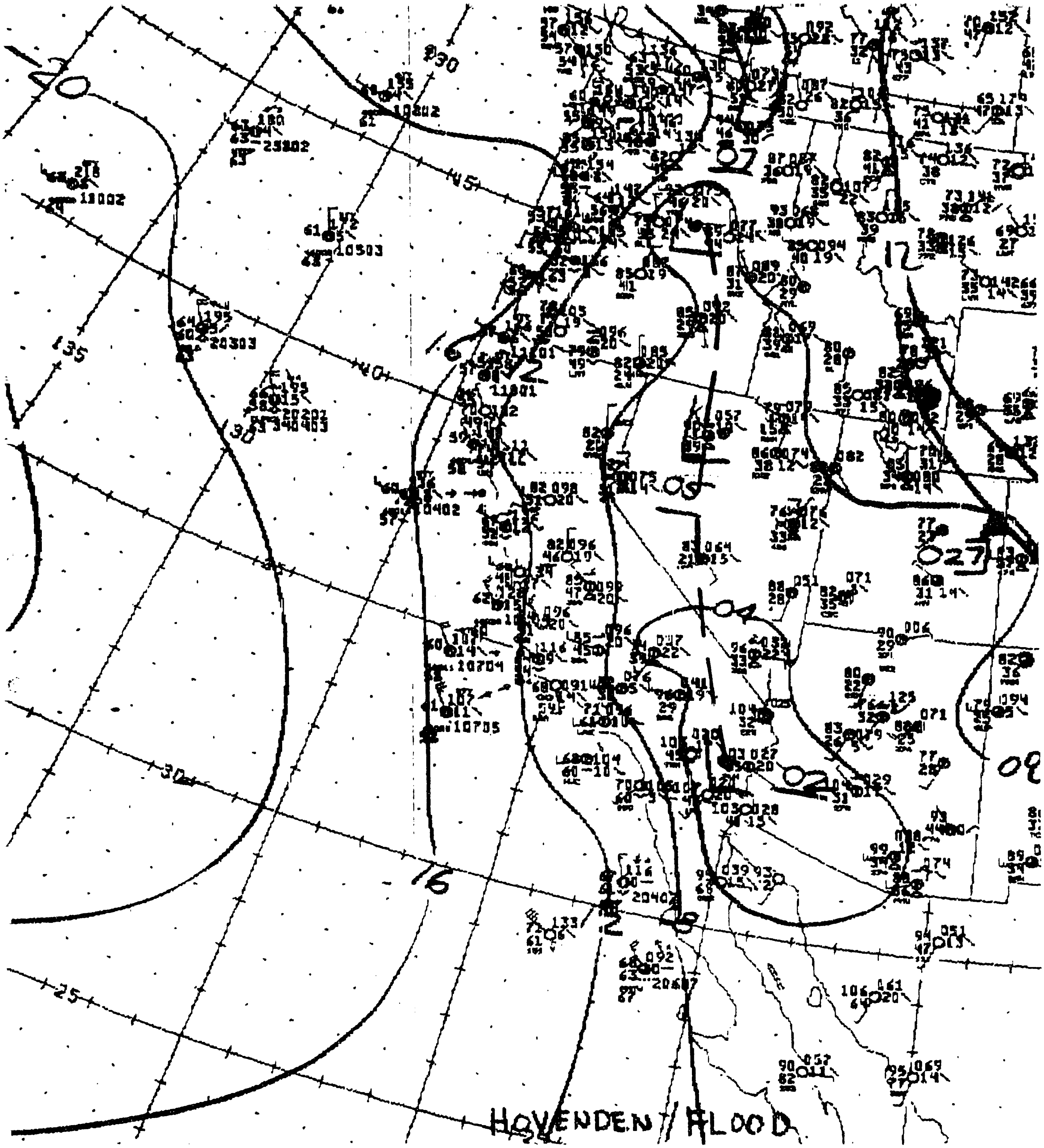


Figure A5. Surface map - Sept 11 1600 PST

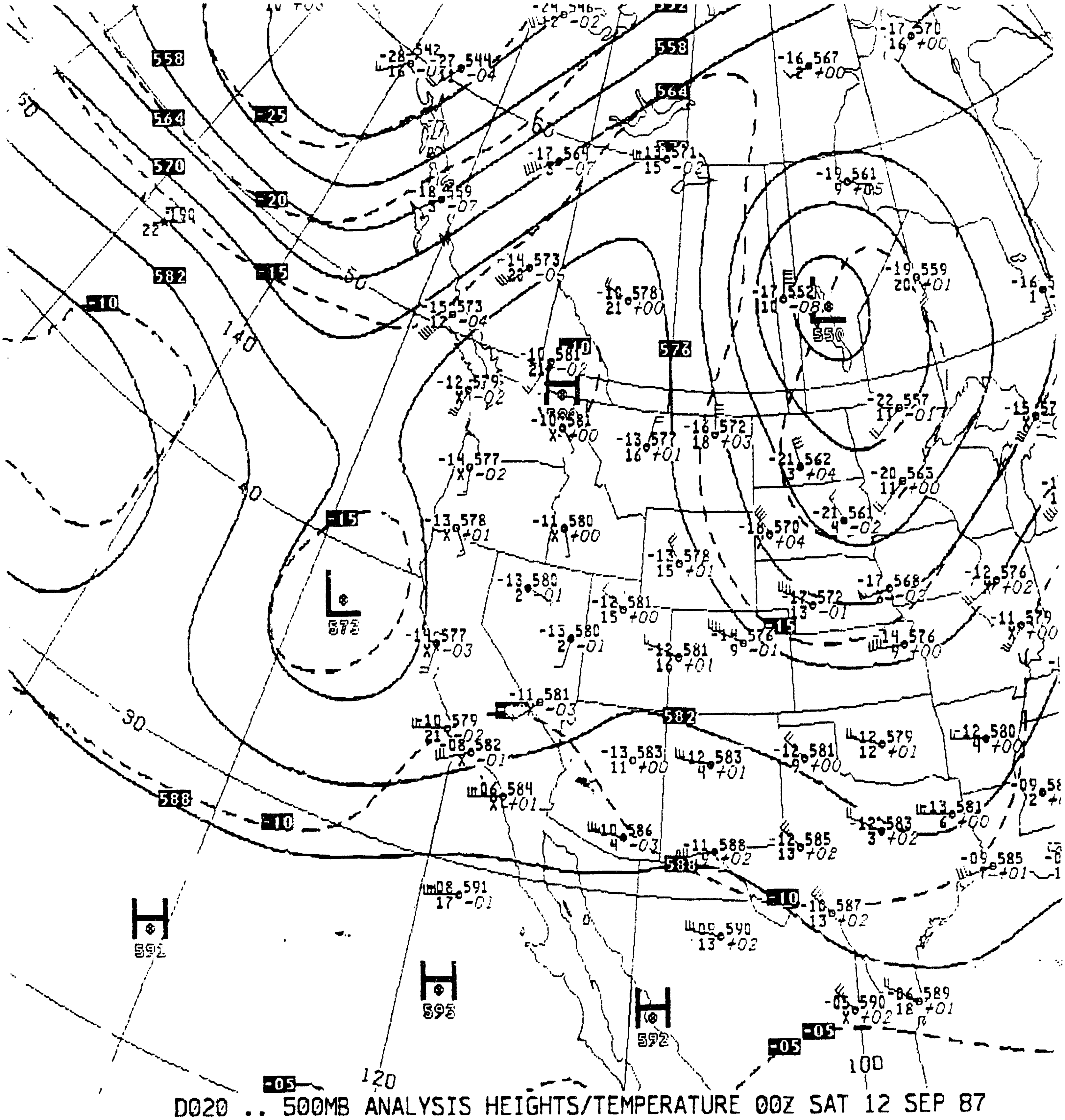


Figure A6. 500 mb map - Sept 11 1600 PST

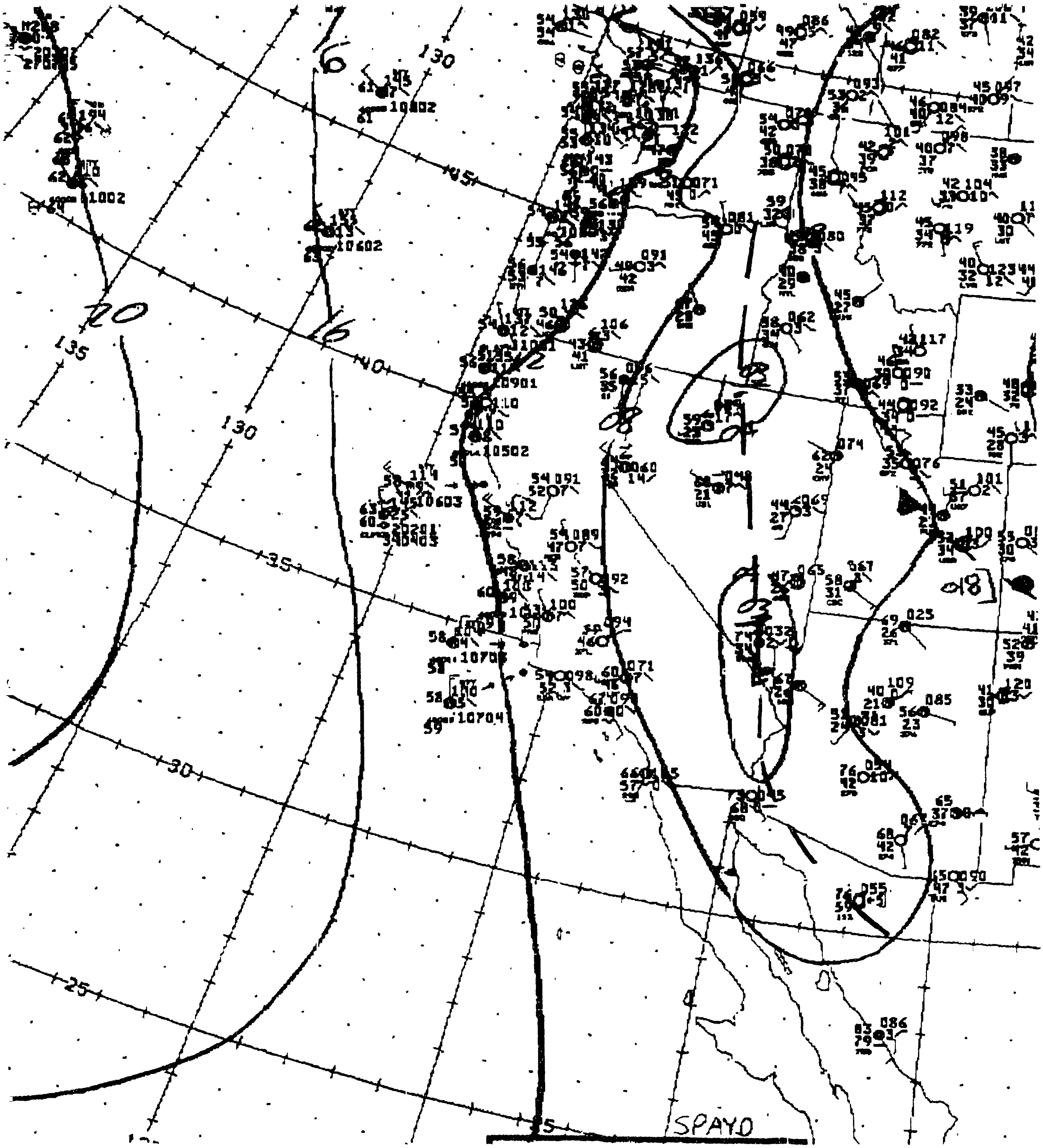


Figure A7. Surface map - Sept 12 0400 PST

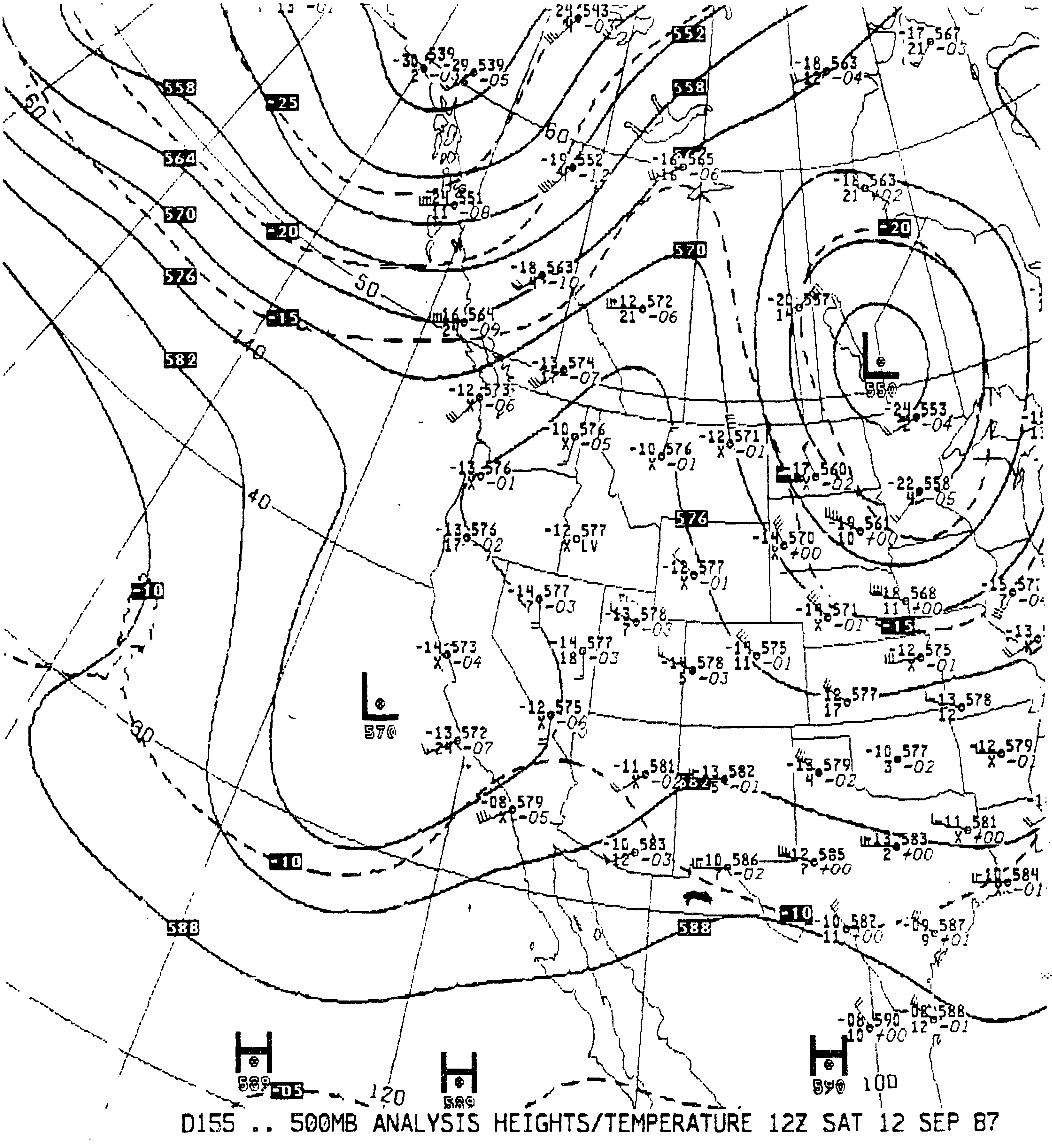


Figure A8. 500 mb map - Sept 12 0400 PST

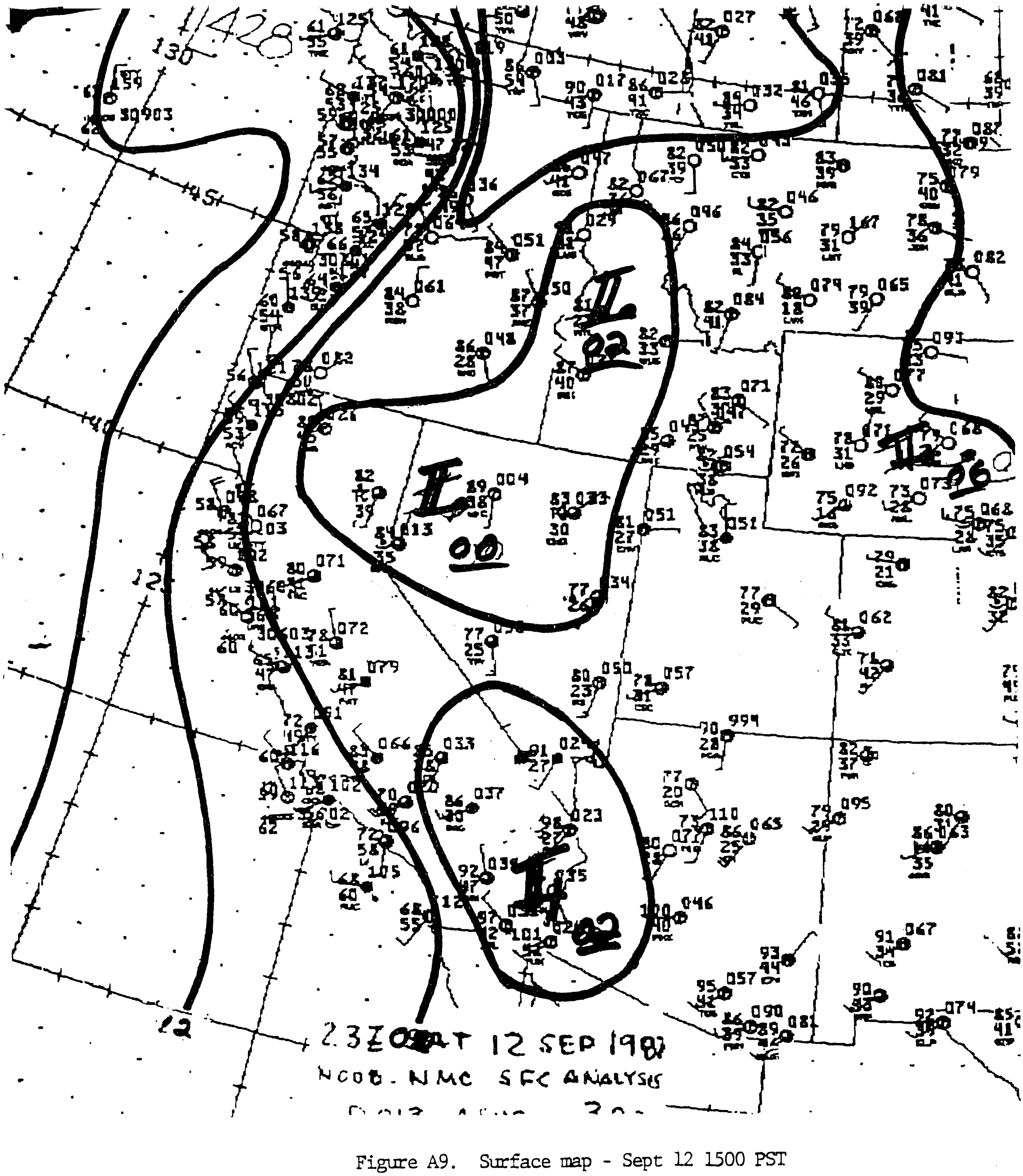


Figure A9. Surface map - Sept 12 1500 PST

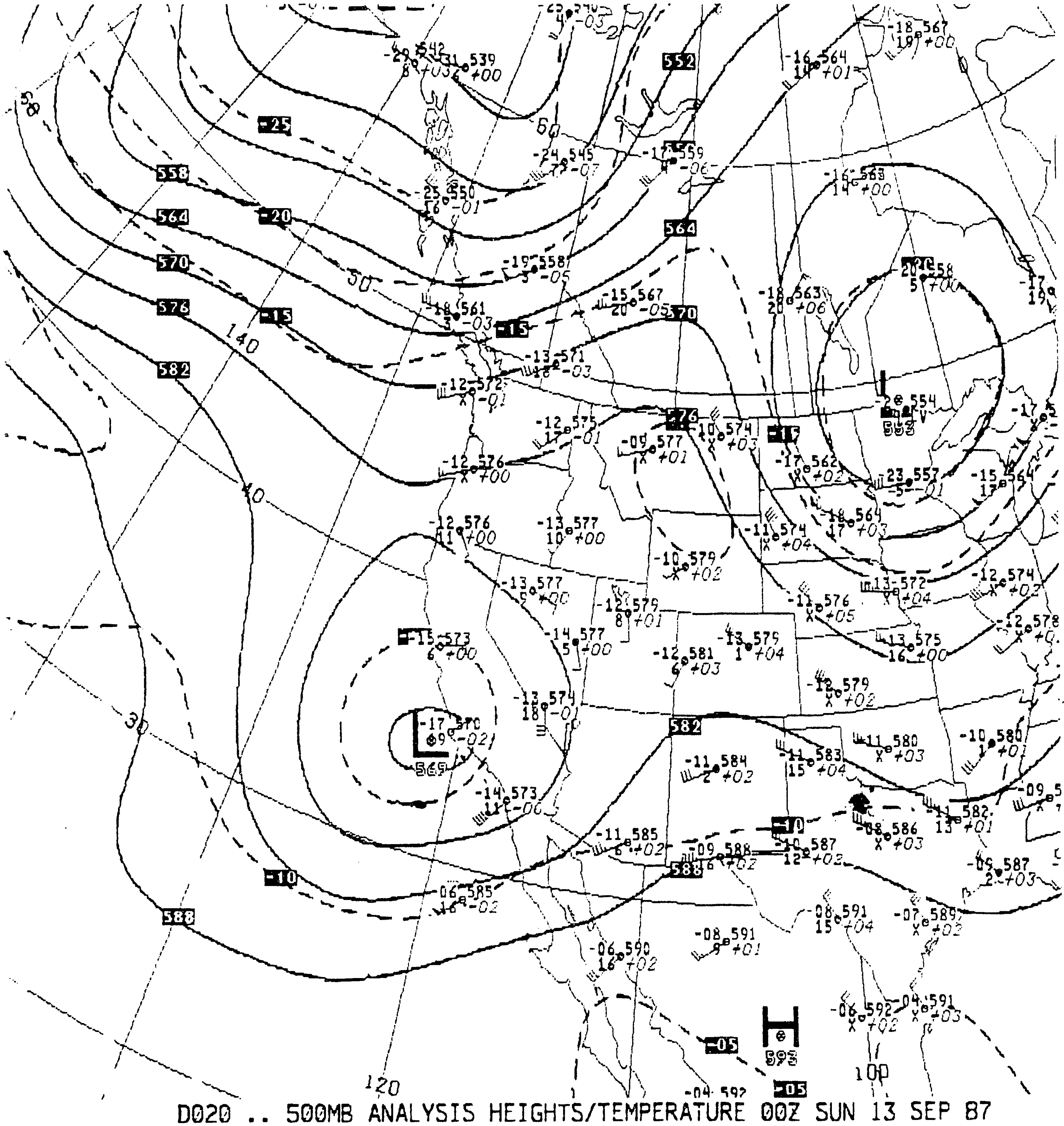


Figure A10. 500 mb map - Sept 12 1600 PST

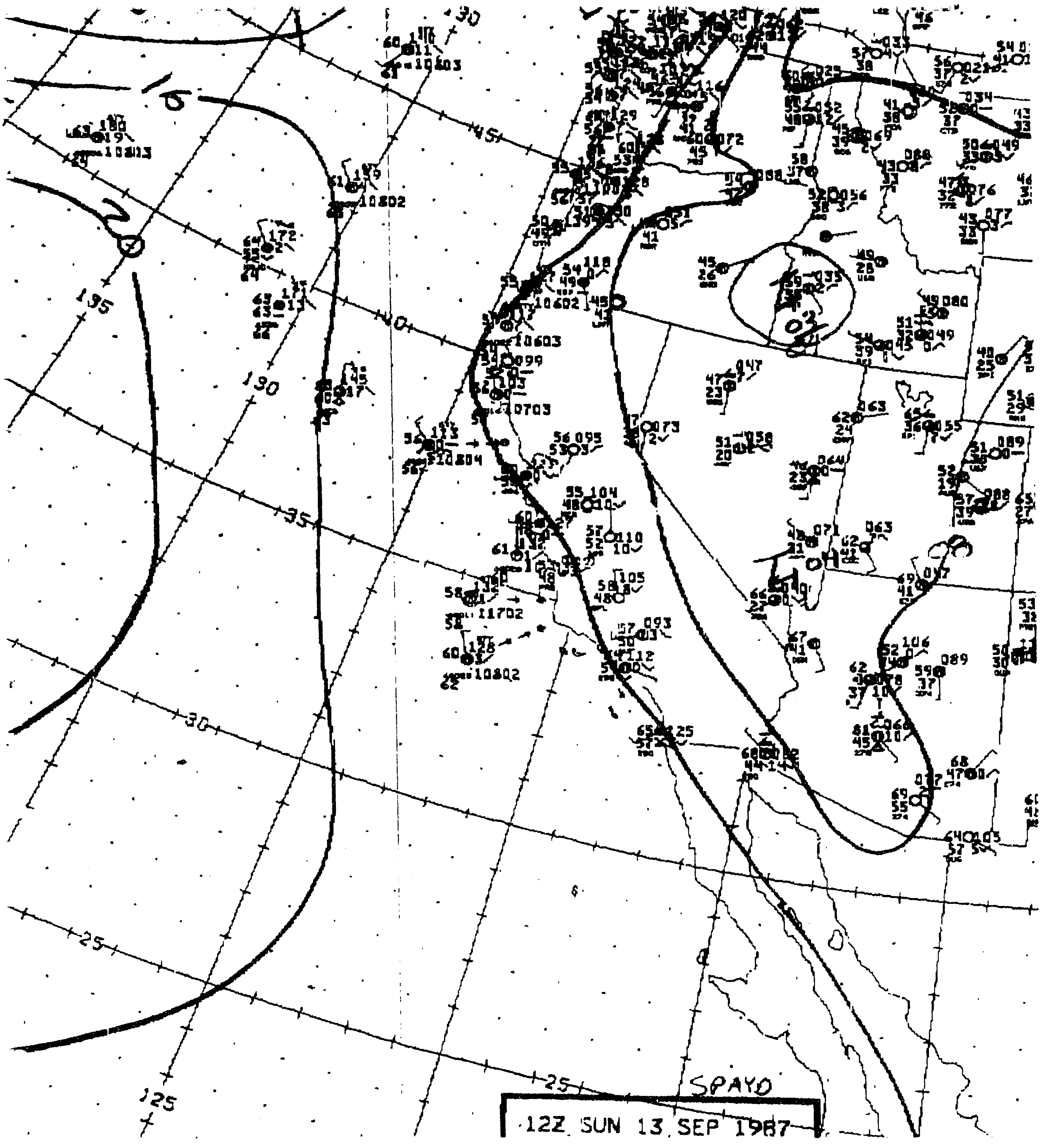


Figure A11. Surface map - Sept 13 0400 PST

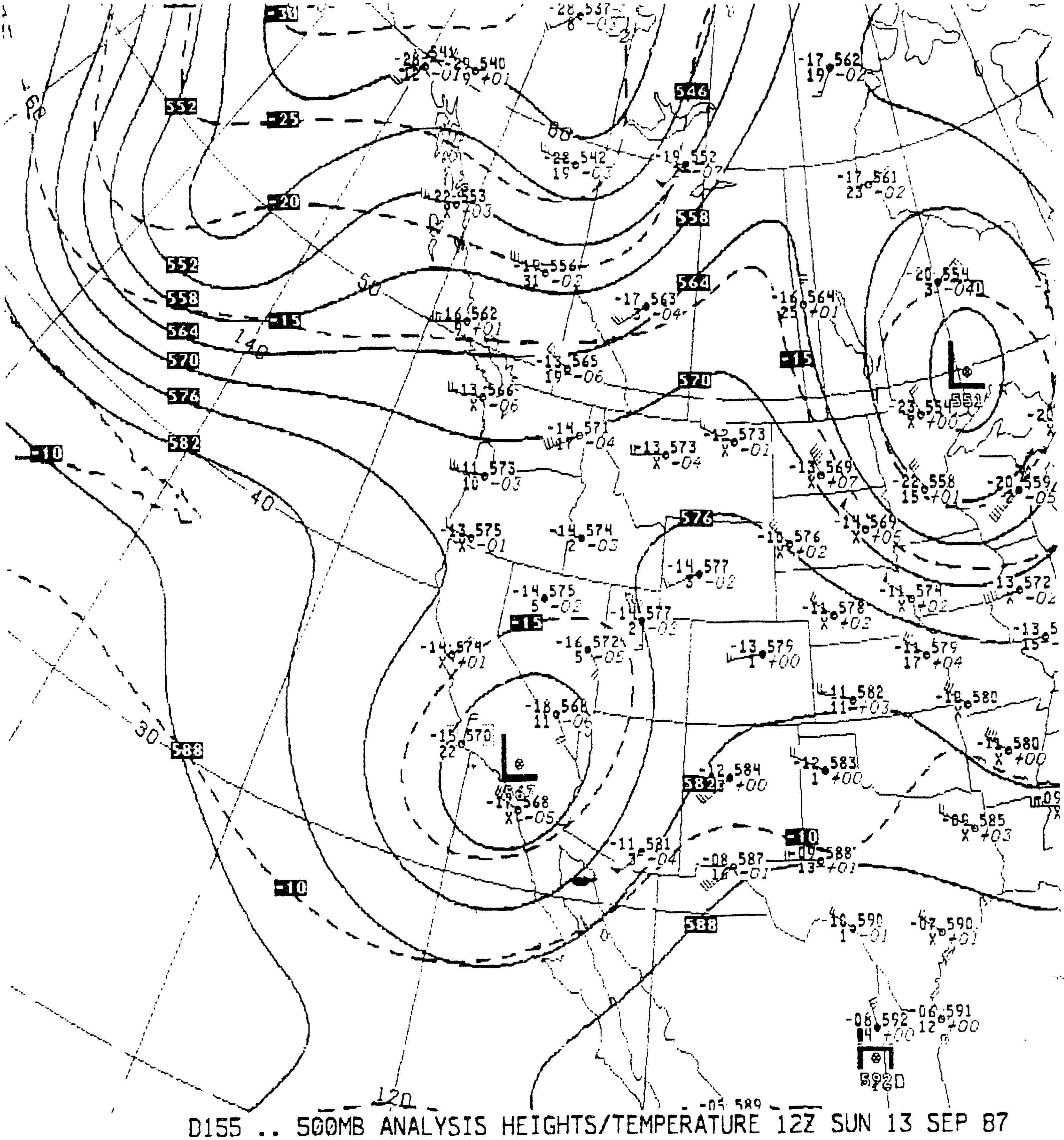


Figure A12. 500 mb map - Sept 13 0400 PST

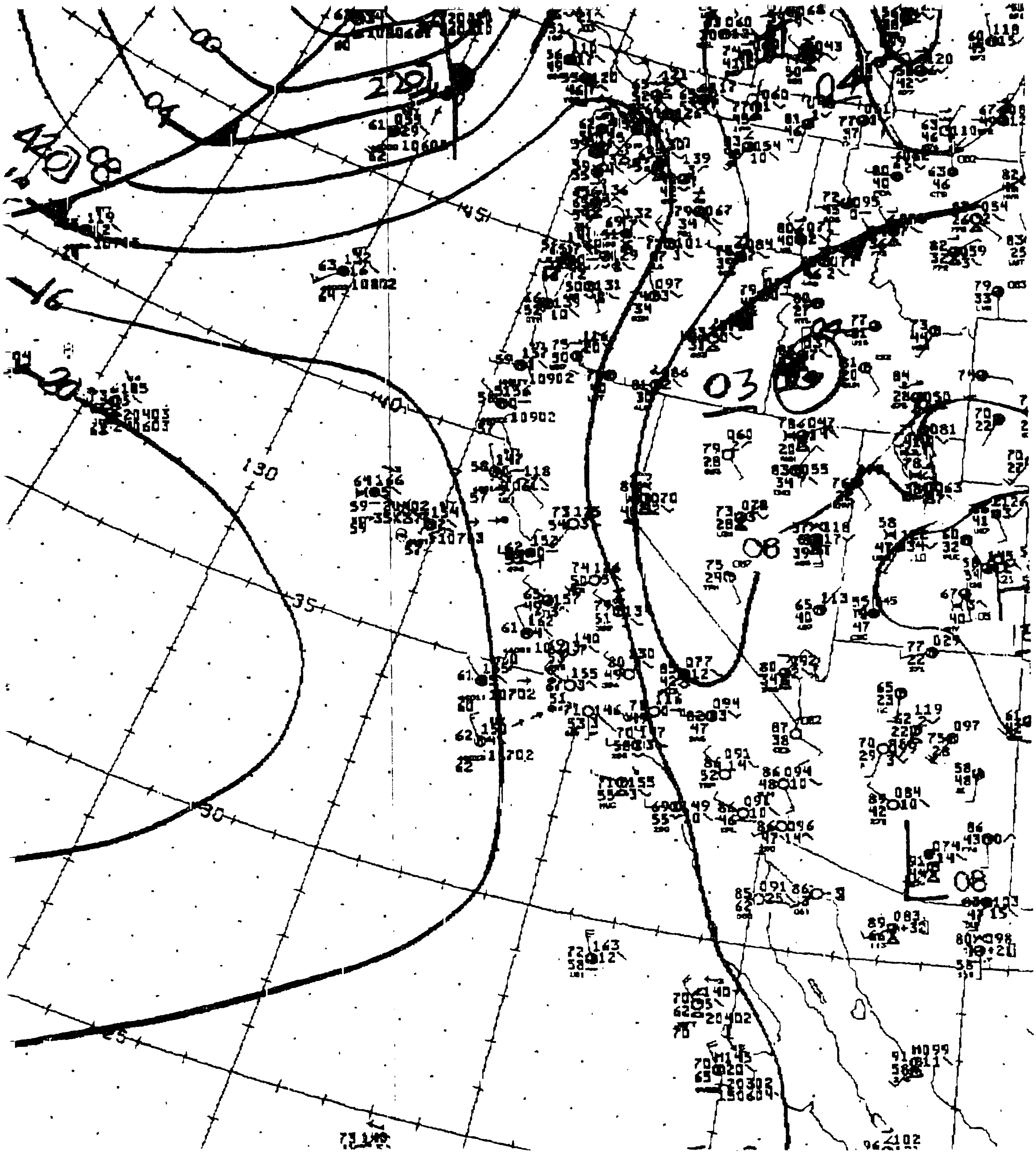


Figure A13. Surface map - Sept 13 1600 PST

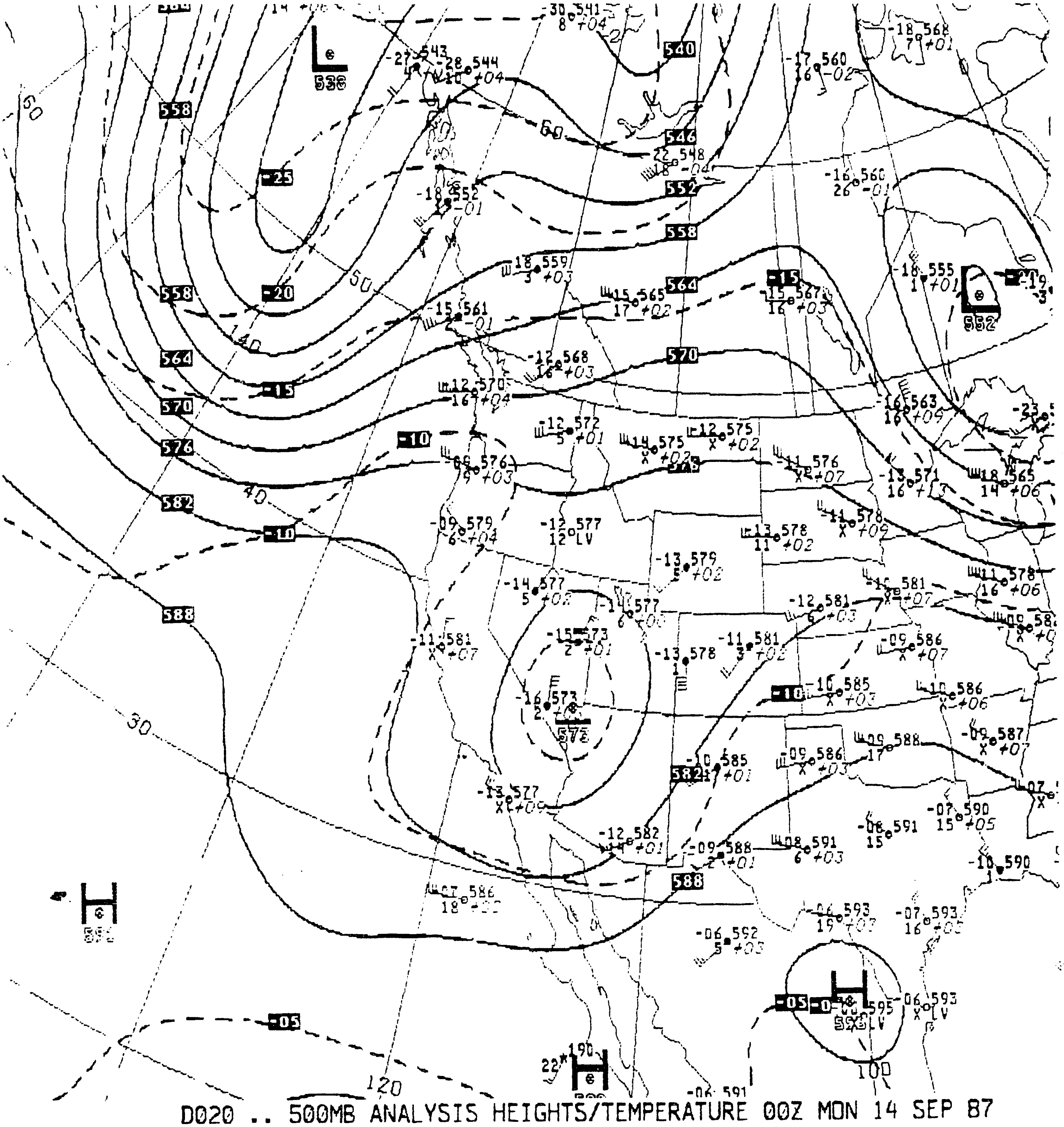


Figure A14. 500 mb map - Sept 13 1600 PST

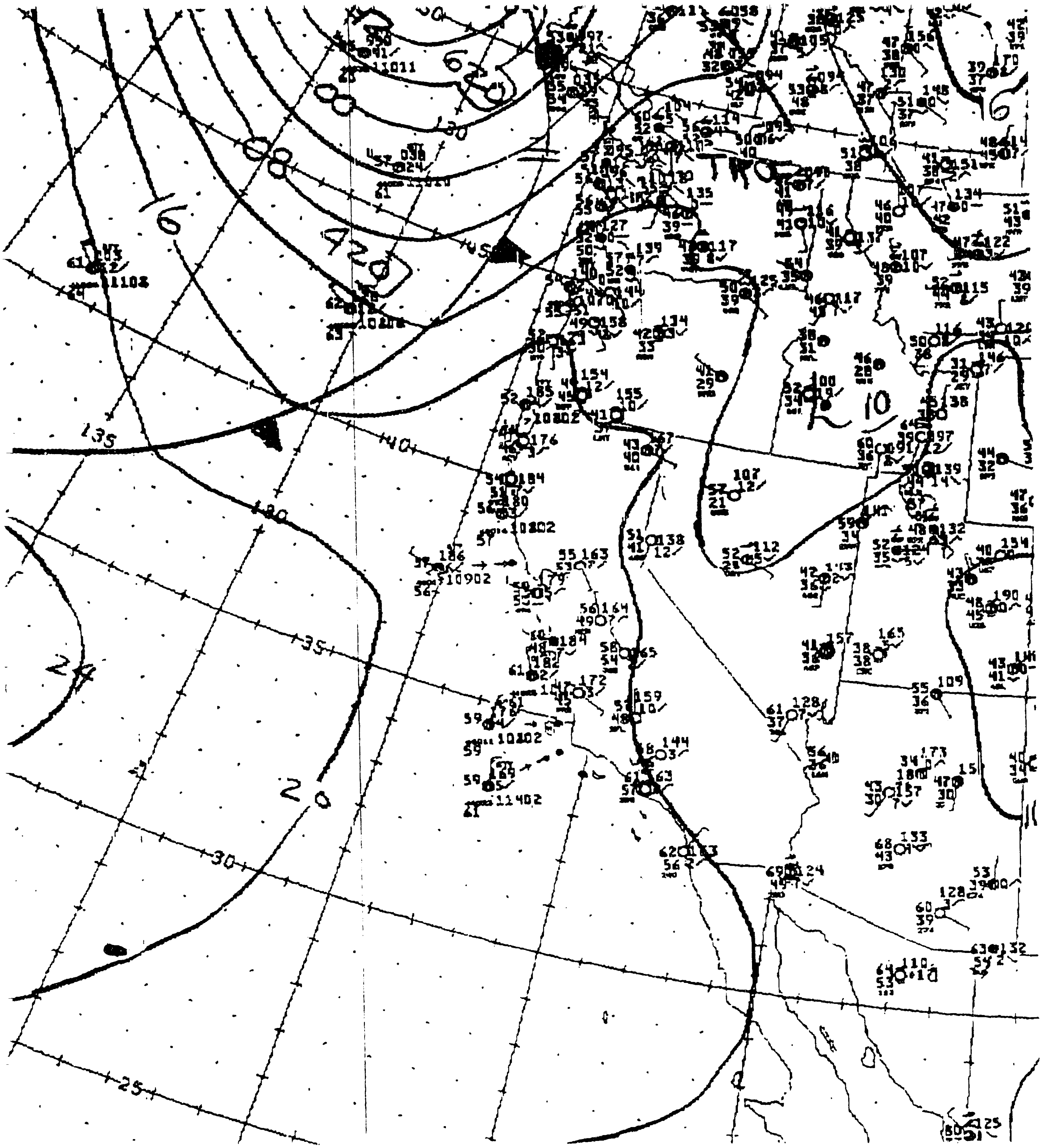


Figure A15. Surface map - Sept 14 0400 PST

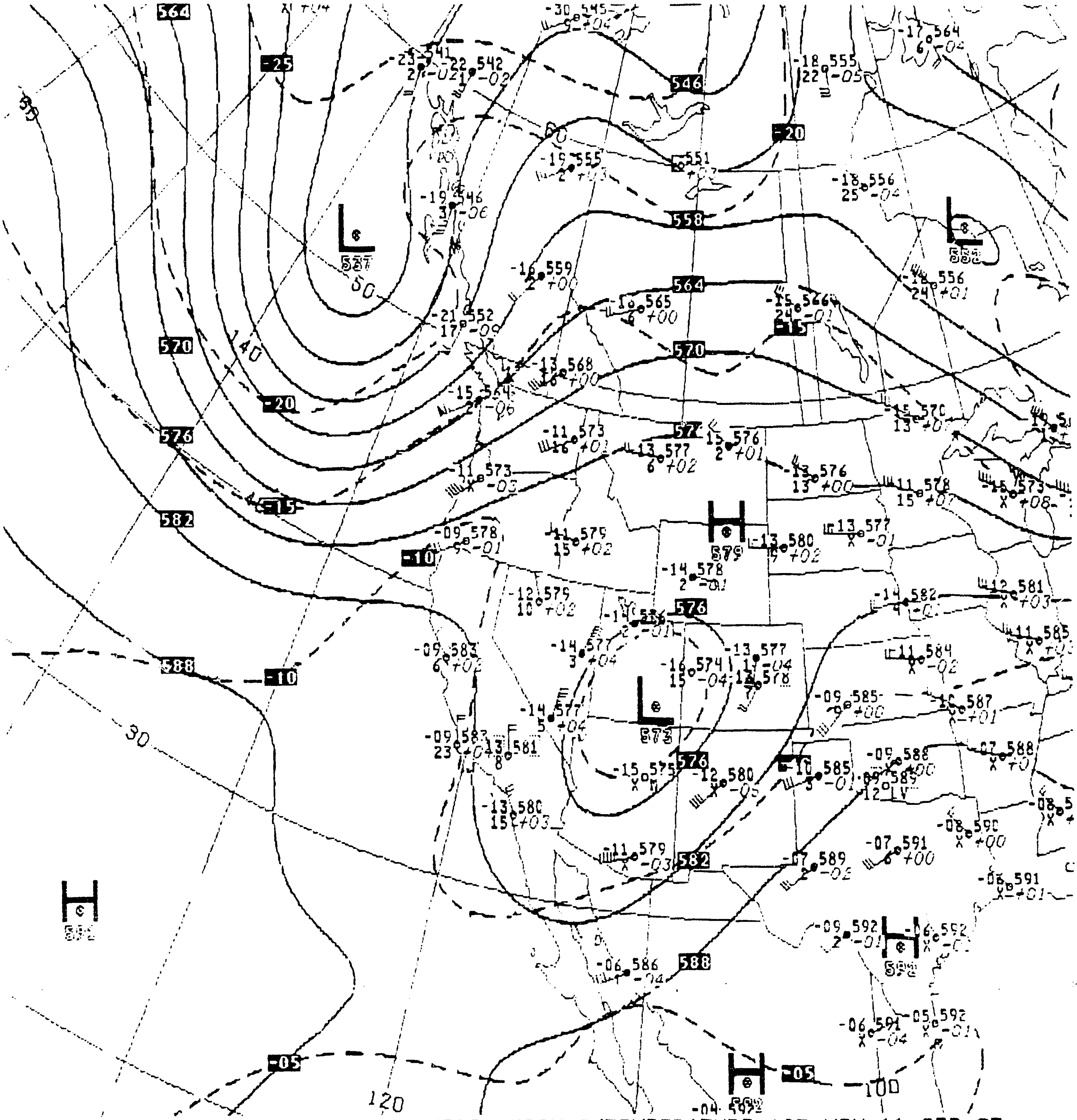


Figure A16. 500 mb map - Sept 14 0400 PST

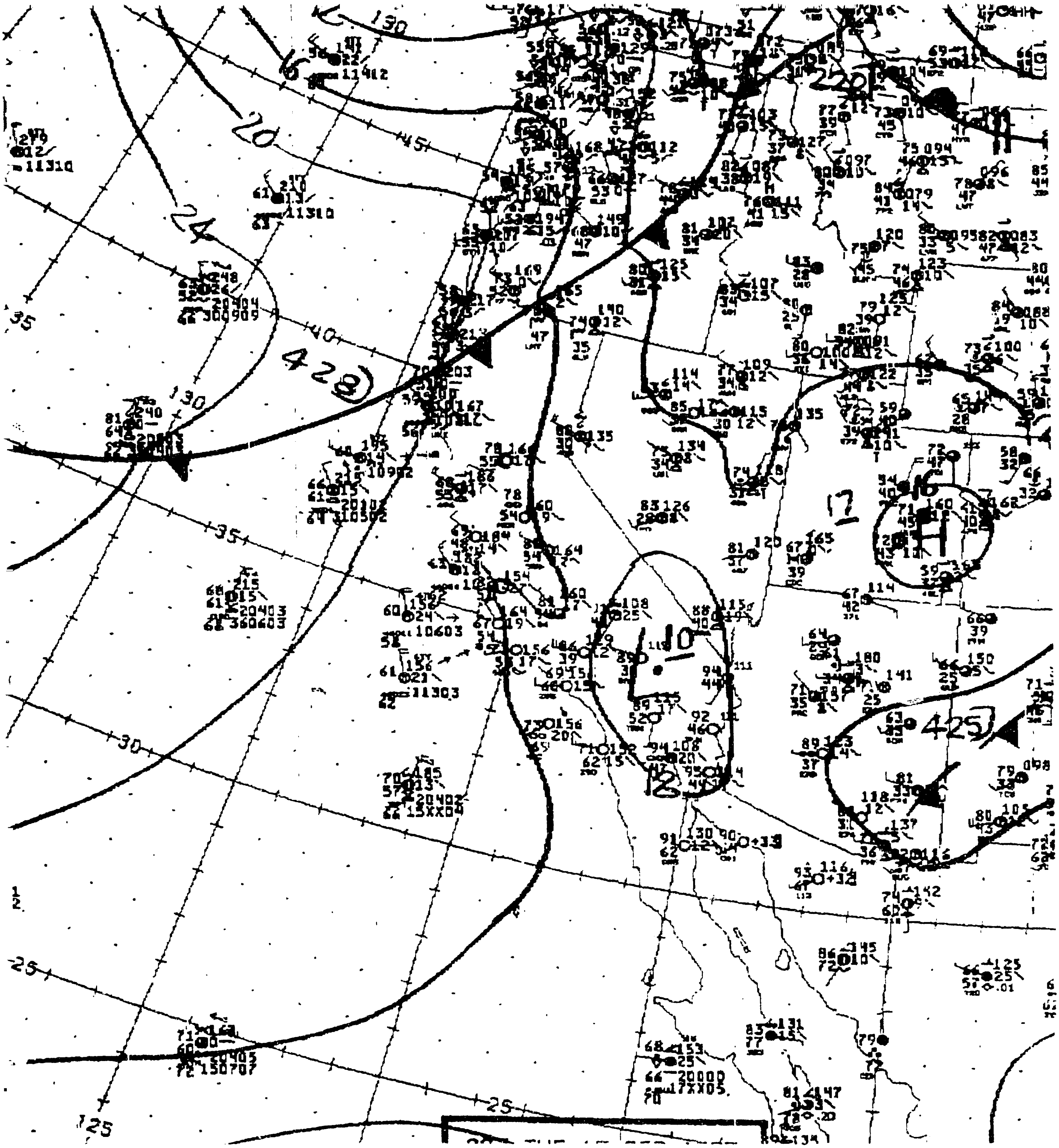


Figure A17. Surface map - Sept 14 1600 PST

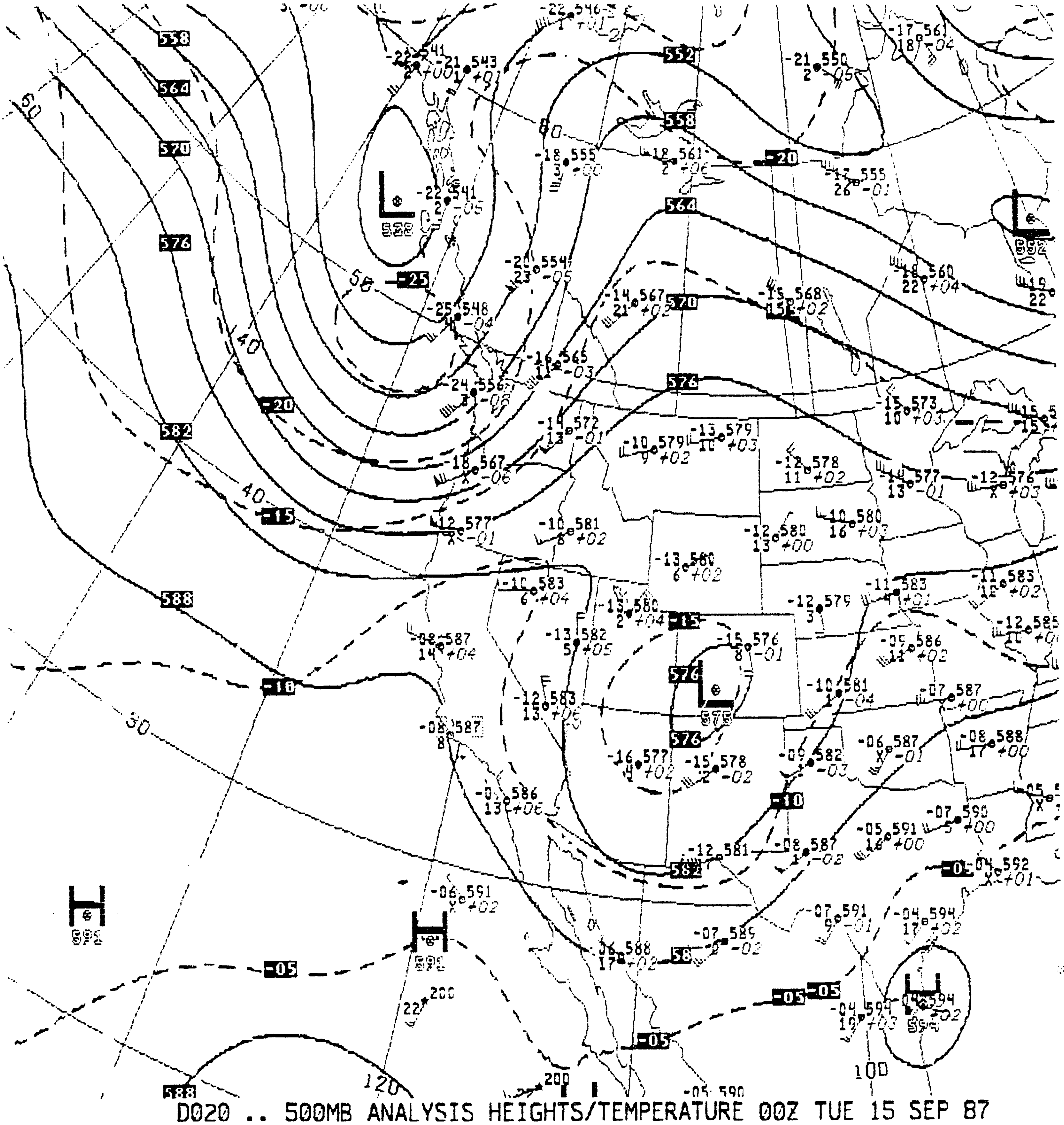


Figure A18. 500 mb map - Sept 14 1600 PST

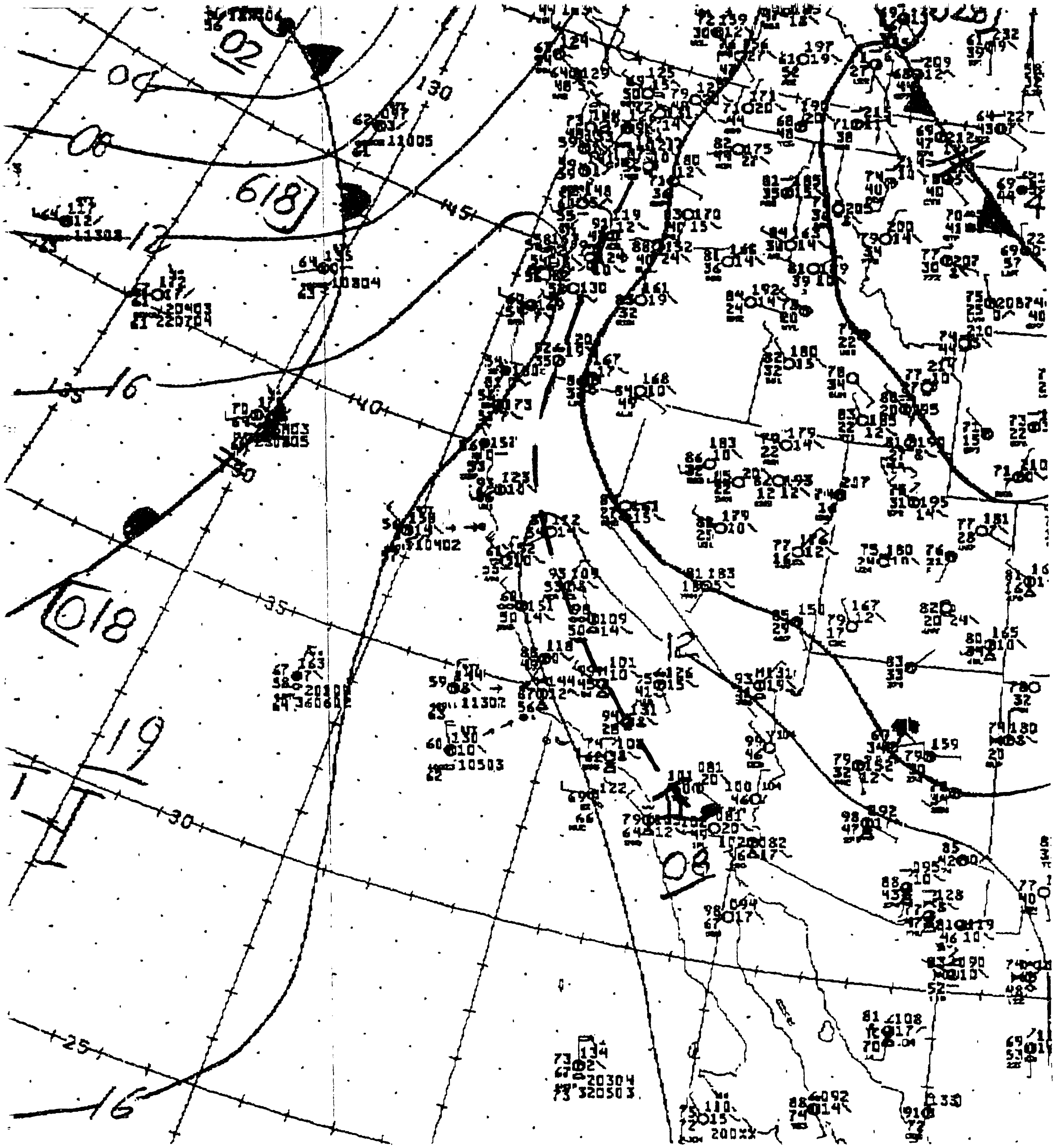


Figure A19. Surface map - Oct 1 1600 PST

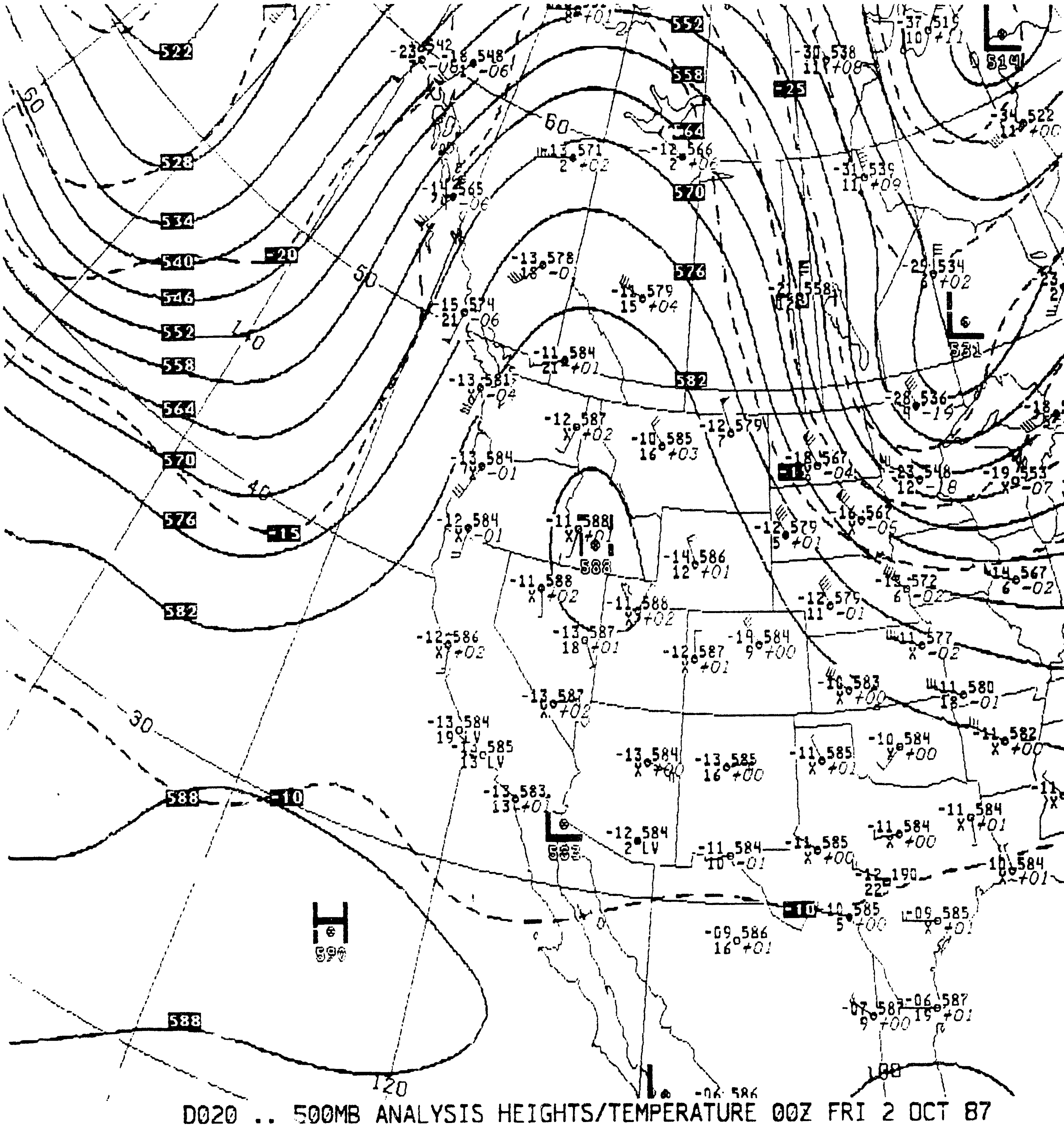


Figure A20. 500 mb map - Oct 1 1600 PST

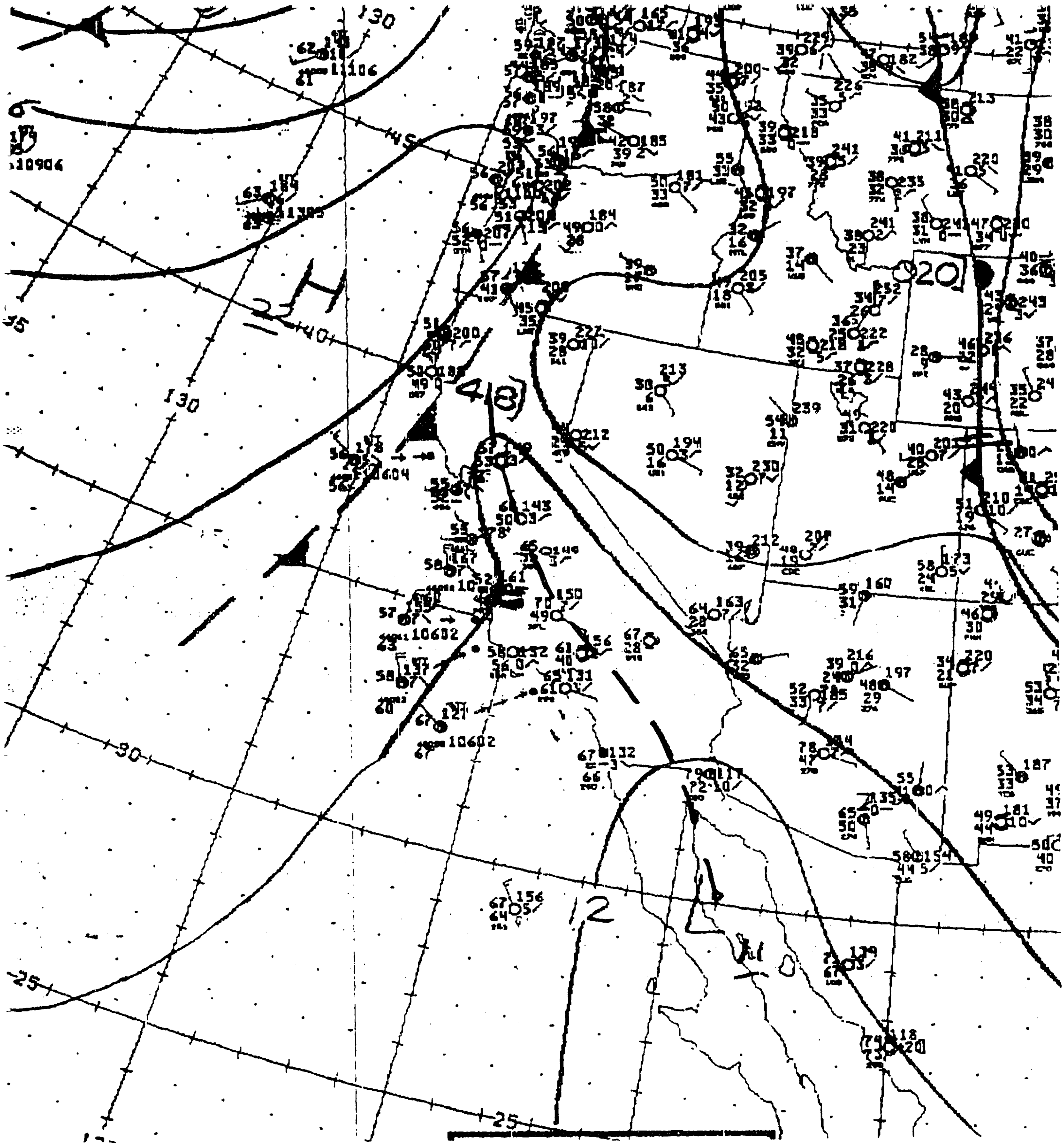


Figure A21. Surface map - Oct 2 0400 PST

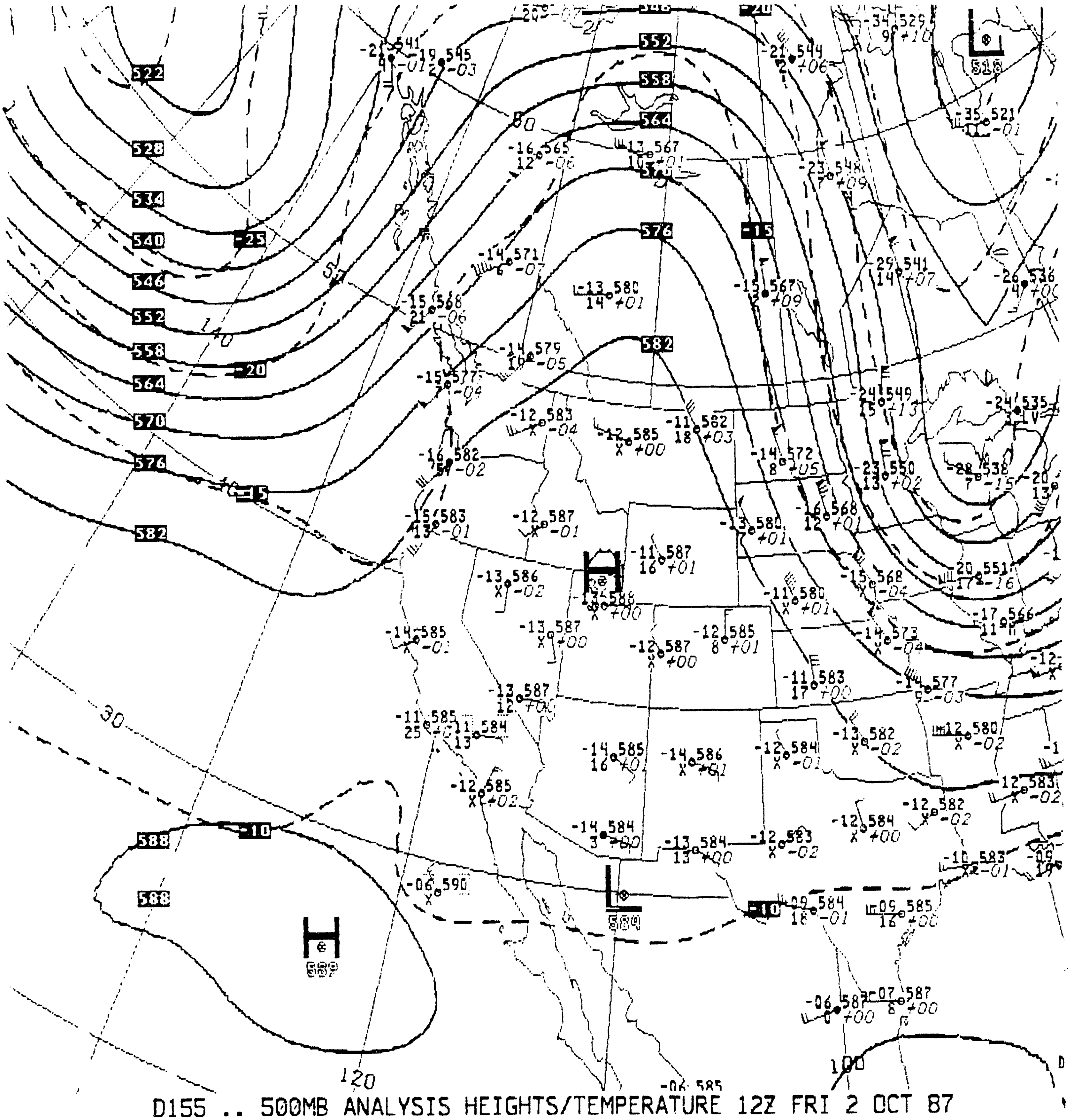


Figure A22. 500 mb map - Oct 2 0400 PST

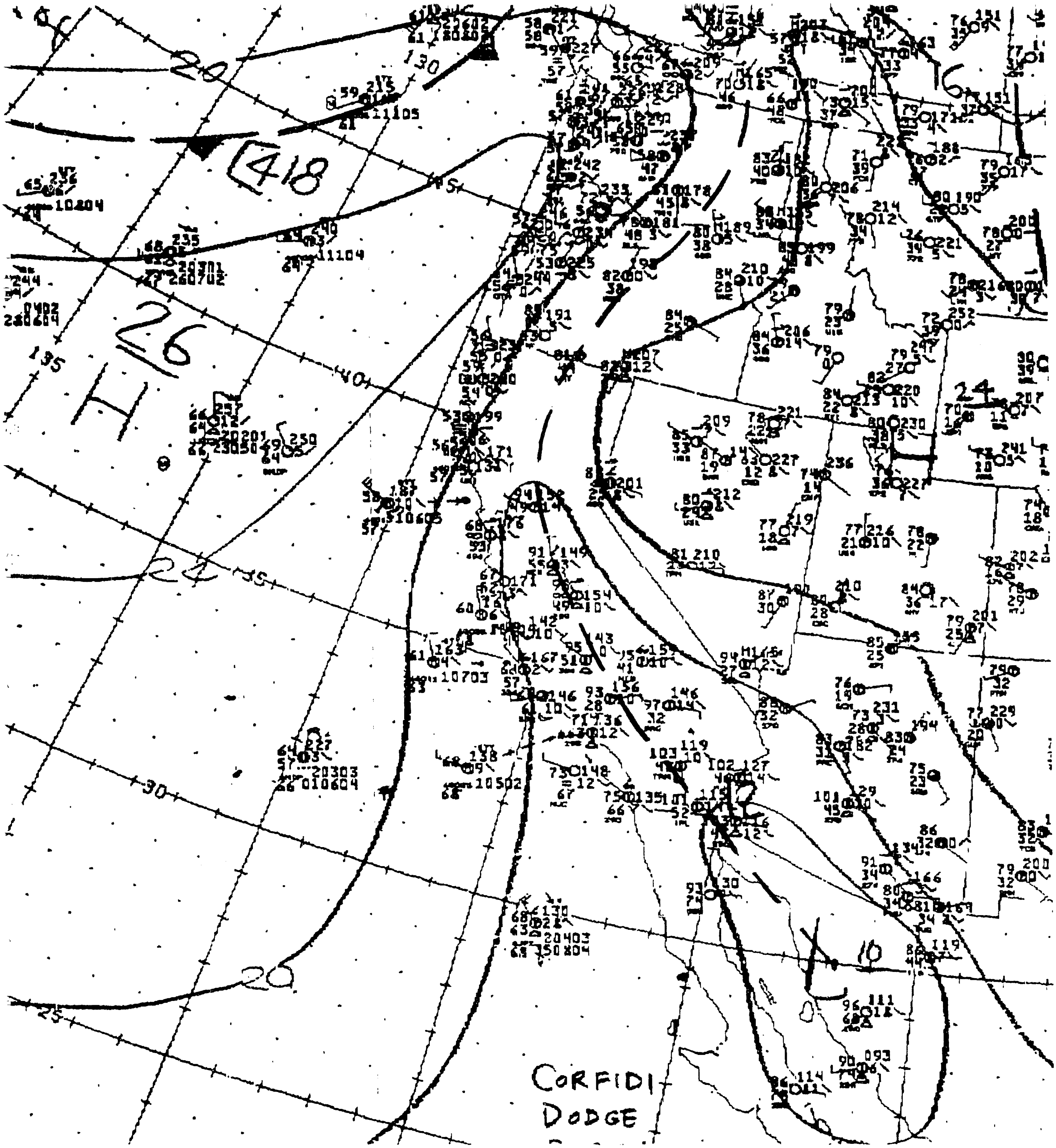


Figure A23. Surface map - Oct 2 1600 PST

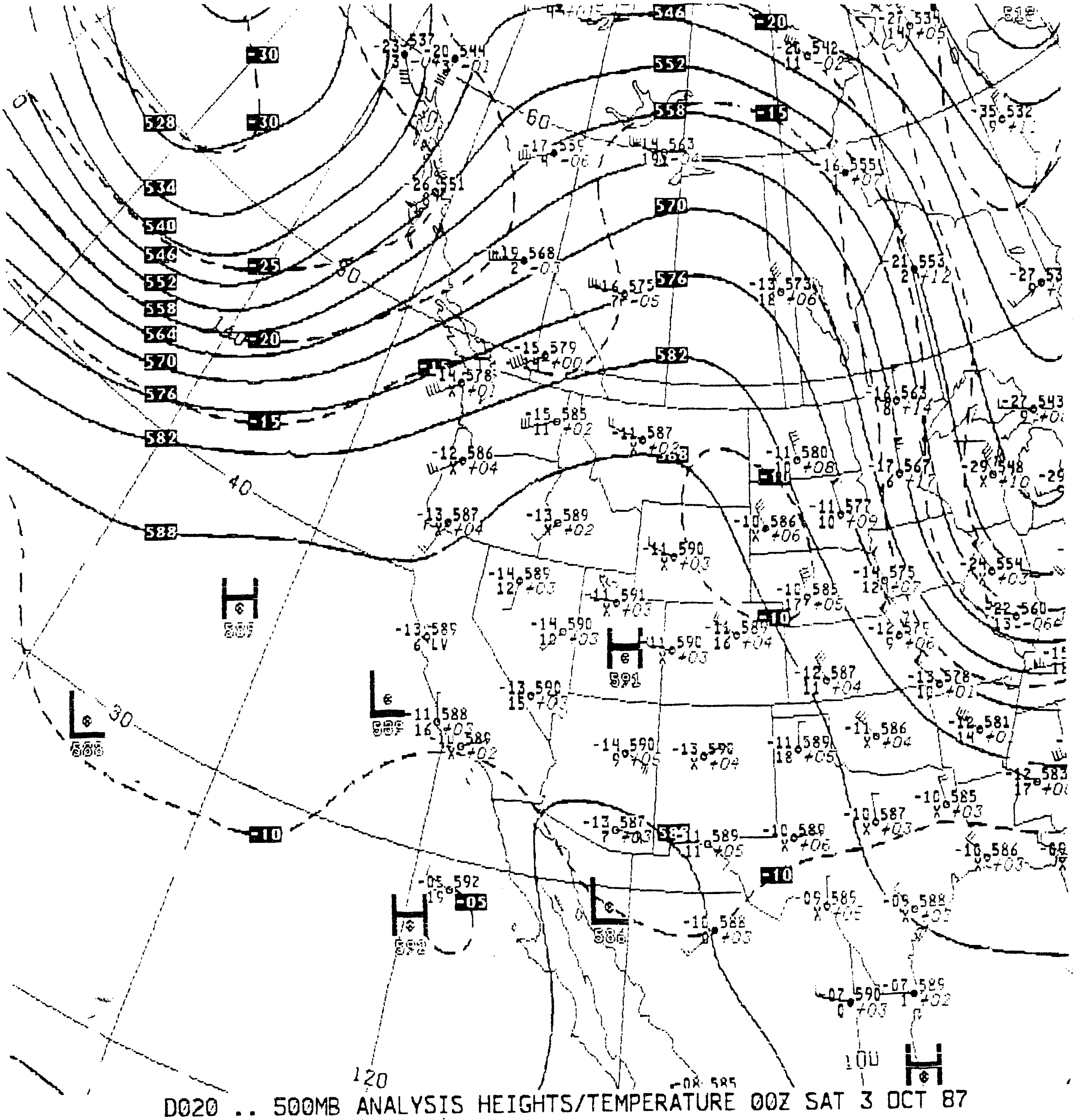


Figure A24. 500 mb map - Oct 2 1600 PST

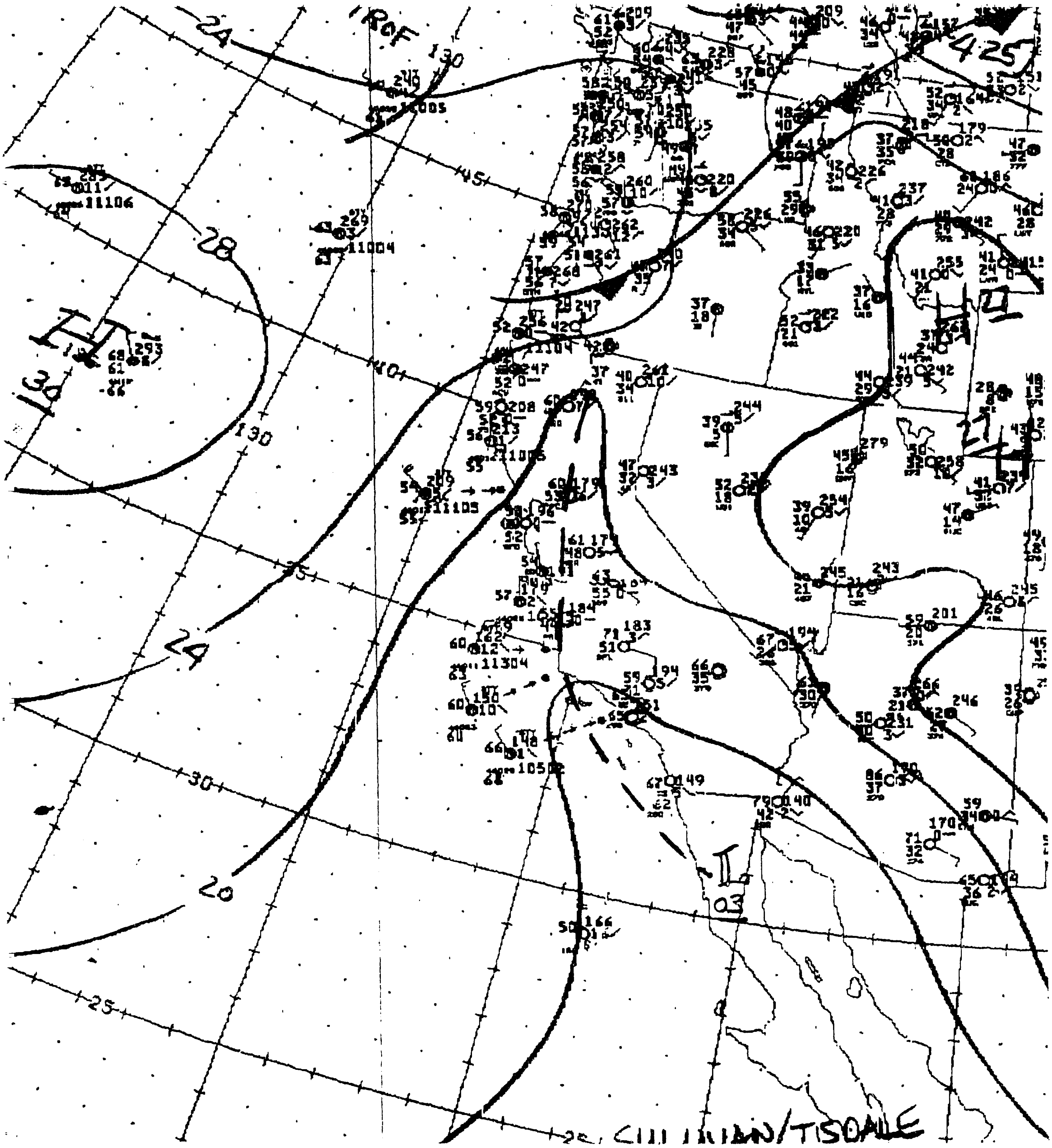


Figure A25. Surface map - Oct 3 0400 PST

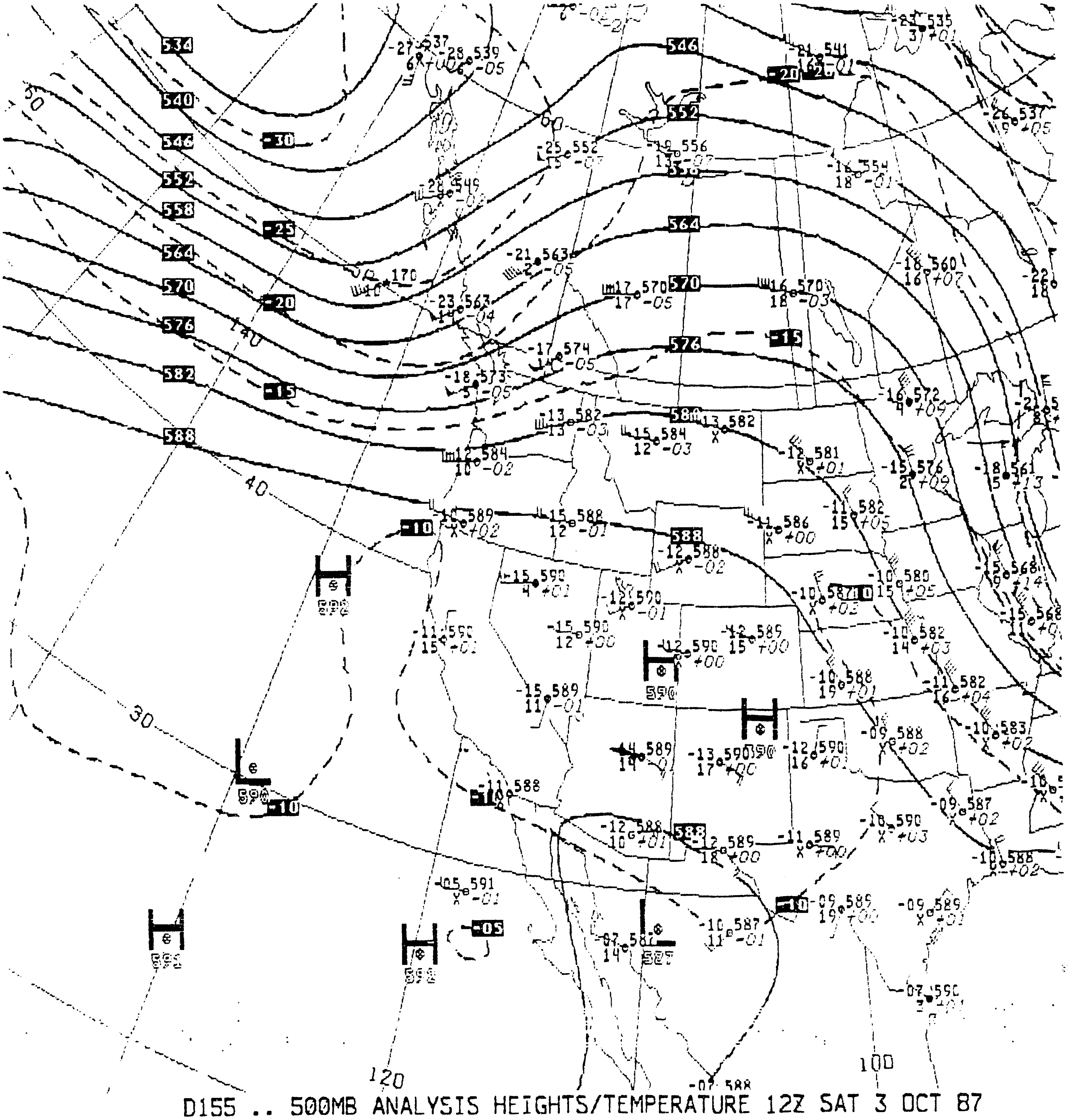


Figure A26. 500 mb map - Oct 3 0400 PST

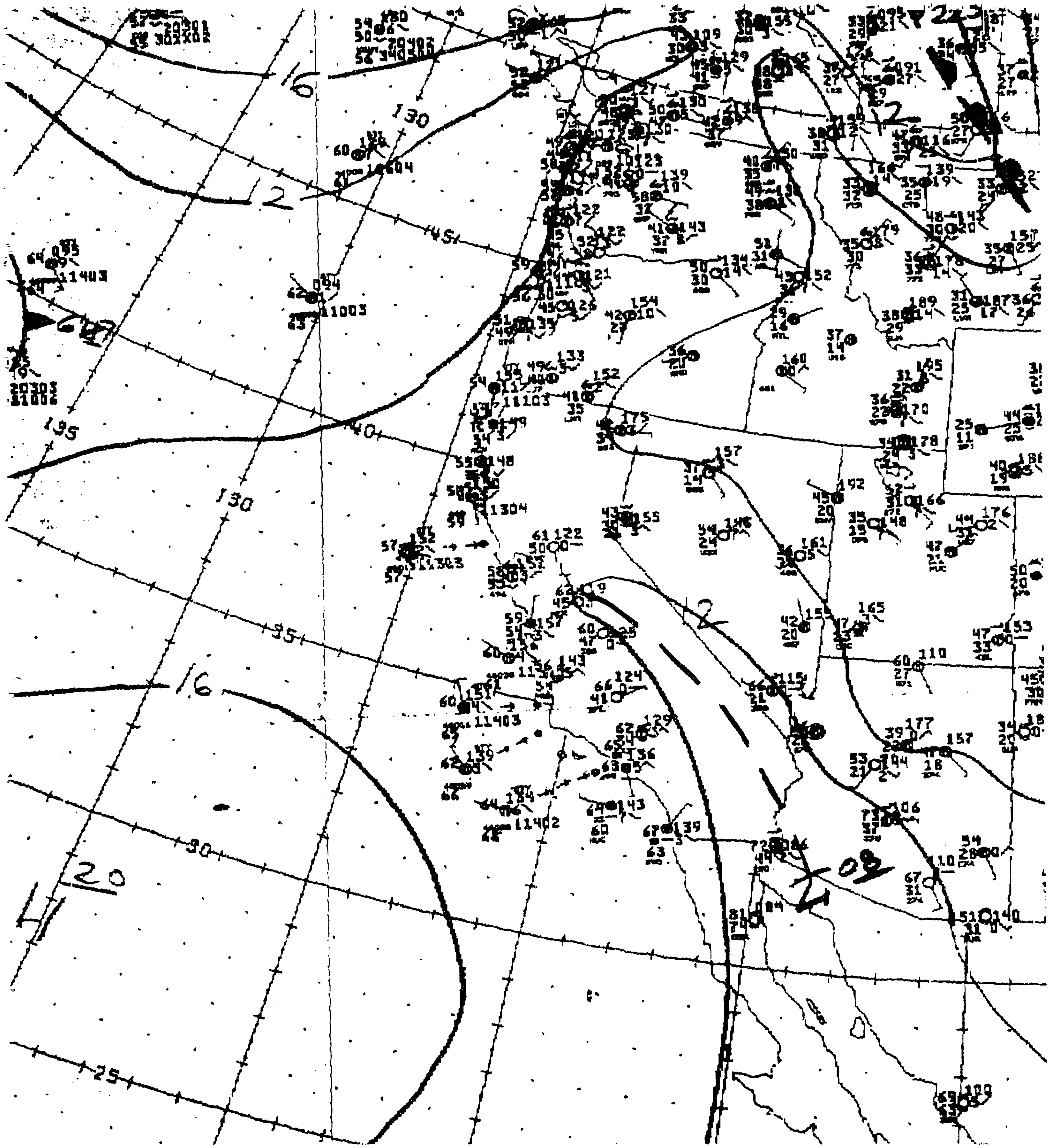
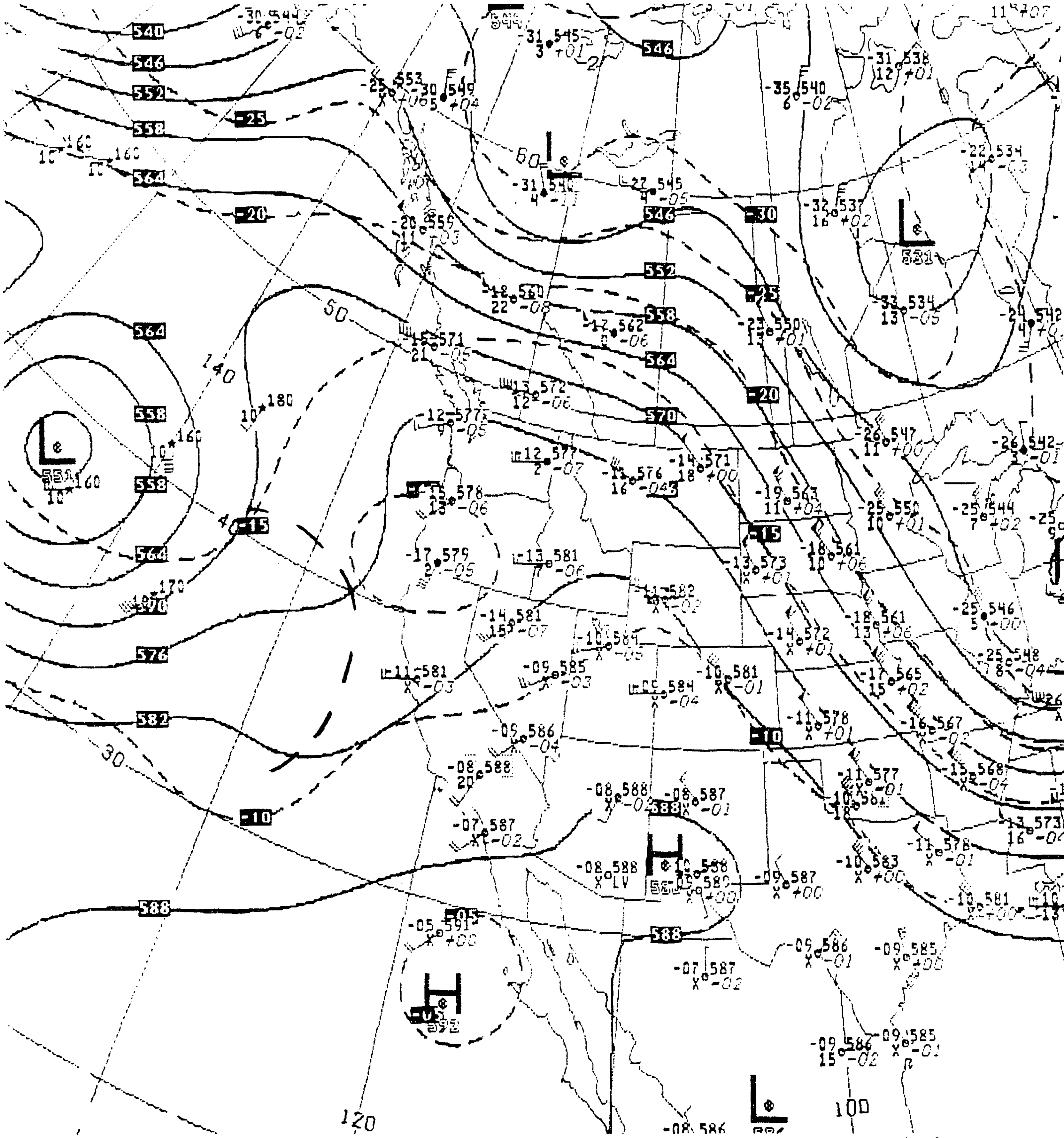


Figure A27. Surface map - Oct 7 0400 PST



D155 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 12Z WED 7 OCT 87

Figure A28. 500 mb map - Oct 7 0400 PST

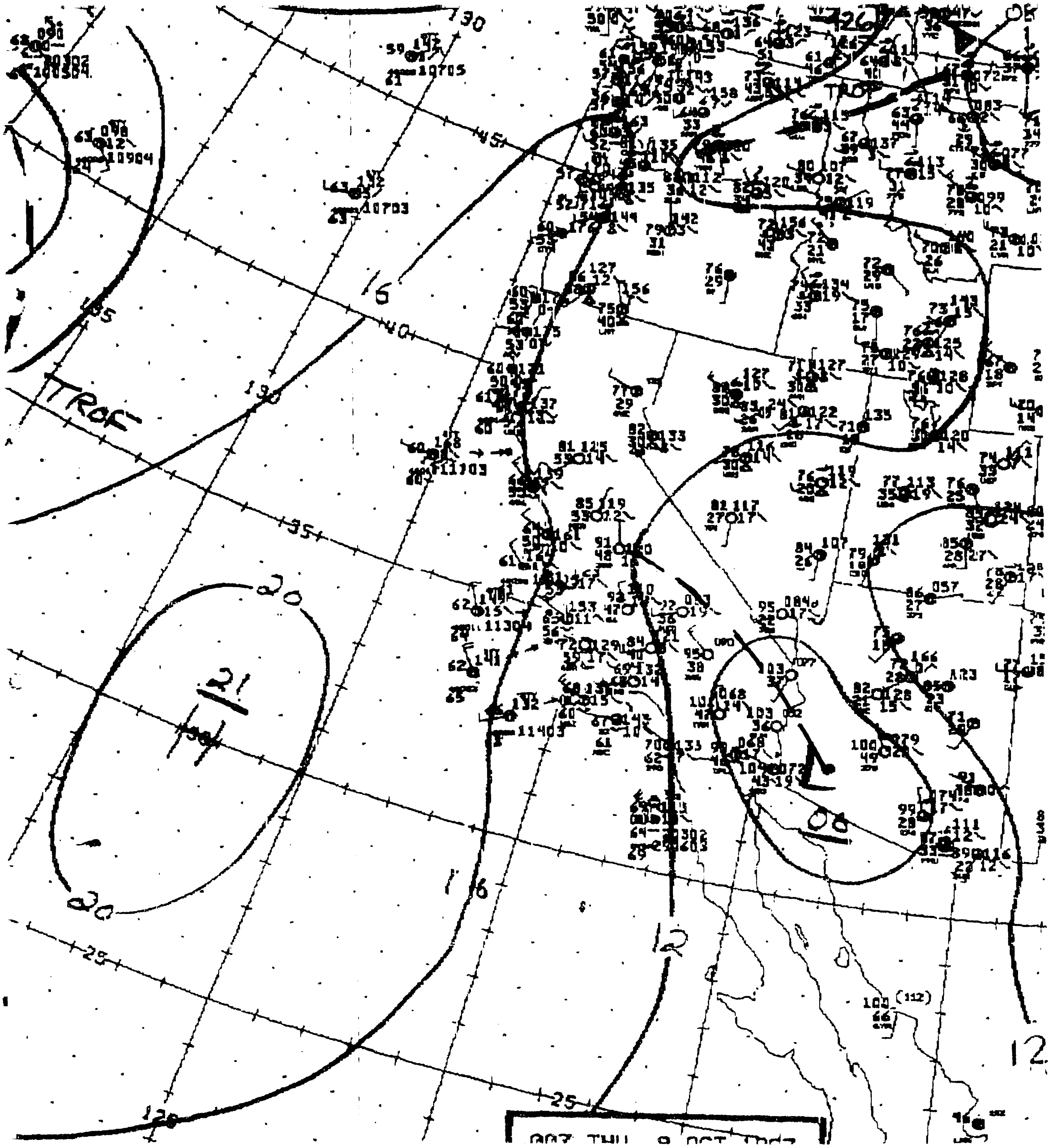
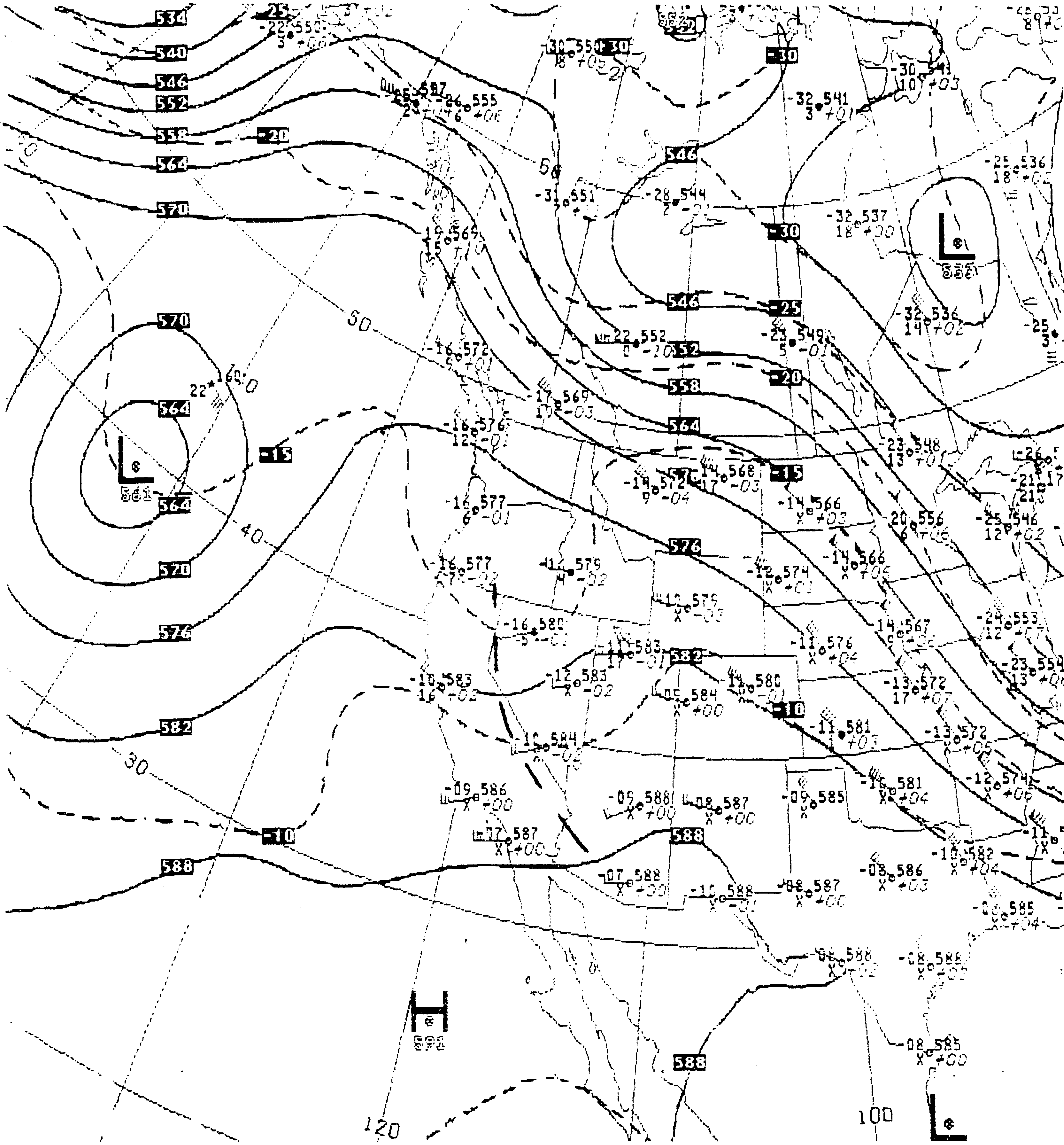


Figure A29. Surface map - Oct 7 1600 PST



D020 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 00Z THU 8 OCT 87

Figure A30. 500 mb map - Oct 7 1600 PST

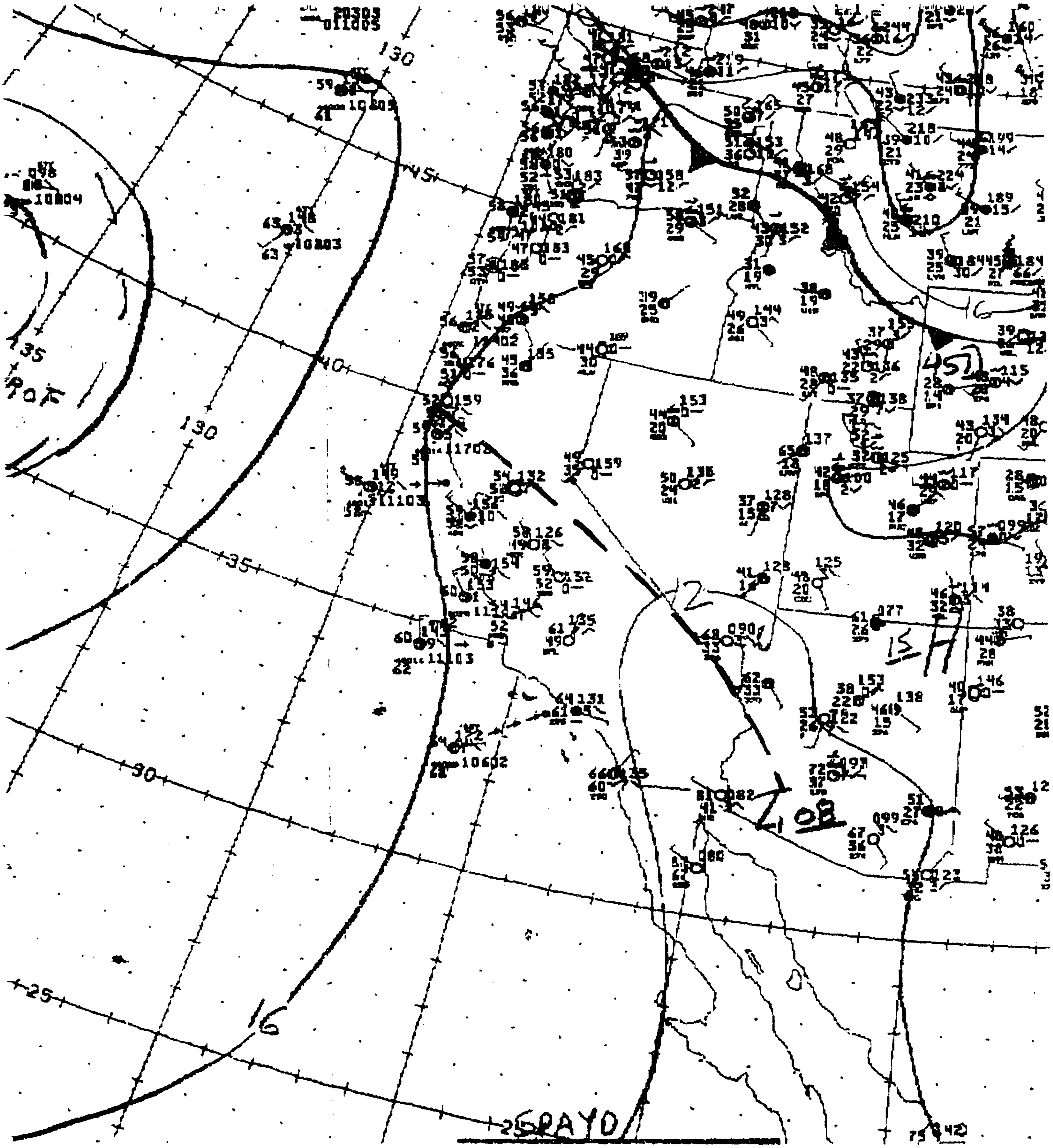
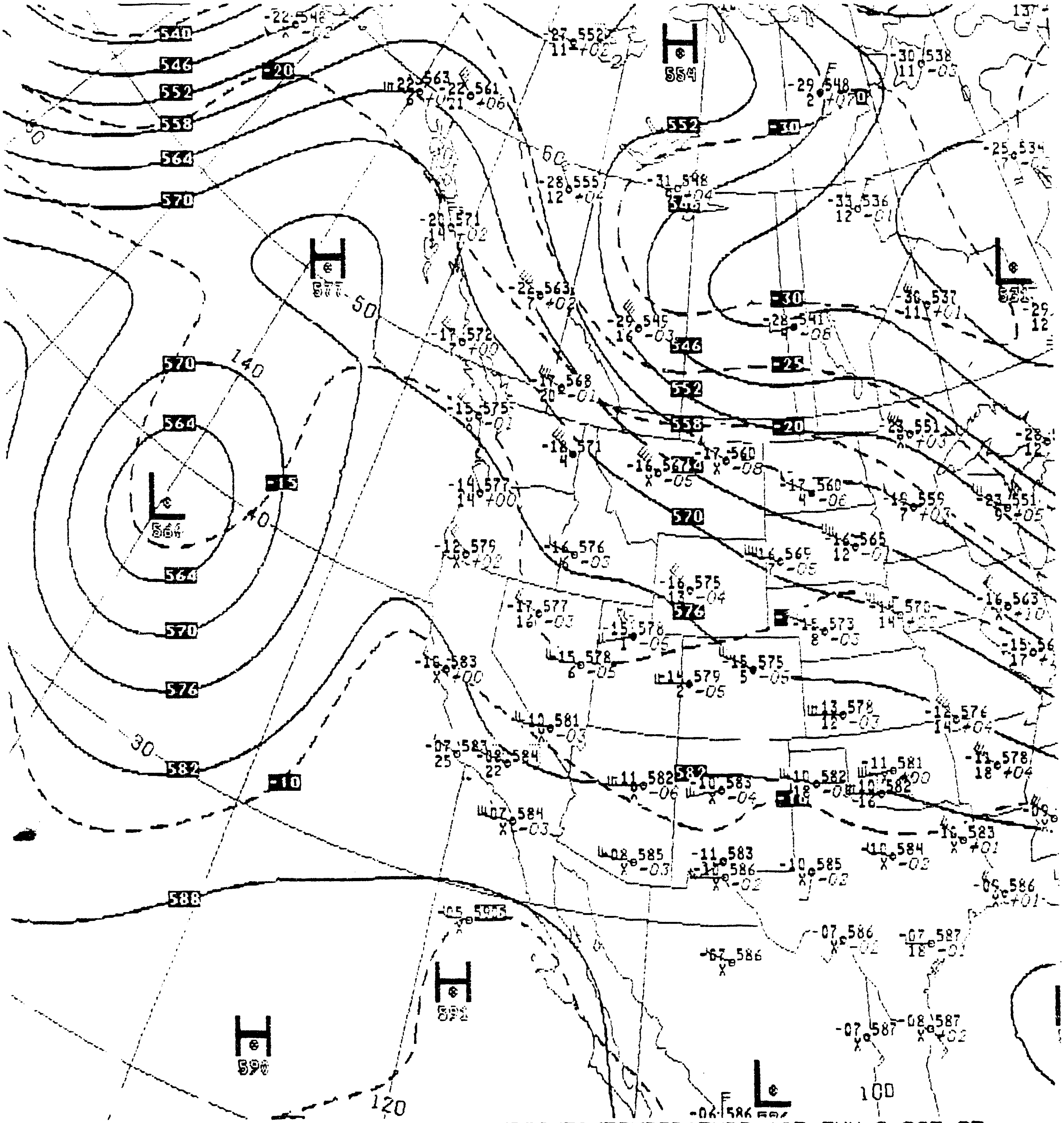


Figure A31. Surface map - Oct 8 0400 PST



D155 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 12Z THU 8 OCT 87

Figure A32. 500 mb map - Oct 8 0400 PST

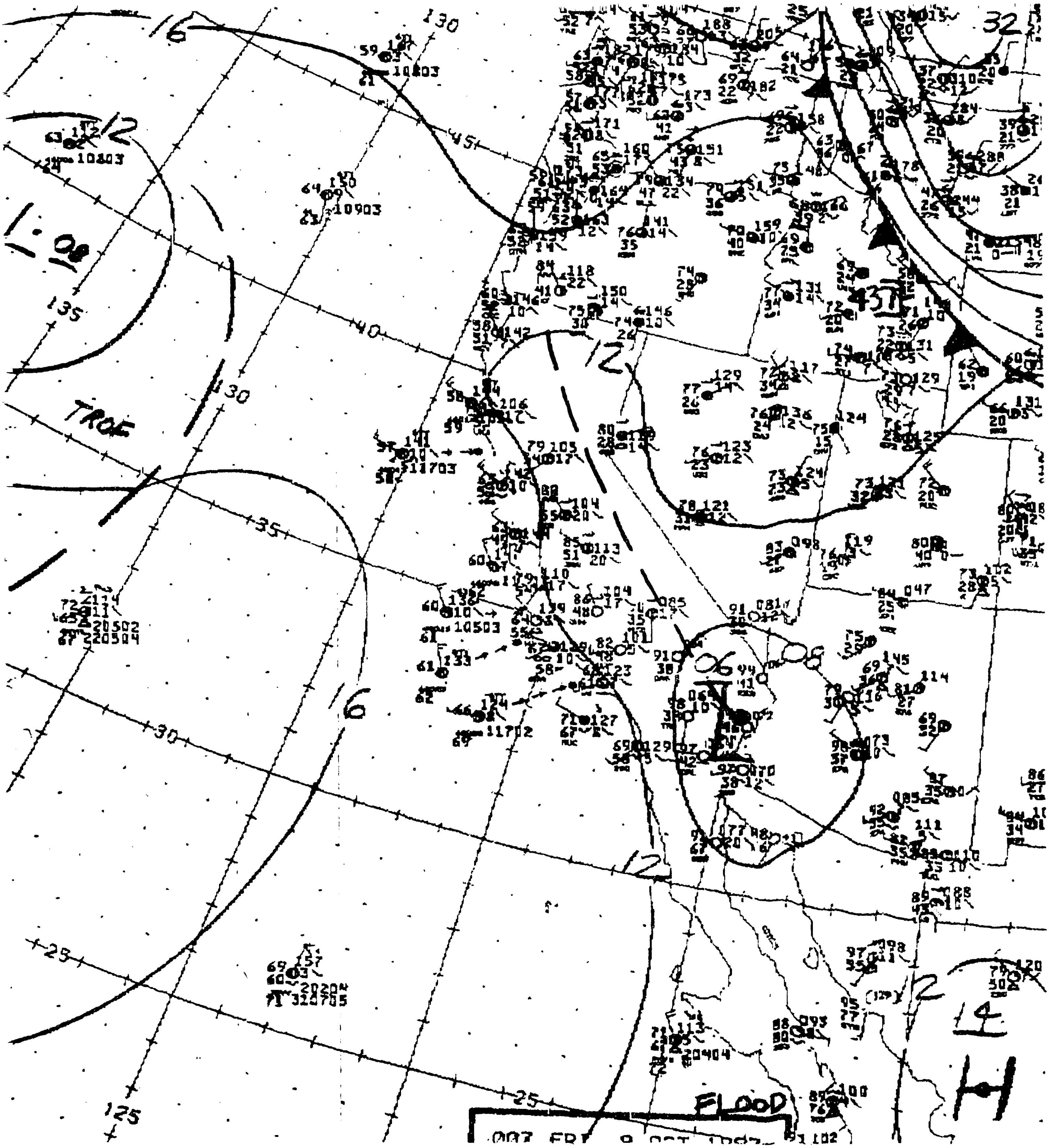
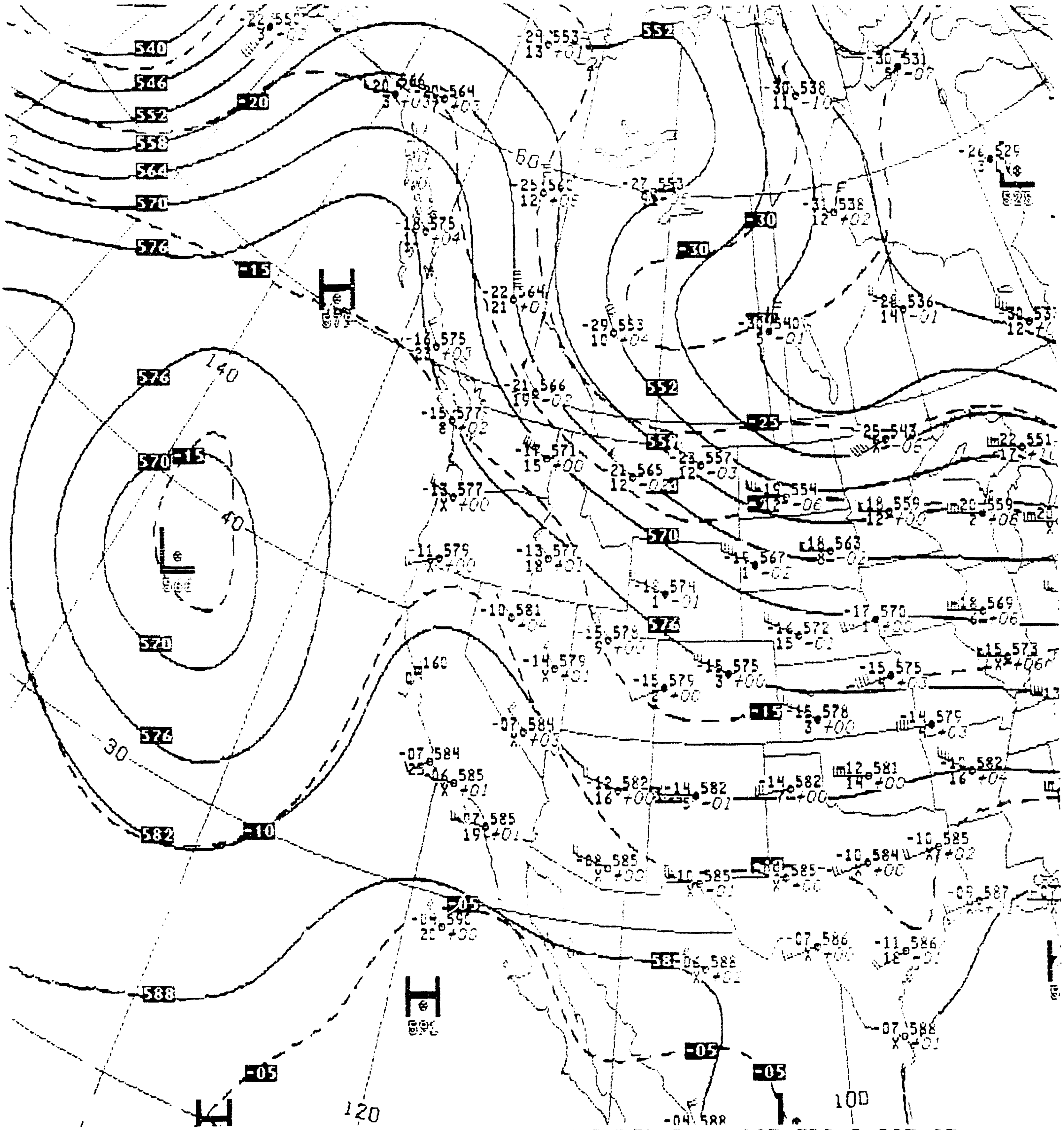


Figure A33. Surface map - Oct 8 1600 PST



D020 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 00Z FRI 9 OCT 87

Figure A34. 500 mb map - Oct 8 1600 PST

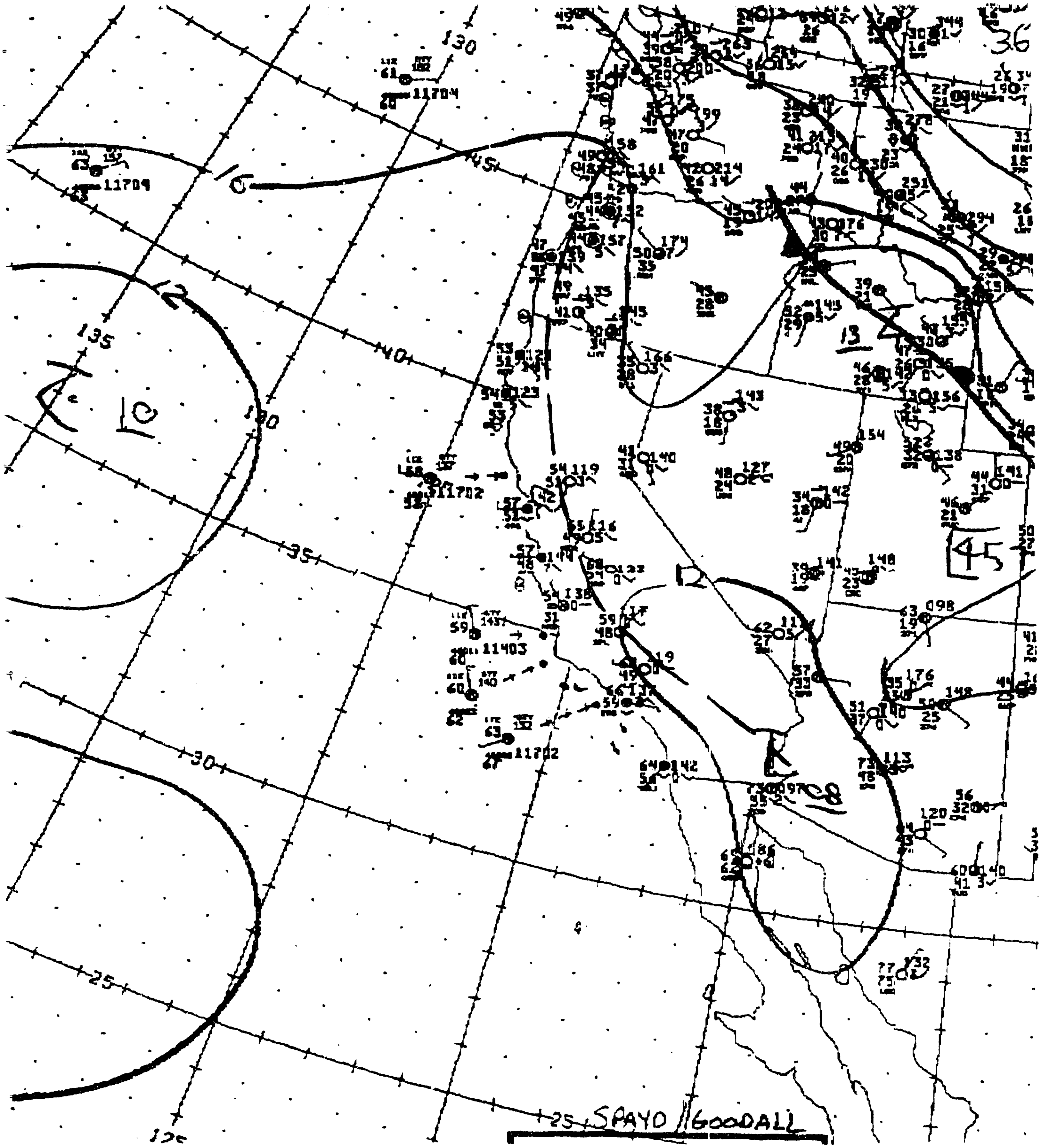
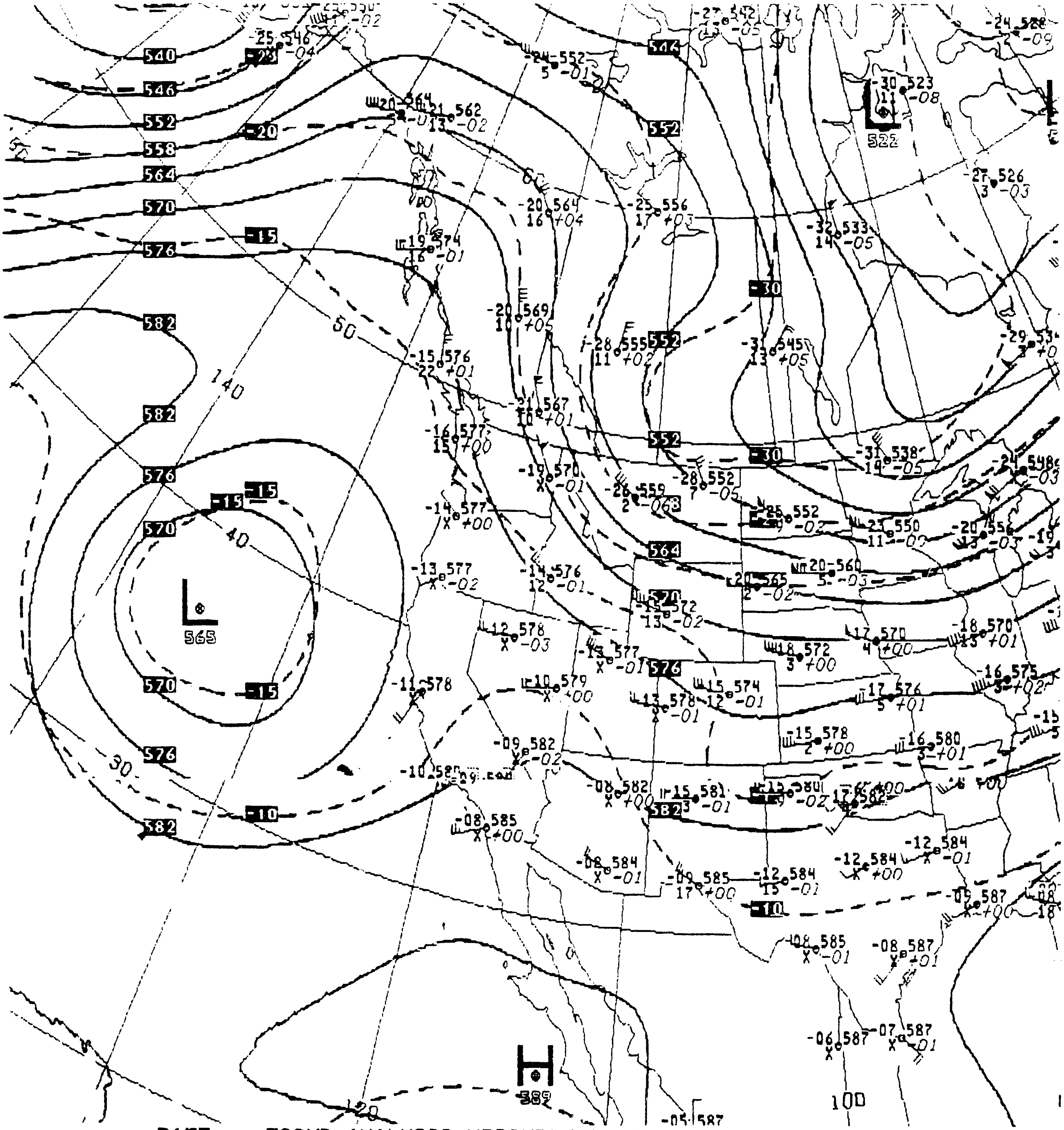


Figure A35. Surface map - Oct 9 0400 PST



D155 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 12Z FRI 9 OCT 87

Figure A36. 500 mb map - Oct 9 0400 PST

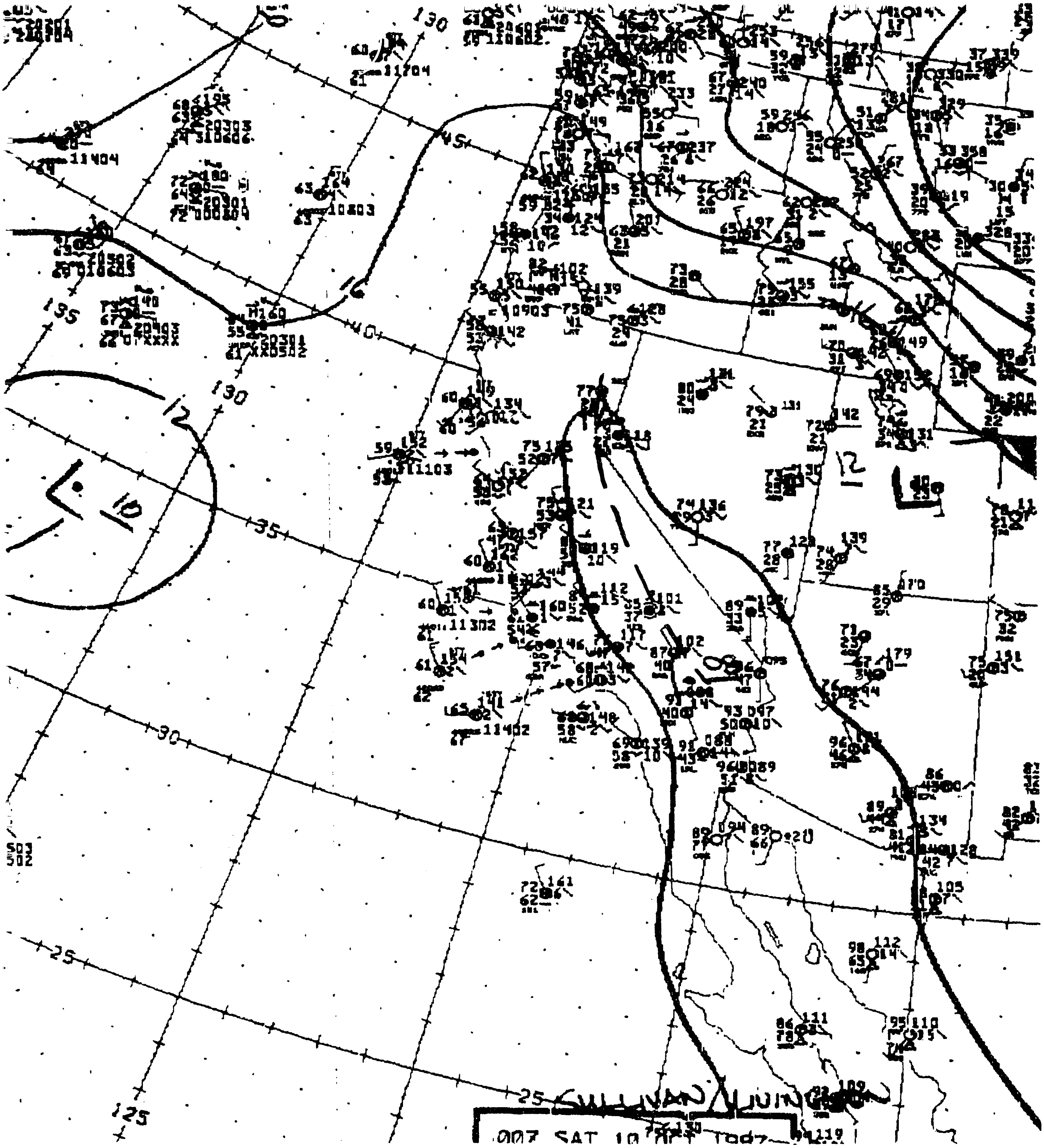
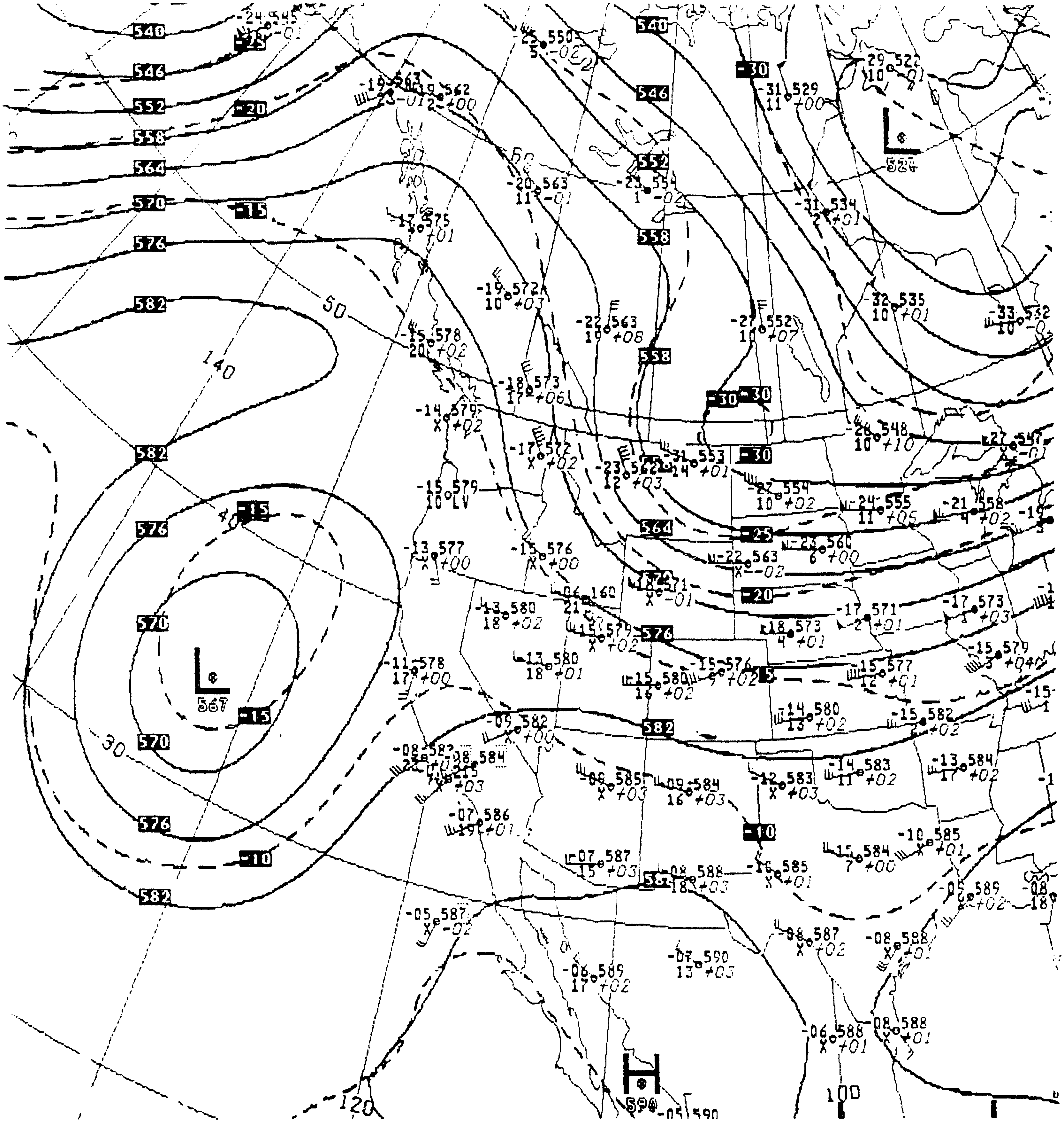


Figure A37. Surface map - Oct 9 1600 PST



D020 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE 00Z SAT 10 OCT 87

Figure A38. 500 mb map - Oct 9 1600 PST

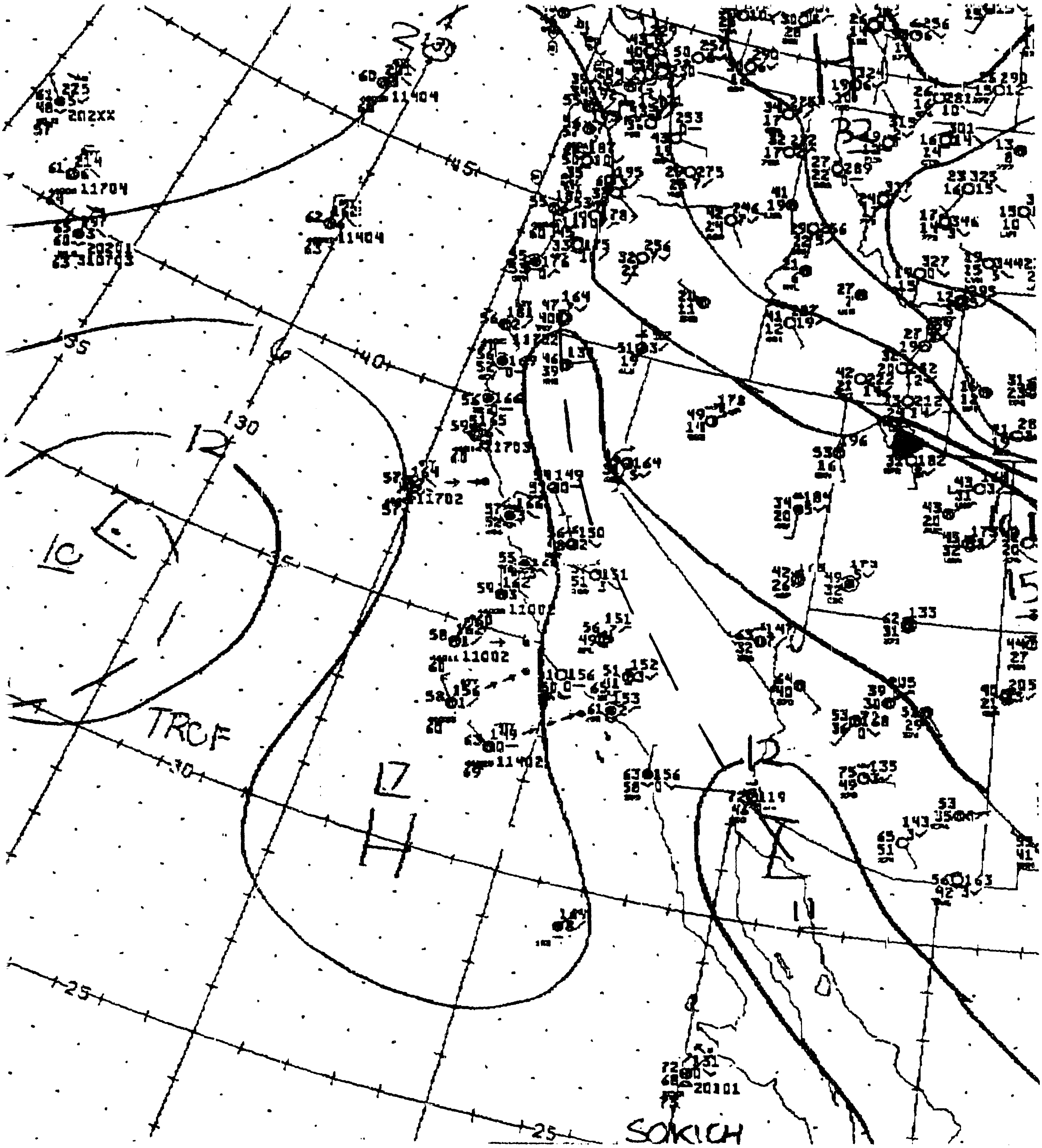


Figure A39. Surface map - Oct 10 0400 PST

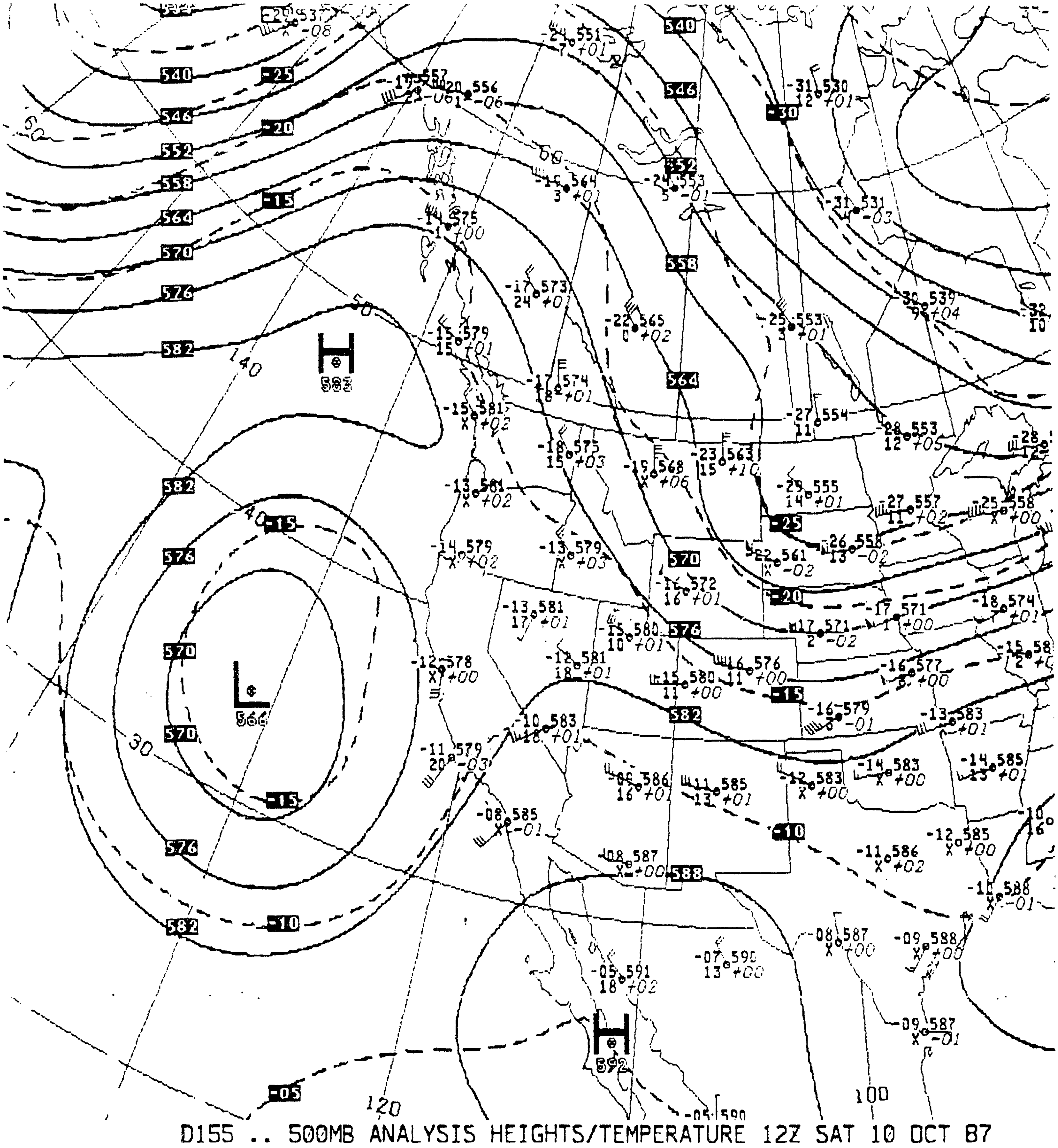


Figure A40. 500 mb map - Oct 9 1600 PST

Appendix B

Anemometer Calibrations

TABLE B1

TABLE OF CALIBRATED ANEMOMETERS

SITE	RANCH	SERIAL NO.	TUNNEL SPEED (MPH)	ANEMOMETER SPEED (MPH)	(ANEMOMETER/TUNNEL)	DATE INSTALLED
J18A*	JESS	B1	30.86	30.41	0.985	11/11/86
L03	JESS	B2	31.82	31.55	0.992	NA
L10	JESS	B3	31.28	31.14	0.996	NA
L08	JESS	B4	31.16	30.59	0.982	NA
M08	JESS	B5	31.17	31.08	0.997	NA
S29*	SOUZA	B6	31.80	31.38	0.987	9/20/86
NOT INSTALLED		B7	31.77	31.44	0.990	NA
L12	JESS	B8	31.14	30.78	0.988	NA
L05	JESS	N9	31.92	31.48	0.986	NA
S13A*	SOUZA	N10	30.77	30.45	0.990	9/25/86
NOT INSTALLED		N11	31.37	31.20	0.995	NA
J17B*	JESS	N12	31.30	31.04	0.992	9/23/86
S13B*	SOUZA	N13	31.88	31.56	0.990	9/25/86
L04	JESS	N14	31.65	31.46	0.994	NA
NOT INSTALLED		N15	31.52	31.27	0.992	NA
L01	JESS	N16	31.42	31.13	0.991	NA
S27A*	SOUZA	N17	30.96	30.84	0.996	10/14/86
M06	JESS	N18	33.88	34.07	1.006	NA
J08*	JESS	N19	31.68	31.48	0.994	9/18/86
J17B*	JESS	N20	31.82	31.54	0.991	9/23/86
G08	JESS	2	34.32	33.59	0.979	8/24/87
G03	JESS	3	33.80	33.08	0.979	8/24/87
F09	JESS	4	34.17	33.42	0.978	8/23/87
F01	JESS	5	33.96	33.31	0.981	8/23/87
F12	JESS	6	33.81	33.20	0.982	8/23/87
F03	JESS	7	33.74	33.11	0.981	8/23/87
G10	JESS	8	33.97	33.48	0.986	8/24/87
J08*	JESS	9	34.69	34.31	0.989	1/13/88
M09	JESS	10	34.03	33.43	0.982	8/22/87
N06	JESS	11	33.96	33.32	0.981	8/22/87
G03	JESS	12	34.24	33.57	0.980	8/24/87
F05	JESS	13	34.63	33.85	0.977	8/23/87
NOT INSTALLED		14	34.17	33.78	0.989	8/22/87
N04	JESS	15	34.12	33.70	0.988	8/22/87
N08	JESS	16	34.07	33.56	0.985	8/22/87
G12	JESS	17	32.17	31.60	0.982	8/24/87
F07	JESS	18	34.32	33.77	0.984	8/23/87
RETURNED TO SUPPLIER		19	34.66	33.13	0.956	NA
G01	JESS	20	33.77	33.12	0.981	8/23/87
G07	JESS	21	34.05	33.41	0.981	8/24/87
NOT INSTALLED		22	34.01	33.51	0.985	NA
M13	JESS	23	33.72	33.31	0.988	8/22/87
J08	JESS	24	33.92	33.53	0.989	9/29/87
K01	JESS	25	33.27	32.82	0.986	8/20/87
SOLD TO 2ND WIND		26	34.22	33.68	0.984	NA
M02	JESS	27	33.69	33.47	0.993	8/22/87
SOLD TO 2ND WIND		28	34.38	33.82	0.984	NA
M11	JESS	29	33.51	32.73	0.977	8/22/87
SOLD TO 2ND WIND		30	34.89	34.54	0.990	NA
K12	JESS	31	32.29	31.80	0.985	8/22/87
K14	JESS	32	31.84	31.76	0.997	8/21/87
S16*	SOUZA	33	33.97	33.51	0.986	1/22/88

TABLE B1

TABLE OF CALIBRATED ANEMOMETERS

SITE	RANCH	SERIAL NO.	TUNNEL SPEED (MPH)	ANEMOMETER SPEED (MPH)	(ANEMOMETER/TUNNEL)	DATE INSTALLED
K07	JESS	34	33.96	33.78	0.995	8/21/87
K09	JESS	35	33.66	33.13	0.984	8/21/87
J06	JESS	36	34.37	34.08	0.992	9/29/87
NOT INSTALLED		37	34.22	33.57	0.981	NA
K05	JESS	38	33.86	33.37	0.986	8/20/87
J11	JESS	39	33.66	32.99	0.980	9/29/87
NOT INSTALLED		40	30.36	30.23	0.996	NA
K03	JESS	41	34.47	33.64	0.976	8/20/87
SOLD TO 2ND WIND		42	34.17	33.69	0.986	NA
J08*	JESS	RM-02	33.27	33.63	1.011	9/07/87
S13A*	SOUZA	RM-01	32.80	33.24	1.013	9/04/87
GROUP MEAN (MAX #40'S EXCLUDING #19)			33.06	32.62	0.987	1986 AND 1987
STANDARD DEVIATION			1.31	1.20	0.01	ANEMOMETERS
GROUP MEAN (R.M. YOUNGS ONLY)			33.04	33.44	1.012	

* The alphanumeric character denotes a met tower location rather than a turbine location.

Appendix C

Hourly Data Listing

HOURLY DATA LISTING

DOE FREE FLOW DATA - SOUZA RANCH

ID	UNITS	DESCRIPTION
WS13	MPH	SITE S-13 70-ft reference
WS12	MPH	SITE S-13 35-ft
WS27	MPH	SITE S-27 80-ft reference
WS26	MPH	SITE S-27 45-ft
WD13	DEG	SITE S-13 70-ft
WS29	MPH	SITE S-29 50-ft
WSD2	MPH	TURBINE D2 35-ft
WSD4	MPH	TURBINE D4 35-ft
WSD6	MPH	TURBINE D6 35-ft
WSD7	MPH	TURBINE D7 35-ft
WSD1	MPH	TURBINE D11 35-ft
WSD3	MPH	TURBINE D13 35-ft
WSE2	MPH	TURBINE E2 35-ft
WSE4	MPH	TURBINE E4 35-ft
WSE6	MPH	TURBINE E6 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH
87/09/10	17	22.4	21.5	21.0	21.4	226.4	21.1	21.6	21.8	21.3	21.9	24.8	25.2	23.2	22.2	22.9
87/09/10	18	23.1	21.9	21.1	21.1	225.9	21.6	21.2	21.4	20.7	21.2	24.5	24.7	22.6	21.7	22.5
87/09/10	19	26.5	24.5	21.9	21.7	233.9	22.7	22.9	21.7	22.1	22.0	25.8	26.8	25.7	24.1	24.2
87/09/10	20	35.3	33.4	29.1	29.0	233.7	30.8	30.2	29.8	29.1	29.6	34.8	34.2	32.9	31.3	32.8
87/09/10	21	36.1	34.9	35.8	35.9	228.3	36.5	34.8	36.8	34.7	33.7	41.4	39.6	33.8	31.3	32.7
87/09/10	22	38.4	37.1	38.0	38.2	229.7	37.0	36.8	37.1	34.1	35.5	41.1	38.8	36.2	34.3	35.6
87/09/10	23	35.4	34.3	36.0	36.2	227.3	34.8	33.6	34.1	32.1	34.1	38.3	37.1	34.9	33.2	34.4
87/09/10	24	34.6	33.4	33.3	33.8	227.8	31.6	31.3	32.5	32.5	31.4	37.3	37.5	33.5	32.1	33.8
87/09/11	01	32.5	31.3	31.5	32.1	225.9	31.4	33.4	32.0	32.4	33.8	36.3	39.4	36.6	31.6	32.0
87/09/11	02	31.4	30.4	31.7	31.9	225.9	29.5	31.9	30.4	33.7	32.6	36.3	39.3	33.7	30.4	32.7
87/09/11	03	27.0	26.3	28.0	28.1	225.0	26.1	28.6	26.6	28.3	28.6	30.7	34.6	32.5	27.8	26.7
87/09/11	04	26.9	26.2	26.8	26.8	229.2	24.5	25.0	25.1	27.8	25.8	30.6	32.2	28.1	24.0	25.3
87/09/11	05	29.3	28.3	28.6	28.7	228.3	27.3	26.9	28.0	29.3	27.1	32.9	34.1	29.9	26.2	27.6
87/09/11	06	30.5	30.0	29.2	29.3	224.5	27.5	28.8	28.5	30.3	29.2	33.6	35.4	31.2	27.1	28.4
87/09/11	07	29.7	28.9	28.6	28.8	223.6	27.7	30.9	28.3	30.3	31.3	33.2	36.3	34.8	30.0	29.4
87/09/11	08	29.4	28.6	27.5	27.7	227.1	26.6	27.8	27.3	28.9	28.9	32.5	34.3	31.4	28.4	29.2
87/09/11	09	28.6	27.6	27.5	28.0	225.0	26.4	26.9	27.8	28.5	27.4	32.3	34.0	32.7	28.6	29.3
87/09/11	10	26.8	25.8	26.2	26.5	225.5	25.6	25.6	25.6	25.2	25.0	29.1	29.1	28.1	26.5	26.9
87/09/11	11	21.9	20.9	21.5	21.9	225.0	21.3	21.3	21.7	21.9	21.2	24.6	24.8	23.2	21.4	21.8
87/09/11	12	23.1	21.8	19.2	19.3	226.9	20.1	19.9	19.6	19.1	19.3	22.3	23.0	22.8	21.5	22.7
87/09/11	13	25.1	24.1	23.1	23.1	223.6	23.1	23.4	22.6	21.8	22.6	25.6	26.1	25.1	23.7	23.8
87/09/11	14	23.3	22.1	21.0	21.3	221.7	21.9	22.0	21.4	20.4	21.2	24.3	24.1	23.4	22.0	22.0
87/09/11	15	24.2	23.1	22.7	22.7	226.4	23.6	23.7	22.5	21.9	22.5	25.8	26.2	25.3	23.7	24.4
87/09/11	16	24.1	23.1	22.2	22.2	224.5	23.5	23.5	22.9	22.0	22.5	26.0	26.3	25.0	23.5	24.0
87/09/11	17	22.6	21.5	23.3	23.1	225.0	23.9	24.0	23.0	22.6	22.9	26.5	26.6	24.9	22.5	23.4
87/09/11	18	27.7	26.4	27.3	27.0	226.4	28.1	28.8	26.8	25.1	27.3	30.0	28.8	27.1	25.6	26.0
87/09/11	19	33.5	31.9	30.3	29.8	232.5	31.3	30.9	30.3	29.2	29.7	34.7	34.5	32.8	30.6	31.0
87/09/11	20	38.0	36.4	34.6	33.7	230.6	35.9	36.3	33.7	32.3	34.4	38.9	38.5	36.9	34.8	36.0
87/09/11	21	37.8	36.3	35.3	34.6	234.8	35.5	35.4	34.0	32.1	33.9	38.5	37.2	34.9	32.4	33.4
87/09/11	22	36.8	35.1	36.9	36.5	230.2	38.4	38.2	36.7	34.8	36.0	42.0	39.2	35.9	33.1	34.0
87/09/11	23	35.7	34.2	33.3	33.2	229.2	33.9	33.1	32.7	32.1	31.3	37.9	38.0	35.5	31.7	32.3
87/09/11	24	34.0	32.5	31.3	30.7	233.0	31.6	30.6	30.7	30.5	30.1	35.9	35.4	32.4	30.2	30.5

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WBD4 MPH	WBD6 MPH	WBD7 MPH	WBD1 MPH	WBD3 MPH	WBE2 MPH	WBE4 MPH	WBE6 MPH
87/09/12	01	29.4	28.1	27.1	27.4	225.9	28.3	28.3	28.2	27.0	28.2	32.2	32.6	29.6	27.4	26.7
87/09/12	02	27.4	26.3	26.7	27.0	220.8	27.5	27.9	27.4	26.9	28.0	31.4	32.6	30.4	26.9	27.0
87/09/12	03	26.8	25.8	26.8	26.7	225.5	27.4	26.8	26.9	26.0	26.1	31.1	30.7	27.8	26.9	26.4
87/09/12	04	26.3	25.2	27.4	27.4	226.9	27.7	26.4	27.8	27.1	26.0	32.2	32.0	28.8	25.8	26.0
87/09/12	05	26.8	25.9	27.1	27.4	220.3	27.5	26.6	27.8	27.4	27.1	31.9	32.9	31.8	28.8	27.2
87/09/12	06	27.5	26.4	25.9	26.0	218.4	26.1	26.0	26.3	26.8	27.0	30.8	32.1	31.2	28.1	27.5
87/09/12	07	24.5	23.5	22.9	23.0	226.6	23.3	23.3	23.1	23.5	23.6	26.9	28.0	25.7	22.9	23.2
87/09/12	08	25.2	24.2	24.1	24.2	222.7	24.1	24.1	24.4	25.0	24.7	28.9	29.7	27.8	24.9	25.0
87/09/12	09	26.4	25.2	25.1	24.9	227.3	25.8	25.8	24.6	24.7	24.4	29.0	29.3	27.6	25.2	25.4
87/09/12	10	24.6	23.7	23.7	23.6	222.2	24.2	24.1	23.4	23.2	23.0	26.9	27.2	25.9	24.4	24.9
87/09/12	11	23.1	22.2	22.6	22.7	225.5	22.8	23.2	22.1	21.5	22.0	25.3	25.3	23.9	22.4	23.3
87/09/12	12	19.8	19.3	18.9	19.3	219.4	19.4	19.4	19.2	18.9	18.9	21.6	22.4	20.9	19.6	20.3
87/09/12	13	20.6	20.2	18.8	19.1	214.7	19.4	19.4	19.6	19.5	18.9	22.1	22.7	21.2	19.4	19.8
87/09/12	14	23.1	22.7	21.1	21.3	219.8	21.6	21.7	21.3	21.1	21.1	24.4	24.9	23.4	22.1	22.8
87/09/12	15	23.6	21.6	21.5	21.3	232.0	22.1	22.2	21.0	19.8	21.0	24.0	23.5	22.9	21.2	21.5
87/09/12	16	25.2	23.3	22.5	22.6	234.4	23.6	23.8	22.7	21.5	22.0	25.7	25.4	25.6	23.1	23.3
87/09/12	17	26.7	24.9	22.8	22.6	229.2	23.8	23.8	23.0	22.3	22.4	26.4	26.8	26.9	24.6	25.1
87/09/12	18	28.3	26.3	23.2	23.3	232.7	25.5	25.4	25.0	24.1	23.9	28.4	28.5	27.6	25.5	26.0
87/09/12	19	30.6	28.5	26.3	25.9	233.4	27.8	28.0	26.6	25.7	26.1	30.4	30.7	30.0	27.9	28.4
87/09/12	20	35.6	33.6	30.6	29.6	235.3	32.1	32.3	30.4	29.1	30.1	35.0	34.9	34.4	32.3	33.3
87/09/12	21	40.4	38.4	35.2	34.1	231.6	35.4	35.9	32.8	31.7	34.5	38.4	38.1	38.0	35.6	36.3
87/09/12	22	33.2	31.8	29.3	29.0	224.1	29.6	30.7	29.2	28.4	30.6	33.2	33.7	33.3	31.3	30.6
87/09/12	23	28.0	26.8	26.0	26.2	218.9	26.7	27.7	26.8	26.4	27.5	30.8	31.1	29.7	28.0	27.3
87/09/12	24	31.1	29.4	28.3	27.9	226.9	29.5	29.1	27.7	26.9	28.2	32.4	32.3	30.6	28.7	28.5
87/09/13	01	31.2	29.4	29.3	29.0	230.2	30.0	29.8	28.6	27.7	29.1	33.0	33.6	32.2	29.9	29.0
87/09/13	02	28.9	27.9	28.5	28.6	220.3	29.3	28.9	29.0	29.8	28.7	34.1	35.6	31.9	28.5	27.9
87/09/13	03	28.5	27.6	25.0	25.3	215.6	25.8	27.1	26.2	26.7	27.3	30.5	32.2	31.7	30.5	28.3
87/09/13	04	23.6	22.8	22.2	22.3	219.4	22.7	23.5	22.7	23.6	23.8	26.7	28.4	26.9	25.1	24.0
87/09/13	05	23.4	22.6	21.9	21.8	216.1	22.3	23.2	22.7	23.6	23.0	26.6	28.2	26.6	24.9	22.6
87/09/13	06	22.4	21.3	21.6	21.4	221.7	22.2	22.6	22.2	20.8	22.3	25.3	24.5	23.7	22.9	22.3
87/09/13	07	20.9	19.7	20.8	20.3	222.2	20.6	20.9	20.5	19.5	21.0	23.3	23.7	22.0	20.2	20.1
87/09/13	08	21.0	19.8	19.9	19.7	224.1	20.1	19.6	19.9	18.8	19.3	22.3	22.4	21.2	19.4	19.1
87/09/13	09	19.6	18.5	18.8	18.8	221.7	19.5	19.3	19.2	19.2	18.9	22.1	22.7	20.8	19.0	19.0
87/09/13	10	19.2	18.2	17.2	17.1	226.0	18.3	18.2	17.5	17.0	17.5	20.0	20.3	18.8	17.6	18.5
87/09/13	11	15.3	14.1	14.6	14.7	235.9	15.6	15.5	14.5	13.8	14.5	16.8	16.8	15.5	14.3	14.6
87/09/13	12	14.8	13.4	14.8	14.9	242.2	15.4	15.3	14.1	13.5	14.0	16.3	16.1	15.0	14.0	14.1
87/09/13	13	13.1	12.1	14.1	14.0	237.3	14.9	14.7	13.3	12.3	13.3	15.1	14.9	13.4	12.3	12.5
87/09/13	14	12.9	12.0	13.5	13.6	250.8	14.6	13.8	12.6	12.0	12.4	14.6	14.1	13.1	12.0	12.5
87/09/13	15	13.9	12.7	14.5	14.6	252.2	15.7	14.8	13.8	13.0	13.4	15.7	15.2	14.0	13.1	13.4
87/09/13	16	12.9	12.1	14.3	14.4	250.4	16.9	15.9	14.7	13.8	14.6	16.6	15.8	13.9	13.1	13.2
87/09/13	17	13.7	12.2	13.7	13.7	245.5	16.1	15.0	14.2	13.1	13.6	15.5	15.0	13.4	12.9	13.3
87/09/13	18	20.0	18.2	17.8	18.0	232.0	19.1	18.4	18.2	17.2	17.3	20.4	20.4	19.8	17.9	17.9
87/09/13	19	19.9	18.7	18.0	18.2	223.6	19.0	19.5	19.3	18.1	19.7	21.8	21.4	19.9	18.3	17.9
87/09/13	20	22.3	21.3	21.1	21.0	219.4	20.5	21.3	21.3	22.1	21.5	24.6	25.8	23.4	21.4	19.9
87/09/13	21	23.6	22.5	23.6	23.4	222.2	22.4	22.7	23.1	23.7	22.9	26.8	27.7	25.1	21.9	21.0
87/09/13	22	21.1	20.0	21.7	22.1	224.1	21.4	21.9	22.6	23.5	22.4	26.3	27.8	25.5	22.7	21.7
87/09/13	23	23.8	22.1	21.5	21.3	226.4	22.1	21.6	21.6	21.3	21.4	25.1	26.2	24.2	22.1	22.2
87/09/13	24	25.5	23.3	20.4	20.3	230.2	21.8	22.0	20.8	20.5	21.3	24.7	24.9	23.4	22.0	22.9

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH
87/09/14	01	25.0	23.4	23.6	23.5	224.5	24.5	24.5	24.1	23.6	24.5	27.9	27.8	24.6	22.9	22.3
87/09/14	02	20.1	19.3	19.9	19.9	211.9	20.8	20.8	21.1	20.3	21.2	24.2	24.3	22.1	20.4	19.9
87/09/14	03	19.7	18.5	18.4	18.2	224.1	19.2	19.5	18.6	18.3	18.9	21.8	22.3	20.5	18.9	18.8
87/09/14	04	21.4	20.1	20.5	20.2	227.8	20.7	20.7	20.1	19.5	20.7	23.1	23.1	21.2	19.3	20.1
87/09/14	05	18.8	17.7	19.6	19.3	222.7	20.0	19.3	19.6	19.5	19.3	22.8	23.2	20.8	18.7	18.8
87/09/14	06	19.0	18.0	19.2	18.8	225.2	19.4	19.3	18.6	17.9	19.3	21.5	21.2	18.8	17.8	18.1
87/09/14	07	19.9	18.4	17.0	16.5	231.1	17.7	17.8	16.8	16.2	16.9	19.4	19.9	18.9	17.6	17.9
87/09/14	08	19.3	17.7	16.3	15.8	229.7	16.7	16.8	15.8	14.8	16.3	17.9	17.9	17.4	16.2	16.7
87/09/14	09	18.9	17.4	17.2	17.1	231.6	17.7	17.7	16.9	16.3	17.2	19.4	19.5	18.8	17.5	18.1
87/09/14	10	19.7	17.9	17.4	17.5	234.4	18.2	18.2	17.2	16.1	17.1	19.3	19.8	19.1	17.9	18.1
87/09/14	11	18.1	17.0	16.6	16.7	228.3	16.9	17.1	16.8	15.6	16.3	18.3	18.6	17.9	16.9	17.6
87/09/14	12	15.7	15.3	14.3	14.6	219.8	14.3	14.6	14.1	14.0	13.9	15.8	16.3	15.7	14.6	15.3
87/09/14	13	14.4	13.9	13.7	14.0	220.3	13.9	13.9	13.7	13.0	13.1	15.2	15.2	14.9	13.6	13.8
87/09/14	14	15.9	15.0	15.4	15.5	230.6	15.9	16.2	15.3	14.8	15.4	17.2	17.5	16.4	15.3	15.5

HOURLY DATA LISTING

DOE FREE FLOW DATA - SOUZA RANCH

ID	UNITS	DESCRIPTION
WSE0	MPH	TURBINE E10 35-ft
WSE1	MPH	TURBINE E12 35-ft
WSE3	MPH	TURBINE E14 35-ft
WSF2	MPH	TURBINE F2 35-ft
WSF4	MPH	TURBINE F4 35-ft
WSF6	MPH	TURBINE F6 35-ft
WSF8	MPH	TURBINE F8 35-ft
WSF0	MPH	TURBINE F10 35-ft
WSF1	MPH	TURBINE F12 35-ft
WSF3	MPH	TURBINE F14 35-ft
WSG2	MPH	TURBINE G2 35-ft
WSG4	MPH	TURBINE G4 35-ft
WSG7	MPH	TURBINE G7 35-ft
WSG9	MPH	TURBINE G9 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WBE0 MPH	WBE1 MPH	WBE3 MPH	WSF2 MPH	WSF4 MPH	WBF6 MPH	WBF8 MPH	WSF0 MPH	WBF1 MPH	WSF3 MPH	WB02 MPH	WB04 MPH	WB07 MPH	WB09 MPH
87/09/10	17	22.7	21.1	21.4	23.7	24.6	26.3	25.6	22.7	23.6	21.8	24.4	22.4	21.0	17.8
87/09/10	18	21.9	20.4	21.2	22.8	24.3	25.8	24.5	22.5	23.9	22.0	23.7	22.6	21.2	18.0
87/09/10	19	23.6	23.0	23.6	26.6	28.0	29.1	26.9	25.3	25.7	24.7	26.8	24.8	21.7	18.3
87/09/10	20	30.6	29.3	30.5	33.7	35.2	37.6	36.2	34.5	36.1	34.8	36.6	34.1	31.1	25.8
87/09/10	21	34.3	31.0	30.0	34.3	34.8	37.1	36.3	35.5	37.9	36.2	36.6	35.9	34.0	27.8
87/09/10	22	34.7	32.5	32.6	36.8	39.5	40.9	39.7	37.8	40.2	39.4	39.7	38.3	37.3	31.6
87/09/10	23	33.1	31.0	32.1	36.1	37.9	40.3	37.6	35.0	37.8	36.2	36.4	35.3	33.7	28.4
87/09/10	24	34.0	30.1	30.7	34.7	36.1	39.2	37.2	34.0	36.7	36.4	35.5	34.5	33.9	29.8
87/09/11	01	37.3	33.5	31.4	38.1	33.8	36.1	37.8	33.7	35.1	34.1	35.7	32.5	30.9	28.1
87/09/11	02	35.9	30.8	29.2	35.4	33.8	37.7	36.6	32.3	33.8	33.9	34.2	31.5	31.8	27.8
87/09/11	03	32.7	28.9	27.7	34.6	30.9	31.4	30.8	26.9	28.0	28.7	29.0	27.1	28.2	24.9
87/09/11	04	29.3	25.9	23.6	29.7	27.3	30.1	27.3	25.3	27.9	28.2	26.5	26.9	27.7	23.8
87/09/11	05	30.7	27.5	25.5	31.1	28.9	32.0	30.5	27.3	29.9	30.7	28.8	29.0	29.8	25.3
87/09/11	06	32.3	28.6	26.1	32.7	29.9	33.2	32.3	29.2	31.6	32.6	30.8	30.8	31.9	28.1
87/09/11	07	33.5	31.7	29.7	35.9	32.4	34.0	34.8	30.0	31.1	32.0	32.3	29.9	30.8	28.0
87/09/11	08	31.3	28.9	27.4	32.3	31.1	33.8	33.0	29.1	30.5	31.0	31.0	29.4	30.1	26.8
87/09/11	09	31.4	29.7	27.8	33.7	31.2	33.6	33.4	29.3	29.8	28.8	31.6	28.6	27.1	23.4
87/09/11	10	26.8	25.2	25.5	28.7	29.6	31.1	29.9	27.0	27.9	26.3	28.8	26.6	24.9	21.4
87/09/11	11	23.3	21.0	20.7	24.3	24.2	25.3	24.3	22.2	22.8	20.9	23.9	21.6	20.2	16.9
87/09/11	12	20.6	20.3	21.3	23.9	24.9	26.5	24.8	22.7	23.2	21.0	24.7	22.4	20.2	16.1
87/09/11	13	23.4	22.4	23.0	25.9	26.9	28.3	26.8	24.6	24.5	23.0	26.7	24.8	23.0	18.6
87/09/11	14	22.1	20.9	21.2	24.4	25.0	26.4	24.9	22.8	23.1	21.6	24.6	22.8	21.0	17.2
87/09/11	15	23.6	22.5	22.9	26.2	27.2	28.8	27.1	24.2	24.5	22.2	26.5	23.9	21.4	17.2
87/09/11	16	23.5	22.5	22.7	25.7	26.6	27.8	26.5	23.9	24.8	23.3	25.9	23.8	22.3	19.2
87/09/11	17	24.1	22.6	21.5	25.5	25.4	27.1	26.2	22.4	22.1	20.5	25.1	22.2	20.3	16.9
87/09/11	18	26.5	24.4	24.7	27.8	28.4	30.5	29.5	27.2	27.8	25.9	29.4	27.2	25.0	20.6
87/09/11	19	30.6	29.5	29.9	33.1	33.9	36.6	35.0	33.0	33.5	33.0	35.2	32.6	30.4	25.4
87/09/11	20	34.7	33.1	34.1	37.0	39.0	41.7	40.0	37.8	38.8	37.1	40.1	37.3	34.1	27.7
87/09/11	21	34.0	31.2	31.2	35.4	36.9	39.3	38.2	36.8	37.7	36.3	39.1	37.0	33.4	26.8
87/09/11	22	36.3	32.6	31.5	36.8	37.7	40.1	37.9	36.0	37.7	36.5	38.2	35.9	33.3	27.2
87/09/11	23	34.5	32.1	30.2	36.4	36.3	38.2	36.2	34.9	35.8	34.6	36.8	35.1	32.3	26.2
87/09/11	24	31.3	29.2	28.9	32.5	34.5	35.5	34.2	32.7	34.9	33.5	34.5	33.3	32.0	26.5

DOE FREE FLOW DATA - BOUZA RANCH

YY/MM/DD	HR	WBE0 MPH	WBE1 MPH	WBE3 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WB02 MPH	WB04 MPH	WB07 MPH	WB09 MPH
87/09/12	01	29.5	27.5	26.7	29.0	29.1	30.2	30.1	28.5	30.2	29.5	30.2	28.9	28.4	24.8
87/09/12	02	29.4	28.2	26.1	30.4	29.0	30.7	30.2	27.6	28.6	27.5	29.5	27.2	25.7	22.3
87/09/12	03	27.4	25.2	26.1	27.6	29.0	30.1	28.7	26.5	28.1	27.2	27.8	26.6	25.9	22.5
87/09/12	04	28.5	26.9	24.9	29.1	27.9	29.8	28.8	26.0	27.6	26.9	27.5	26.0	25.4	22.1
87/09/12	05	29.6	28.8	28.1	31.7	30.8	30.6	29.7	27.0	28.3	27.2	28.9	26.9	25.4	22.7
87/09/12	06	29.3	28.4	27.1	31.4	30.3	31.1	30.8	27.5	28.7	27.3	29.4	27.3	25.7	22.4
87/09/12	07	25.3	23.8	22.3	26.0	25.0	26.3	25.9	23.8	25.3	24.0	25.3	24.1	23.3	19.9
87/09/12	08	26.7	25.3	24.5	28.2	27.0	28.6	27.8	25.1	26.4	24.6	26.7	25.0	23.6	20.4
87/09/12	09	26.2	25.0	24.5	28.1	28.7	29.7	27.5	25.9	27.5	25.4	27.2	25.9	24.0	19.8
87/09/12	10	24.5	23.5	23.6	26.5	27.1	26.6	27.4	24.7	25.4	23.8	26.8	24.4	22.4	19.0
87/09/12	11	23.0	21.6	21.8	24.7	25.6	27.1	26.0	23.5	24.1	21.9	25.3	24.0	20.7	17.2
87/09/12	12	20.3	19.0	18.9	21.7	22.2	23.4	22.6	20.1	20.4	18.6	22.1	20.0	17.7	14.9
87/09/12	13	20.6	19.1	18.6	21.4	21.5	23.0	22.7	20.5	20.9	19.9	22.5	20.9	19.1	16.2
87/09/12	14	22.1	21.4	21.3	23.9	24.7	26.2	25.7	23.2	24.0	22.3	25.5	23.6	21.4	17.2
87/09/12	15	21.3	20.1	20.5	24.7	25.3	26.5	24.4	22.2	22.4	21.8	24.6	22.0	19.5	16.2
87/09/12	16	23.6	22.1	22.2	27.5	28.0	28.5	26.1	24.1	24.1	22.6	26.3	23.9	21.1	16.5
87/09/12	17	24.3	23.4	23.7	28.2	29.3	30.1	27.5	25.7	25.5	24.0	27.5	25.5	22.1	17.5
87/09/12	18	26.0	24.6	25.2	29.0	29.3	30.7	29.0	27.3	27.6	27.0	29.3	26.8	23.9	19.5
87/09/12	19	27.9	26.5	27.6	30.8	31.9	33.7	31.8	30.0	29.6	29.2	32.2	29.0	25.4	20.8
87/09/12	20	32.0	30.5	32.3	35.1	36.5	39.4	37.8	35.3	33.6	32.5	37.9	34.2	27.6	21.6
87/09/12	21	34.2	33.8	34.5	37.7	40.7	42.5	40.4	39.3	40.7	37.6	41.3	39.4	36.4	28.4
87/09/12	22	30.9	29.9	30.1	32.9	34.3	34.7	34.1	32.5	33.8	32.0	34.8	32.8	30.8	25.8
87/09/12	23	28.8	27.1	26.5	29.2	30.0	31.4	29.7	27.0	27.9	27.4	29.2	27.6	26.4	22.1
87/09/12	24	28.5	27.6	27.5	31.0	32.4	33.4	31.5	29.9	31.3	29.9	31.7	30.1	27.9	22.9
87/09/13	01	29.5	29.1	28.8	32.0	33.4	33.9	31.6	30.0	31.8	29.7	31.6	30.3	28.2	22.4
87/09/13	02	31.7	29.5	27.8	31.9	30.5	31.7	31.8	29.1	30.2	28.6	31.2	29.0	27.1	23.5
87/09/13	03	29.7	28.4	29.3	30.9	32.4	31.7	30.6	28.0	29.0	28.4	30.0	28.6	26.8	22.7
87/09/13	04	25.7	24.7	24.1	26.5	26.9	27.1	26.3	23.6	24.1	22.8	25.7	23.7	21.7	18.3
87/09/13	05	26.1	24.3	24.0	26.1	25.6	25.1	25.2	23.0	24.1	23.1	25.2	23.5	21.7	19.1
87/09/13	06	22.3	21.9	22.0	23.3	24.7	25.0	23.6	21.9	22.9	21.6	23.2	21.9	21.0	18.0
87/09/13	07	21.3	20.0	19.5	21.8	22.0	23.0	22.5	20.3	21.2	19.9	22.0	20.3	19.8	17.1
87/09/13	08	20.2	19.2	18.6	21.2	21.4	22.1	21.2	20.1	21.3	19.8	21.2	20.4	19.6	16.8
87/09/13	09	20.4	19.1	18.5	20.7	20.8	21.4	21.2	19.3	19.9	18.4	20.8	19.1	17.7	15.1
87/09/13	10	18.0	17.0	17.0	19.3	19.8	21.5	20.8	18.8	19.3	17.1	20.4	18.8	16.9	13.4
87/09/13	11	14.5	13.6	14.2	16.9	17.1	17.5	16.4	14.7	14.2	14.1	16.1	14.4	12.1	10.1
87/09/13	12	13.4	13.1	13.8	16.9	17.1	17.4	15.9	14.5	14.4	14.3	15.8	13.8	11.7	10.3
87/09/13	13	12.3	11.7	12.4	15.1	15.4	15.6	14.0	13.1	13.2	13.1	14.1	12.1	10.4	8.9
87/09/13	14	11.7	11.1	12.4	15.2	15.3	15.1	13.8	13.3	13.6	13.9	13.7	11.5	10.1	9.3
87/09/13	15	12.6	12.3	13.3	16.6	16.6	16.8	14.7	14.3	14.7	14.4	15.0	12.5	11.0	9.9
87/09/13	16	12.7	12.5	14.0	15.2	15.3	15.5	14.4	13.9	15.1	14.9	13.7	11.8	10.0	9.1
87/09/13	17	11.8	12.3	13.7	15.3	15.4	15.3	14.5	14.3	14.9	15.2	13.6	12.2	11.3	10.4
87/09/13	18	18.4	17.7	17.3	20.7	21.0	21.5	20.2	18.9	19.1	18.2	20.2	18.7	16.7	13.9
87/09/13	19	19.0	18.6	18.0	19.3	18.9	20.0	20.2	18.6	19.4	18.2	20.1	19.2	18.1	14.5
87/09/13	20	23.7	21.8	20.8	22.7	22.2	21.7	20.9	19.9	20.9	21.2	21.4	21.6	22.2	18.8
87/09/13	21	25.0	23.1	21.8	24.8	23.0	23.3	23.7	22.2	23.6	23.1	23.6	23.1	22.8	19.8
87/09/13	22	25.0	23.7	22.4	25.0	23.9	24.0	22.5	20.3	21.6	21.1	21.4	20.6	20.3	17.6
87/09/13	23	22.9	22.2	21.8	24.1	24.5	25.2	24.1	23.0	24.4	23.2	23.8	22.8	21.3	18.4
87/09/13	24	21.6	21.1	21.6	23.5	24.6	26.3	25.1	24.1	25.1	24.2	25.4	23.8	21.5	18.3

DOE FREE FLOW DATA - SOUZA RANCH

YY/MM/DD	HR	WSE0 MPH	WSE1 MPH	WSE3 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSG2 MPH	WSG4 MPH	WSG7 MPH	WSG9 MPH
87/09/14	01	25.0	22.8	22.1	24.2	24.8	25.2	24.3	23.0	24.1	23.2	25.0	24.0	23.0	19.6
87/09/14	02	21.9	20.4	20.0	21.3	21.6	21.4	21.0	19.2	20.3	19.9	20.4	19.9	19.3	16.7
87/09/14	03	19.7	18.6	18.3	20.1	20.6	21.3	19.9	18.4	19.6	18.9	19.4	18.7	18.3	15.5
87/09/14	04	20.3	19.4	18.8	21.3	21.6	23.0	22.4	20.6	21.4	20.3	22.0	20.6	19.1	15.8
87/09/14	05	20.3	19.1	18.1	20.9	20.4	21.6	20.5	18.7	19.4	18.0	20.0	18.3	17.0	14.1
87/09/14	06	18.6	17.0	17.1	18.8	19.7	21.2	20.1	18.4	19.3	17.8	19.6	18.5	17.8	15.1
87/09/14	07	17.2	16.9	17.1	18.9	20.2	21.1	19.9	19.0	19.4	17.8	19.9	18.8	17.3	13.9
87/09/14	08	15.8	15.5	15.9	17.7	18.3	19.6	18.9	18.4	18.8	17.4	19.3	18.2	16.7	13.4
87/09/14	09	17.4	16.4	16.9	19.0	20.2	21.3	19.7	18.3	18.6	16.9	19.5	17.9	16.3	12.9
87/09/14	10	17.4	16.8	17.5	20.2	20.8	22.0	20.3	18.7	18.7	18.0	20.1	18.3	16.1	13.8
87/09/14	11	17.0	15.8	15.4	18.9	19.6	20.7	19.6	17.8	18.1	16.6	19.4	17.7	16.0	12.8
87/09/14	12	15.0	13.6	13.9	16.4	17.0	17.9	17.3	15.6	15.4	14.1	17.4	15.9	14.3	11.9
87/09/14	13	14.1	12.5	13.0	15.9	16.1	16.5	15.7	14.1	13.7	13.6	15.7	14.5	12.4	10.2
87/09/14	14	15.3	14.2	14.5	17.3	17.9	18.6	17.4	15.7	15.4	14.8	17.3	15.7	13.3	11.2

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WS08	MPH	SITE J-08 50-ft reference
WD08	DEG	SITE J-08 DIRECTION
WS14	MPH	SITE J-04 120-ft reference
WS15	MPH	SITE J-19 40-ft level
WS16	MPH	SITE J-17 35-ft level
WS17	MPH	SITE J-17 70-ft tower
WS18	MPH	SITE J-18 35-ft level
WS19	MPH	SITE J-18 70-ft tower
TT01	DEG F	TEMPERATURE
WSC1	MPH	TURBINE C1 50-ft
WSC3	MPH	TURBINE C3 50-ft
WSC5	MPH	TURBINE C5 50-ft
WSC7	MPH	TURBINE C7 50-ft
WSC9	MPH	TURBINE C9 50-ft
WSC2	MPH	TURBINE C12 50-ft

NOTES:

VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/01	15	27.3	246.1	25.8	25.5	22.4	24.2	23.0	23.9	82.2	23.3	22.4	20.0	18.2	17.9	23.1
87/10/01	16	27.2	252.2	26.2	25.0	22.8	24.5	22.3	23.1	82.7	24.5	24.6	21.8	19.1	18.3	24.8
87/10/01	17	24.6	252.2	23.8	23.0	20.6	22.4	21.6	22.4	83.0	22.5	20.9	18.6	15.9	16.3	21.5
87/10/01	18	26.0	253.1	23.8	21.8	20.6	22.4	20.8	21.9	79.6	22.1	21.6	18.0	14.3	16.2	22.4
87/10/01	19	27.4	243.5	26.5	28.0	20.4	22.5	21.2	22.8	77.2	24.5	23.0	22.5	18.9	20.1	25.1
87/10/01	20	16.7	241.2	17.8	16.8	9.6	10.7	12.7	14.0	78.5	16.5	16.6	14.1	13.8	14.7	15.6
87/10/01	21	21.7	250.3	19.2	22.0	18.8	20.2	13.0	14.0	71.1	17.7	17.0	14.1	12.1	14.0	17.5
87/10/01	22	27.0	243.3	30.0	31.0	19.9	22.3	21.2	22.3	69.8	24.9	24.7	23.6	21.9	25.7	27.6
87/10/01	23	29.7	246.6	28.5	28.2	23.0	25.2	22.2	23.9	73.5	26.2	26.0	24.7	23.6	24.6	28.0
87/10/01	24	28.0	244.2	25.2	26.0	22.1	23.3	19.2	20.6	73.9	23.0	24.6	24.2	23.5	21.4	26.0
87/10/02	01	29.1	250.8	29.0	29.8	23.8	24.9	18.3	19.2	72.5	26.8	27.0	26.0	23.7	23.0	28.5
87/10/02	02	26.0	252.2	24.8	24.8	20.5	21.5	13.4	14.8	73.7	25.4	25.6	23.6	20.9	21.3	25.2
87/10/02	03	27.8	254.5	28.2	24.8	22.7	24.1	7.6	9.0	67.6	27.6	28.5	25.6	24.0	23.9	27.4
87/10/02	04	26.4	256.6	27.8	25.5	22.4	23.3	9.6	9.6	67.1	27.9	27.3	23.6	22.2	21.0	24.7
87/10/02	05	23.4	254.5	25.0	25.5	19.9	20.6	13.9	15.4	71.1	25.3	24.3	22.0	21.2	19.3	23.1
87/10/02	06	20.4	257.3	20.2	17.5	16.3	16.5	3.1	5.0	72.0	20.6	20.9	19.6	18.8	17.4	19.9
87/10/02	07	15.8	257.3	16.2	11.2	13.0	13.4	0.0	0.0	72.5	13.3	14.0	12.1	10.4	9.7	14.5
87/10/02	08	16.4	259.2	13.8	13.0	13.1	14.5	2.4	3.7	78.2	11.4	11.5	10.5	9.5	10.7	12.9
87/10/02	19	10.8	248.7	11.0	9.2	8.5	9.6	9.1	10.0	88.5	9.7	9.1	9.0	8.0	9.1	9.6
87/10/02	20	13.8	253.8	11.2	7.5	11.7	12.7	9.0	10.6	85.6	8.2	7.4	6.6	6.6	7.7	9.1
87/10/02	21	14.8	248.9	13.8	13.0	12.3	13.9	12.1	13.8	86.2	11.7	13.1	12.5	11.1	12.3	13.4
87/10/02	22	14.9	256.6	13.0	14.5	13.1	13.4	10.0	11.2	86.8	13.0	13.2	11.8	11.1	10.7	12.0
87/10/02	23	15.5	253.6	14.0	15.2	13.5	13.8	10.3	11.1	87.3	15.1	14.7	13.1	12.3	11.8	13.1
87/10/02	24	14.5	257.1	13.5	16.8	13.1	13.5	10.4	11.1	87.8	14.9	14.1	12.2	10.6	10.6	12.3
87/10/03	01	17.0	257.3	14.0	16.8	14.9	15.1	9.8	11.0	88.4	15.0	14.2	12.8	11.6	11.4	12.9
87/10/03	02	17.2	251.2	14.0	15.2	14.4	15.0	5.4	6.2	86.3	14.8	14.9	13.8	13.1	13.1	13.6
87/10/03	03	17.4	251.0	15.5	15.8	14.6	15.4	8.9	9.3	86.7	15.9	15.7	14.3	13.3	12.9	14.5
87/10/03	04	14.2	250.3	13.2	15.2	11.3	11.5	4.9	6.6	85.2	15.1	14.6	12.7	11.3	10.6	12.5
87/10/03	05	15.4	253.1	12.2	14.5	12.8	13.1	7.0	8.5	86.5	13.8	13.4	11.5	9.9	10.5	11.4

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/07 09	29.1	243.0	32.8	17.8	14.2	15.2	17.0	19.0	61.9	27.9	27.4	22.7	20.5	16.9	28.9
87/10/07 10	35.1	250.1	35.0	33.0	25.5	25.2	25.0	26.5	63.4	33.2	33.5	30.3	28.0	28.5	33.5
87/10/07 11	33.5	250.1	32.5	26.0	24.7	26.7	24.5	26.1	66.1	29.5	30.4	26.7	24.3	24.6	30.6
87/10/07 12	31.9	254.5	29.8	26.2	24.5	26.6	25.0	26.3	68.8	28.3	27.6	24.7	22.4	22.2	28.1
87/10/07 13	29.0	251.5	25.5	23.5	23.0	24.9	21.3	22.3	71.5	23.6	22.3	20.1	18.8	17.6	23.1
87/10/07 14	28.5	251.0	19.5	20.5	22.9	25.1	19.8	20.6	72.9	19.0	17.2	16.4	16.0	17.0	18.0
87/10/07 15	26.6	250.3	20.8	21.0	22.1	24.2	20.3	21.1	74.8	20.1	18.0	16.7	15.7	16.4	18.8
87/10/07 16	27.2	250.1	22.8	20.5	22.3	24.3	21.6	22.5	74.8	21.7	19.8	18.4	17.0	17.0	21.2
87/10/07 17	25.6	252.4	24.0	23.0	20.0	21.8	19.9	20.6	74.5	21.9	20.7	19.7	18.2	17.8	22.1
87/10/07 18	29.6	245.6	30.0	27.5	24.1	26.1	24.3	25.5	71.5	27.4	26.1	24.6	20.1	22.5	28.7
87/10/07 19	34.1	250.5	34.8	32.5	29.0	31.5	27.4	28.9	66.3	31.9	30.1	29.3	22.7	26.8	33.1
87/10/07 20	38.8	248.7	36.8	32.2	32.5	35.1	31.5	32.8	61.8	33.6	34.1	31.7	28.3	27.9	36.0
87/10/07 21	37.7	249.6	38.8	36.5	30.6	33.5	27.7	29.0	59.8	36.3	36.6	33.2	30.0	32.2	36.5
87/10/07 22	36.3	250.1	37.2	37.8	29.4	32.3	28.7	30.5	59.3	33.7	35.6	33.1	30.8	32.3	36.2
87/10/07 23	37.4	248.2	38.5	39.5	30.6	33.2	29.2	31.5	59.1	35.1	36.9	33.4	30.5	34.6	37.1
87/10/07 24	35.9	244.2	38.0	37.5	30.1	33.1	26.7	28.9	58.8	32.7	36.1	32.5	29.0	32.3	35.6
87/10/08 01	33.3	244.2	33.8	34.5	26.4	28.7	24.1	26.1	59.1	31.4	32.1	30.1	27.3	30.2	32.6
87/10/08 02	29.3	243.7	31.2	32.8	19.5	20.5	24.5	26.9	58.8	29.6	30.4	28.2	26.0	28.5	30.2
87/10/08 03	27.0	241.4	31.0	32.2	18.3	19.5	22.7	25.0	58.4	30.0	29.6	27.2	25.2	28.1	29.4
87/10/08 04	23.8	242.8	32.0	30.2	18.5	20.2	22.4	24.4	58.5	29.8	30.4	27.0	25.3	27.8	29.8
87/10/08 05	26.4	243.3	31.5	30.5	21.2	22.7	22.3	24.5	58.5	28.7	28.7	25.5	23.6	24.9	28.4
87/10/08 06	25.8	245.9	28.5	29.0	20.6	22.3	19.9	21.9	58.4	26.4	26.9	24.3	22.1	23.2	26.8
87/10/06 07	23.2	247.7	26.5	28.5	17.9	18.9	19.6	21.6	58.4	26.8	24.8	22.6	20.7	23.1	24.7
87/10/08 08	21.7	244.9	26.5	27.0	18.0	19.3	19.0	20.6	58.6	24.8	25.4	22.0	20.4	20.8	25.2
87/10/08 09	18.3	237.2	26.2	25.8	15.6	16.6	19.5	21.3	59.6	24.5	25.1	22.1	21.4	21.2	25.1
87/10/08 10	16.1	243.5	20.8	21.8	13.4	14.3	15.9	17.2	62.4	20.3	19.5	17.4	16.4	16.1	19.7
87/10/08 11	17.7	243.7	19.2	19.2	14.2	15.2	13.9	14.7	65.5	18.4	17.8	15.6	14.6	14.3	17.7
87/10/08 12	18.6	252.7	18.8	18.8	14.8	15.8	13.6	14.3	68.5	18.0	17.1	15.2	14.1	14.5	17.1
87/10/08 13	20.7	251.3	19.0	19.0	16.8	16.1	15.5	16.2	70.8	18.5	16.8	15.3	14.3	14.7	17.4
87/10/08 14	22.8	251.3	21.5	20.5	18.4	19.7	17.8	18.5	72.2	20.3	18.9	17.7	15.6	15.8	19.8
87/10/08 15	24.0	253.1	22.5	22.0	19.5	21.1	18.2	19.1	73.9	21.5	19.6	18.4	16.7	16.4	20.6
87/10/08 16	26.3	249.8	23.2	22.2	21.7	23.5	20.4	21.3	72.8	22.3	19.9	18.6	17.1	18.2	21.1
87/10/08 17	25.1	244.7	23.0	23.2	20.3	21.9	19.3	20.1	71.1	22.0	20.3	19.0	17.3	17.5	21.1
87/10/08 18	23.7	240.0	23.5	22.8	19.3	20.9	16.8	17.7	69.7	23.0	21.3	18.9	18.0	17.5	21.2
87/10/08 19	27.5	246.3	25.8	27.0	22.6	24.4	19.5	20.8	65.8	25.0	24.8	21.5	19.7	19.9	23.2
87/10/08 20	32.5	249.4	26.8	30.5	29.1	31.3	24.4	26.3	61.4	26.2	26.0	24.8	23.7	19.9	26.7
87/10/08 21	31.5	247.0	33.8	33.2	28.3	30.7	27.7	28.3	59.2	31.9	31.2	29.3	27.7	27.8	31.3
87/10/08 22	33.2	246.8	32.0	35.8	28.6	31.1	24.0	25.3	58.4	33.7	30.8	26.8	25.7	31.3	29.9
87/10/08 23	35.7	249.6	31.2	32.8	29.7	32.5	28.4	30.0	57.7	32.1	29.5	27.2	25.3	27.6	29.6
87/10/08 24	34.5	244.7	31.0	35.8	24.8	27.4	23.4	25.0	57.5	29.2	29.1	28.4	27.2	28.4	30.7

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH
87/10/09	01	30.9	244.2	33.2	35.5	27.6	30.1	22.9	24.2	58.6	30.9	30.5	26.7	24.9	26.8	30.4
87/10/09	02	30.2	238.4	30.5	32.0	26.6	29.0	23.2	24.4	57.5	29.7	29.2	25.5	23.9	24.1	28.6
87/10/09	03	29.0	240.0	31.8	30.2	22.7	24.5	21.8	23.7	56.6	30.0	30.7	27.2	25.1	26.7	29.9
87/10/09	04	20.1	242.3	26.5	21.2	12.9	13.8	16.9	18.3	57.2	25.8	25.7	23.0	21.7	21.8	25.0
87/10/09	05	13.3	242.8	16.8	14.8	9.6	10.6	11.1	12.6	57.2	16.0	15.5	13.7	12.1	12.2	15.4
87/10/09	06	21.3	245.6	23.0	24.2	16.2	17.7	17.0	18.5	56.5	21.6	21.1	18.8	17.2	17.9	20.9
87/10/09	07	25.9	245.6	25.8	25.0	21.4	23.1	18.3	19.5	55.7	24.0	22.4	19.7	18.7	18.0	22.5
87/10/09	08	29.6	245.6	31.0	29.0	23.8	26.1	21.1	22.5	55.7	27.4	27.6	24.1	22.5	22.6	28.3
87/10/09	09	28.4	245.6	28.5	29.2	22.8	24.7	19.9	21.3	57.3	26.7	26.9	23.4	21.7	22.3	26.9
87/10/09	10	28.5	238.4	30.5	27.5	23.0	24.7	21.6	22.8	58.1	28.5	28.0	24.9	24.3	23.5	28.6
87/10/09	11	26.8	238.4	29.2	26.0	22.5	24.3	22.8	24.4	59.1	27.6	26.3	24.4	22.7	22.3	27.4
87/10/09	12	26.3	246.6	28.0	26.5	22.5	24.3	22.0	23.3	59.9	26.1	25.3	23.4	21.9	20.8	26.2
87/10/09	13	24.8	244.2	26.2	24.2	20.6	22.2	21.3	22.4	62.4	24.9	23.8	22.0	19.9	19.7	24.9
87/10/09	14	25.4	245.4	26.0	24.8	20.9	22.6	20.8	22.0	63.7	24.3	23.6	21.8	20.1	19.6	24.7
87/10/09	15	24.0	246.1	24.0	22.8	20.1	21.7	19.6	20.8	65.5	22.5	21.3	19.6	17.8	17.3	22.4
87/10/09	16	23.8	254.1	23.0	22.0	19.0	20.5	19.0	20.0	67.1	21.8	20.2	19.0	16.8	16.8	21.4
87/10/09	17	23.4	254.5	18.0	17.5	18.7	20.1	15.6	16.8	66.6	16.9	15.4	14.2	12.4	12.5	16.4
87/10/09	18	24.8	249.1	24.5	19.8	18.4	19.8	15.9	17.2	66.4	21.5	22.4	20.0	18.5	17.2	23.4
87/10/09	19	28.1	253.6	24.8	24.0	22.2	24.0	19.3	20.9	63.5	23.8	22.3	20.8	18.5	17.5	23.1
87/10/09	20	28.6	246.1	24.5	23.2	23.8	26.0	20.5	22.0	60.5	23.0	21.7	19.9	17.3	17.4	23.0
87/10/09	21	30.9	246.3	26.8	26.2	25.6	27.7	22.6	24.1	58.7	25.1	23.4	21.6	20.0	22.2	24.9
87/10/09	22	28.9	244.7	25.8	28.0	23.7	25.6	21.9	23.3	57.9	24.5	23.7	22.5	20.6	21.2	24.8
87/10/09	23	25.4	242.8	26.0	24.0	20.3	22.0	18.3	19.6	57.4	24.9	25.2	22.1	20.6	20.4	24.6
87/10/09	24	24.3	245.9	23.8	23.8	19.4	21.0	17.6	19.0	57.3	22.8	23.0	20.2	19.0	19.0	22.4
87/10/10	01	24.9	242.6	23.5	24.8	19.5	21.4	17.6	19.1	57.0	21.7	22.1	20.1	18.5	19.0	22.4
87/10/10	02	24.5	245.2	21.0	22.8	19.7	21.5	15.6	16.7	57.1	20.1	19.7	17.6	17.0	17.4	19.2
87/10/10	03	22.0	240.9	17.8	19.0	15.5	17.2	11.3	12.3	57.0	16.7	16.7	15.2	13.9	14.7	16.6
87/10/10	04	24.1	245.4	22.2	19.0	18.9	20.8	15.0	16.1	56.7	20.6	20.3	17.8	16.1	16.1	20.6
87/10/10	05	21.1	242.3	21.5	18.8	15.4	17.1	15.1	16.3	57.0	20.2	20.2	17.4	16.1	15.8	20.1
87/10/10	06	20.0	244.2	20.8	17.5	15.8	17.4	13.9	15.2	57.1	19.3	18.6	15.4	15.4	15.0	18.2
87/10/10	07	18.6	241.9	20.8	18.5	13.1	14.5	13.8	15.3	57.1	19.8	19.6	16.5	16.0	15.6	19.3
87/10/10	08	18.4	245.4	21.0	18.2	13.8	15.1	13.6	15.0	57.0	19.4	19.2	16.2	15.6	15.4	19.2
87/10/10	09	17.2	248.7	19.8	16.5	12.9	13.8	12.6	13.7	58.4	19.0	18.3	15.5	14.8	14.1	18.1

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSC4	MPH	TURBINE C14 50-ft
WSC6	MPH	TURBINE C16 50-ft
WSC8	MPH	TURBINE C18 50-ft
WSD2	MPH	TURBINE D2 50-ft
WSD4	MPH	TURBINE D4 50-ft
WSD6	MPH	TURBINE D6 50-ft
WSD3	MPH	TURBINE D13 50-ft
WSD5	MPH	TURBINE D15 50-ft
WSD1	MPH	TURBINE D21 50-ft
WSE2	MPH	TURBINE E2 50-ft
WSE4	MPH	TURBINE E4 50-ft
WSE6	MPH	TURBINE E6 50-ft
WSE8	MPH	TURBINE E8 50-ft
WSE0	MPH	TURBINE E10 50-ft
WSE1	MPH	TURBINE E11 50-ft

NOTES:

VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WBC4 MPH	WBC6 MPH	WBC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WBEB MPH	WSE0 MPH	WBE1 MPH
87/10/01	15	25.4	19.1	18.3	19.9	19.6	18.9	19.7	18.6	19.2	19.7	20.0	18.8	22.2	22.4	18.2
87/10/01	16	27.2	20.5	18.3	19.5	19.2	18.8	19.3	18.4	19.4	20.9	19.6	17.6	22.1	22.1	18.6
87/10/01	17	23.6	16.9	16.8	17.8	16.9	16.6	16.6	16.6	19.0	18.7	19.3	17.0	20.9	20.8	17.3
87/10/01	18	23.7	15.4	16.6	17.3	16.2	16.4	16.3	16.2	18.0	18.3	17.9	16.7	21.1	22.1	16.8
87/10/01	19	29.7	22.0	20.6	21.0	21.3	20.5	22.3	20.9	17.1	18.4	17.3	17.7	20.9	22.1	18.3
87/10/01	20	19.7	15.0	15.1	14.1	13.3	13.8	14.9	14.2	11.1	10.4	10.7	11.2	13.3	13.8	12.5
87/10/01	21	19.0	13.8	15.8	14.1	13.7	12.9	14.5	13.4	11.9	11.9	11.5	10.1	12.1	11.6	11.4
87/10/01	22	30.1	23.7	27.9	29.9	30.9	28.9	29.7	27.6	22.7	25.0	22.7	19.4	19.6	22.9	23.4
87/10/01	23	32.2	26.4	25.8	27.6	28.1	27.8	27.7	27.3	24.8	25.8	23.3	20.2	19.6	22.2	23.2
87/10/01	24	29.9	24.4	20.1	21.2	23.4	23.8	23.6	23.9	20.8	22.1	19.6	17.6	17.6	23.2	20.4
87/10/02	01	32.3	23.6	22.5	22.5	25.7	27.3	26.8	27.8	22.1	24.9	20.8	16.3	20.3	24.8	23.4
87/10/02	02	27.8	21.2	20.8	20.0	20.7	22.0	22.7	22.7	17.4	20.8	17.5	14.0	15.1	21.1	19.6
87/10/02	03	30.3	24.3	22.5	22.3	20.8	19.4	19.9	19.9	15.5	21.8	18.0	10.1	10.6	17.0	21.2
87/10/02	04	26.5	20.1	21.5	20.6	20.0	20.5	23.6	23.0	10.2	21.3	15.1	9.6	13.1	14.6	23.3
87/10/02	05	25.8	18.9	19.3	18.7	18.4	20.8	21.9	21.7	17.2	21.1	17.6	14.6	14.2	20.7	20.2
87/10/02	06	22.2	16.9	14.8	13.6	11.7	13.3	17.0	16.8	9.0	13.5	10.9	8.2	7.5	11.3	16.2
87/10/02	07	16.1	11.3	9.6	8.0	5.4	2.5	5.5	4.4	0.9	1.6	0.7	0.1	0.5	0.9	4.8
87/10/02	08	14.4	11.7	11.5	10.4	10.5	9.7	11.2	10.1	5.7	7.0	5.8	4.6	5.1	5.8	8.4
87/10/02	19	10.8	8.7	9.5	9.4	8.1	7.8	8.7	7.8	8.1	7.5	7.8	6.8	8.6	9.5	7.1
87/10/02	20	10.0	7.1	9.0	8.5	7.0	6.0	8.1	7.1	8.5	6.6	8.5	7.7	9.6	9.6	6.1
87/10/02	21	14.8	12.2	12.3	12.5	13.2	12.5	13.2	12.5	11.3	10.2	11.4	10.8	11.4	12.2	11.0
87/10/02	22	13.3	10.9	10.9	11.3	12.3	12.4	12.4	12.3	10.2	10.8	9.9	9.0	9.9	8.8	11.3
87/10/02	23	14.3	11.7	11.5	11.7	13.1	13.8	13.8	13.8	11.2	13.0	10.2	9.3	11.1	11.8	12.7
87/10/02	24	13.1	10.2	12.0	12.6	14.7	14.6	14.4	14.2	11.2	13.1	10.5	8.7	10.9	11.9	12.9
87/10/03	01	14.3	11.4	11.8	12.6	14.6	14.7	14.4	14.5	13.1	14.4	12.3	9.4	9.8	11.6	13.3
87/10/03	02	15.2	13.0	11.8	12.3	11.4	11.2	11.9	12.4	7.5	11.8	8.4	5.8	6.3	5.6	12.3
87/10/03	03	15.8	13.1	12.0	12.3	12.4	12.9	13.4	13.4	9.1	12.6	9.4	7.6	9.0	10.0	13.1
87/10/03	04	12.8	10.6	11.6	11.1	12.5	12.7	13.5	13.4	7.6	12.7	10.1	6.9	6.3	7.6	12.5
87/10/03	05	11.6	10.2	12.5	12.2	13.0	12.1	12.6	12.1	9.5	11.7	9.9	8.4	6.5	7.6	11.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSC4 MPH	WSC6 MPH	WSC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH
87/10/07	09	31.3	24.6	19.0	16.4	16.1	15.4	19.7	18.5	16.9	18.0	19.5	18.9	21.6	21.5	18.7
87/10/07	10	37.6	31.8	28.6	26.3	25.7	24.7	27.1	25.6	23.9	25.9	25.1	22.9	26.0	27.7	25.1
87/10/07	11	33.5	27.8	25.4	22.6	21.6	20.9	22.5	21.4	21.9	22.5	23.0	21.6	25.2	25.7	20.4
87/10/07	12	31.0	24.5	22.7	20.9	20.6	20.2	20.6	20.6	20.7	21.7	21.5	20.9	24.5	25.4	21.0
87/10/07	13	24.5	19.9	17.9	16.9	17.2	17.0	16.6	16.4	17.5	16.5	16.6	16.6	20.5	20.6	17.9
87/10/07	14	19.2	16.2	17.0	17.2	17.6	17.6	17.0	17.5	17.4	17.4	17.1	15.8	18.7	18.9	17.2
87/10/07	15	19.9	16.4	16.5	16.9	18.1	17.9	17.5	18.3	17.9	17.4	18.3	17.1	18.8	18.9	16.5
87/10/07	16	22.4	17.8	17.5	17.3	18.6	18.6	17.3	19.1	18.7	18.8	19.4	17.4	19.9	20.0	17.8
87/10/07	17	24.2	19.5	17.8	17.3	16.6	16.2	16.6	16.3	17.2	17.1	17.4	16.3	18.8	19.1	15.3
87/10/07	18	31.4	21.5	23.4	22.5	21.5	20.3	21.6	20.1	19.3	21.3	20.3	19.2	23.4	23.1	19.9
87/10/07	19	36.1	25.1	28.3	25.8	24.7	22.5	25.0	22.9	22.2	24.8	23.0	19.9	26.2	26.1	23.5
87/10/07	20	39.7	30.2	29.4	29.1	27.7	26.1	28.4	26.3	25.5	28.3	26.2	23.2	30.1	31.2	25.3
87/10/07	21	40.4	34.3	33.6	31.0	28.8	26.4	28.4	25.8	28.0	27.6	28.7	23.4	29.3	31.8	23.9
87/10/07	22	40.2	34.5	34.3	31.8	29.3	28.3	28.8	28.2	28.3	28.6	29.2	25.4	27.4	31.9	25.3
87/10/07	23	40.3	35.5	36.9	33.0	31.4	30.5	31.3	30.8	28.9	29.6	30.7	27.1	27.0	32.3	27.1
87/10/07	24	38.9	33.4	33.8	31.0	29.8	29.4	30.1	29.0	27.4	27.3	29.1	24.5	27.2	31.4	25.1
87/10/08	01	36.4	30.6	30.7	28.6	27.1	25.5	26.6	25.3	23.0	23.6	23.8	22.3	23.6	27.7	22.3
87/10/08	02	34.3	29.1	29.2	27.5	25.5	25.1	25.4	25.0	24.1	24.6	23.1	23.2	22.5	24.5	22.5
87/10/08	03	33.3	28.5	28.6	27.3	25.3	23.7	24.4	23.5	23.6	23.7	22.1	22.0	20.3	22.6	21.6
87/10/08	04	33.1	28.7	27.0	25.4	24.5	23.3	23.6	22.8	22.9	23.3	21.4	21.2	20.3	22.2	21.2
87/10/08	05	31.4	26.6	25.1	22.8	23.0	23.3	23.8	23.6	22.6	23.4	22.2	21.3	18.5	23.5	21.6
87/10/08	06	29.9	24.6	23.3	21.6	21.6	22.0	22.2	22.0	20.1	21.2	19.2	18.7	17.2	21.0	20.4
87/10/08	07	28.5	23.9	23.4	20.8	20.5	21.0	21.2	21.6	20.8	22.0	20.5	18.8	17.2	20.4	20.8
87/10/08	08	27.6	22.7	21.1	20.6	21.0	20.9	21.4	21.1	19.8	20.5	20.1	17.6	18.5	22.0	19.7
87/10/08	09	27.5	22.5	21.4	20.6	20.8	19.7	20.0	19.1	19.6	20.3	18.8	17.3	17.8	18.3	18.0
87/10/08	10	21.4	17.2	16.4	16.9	16.8	16.1	16.2	15.5	15.8	16.0	14.8	13.8	14.4	15.0	14.3
87/10/08	11	18.9	15.6	14.5	14.2	14.4	13.5	14.0	13.4	13.7	14.2	13.1	12.3	13.0	14.3	12.5
87/10/08	12	18.4	14.9	14.7	14.6	14.2	13.3	13.9	13.0	13.2	13.3	12.9	11.9	13.2	14.0	12.6
87/10/08	13	18.6	15.2	15.2	14.5	14.6	14.2	14.5	14.0	14.1	13.9	13.8	13.3	14.8	15.4	13.5
87/10/08	14	21.6	16.5	16.4	16.6	16.8	16.1	16.3	15.9	16.2	15.6	15.9	15.2	16.7	16.7	15.0
87/10/08	15	22.4	17.5	16.6	16.9	16.8	16.0	16.2	15.7	16.5	16.2	16.3	15.3	17.3	17.2	14.9
87/10/08	16	22.5	17.4	18.8	18.5	17.6	17.2	16.8	17.4	18.1	17.6	18.6	16.8	19.0	19.1	16.0
87/10/08	17	23.1	18.2	18.0	18.4	17.8	17.1	17.7	17.0	16.9	17.1	16.9	15.5	18.3	18.8	16.0
87/10/08	18	22.8	18.7	17.3	17.0	16.3	15.8	15.5	15.0	15.9	15.5	15.3	13.2	15.8	16.8	13.3
87/10/08	19	25.9	21.1	20.1	18.6	18.2	17.4	19.6	18.1	18.1	18.7	19.0	16.5	20.3	20.5	16.9
87/10/08	20	31.2	25.5	20.6	22.0	21.6	19.6	22.8	20.7	20.9	22.5	21.9	20.3	23.5	24.2	21.3
87/10/08	21	36.8	31.2	27.3	28.4	30.5	29.5	31.2	29.7	25.1	25.9	27.0	21.8	27.5	27.9	26.5
87/10/08	22	33.0	31.5	32.1	27.8	27.3	29.4	30.6	30.2	25.0	28.0	26.1	22.4	23.4	27.2	27.2
87/10/08	23	33.7	29.1	27.5	23.1	22.4	21.1	26.0	23.1	23.0	22.2	23.0	23.8	27.4	28.4	23.0
87/10/08	24	35.8	29.8	29.1	27.1	23.8	19.8	22.1	18.9	20.1	20.5	21.1	18.1	25.3	25.7	16.4

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSC4 MPH	WSC6 MPH	WSC8 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH
87/10/09	01	33.6	28.3	27.4	25.7	23.9	22.7	23.7	22.2	20.7	21.4	21.1	20.0	23.2	24.6	20.1
87/10/09	02	30.8	25.7	24.1	23.2	22.6	20.9	21.9	20.0	20.8	20.7	20.9	19.5	22.3	23.7	18.8
87/10/09	03	32.6	27.3	26.5	25.4	23.4	21.6	22.2	21.2	21.4	21.8	21.3	19.9	19.4	23.2	20.2
87/10/09	04	28.0	21.4	22.8	21.7	19.8	19.1	19.2	18.7	17.8	17.2	16.0	15.9	16.2	15.8	16.3
87/10/09	05	17.2	13.1	13.3	12.0	11.1	10.5	11.3	10.5	12.0	12.2	11.6	10.8	10.6	11.4	11.6
87/10/09	06	23.3	18.4	18.3	17.7	16.6	15.6	16.3	15.3	16.8	16.8	17.2	15.8	16.8	18.3	15.5
87/10/09	07	24.8	20.1	18.6	18.0	17.1	16.7	17.2	16.6	17.3	17.6	17.5	16.1	18.1	18.6	16.0
87/10/09	08	30.9	24.4	23.2	21.8	20.4	19.1	20.3	19.1	20.6	20.6	21.0	18.1	21.2	22.9	18.5
87/10/09	09	29.4	24.3	22.5	21.1	20.4	18.8	20.0	18.0	19.5	18.6	19.4	17.4	19.6	21.9	17.0
87/10/09	10	31.3	26.0	24.1	22.7	20.8	19.7	20.1	19.1	21.5	21.2	21.4	18.5	20.8	22.8	18.9
87/10/09	11	30.1	24.2	22.9	22.0	20.5	20.4	20.1	19.8	21.3	21.2	21.1	19.5	21.2	22.7	19.1
87/10/09	12	28.8	23.1	21.5	21.1	20.6	20.0	20.0	19.5	21.2	20.7	21.0	18.8	20.4	21.8	18.7
87/10/09	13	27.1	21.0	20.1	19.6	18.7	18.9	17.9	18.7	18.9	18.5	19.0	17.5	19.9	20.7	17.5
87/10/09	14	27.0	21.4	19.8	20.0	18.9	17.8	18.8	17.5	19.2	19.3	19.4	17.5	19.3	20.4	16.8
87/10/09	15	24.0	19.0	17.7	17.9	18.1	17.4	17.7	17.2	18.2	17.8	18.3	16.9	18.6	19.6	15.7
87/10/09	16	23.3	17.8	17.3	17.2	17.3	17.0	16.9	16.9	17.1	17.0	17.6	15.8	17.4	18.1	15.9
87/10/09	17	17.1	13.5	12.8	12.4	12.9	13.2	12.8	13.5	14.1	13.7	15.1	13.5	15.2	14.9	13.2
87/10/09	18	25.7	19.7	17.5	15.7	14.2	13.8	14.4	13.6	14.4	14.0	15.1	13.6	16.9	17.9	13.9
87/10/09	19	25.6	20.0	18.0	17.2	16.2	15.2	16.4	15.6	16.3	16.9	17.3	16.4	19.4	20.0	16.0
87/10/09	20	24.6	18.5	18.2	18.0	17.6	18.1	17.5	17.9	17.8	18.9	18.5	17.1	19.8	19.9	18.1
87/10/09	21	26.7	20.8	23.1	22.1	20.9	20.4	20.9	20.0	20.7	21.0	20.9	18.8	21.7	22.0	19.1
87/10/09	22	27.6	21.7	21.7	21.8	21.3	20.0	20.9	19.4	20.4	20.9	20.4	18.4	21.1	22.3	18.5
87/10/09	23	27.1	21.9	20.1	19.4	19.2	17.9	18.5	17.0	18.7	17.4	18.6	15.9	17.2	20.1	15.7
87/10/09	24	24.4	20.1	18.6	18.5	17.7	16.7	17.0	15.8	16.7	16.2	16.3	15.2	16.8	17.3	14.0
87/10/10	01	25.0	20.7	19.0	18.5	17.4	16.3	16.7	15.7	17.9	17.4	17.5	15.3	17.8	18.4	15.0
87/10/10	02	21.0	18.3	17.4	16.9	16.3	15.3	15.2	14.4	15.3	15.1	14.8	13.1	14.3	15.4	12.8
87/10/10	03	18.6	15.6	14.4	13.5	12.2	11.2	11.3	9.9	11.2	10.9	10.2	9.5	10.6	12.6	9.1
87/10/10	04	22.3	17.9	16.4	15.6	14.7	14.4	14.3	13.9	14.5	14.2	14.5	12.8	15.2	16.7	12.7
87/10/10	05	22.0	17.7	15.8	15.0	14.8	13.5	14.3	12.9	14.1	13.9	13.8	12.5	14.2	15.6	12.2
87/10/10	06	19.6	16.8	15.2	15.1	15.0	14.3	14.9	14.0	13.8	13.5	13.8	12.5	13.8	15.3	12.9
87/10/10	07	20.8	17.1	16.0	16.0	15.7	14.9	15.4	14.3	14.1	13.8	13.8	12.3	13.1	14.9	12.8
87/10/10	08	20.6	16.8	15.8	16.1	16.6	15.4	16.2	15.1	13.9	13.8	13.9	12.4	13.2	15.3	13.4
87/10/10	09	19.5	15.8	14.2	13.9	14.2	13.5	13.9	12.8	13.1	12.6	12.8	11.2	11.6	12.4	11.7

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSE3	MPH	TURBINE E13 50-ft
WSE5	MPH	TURBINE E15 50-ft
WSEA	MPH	TURBINE E18 50-ft
WSEB	MPH	TURBINE E20 50-ft
WSEC	MPH	TURBINE E22 50-ft
WSF1	MPH	TURBINE F1 35-ft
WSF3	MPH	TURBINE F3 35-ft
WSF5	MPH	TURBINE H2 50-ft
WSF7	MPH	TURBINE F7 35-ft
WSF9	MPH	TURBINE F9 35-ft
WSF2	MPH	TURBINE F12 35-ft
WSG1	MPH	TURBINE G1 35-ft
WSG3	MPH	TURBINE G3 35-ft
WSG5	MPH	TURBINE G5 35-ft
WSG7	MPH	TURBINE G7 35-ft

NOTES:

VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSG1 MPH	WSG3 MPH	WSG5 MPH	WSG7 MPH
87/10/01	15	19.3	19.7	20.5	22.5	23.8	21.3	20.3	22.0	20.1	17.4	16.1	17.2	17.2	22.6	24.2
87/10/01	16	20.1	20.8	20.2	22.4	23.9	19.6	20.2	24.2	20.5	17.1	16.6	16.4	15.9	22.0	23.8
87/10/01	17	18.1	18.6	19.5	21.2	22.5	19.3	19.4	20.2	19.4	15.6	15.4	15.6	16.4	21.6	22.7
87/10/01	18	17.5	18.4	19.5	21.7	23.8	18.7	18.9	18.4	19.6	16.2	16.5	15.0	14.3	20.7	22.1
87/10/01	19	19.3	18.6	19.2	21.6	23.4	19.2	19.0	25.6	20.9	18.7	18.7	18.7	18.6	21.7	25.5
87/10/01	20	12.2	11.2	12.0	14.4	14.9	11.4	11.0	16.3	13.0	11.2	10.6	10.6	11.0	11.7	13.3
87/10/01	21	11.6	11.5	11.3	12.3	13.1	12.0	10.6	16.0	10.8	10.5	10.7	10.8	11.3	15.2	17.5
87/10/01	22	24.5	23.1	22.1	21.3	24.3	20.5	18.4	28.4	21.4	19.2	18.8	17.4	17.2	19.6	22.3
87/10/01	23	24.7	24.1	23.0	22.1	23.7	21.4	18.5	30.8	23.5	22.2	22.9	18.8	17.9	22.3	24.7
87/10/01	24	21.0	20.2	19.5	18.7	24.3	18.7	16.5	31.1	24.3	21.9	22.9	17.2	15.7	19.4	22.4
87/10/02	01	24.5	22.6	18.4	20.7	26.2	17.7	18.1	32.6	23.4	17.3	17.4	15.1	15.1	19.5	23.8
87/10/02	02	18.7	19.2	17.9	15.7	22.2	14.0	13.2	29.2	18.0	13.1	13.1	11.0	11.0	17.3	21.1
87/10/02	03	22.4	21.0	13.1	12.3	18.6	9.6	7.8	31.4	9.0	5.2	3.1	8.0	13.2	18.4	22.2
87/10/02	04	23.8	20.8	14.5	13.6	20.6	8.3	10.7	28.9	5.9	4.0	3.5	6.4	10.9	17.4	20.3
87/10/02	05	21.8	19.8	17.4	15.7	21.9	14.8	12.5	27.4	17.9	12.5	13.0	8.9	6.6	14.7	18.5
87/10/02	06	13.2	13.4	11.1	9.2	14.1	6.4	5.1	24.4	10.6	8.5	11.0	4.5	4.2	11.6	15.3
87/10/02	07	3.4	2.4	0.1	1.1	3.3	0.3	0.1	13.7	0.3	1.2	0.4	2.9	5.3	9.8	12.3
87/10/02	08	5.3	6.9	7.3	7.9	10.5	3.6	1.8	12.3	4.2	6.4	1.7	7.3	9.2	12.4	13.6
87/10/02	19	4.3	7.7	8.1	9.2	10.0	7.8	6.2	11.1	9.2	7.8	6.4	6.8	6.6	8.4	8.9
87/10/02	20	6.1	6.6	9.5	10.2	11.6	8.4	6.2	9.3	6.9	6.0	7.7	5.7	6.5	9.5	10.9
87/10/02	21	10.8	10.7	12.0	11.5	13.2	11.6	9.5	14.6	11.3	9.9	9.0	9.4	8.9	11.4	12.7
87/10/02	22	11.2	10.4	9.7	11.0	10.9	9.3	7.8	14.3	8.8	8.4	6.8	6.4	6.8	9.7	11.1
87/10/02	23	12.9	11.6	9.4	12.2	13.4	10.1	8.9	15.8	10.0	8.7	8.1	7.7	6.7	10.1	12.1
87/10/02	24	13.1	11.8	9.4	12.0	13.1	9.7	9.0	14.3	10.3	9.8	9.3	9.1	5.8	9.7	11.0
87/10/03	01	13.8	13.4	10.3	10.6	13.7	9.7	7.8	15.9	8.6	5.4	6.3	5.3	5.8	10.6	12.5
87/10/03	02	12.7	11.8	7.7	8.4	10.2	5.2	2.5	17.0	6.7	7.9	2.6	9.1	10.4	12.6	13.9
87/10/03	03	13.6	12.0	8.2	10.2	13.3	7.8	6.3	17.1	8.0	8.9	7.2	9.7	10.4	12.8	14.0
87/10/03	04	11.9	11.8	9.3	8.5	11.1	5.1	3.2	14.1	6.5	4.9	4.8	3.0	2.8	8.3	10.6
87/10/03	05	11.2	11.2	9.9	9.0	10.6	7.1	3.4	13.0	5.0	4.9	2.1	7.1	8.6	10.7	12.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WBE3 MPH	WBE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WBF2 MPH	WB01 MPH	WB03 MPH	WB05 MPH	WB07 MPH
87/10/07	09	19.6	20.5	22.4	25.0	25.7	17.9	16.7	23.9	18.6	15.8	16.5	15.2	14.2	22.2	26.6
87/10/07	10	25.7	25.2	25.4	27.4	30.2	23.4	23.6	35.4	22.7	20.3	19.2	20.1	20.9	27.6	30.9
87/10/07	11	21.9	22.6	24.2	26.5	27.7	23.1	22.4	30.3	22.7	19.8	18.9	19.4	18.4	26.3	29.6
87/10/07	12	21.9	21.8	22.8	24.9	26.9	23.0	22.3	28.1	21.4	18.6	20.7	18.7	18.4	24.0	26.8
87/10/07	13	14.1	16.4	14.4	19.9	22.8	19.6	18.1	22.9	17.0	16.7	18.5	15.8	16.4	21.9	25.6
87/10/07	14	15.1	17.2	15.3	18.8	20.5	18.1	16.7	19.8	18.2	17.7	19.4	16.7	16.1	22.1	25.2
87/10/07	15	16.8	17.1	18.4	19.7	20.0	18.7	17.4	19.1	17.5	16.4	17.7	15.6	15.2	20.9	23.7
87/10/07	16	18.2	18.7	19.5	20.8	21.4	19.6	18.3	20.9	18.5	16.4	17.3	15.5	15.0	20.3	24.0
87/10/07	17	16.4	17.1	18.2	19.6	20.4	17.7	17.2	22.2	16.5	14.6	16.3	14.6	14.6	18.9	21.0
87/10/07	18	21.2	21.4	21.5	24.6	25.1	22.0	20.9	25.4	20.3	18.0	20.1	18.6	17.5	24.1	25.7
87/10/07	19	25.0	24.6	24.0	27.1	28.6	23.9	23.8	29.1	24.3	21.3	20.6	21.3	19.7	26.3	29.4
87/10/07	20	27.9	27.7	27.1	30.7	32.9	25.7	28.1	35.8	27.7	23.1	23.2	23.2	22.9	32.0	31.8
87/10/07	21	26.4	27.9	26.4	29.7	33.6	24.3	26.6	38.6	28.5	23.8	25.4	22.4	21.4	31.3	32.4
87/10/07	22	27.5	28.7	28.2	29.3	34.0	27.0	25.8	39.5	28.9	24.5	25.9	22.6	22.0	29.0	31.1
87/10/07	23	30.1	28.7	29.6	29.5	34.7	28.4	24.9	39.7	29.7	24.8	26.6	23.6	22.4	29.9	31.0
87/10/07	24	28.0	26.7	26.7	29.3	33.5	25.7	24.9	38.6	27.3	22.3	24.8	23.5	21.5	29.5	31.7
87/10/08	01	23.6	22.5	24.3	25.7	29.7	23.4	21.4	36.5	25.5	21.3	22.4	19.2	19.6	26.1	28.1
87/10/08	02	24.0	23.5	25.1	24.7	27.0	24.0	21.0	34.1	26.1	23.5	24.4	20.0	16.8	18.3	24.4
87/10/08	03	23.0	22.8	24.1	22.8	25.5	22.4	19.1	33.1	24.4	22.9	24.3	18.9	14.9	18.2	23.6
87/10/08	04	22.5	22.1	22.9	22.7	24.4	21.9	19.1	32.4	23.3	22.1	23.4	19.9	16.7	17.4	18.8
87/10/08	05	22.9	22.1	23.2	21.7	25.4	22.4	17.6	30.5	24.1	21.4	22.6	16.3	15.3	19.1	22.9
87/10/08	06	20.7	19.7	20.5	19.5	23.0	19.7	16.0	28.7	21.2	17.7	19.0	13.7	12.6	19.3	21.7
87/10/08	07	21.5	20.5	20.7	19.8	21.8	20.1	16.2	27.8	22.0	20.8	21.9	18.1	15.4	14.9	18.0
87/10/08	08	20.6	18.9	19.1	19.6	22.9	18.5	17.6	26.4	22.5	20.8	21.5	17.6	15.6	15.9	17.5
87/10/08	09	19.4	18.7	18.4	19.2	20.1	19.1	16.2	27.0	20.5	19.9	20.8	19.5	15.9	15.2	15.2
87/10/08	10	15.3	15.0	15.4	15.6	16.3	15.4	13.8	20.4	17.3	16.4	17.0	15.2	13.4	12.4	12.7
87/10/08	11	13.6	13.2	13.2	13.3	15.1	13.5	12.2	17.7	14.6	12.9	13.1	11.4	10.0	12.1	13.4
87/10/08	12	13.1	12.6	12.7	13.8	14.8	13.2	12.4	16.9	13.5	12.3	12.0	10.8	10.2	12.5	14.0
87/10/08	13	13.7	13.4	14.0	15.6	16.5	14.5	13.8	17.0	14.4	12.5	12.1	11.2	11.3	15.0	17.3
87/10/08	14	15.1	14.9	16.2	17.3	18.0	16.7	15.6	18.7	15.9	13.8	13.3	12.8	12.5	16.8	18.6
87/10/08	15	15.8	15.6	16.3	17.8	18.3	16.9	15.8	20.3	15.4	13.7	12.4	13.7	13.6	17.5	19.9
87/10/08	16	17.2	17.2	18.7	19.8	20.1	19.2	17.2	20.9	17.8	15.7	14.6	15.3	14.4	19.3	22.5
87/10/08	17	16.5	16.3	16.7	18.4	19.8	17.5	17.0	21.3	17.1	14.6	14.3	14.6	15.1	19.1	20.5
87/10/08	18	14.3	14.9	14.6	15.9	17.6	14.8	14.5	22.4	16.1	13.8	13.0	14.4	13.9	18.7	19.9
87/10/08	19	17.6	19.4	19.1	20.9	22.5	17.2	17.9	25.9	17.6	15.2	17.7	15.7	15.3	22.0	25.4
87/10/08	20	23.0	22.4	23.4	25.3	25.8	22.7	20.9	30.2	21.7	21.1	23.4	20.7	20.0	27.6	30.8
87/10/08	21	27.2	24.9	23.7	27.4	30.2	22.3	26.1	35.6	24.2	20.2	20.0	20.7	19.3	25.4	29.0
87/10/08	22	28.7	27.0	25.8	24.2	28.9	22.9	22.1	32.6	24.4	20.8	19.7	19.7	18.8	25.4	29.0
87/10/08	23	23.3	22.8	24.9	28.2	29.8	26.3	25.0	33.0	26.3	23.0	22.0	23.9	21.9	28.9	31.9
87/10/08	24	19.5	20.6	22.1	25.7	28.4	19.9	22.3	35.1	23.6	19.9	20.3	19.2	18.8	25.9	29.6

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WBE3 MPH	WBE5 MPH	WBEA MPH	WBEB MPH	WBEC MPH	WSF1 MPH	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WBF2 MPH	WB01 MPH	WB03 MPH	WB05 MPH	WB07 MPH
87/10/09	01	21.3	20.8	21.4	23.7	26.0	21.6	21.6	31.9	23.3	20.7	20.7	20.8	19.9	25.4	27.4
87/10/09	02	19.6	19.5	20.4	22.8	24.7	21.2	20.9	30.8	22.4	20.6	20.4	20.7	19.7	24.4	26.7
87/10/09	03	21.2	20.6	21.0	20.9	24.9	21.5	18.2	32.7	23.3	21.4	22.1	17.8	16.4	20.6	24.3
87/10/09	04	16.7	16.2	16.8	16.7	17.3	16.4	14.6	27.5	16.9	16.0	16.4	14.0	12.0	11.5	14.6
87/10/09	05	12.0	11.7	11.4	11.3	12.7	11.3	9.2	15.9	11.4	10.8	11.3	9.4	7.7	8.0	9.9
87/10/09	06	16.5	16.3	16.6	17.8	19.7	16.6	15.0	22.1	16.9	15.2	15.8	12.3	11.2	14.8	16.9
87/10/09	07	17.4	17.4	17.6	19.1	20.2	17.4	16.4	23.5	16.8	14.2	14.1	13.9	14.5	18.8	22.0
87/10/09	08	20.0	20.5	20.4	21.7	24.4	19.4	19.6	28.3	21.5	18.8	19.3	17.5	17.0	22.5	25.0
87/10/09	09	18.5	18.6	19.0	20.5	23.4	18.8	17.9	27.7	20.5	17.8	18.6	16.1	15.9	21.3	23.8
87/10/09	10	20.2	19.8	20.0	21.6	24.1	20.3	19.7	30.0	22.0	19.5	20.3	17.6	16.8	21.3	24.7
87/10/09	11	20.0	20.2	20.7	22.2	24.0	21.4	19.8	28.1	22.4	19.6	20.4	17.8	16.4	20.2	23.0
87/10/09	12	19.7	20.1	20.1	21.5	23.2	20.8	19.3	26.9	21.1	18.5	19.1	18.2	16.9	20.3	22.5
87/10/09	13	18.6	17.9	18.9	20.5	22.0	19.3	18.8	24.3	20.2	17.7	18.2	16.3	15.4	19.0	21.0
87/10/09	14	18.5	18.6	19.1	20.4	21.6	19.4	17.9	24.6	19.3	17.4	16.9	16.4	15.2	19.0	21.4
87/10/09	15	17.1	17.3	18.3	19.5	20.7	18.8	17.1	21.8	18.3	16.1	16.0	14.8	14.7	18.2	20.3
87/10/09	16	16.3	16.3	17.3	18.4	19.2	17.4	16.4	20.4	16.9	15.6	14.7	14.1	14.8	18.0	19.8
87/10/09	17	13.4	13.7	15.4	16.4	16.6	15.1	13.2	15.1	13.6	12.5	12.0	12.2	13.2	18.1	21.1
87/10/09	18	15.2	14.8	16.2	17.9	19.9	14.2	14.8	23.1	16.3	13.7	13.8	12.1	11.4	17.6	20.8
87/10/09	19	17.7	17.2	18.5	20.5	21.8	17.5	17.1	23.4	17.2	15.2	14.7	14.7	14.4	20.4	23.6
87/10/09	20	19.1	18.7	19.4	21.0	21.8	19.0	17.6	21.6	17.8	15.3	15.0	15.7	15.7	21.8	25.5
87/10/09	21	20.4	20.3	21.2	22.4	23.6	21.0	19.8	25.3	20.8	17.3	17.7	16.6	16.6	22.4	26.0
87/10/09	22	19.6	20.3	20.1	21.3	23.4	19.8	19.9	26.1	21.4	17.8	19.2	17.0	16.3	22.0	24.3
87/10/09	23	16.3	16.8	17.0	17.8	21.2	17.9	15.9	26.2	19.4	16.6	17.6	14.7	14.3	18.0	21.3
87/10/09	24	15.2	15.5	16.1	17.6	18.5	16.7	15.3	24.0	16.3	15.0	15.2	13.6	13.3	17.7	19.8
87/10/10	01	17.0	16.9	16.5	18.4	20.2	16.5	16.3	24.1	17.1	15.3	15.5	14.5	13.5	18.3	20.7
87/10/10	02	14.2	14.4	14.1	15.0	16.5	14.8	13.3	21.4	15.2	13.8	13.7	13.3	12.9	16.5	20.9
87/10/10	03	10.6	10.0	10.2	11.3	14.0	10.7	9.1	18.1	13.6	12.7	12.9	11.7	11.1	14.8	17.9
87/10/10	04	13.7	13.9	14.6	15.9	18.0	13.8	13.7	20.4	16.5	14.4	14.6	13.9	13.7	17.7	20.4
87/10/10	05	13.0	13.3	13.4	15.0	16.5	13.8	13.0	20.5	15.1	13.6	14.0	12.4	11.9	14.7	17.1
87/10/10	06	13.3	12.8	13.2	14.3	16.0	13.5	12.4	19.4	14.0	11.8	12.4	10.4	10.1	15.0	16.4
87/10/10	07	13.5	13.0	13.2	14.3	16.0	13.4	11.8	20.1	15.1	13.1	13.5	10.7	10.0	12.7	14.8
87/10/10	08	13.8	13.1	13.3	14.2	16.2	13.3	12.0	19.8	14.1	12.1	12.8	9.8	9.1	13.4	14.9
87/10/10	09	12.4	12.1	11.8	12.6	13.4	12.6	10.5	18.5	11.6	9.8	10.4	8.7	8.1	12.3	13.9

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSG8	MPH	TURBINE G8 35-ft
WSG0	MPH	TURBINE G10 35-ft
WSG2	MPH	TURBINE G12 35-ft
WSH1	MPH	TURBINE H1 50-ft
WSH7	MPH	TURBINE H7 50-ft
WSH0	MPH	TURBINE H10 50-ft
WSH2	MPH	TURBINE H12 50-ft
WSH5	MPH	TURBINE H15 50-ft
WSI1	MPH	TURBINE I1 50-ft
WSI3	MPH	TURBINE I3 50-ft
WSI5	MPH	TURBINE I5 50-ft
WSI9	MPH	TURBINE I9 50-ft
WSI4	MPH	TURBINE I14 50-ft
WSJ6	MPH	TURBINE J6 50-ft
WSJ8	MPH	TURBINE J8 50-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESB RANCH

YY/MM/DD	HR	WS08 MPH	WS00 MPH	WS02 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WBI1 MPH	WBI3 MPH	WBI5 MPH	WBI9 MPH	WBI4 MPH	WBJ6 MPH	WBJ8 MPH
87/10/01	15	17.4	19.9	21.4	23.3	21.8	22.6	19.1	22.0	22.6	22.9	22.5	21.5	24.1	23.8	22.4
87/10/01	16	17.2	19.0	20.2	25.9	21.7	22.1	20.9	21.4	21.9	24.2	22.8	23.0	23.7	24.2	22.8
87/10/01	17	16.1	18.3	20.5	21.9	19.1	20.1	18.5	19.8	20.8	21.9	19.8	20.4	23.7	22.9	21.7
87/10/01	18	16.3	17.3	19.5	19.9	18.4	19.8	17.6	19.3	19.8	21.2	18.7	20.2	22.2	22.8	21.6
87/10/01	19	19.4	20.6	22.5	27.6	22.6	23.3	20.7	21.2	22.9	23.1	20.9	21.4	22.1	25.5	24.9
87/10/01	20	10.5	10.9	11.7	17.5	14.4	13.3	14.9	12.6	13.6	15.0	13.3	14.1	11.4	13.5	11.1
87/10/01	21	9.5	10.8	13.6	17.2	14.9	14.8	14.1	15.1	15.0	15.3	14.8	14.5	15.4	13.8	13.5
87/10/01	22	17.2	19.1	21.0	29.9	32.3	32.8	29.9	30.0	31.1	29.5	27.5	27.9	27.5	22.8	23.7
87/10/01	23	18.9	19.3	21.7	32.2	30.4	31.9	28.8	29.9	31.4	31.9	30.4	31.1	30.0	23.0	22.9
87/10/01	24	16.8	17.6	18.9	32.1	24.0	26.1	24.0	24.3	26.0	26.9	26.4	25.8	26.2	22.2	26.1
87/10/02	01	14.6	17.5	18.9	33.5	24.8	27.8	26.6	24.8	28.0	29.4	28.6	26.5	27.5	22.8	26.2
87/10/02	02	11.1	13.1	15.6	30.1	22.6	21.8	24.9	20.7	21.6	22.1	21.3	20.4	20.9	19.7	21.6
87/10/02	03	1.4	5.4	15.7	32.7	25.1	22.7	26.9	24.0	21.1	18.9	16.3	20.6	13.9	10.6	11.1
87/10/02	04	2.1	4.3	13.4	31.7	22.6	19.8	25.1	20.2	17.8	15.1	14.2	12.2	8.7	12.1	9.4
87/10/02	05	9.8	11.0	12.1	29.1	20.8	19.8	24.8	19.1	19.8	20.6	21.1	17.9	20.1	18.1	20.1
87/10/02	06	5.8	4.1	6.8	25.6	16.0	12.1	20.5	12.8	11.0	11.2	10.0	6.3	5.9	6.0	7.3
87/10/02	07	0.5	0.9	5.1	14.8	8.7	5.1	9.2	5.9	3.3	2.4	2.2	3.4	0.8	0.5	1.5
87/10/02	08	2.8	6.5	9.5	12.9	10.9	10.3	9.2	8.7	9.2	9.1	7.4	6.9	5.1	7.3	2.3
87/10/02	19	7.8	8.2	9.3	11.8	10.5	9.7	10.3	9.7	8.9	10.2	10.1	9.4	10.7	10.9	9.3
87/10/02	20	6.6	7.3	8.9	9.6	9.3	7.1	9.2	8.7	6.5	8.7	9.8	8.3	12.2	11.1	6.6
87/10/02	21	9.4	10.6	11.8	15.6	14.1	14.2	13.9	13.0	13.2	12.8	11.6	11.3	14.7	14.3	6.3
87/10/02	22	8.0	7.3	9.3	15.4	12.3	13.0	12.8	11.9	12.2	13.1	12.4	12.1	11.8	11.8	5.7
87/10/02	23	7.8	8.2	9.7	17.1	13.1	13.9	14.0	12.6	13.7	15.1	14.6	13.5	13.3	13.3	8.8
87/10/02	24	9.4	9.5	9.3	15.7	13.4	15.6	12.9	12.9	15.2	16.0	14.9	14.7	13.3	13.8	10.4
87/10/03	01	5.3	5.2	7.8	17.3	13.7	15.2	13.6	13.1	15.1	16.2	15.3	14.2	13.8	9.9	9.6
87/10/03	02	4.7	7.3	10.1	18.1	13.9	11.8	14.7	10.8	10.5	9.4	8.1	5.7	7.8	8.4	9.9
87/10/03	03	6.1	8.9	11.3	18.3	13.6	12.7	14.3	11.4	11.4	11.2	10.9	7.8	10.6	10.3	10.9
87/10/03	04	3.8	1.9	4.0	16.1	9.4	10.3	10.1	6.6	9.2	8.7	8.0	5.5	6.5	6.1	4.8
87/10/03	05	2.0	5.1	8.8	14.5	12.3	13.0	9.8	8.1	12.4	11.7	10.6	5.3	9.4	8.3	7.7

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WS08 MPH	WS00 MPH	WS02 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH	WSI3 MPH	WBI5 MPH	WBI9 MPH	WBI4 MPH	WBJ6 MPH	WBJ8 MPH
87/10/07	09	16.7	19.4	20.0	25.8	15.9	14.7	14.4	12.4	14.6	15.8	16.5	13.5	18.0	18.4	17.4
87/10/07	10	20.7	23.9	26.8	36.5	27.7	26.1	27.0	23.5	26.3	27.7	26.8	24.4	26.6	25.8	24.4
87/10/07	11	20.4	22.8	24.3	31.4	23.3	23.0	22.6	21.0	22.3	22.2	23.4	20.4	24.9	25.4	24.6
87/10/07	12	19.3	21.8	23.6	29.1	22.3	23.2	21.9	22.0	23.2	25.2	24.3	23.3	25.5	25.2	23.5
87/10/07	13	17.1	17.7	21.3	23.6	19.0	20.4	18.7	20.2	20.2	19.7	20.0	19.1	22.3	21.0	19.8
87/10/07	14	18.0	19.3	21.1	19.9	19.8	21.2	19.8	20.8	20.9	20.7	20.6	19.8	21.9	21.6	22.0
87/10/07	15	16.3	17.0	19.5	19.8	20.0	21.3	20.3	21.0	21.2	21.2	21.0	20.1	22.8	20.8	20.9
87/10/07	16	16.0	17.0	19.2	21.6	20.8	22.8	21.0	22.3	22.8	22.6	22.4	21.0	23.5	22.4	21.2
87/10/07	17	15.0	17.3	18.4	23.4	18.8	19.3	18.2	19.1	19.3	19.7	19.7	18.7	21.6	20.0	19.0
87/10/07	18	18.7	22.2	22.8	25.4	24.1	24.8	23.1	23.9	24.5	25.0	25.1	23.5	24.9	24.3	23.6
87/10/07	19	21.5	24.5	25.1	30.7	28.3	27.3	26.8	26.2	27.2	29.7	29.3	27.9	27.3	28.9	27.9
87/10/07	20	23.8	26.2	28.3	38.4	31.5	31.2	29.6	29.8	30.5	32.0	32.7	30.2	32.4	33.7	31.3
87/10/07	21	23.3	25.4	27.4	40.5	33.3	30.2	33.2	29.1	28.5	29.1	28.3	27.7	32.2	33.2	32.1
87/10/07	22	22.8	25.7	27.1	40.9	33.4	31.4	33.3	30.6	30.3	29.9	30.0	29.4	32.3	31.5	31.9
87/10/07	23	23.4	26.2	27.0	41.5	35.8	32.9	36.1	31.8	31.8	32.4	31.0	30.9	33.4	32.1	32.6
87/10/07	24	22.8	25.5	26.9	40.5	33.5	31.5	34.3	30.3	30.9	30.4	28.6	30.2	30.8	31.4	31.5
87/10/08	01	18.5	22.1	24.1	37.8	30.9	28.9	32.1	28.3	26.9	26.6	26.0	26.7	26.8	27.7	29.1
87/10/08	02	19.7	18.7	20.2	35.5	29.8	27.3	30.8	27.1	26.3	27.0	26.7	26.6	28.1	25.3	26.1
87/10/08	03	18.6	17.0	18.3	34.4	29.7	27.0	30.3	27.4	25.1	25.4	25.6	25.5	26.9	23.0	24.0
87/10/08	04	20.3	18.6	18.6	34.0	27.5	25.9	28.4	25.6	24.8	25.2	25.7	24.9	26.4	23.4	24.3
87/10/08	05	16.4	17.1	18.2	32.0	24.7	25.0	25.4	23.0	24.[illegible]	25.4	25.4	24.1	26.9	23.3	26.5
87/10/08	06	12.6	15.0	16.2	30.1	23.5	23.5	23.9	21.9	23.1	23.7	23.8	22.8	24.1	20.9	23.5
87/10/08	07	18.1	17.2	17.2	28.7	22.6	21.7	23.6	19.9	22.0	23.2	23.4	21.7	24.8	21.2	24.0
87/10/08	08	17.5	17.2	17.9	26.4	22.3	23.1	22.0	21.1	22.7	23.0	23.0	21.7	23.8	23.6	25.6
87/10/08	09	19.7	16.6	16.1	27.9	22.4	22.4	22.3	21.4	21.8	22.3	22.4	21.7	24.3	21.0	20.3
87/10/08	10	14.8	14.3	13.9	21.3	18.3	18.3	17.4	17.4	17.7	18.0	17.8	17.3	19.4	17.0	16.7
87/10/08	11	11.0	11.1	11.9	18.2	15.3	15.2	14.5	14.3	15.1	15.6	15.5	14.7	16.3	15.1	15.7
87/10/08	12	10.1	11.1	12.2	17.4	15.7	15.1	15.5	14.9	15.0	15.3	14.9	14.6	15.4	14.7	14.9
87/10/08	13	10.5	12.0	13.5	17.4	15.9	16.8	15.7	16.4	16.5	16.6	16.4	15.6	17.1	16.3	16.8
87/10/08	14	12.2	14.0	15.5	19.5	18.4	19.2	18.6	19.0	19.0	19.3	18.5	18.1	19.9	18.0	18.1
87/10/08	15	13.9	14.8	16.8	21.4	18.9	19.1	18.5	18.8	18.8	19.6	19.1	18.7	20.3	18.4	18.2
87/10/08	16	15.6	16.8	18.0	21.3	20.0	21.1	19.8	21.0	21.1	21.4	21.2	20.0	23.0	21.4	21.1
87/10/08	17	14.3	16.2	18.1	22.3	20.3	20.4	19.8	19.9	20.0	20.7	20.0	19.4	21.1	21.0	20.3
87/10/08	18	13.8	16.0	17.3	23.3	18.9	19.0	19.1	19.1	18.4	18.6	18.5	18.2	20.3	19.7	19.1
87/10/08	19	16.3	18.4	19.5	27.0	20.0	18.8	20.3	17.3	18.7	18.2	18.3	16.5	20.9	20.4	19.5
87/10/08	20	21.9	23.8	25.1	31.7	23.7	22.3	21.7	20.4	22.6	25.3	25.4	23.5	26.0	26.2	27.2
87/10/08	21	21.5	22.6	24.5	37.0	30.6	32.8	28.6	29.1	31.6	30.8	29.4	28.3	29.6	29.5	26.9
87/10/08	22	20.2	22.3	23.4	34.3	30.7	29.4	32.7	26.0	29.1	29.5	29.5	26.7	28.6	28.6	28.0
87/10/08	23	23.6	26.1	26.4	34.4	25.3	21.9	26.9	18.8	21.4	21.3	23.7	19.0	29.0	31.5	30.5
87/10/08	24	19.5	23.0	25.0	36.4	29.2	23.9	29.7	24.7	21.8	20.6	20.6	21.1	24.1	27.6	27.5

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WB08 MPH	WSQ0 MPH	WSQ2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WBI1 MPH	WBI3 MPH	WBI5 MPH	WBI9 MPH	WBI4 MPH	WSJ6 MPH	WBJB MPH
87/10/09	01	20.0	22.1	23.7	33.4	27.3	26.0	27.3	25.4	24.8	25.3	24.8	24.8	25.5	26.1	26.5
87/10/09	02	19.9	21.9	22.8	32.0	25.2	24.1	25.3	23.3	22.8	23.1	23.0	22.3	25.5	26.0	26.3
87/10/09	03	17.4	18.0	19.3	34.5	27.7	25.3	28.7	25.8	23.7	23.7	23.7	23.8	25.6	24.1	26.5
87/10/09	04	13.8	12.8	12.5	28.6	23.2	21.0	24.0	21.2	19.9	19.8	20.1	20.3	20.6	17.2	16.4
87/10/09	05	9.6	8.2	9.0	16.9	12.9	11.7	13.2	11.1	11.5	11.8	12.3	11.5	13.5	12.0	12.4
87/10/09	06	12.2	12.3	13.2	23.4	19.2	18.0	19.1	17.6	17.6	17.7	17.7	17.4	19.3	18.6	18.5
87/10/09	07	13.9	15.8	18.1	24.3	19.6	19.0	19.0	18.0	18.4	18.3	19.4	17.3	20.3	19.7	18.8
87/10/09	08	17.8	18.8	20.6	29.4	23.1	22.3	22.9	21.7	21.7	22.4	22.9	21.3	24.6	24.4	24.6
87/10/09	09	16.3	17.7	19.4	28.7	22.8	21.7	22.8	21.5	20.9	20.8	20.6	20.5	23.1	22.7	23.2
87/10/09	10	17.7	18.4	19.9	30.2	24.3	23.5	23.9	23.3	23.6	24.5	24.6	23.5	27.0	24.8	25.5
87/10/09	11	17.5	17.8	19.8	28.3	23.9	24.7	23.8	24.5	24.8	25.1	24.9	24.1	27.2	25.1	25.9
87/10/09	12	17.7	19.0	20.6	27.0	23.5	24.3	23.3	24.1	24.2	24.6	24.6	23.5	26.4	24.3	24.3
87/10/09	13	16.8	17.9	19.1	24.9	21.3	22.9	21.6	23.0	22.9	23.1	22.5	21.8	24.0	23.7	23.9
87/10/09	14	16.4	17.4	18.8	25.1	21.9	21.6	21.6	21.2	21.3	22.4	22.7	21.4	24.0	22.6	22.8
87/10/09	15	14.6	16.1	17.9	22.7	20.2	21.2	20.1	21.0	20.8	20.9	21.3	20.1	22.9	21.3	21.8
87/10/09	16	14.9	16.1	18.5	21.4	19.3	20.8	19.5	20.4	20.6	20.3	20.6	19.4	21.7	20.2	20.8
87/10/09	17	12.4	14.3	17.7	16.0	14.4	15.5	14.5	15.0	15.5	15.7	15.9	14.6	17.4	16.5	16.8
87/10/09	18	13.0	14.6	16.7	24.1	16.5	16.1	16.2	15.5	16.0	16.1	15.6	15.6	16.6	18.6	18.3
87/10/09	19	15.8	17.8	19.4	24.9	18.7	18.1	18.3	17.5	17.9	18.6	18.5	17.5	19.9	20.4	19.9
87/10/09	20	15.8	18.8	20.4	23.1	19.9	21.7	19.4	21.0	21.8	22.3	22.0	20.9	22.8	21.7	20.9
87/10/09	21	17.1	19.2	20.9	25.8	24.3	24.9	24.0	24.3	24.8	24.9	25.2	23.7	26.5	25.3	24.3
87/10/09	22	17.2	18.2	20.4	27.2	24.1	24.5	23.7	24.2	24.3	24.6	24.6	23.7	26.4	25.5	25.9
87/10/09	23	14.6	16.0	17.1	27.9	21.6	21.1	21.8	20.9	20.5	20.6	20.8	20.4	22.8	21.8	22.9
87/10/09	24	13.2	14.6	16.4	25.3	20.3	19.4	20.6	19.3	18.7	18.7	18.9	18.4	20.8	19.3	19.3
87/10/10	01	14.3	15.3	16.9	24.9	20.3	19.2	20.4	18.9	18.7	19.3	19.6	18.8	21.9	20.3	19.8
87/10/10	02	12.9	14.1	16.2	22.3	18.7	18.1	19.1	18.1	17.5	17.8	17.8	17.6	19.2	17.4	17.8
87/10/10	03	11.4	11.8	14.6	19.0	15.1	13.6	15.8	14.0	13.0	12.9	13.2	13.3	14.6	13.8	15.1
87/10/10	04	13.9	15.5	17.5	21.6	17.0	16.8	16.7	16.6	16.7	16.5	16.4	16.0	18.0	18.9	19.6
87/10/10	05	12.8	13.2	14.8	21.6	16.7	16.0	16.5	15.9	15.7	16.0	16.0	15.7	17.7	17.2	17.9
87/10/10	06	10.7	11.6	13.0	20.0	16.6	16.8	16.3	16.2	16.3	16.3	16.4	15.5	17.2	16.6	16.5
87/10/10	07	10.7	11.2	12.1	21.1	17.4	17.2	17.2	16.7	16.5	16.1	16.1	15.6	17.5	15.9	17.1
87/10/10	08	10.0	10.6	12.0	20.8	17.9	17.9	17.4	17.2	17.3	17.4	16.7	16.7	17.2	16.2	16.3
87/10/10	09	9.0	9.0	11.1	19.3	15.5	15.5	15.2	14.9	14.9	15.2	14.8	14.6	15.7	13.5	13.5

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSJ1	MPH	TURBINE J11 50-ft
WSJ3	MPH	TURBINE J13 50-ft
WSK1	MPH	TURBINE K1 35-ft
WSK3	MPH	TURBINE K3 35-ft
WSK5	MPH	TURBINE K5 35-ft
WSK7	MPH	TURBINE K7 35-ft
WSK9	MPH	TURBINE K9 35-ft
WSK2	MPH	TURBINE K12 35-ft
WSK4	MPH	TURBINE K14 35-ft
WSL1	MPH	TURBINE L1 35-ft
WSL3	MPH	TURBINE L3 35-ft
WSL5	MPH	TURBINE L5 35-ft
WSL8	MPH	TURBINE L8 35-ft
WSL0	MPH	TURBINE L10 35-ft
WSL2	MPH	TURBINE L12 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WBJ1 MPH	WBJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH	WSLB MPH	WSLO MPH	WSL2 MPH
87/10/01	15	23.1	21.7	19.5	20.0	20.3	19.9	22.5	20.9	23.7	24.3	25.3	26.5	24.1	25.8	27.1
87/10/01	16	23.4	22.2	19.3	19.4	19.3	19.8	21.7	20.9	23.3	23.9	25.2	26.0	24.3	25.3	26.2
87/10/01	17	22.2	21.1	18.1	18.5	19.3	19.1	21.1	20.3	22.3	22.3	22.8	23.9	21.8	23.3	24.8
87/10/01	18	21.7	20.1	17.8	17.4	17.0	17.7	20.3	18.4	21.4	22.6	24.1	25.0	22.9	24.6	26.0
87/10/01	19	26.0	26.1	20.9	22.3	22.1	18.8	20.9	19.6	21.0	24.2	24.6	25.3	23.2	24.2	25.7
87/10/01	20	13.3	12.8	11.9	12.8	13.4	11.7	12.3	12.4	12.4	14.4	14.9	14.8	12.9	13.8	14.2
87/10/01	21	14.7	14.9	12.6	13.4	15.4	14.8	16.8	16.2	18.7	19.0	20.0	20.9	19.4	20.8	22.0
87/10/01	22	24.8	25.3	21.1	21.3	20.0	17.4	19.5	17.9	20.5	22.5	23.9	25.0	22.4	23.6	24.9
87/10/01	23	24.5	26.9	23.7	24.2	21.6	20.8	22.5	21.7	23.4	25.3	26.6	27.5	25.1	26.8	27.9
87/10/01	24	24.6	27.4	22.8	22.4	20.1	17.8	20.1	18.7	21.6	23.6	25.5	27.0	24.3	26.2	27.8
87/10/02	01	25.0	25.8	19.9	18.6	17.4	16.2	20.5	17.0	21.8	25.2	26.8	28.4	25.7	27.8	29.3
87/10/02	02	21.7	19.3	14.9	13.1	13.9	14.4	18.7	15.3	19.6	22.0	23.4	23.8	22.3	23.1	24.5
87/10/02	03	10.7	10.8	9.0	11.5	15.9	16.7	21.1	18.7	22.9	24.2	25.4	26.1	24.7	25.6	27.2
87/10/02	04	10.6	10.0	7.3	10.6	15.2	16.4	20.1	18.3	22.4	23.2	24.6	26.1	24.0	25.3	27.5
87/10/02	05	19.4	14.0	14.1	9.6	9.8	12.2	17.0	14.0	19.0	20.4	21.6	22.8	21.1	22.2	24.4
87/10/02	06	6.3	5.4	6.8	5.7	7.4	10.3	14.4	12.4	16.5	17.4	18.6	19.1	17.9	18.5	19.6
87/10/02	07	2.1	2.7	3.0	5.1	8.9	9.3	11.9	11.0	13.3	13.4	14.0	14.2	12.9	14.0	14.4
87/10/02	08	10.0	10.6	9.3	11.3	13.0	12.1	12.5	13.0	14.3	13.7	14.5	15.2	13.6	14.7	14.5
87/10/02	19	11.1	10.1	8.6	8.5	9.0	7.8	8.5	8.2	8.6	8.9	9.2	9.3	8.3	9.3	10.0
87/10/02	20	11.3	10.8	7.6	8.3	9.6	9.0	10.6	10.0	11.5	11.8	12.2	12.3	11.4	12.3	13.1
87/10/02	21	13.7	12.8	11.2	11.1	10.7	9.7	11.4	10.4	12.5	12.5	12.8	13.0	12.2	12.8	13.6
87/10/02	22	10.1	8.2	8.2	8.3	9.5	9.4	11.4	10.6	12.6	12.7	13.5	13.5	13.0	13.4	14.3
87/10/02	23	13.0	10.5	8.2	9.9	9.2	9.2	11.4	9.9	12.7	13.3	14.0	14.5	13.6	14.5	15.9
87/10/02	24	13.1	8.6	8.7	8.8	8.0	8.7	11.2	10.5	12.7	12.8	13.2	13.9	13.0	14.1	15.5
87/10/03	01	10.0	8.8	7.3	7.5	9.9	11.1	13.3	12.9	15.1	15.0	15.3	15.9	15.1	15.9	17.3
87/10/03	02	10.2	10.5	10.2	11.9	13.3	12.8	14.6	13.5	15.1	15.5	15.7	16.0	14.9	16.0	16.7
87/10/03	03	11.5	11.5	10.7	11.8	13.5	12.7	14.3	13.3	15.2	15.5	15.5	15.9	14.7	15.8	16.5
87/10/03	04	5.0	4.1	4.9	4.2	7.0	8.0	10.8	9.0	11.5	12.3	12.7	13.1	11.9	13.1	13.4
87/10/03	05	7.8	7.5	7.7	9.2	11.1	11.0	12.5	11.4	13.2	13.3	13.5	13.2	12.9	13.6	13.7

DOE FREE FLOW DATA - JEBB RANCH

YY/MM/DD	HR	WBJ1 MPH	WBJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WBK2 MPH	WBK4 MPH	WBL1 MPH	WBL3 MPH	WBL5 MPH	WBL8 MPH	WBL0 MPH	WBL2 MPH
87/10/07	09	17.2	15.6	16.0	17.0	16.7	16.0	19.0	15.3	17.7	22.4	25.4	29.4	19.1	23.9	26.9
87/10/07	10	23.6	23.2	22.0	23.2	24.8	25.4	26.5	25.6	28.4	30.4	32.2	34.2	30.0	32.8	33.8
87/10/07	11	24.3	23.9	21.8	22.3	22.1	22.9	25.6	23.1	27.2	29.1	30.8	32.2	28.7	30.7	32.1
87/10/07	12	23.8	23.6	20.7	21.7	22.4	22.1	23.7	22.8	25.6	27.7	29.5	29.7	27.3	28.7	29.9
87/10/07	13	21.3	21.3	18.5	18.9	21.3	20.4	22.6	21.0	24.3	25.6	26.6	27.5	24.8	26.7	27.7
87/10/07	14	22.5	22.4	19.7	19.7	20.7	20.7	22.1	21.4	23.9	24.6	26.0	26.9	24.8	26.2	26.7
87/10/07	15	21.5	21.5	18.7	18.7	19.4	19.8	21.1	20.5	23.2	23.5	24.4	25.5	23.5	24.9	25.6
87/10/07	16	22.1	21.2	18.3	18.2	19.3	19.3	21.6	20.2	23.2	23.8	25.0	25.8	23.6	25.2	25.9
87/10/07	17	19.6	19.1	13.2	17.1	18.0	17.6	18.8	18.8	20.3	21.3	23.5	24.2	21.8	23.5	23.9
87/10/07	18	24.4	24.7	18.3	21.7	21.9	22.5	23.0	23.4	25.2	25.6	27.2	29.0	25.9	27.7	29.6
87/10/07	19	28.2	29.0	23.3	25.1	24.3	24.1	25.2	24.8	28.7	30.6	31.2	32.3	30.0	31.5	32.7
87/10/07	20	32.3	31.4	26.3	27.6	27.3	27.9	29.3	29.5	32.7	33.4	35.9	36.4	34.2	36.7	35.5
87/10/07	21	33.0	31.0	27.2	26.7	25.9	27.0	29.8	28.0	32.3	32.5	34.6	36.2	33.0	35.3	36.3
87/10/07	22	31.8	31.7	28.1	27.0	26.1	25.4	28.2	26.6	30.5	31.5	33.3	35.1	31.7	34.3	34.8
87/10/07	23	32.6	31.5	27.9	28.0	27.3	25.9	29.2	27.3	31.8	31.6	34.6	36.2	32.7	35.6	35.5
87/10/07	24	32.0	29.4	25.7	27.3	26.2	25.9	29.6	27.6	31.7	31.2	33.1	34.9	31.7	33.8	34.8
87/10/08	01	28.7	28.2	24.1	23.2	23.0	21.7	25.9	22.6	27.1	28.3	30.5	32.0	28.8	30.9	31.8
87/10/08	02	25.3	28.3	25.1	25.7	21.5	17.6	18.1	18.1	18.1	23.8	26.6	28.6	24.5	26.9	28.3
87/10/08	03	23.5	25.8	23.8	25.1	20.0	15.4	17.4	16.4	17.1	23.0	24.5	26.7	22.7	24.7	26.5
87/10/08	04	23.9	25.8	22.9	24.4	22.0	17.2	17.6	18.4	18.2	19.6	21.9	23.0	20.4	22.0	22.7
87/10/08	05	25.9	27.2	23.8	21.7	18.1	16.2	19.5	17.3	20.5	23.0	24.0	25.0	23.1	24.3	24.8
87/10/08	06	22.7	23.7	20.4	17.6	14.9	14.9	19.1	15.9	20.4	22.1	23.5	24.2	22.5	23.7	24.0
87/10/08	07	23.1	25.3	22.7	22.8	19.3	15.3	15.2	16.0	16.3	18.9	21.1	21.6	19.9	21.2	21.5
87/10/08	08	25.3	25.4	22.3	22.5	18.9	15.9	16.1	16.4	17.3	18.6	19.8	20.5	19.0	20.0	19.9
87/10/08	09	21.1	22.4	20.1	22.3	21.1	16.1	14.8	18.0	16.2	15.9	16.7	19.0	15.8	17.2	19.1
87/10/08	10	17.4	18.8	17.0	18.4	16.8	13.5	12.5	14.5	13.7	13.5	14.8	16.5	13.9	15.2	16.6
87/10/08	11	15.5	14.9	13.9	13.8	12.9	11.1	12.6	12.2	13.6	14.8	16.6	17.6	15.3	16.7	18.1
87/10/08	12	14.9	14.6	13.6	13.5	12.9	11.6	13.2	12.7	14.3	15.6	17.2	18.3	16.1	17.4	18.6
87/10/08	13	16.8	15.5	14.3	13.6	14.4	14.0	16.0	15.0	17.2	18.4	19.2	20.0	18.1	19.3	20.4
87/10/08	14	18.1	17.9	15.6	15.7	15.7	15.6	17.4	16.7	18.7	19.8	21.0	21.8	19.8	21.1	22.2
87/10/08	15	18.2	18.2	15.7	16.3	17.1	16.7	18.2	17.5	19.6	20.9	22.0	22.6	20.9	22.0	23.0
87/10/08	16	21.2	20.9	17.7	18.3	18.6	18.0	19.9	18.9	21.6	22.9	24.3	24.9	23.0	24.3	25.0
87/10/08	17	20.4	19.8	17.0	17.6	18.1	17.6	19.4	19.1	20.9	20.9	23.2	24.4	22.1	23.8	24.6
87/10/08	18	19.8	19.2	15.2	17.4	17.1	16.2	18.9	17.6	20.0	19.7	21.5	23.5	19.9	22.2	24.1
87/10/08	19	19.6	19.9	15.5	18.5	18.8	19.8	21.5	20.1	23.7	25.0	24.9	25.8	24.6	24.7	26.2
87/10/08	20	27.2	28.3	24.3	24.5	25.3	25.6	27.0	26.7	30.7	30.4	29.8	32.6	29.7	31.6	33.8
87/10/08	21	27.5	27.2	23.1	24.5	24.0	24.4	25.2	25.4	28.9	29.8	28.6	30.2	28.1	29.3	31.1
87/10/08	22	28.3	27.0	23.6	23.4	23.8	24.4	25.7	25.2	28.9	29.4	30.4	32.2	29.6	31.4	32.0
87/10/08	23	30.5	31.1	26.7	28.0	26.3	24.8	28.0	26.2	30.8	31.3	32.6	35.6	31.7	34.8	35.7
87/10/08	24	28.3	27.3	22.7	23.1	22.3	21.8	24.6	22.7	26.1	28.1	31.3	33.3	28.5	31.6	33.2

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WSJ1 MPH	WBJ3 MPH	WSK1 MPH	WSK3 MPH	WBK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WBK4 MPH	WSL1 MPH	WBL3 MPH	WSL5 MPH	WBL8 MPH	WSLO MPH	WBL2 MPH
87/10/09 01	26.4	27.2	23.7	24.5	24.6	22.7	26.0	24.7	28.0	27.8	28.4	30.0	27.8	29.0	30.3
87/10/09 02	26.4	27.1	23.3	24.9	24.1	22.4	24.9	24.1	27.1	27.1	27.7	28.8	27.3	28.2	29.2
87/10/09 03	25.[illegible]	27.4	23.9	23.4	20.4	17.9	20.8	19.4	21.7	24.6	26.1	27.7	24.9	26.1	27.3
87/10/09 04	17.9	18.0	16.3	17.0	14.5	12.1	11.7	12.4	12.1	15.4	17.8	19.8	15.3	18.3	19.5
87/10/09 05	12.3	12.6	11.3	11.1	10.0	8.1	8.9	8.4	9.4	10.4	11.4	13.2	10.1	11.8	13.4
87/10/09 06	18.4	18.1	16.6	15.9	14.3	13.1	15.2	14.2	15.9	17.6	19.3	20.4	17.9	19.5	20.6
87/10/09 07	19.3	18.3	15.7	16.7	17.9	17.4	19.4	18.4	21.2	22.5	23.7	24.1	22.6	23.6	24.1
87/10/09 08	25.0	24.8	19.9	21.4	21.1	19.5	22.7	20.8	24.5	25.0	27.0	28.3	25.6	27.4	28.2
87/10/09 09	23.2	22.5	16.6	19.6	19.3	18.4	21.4	19.6	22.9	24.3	26.0	27.3	24.8	26.3	27.4
87/10/09 10	25.8	25.7	18.1	21.9	20.9	18.7	21.5	20.3	22.7	24.7	26.1	26.7	24.5	26.3	26.7
87/10/09 11	26.3	26.1	11.3	22.1	20.4	18.4	21.1	20.2	22.6	23.5	24.8	25.7	23.6	24.8	25.4
87/10/09 12	24.6	24.9	15.4	21.9	21.2	19.6	21.4	21.0	23.1	23.1	23.9	25.3	23.2	24.4	25.1
87/10/09 13	24.2	23.7	19.3	20.2	19.5	17.8	19.5	19.2	20.9	21.6	22.9	24.3	21.7	23.5	24.5
87/10/09 14	23.2	23.5	19.5	20.4	19.1	17.4	19.8	18.9	21.5	22.1	23.4	23.9	22.1	23.2	24.0
87/10/09 15	22.2	21.9	17.7	18.5	18.4	16.9	18.8	18.4	20.5	21.0	22.0	23.0	21.1	22.1	23.2
87/10/09 16	20.9	20.6	16.8	17.6	18.4	17.3	18.2	18.7	19.7	20.4	21.9	22.5	20.4	21.8	22.8
87/10/09 17	17.0	17.3	14.4	15.0	17.2	16.7	18.5	17.8	20.0	20.5	21.3	21.8	19.9	21.1	22.1
87/10/09 18	18.5	17.6	14.4	15.0	14.8	14.9	17.0	15.4	18.2	20.5	22.5	23.6	20.4	22.2	22.6
87/10/09 19	20.0	20.0	16.9	17.7	18.5	18.9	21.0	19.4	22.7	24.4	25.6	26.1	23.8	25.4	26.2
87/10/09 20	21.3	21.8	18.1	18.9	19.3	19.4	22.0	20.7	24.2	25.3	25.8	26.8	25.3	26.0	27.6
87/10/09 21	24.9	24.2	19.3	20.2	20.4	20.2	22.4	21.7	25.1	26.4	27.9	28.7	27.4	28.2	28.9
87/10/09 22	26.4	25.0	20.2	21.1	20.1	19.1	22.6	20.6	24.2	23.7	26.3	27.8	25.0	26.9	27.7
87/10/09 23	23.1	22.5	17.6	18.4	17.9	15.9	18.7	17.1	19.8	21.6	23.3	23.3	22.1	23.2	23.2
87/10/09 24	19.5	19.6	16.2	16.9	16.4	15.5	18.1	16.8	19.3	20.0	22.0	23.3	20.8	22.5	23.4
87/10/10 01	20.3	20.1	17.2	18.0	16.8	15.8	18.8	17.0	20.0	20.8	22.8	24.0	21.0	23.0	23.8
87/10/10 02	18.0	18.1	15.5	16.2	16.0	15.4	18.7	16.6	19.8	20.8	22.3	22.6	21.2	22.1	22.5
87/10/10 03	14.9	16.9	14.0	14.6	14.5	12.7	14.3	14.1	15.4	17.8	19.7	21.7	17.7	19.6	21.0
87/10/10 04	19.9	19.4	16.4	17.1	16.8	15.1	18.2	16.6	19.0	20.3	21.8	23.3	20.3	22.2	23.2
87/10/10 05	17.8	18.1	14.7	15.4	14.9	13.3	14.8	14.6	15.8	17.3	18.9	20.2	17.4	19.0	19.8
87/10/10 06	16.6	15.6	13.3	13.3	12.6	12.3	15.4	13.5	16.3	16.2	17.8	18.3	17.1	17.7	17.9
87/10/10 07	16.7	17.1	14.0	13.8	12.6	10.9	12.9	11.7	13.3	14.8	16.5	17.6	15.2	16.3	17.7
87/10/10 08	16.3	15.8	12.9	12.9	11.6	10.8	13.8	11.6	14.2	14.7	16.4	17.2	15.1	16.1	17.4
87/10/10 09	13.3	13.0	11.2	11.2	10.7	10.1	12.3	10.9	13.0	14.1	15.4	16.6	14.2	15.5	16.7

HOURLY DATA LISTING

DOE FREE FLOW DATA - JESS RANCH

ID	UNITS	DESCRIPTION
WSM2	MPH	TURBINE M2 35-ft
WSM4	MPH	TURBINE M4 35-ft
WSM6	MPH	TURBINE M6 35-ft
WSM8	MPH	TURBINE M8 35-ft
WSM9	MPH	TURBINE M9 35-ft
WSM1	MPH	TURBINE M11 35-ft
WSM3	MPH	TURBINE M13 35-ft
WSN1	MPH	TURBINE N1 35-ft
WSN4	MPH	TURBINE N4 35-ft
WSN6	MPH	TURBINE N6 35-ft
WSN8	MPH	TURBINE N8 35-ft

NOTES:
VALUES ARE THE 60 MINUTE AVERAGE FOR THE PERIOD ENDING ON THE HOUR SHOWN.
ALL VALUES ARE ROUNDED TO THE NEAREST DECIMAL PLACE.

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WBM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
87/10/01	15	23.6	23.2	25.3	27.2	23.4	23.8	26.8	24.0	22.4	21.5	21.0
87/10/01	16	23.5	23.4	25.2	26.6	24.2	24.4	26.6	24.2	22.9	22.3	22.5
87/10/01	17	21.6	20.8	23.3	24.8	21.6	22.7	25.3	22.9	22.2	20.2	19.7
87/10/01	18	21.6	21.9	24.2	25.6	22.5	23.2	26.0	21.5	19.6	19.6	20.5
87/10/01	19	21.8	21.8	23.9	25.1	21.8	22.7	24.9	20.5	18.0	17.9	18.7
87/10/01	20	10.6	11.8	12.5	13.0	10.3	10.9	12.7	9.8	10.0	8.4	8.7
87/10/01	21	18.9	19.3	21.2	21.5	19.9	20.8	21.9	19.7	19.1	18.7	18.5
87/10/01	22	20.6	21.4	23.3	24.2	21.6	22.3	24.4	20.6	19.5	18.5	18.9
87/10/01	23	24.0	24.6	26.7	27.8	24.9	25.4	27.7	24.7	24.2	22.6	22.3
87/10/01	24	22.8	24.2	26.3	28.3	24.2	25.1	27.9	22.9	23.3	21.8	21.5
87/10/02	01	24.8	26.1	27.9	29.5	26.0	27.3	29.5	23.4	21.1	22.8	24.2
87/10/02	02	21.5	21.4	23.5	24.8	22.0	23.1	25.1	20.4	17.8	19.4	20.2
87/10/02	03	23.6	23.3	25.7	27.6	23.6	25.3	27.9	23.5	21.6	22.2	22.1
87/10/02	04	23.3	23.6	26.0	27.7	23.7	25.2	27.7	22.8	20.9	21.7	21.8
87/10/02	05	20.1	20.5	23.0	25.1	21.3	23.0	25.4	19.6	17.4	18.9	20.0
87/10/02	06	17.0	16.9	18.3	19.0	17.1	17.8	18.7	15.6	13.2	14.5	14.5
87/10/02	07	13.1	13.1	13.2	14.1	13.4	13.3	14.7	12.6	10.1	11.8	11.7
87/10/02	08	13.4	12.8	12.6	12.0	13.2	11.8	14.1	13.7	13.5	12.7	11.9
87/10/02	19	8.9	8.3	9.3	10.5	8.7	9.3	10.6	9.3	8.8	8.1	8.5
87/10/02	20	11.7	11.4	12.5	13.4	12.2	12.5	13.9	12.4	11.9	11.9	11.7
87/10/02	21	12.4	12.0	12.6	14.5	12.7	12.7	14.8	13.2	12.9	12.6	11.8
87/10/02	22	13.0	12.9	13.7	15.0	13.5	13.8	15.3	13.4	12.7	13.2	13.8
87/10/02	23	13.5	13.8	15.0	16.3	14.7	15.1	16.7	13.6	12.7	13.6	13.7
87/10/02	24	13.1	13.4	14.6	16.3	14.3	15.0	16.7	13.4	12.9	13.7	13.4
87/10/03	01	15.1	15.1	16.4	17.7	15.5	16.2	17.7	15.3	14.2	14.8	14.5
87/10/03	02	15.4	15.0	15.6	16.3	14.9	15.1	16.2	15.1	14.1	14.1	13.4
87/10/03	03	15.3	14.9	15.4	16.1	14.9	14.8	15.7	15.3	14.1	13.9	13.5
87/10/03	04	12.1	12.2	12.7	13.1	11.9	11.9	12.6	10.9	5.9	8.4	9.3
87/10/03	05	13.5	13.0	13.1	13.7	13.1	12.6	13.2	13.3	11.9	12.4	12.0

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD HR	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
87/10/07 09	17.0	16.5	20.6	24.2	14.6	14.4	18.4	14.2	9.9	9.2	10.4
87/10/07 10	28.1	28.4	31.3	32.5	27.0	28.4	31.2	26.5	21.7	20.6	21.6
87/10/07 11	26.9	26.9	29.5	31.2	26.0	26.6	29.9	25.4	20.9	20.1	21.0
87/10/07 12	25.8	25.5	28.1	28.9	25.4	26.3	28.6	25.6	22.5	21.9	22.1
87/10/07 13	24.0	23.9	26.2	26.8	24.3	24.9	27.0	24.7	23.0	21.8	22.2
87/10/07 14	23.8	23.8	25.4	26.4	24.1	24.0	26.1	24.4	23.3	22.1	22.1
87/10/07 15	23.1	22.9	24.4	25.5	23.3	23.3	25.5	24.0	23.0	21.9	21.4
87/10/07 16	23.3	23.0	24.7	25.5	23.6	23.5	25.4	24.1	22.9	22.0	21.8
87/10/07 17	20.8	21.2	22.5	24.0	21.4	21.6	23.8	21.6	20.6	19.4	19.1
87/10/07 18	25.3	25.3	27.6	28.9	25.7	26.3	28.5	25.9	25.5	23.5	23.7
87/10/07 19	29.9	28.9	30.8	32.6	29.7	29.8	32.6	30.1	28.9	28.1	27.4
87/10/07 20	33.7	33.9	34.6	35.0	34.6	32.9	35.0	34.2	32.9	31.4	31.6
87/10/07 21	32.1	32.0	34.3	35.8	32.4	32.4	35.4	32.7	29.9	29.2	29.3
87/10/07 22	30.6	31.1	33.4	34.8	31.5	31.9	34.5	31.3	29.0	28.2	28.6
87/10/07 23	31.7	32.4	34.3	34.8	32.5	32.7	35.1	32.8	31.0	29.6	29.5
87/10/07 24	31.1	30.8	33.2	34.4	31.7	31.7	34.2	33.4	30.7	29.9	29.9
87/10/08 01	27.9	28.1	30.2	31.5	28.5	28.5	31.4	27.4	23.9	24.7	25.9
87/10/08 02	21.5	24.2	26.6	28.1	23.2	24.9	27.9	20.0	22.5	18.0	20.0
87/10/08 03	20.6	22.1	24.4	26.0	21.7	23.0	25.7	19.3	22.4	17.7	18.6
87/10/08 04	19.2	20.3	21.9	22.7	20.7	21.3	22.7	20.6	21.9	18.3	18.5
87/10/08 05	22.4	22.5	23.8	25.0	23.1	22.8	24.9	21.8	20.4	20.3	21.0
87/10/08 06	21.6	22.0	23.0	24.0	22.4	22.2	23.9	21.6	18.9	19.9	20.1
87/10/08 07	18.6	19.9	20.9	21.7	19.9	20.4	22.0	18.5	18.6	17.3	17.6
87/10/08 08	18.5	18.8	19.7	20.4	19.2	19.4	20.9	19.1	18.4	17.8	17.5
87/10/08 09	15.6	16.1	17.8	19.5	16.4	17.3	19.5	19.3	20.7	17.3	14.8
87/10/08 10	13.6	14.4	15.8	17.0	14.5	15.6	17.0	15.6	16.8	13.9	13.1
87/10/08 11	14.7	15.5	17.2	17.9	15.6	16.9	18.1	15.2	14.6	14.2	14.2
87/10/08 12	15.4	16.1	17.6	18.5	16.1	17.1	18.4	15.5	14.6	14.5	14.5
87/10/08 13	17.6	17.5	19.2	20.3	18.0	18.6	20.2	17.9	16.9	16.5	16.4
87/10/08 14	19.2	19.2	21.0	22.0	19.6	20.3	21.9	19.7	18.6	18.0	18.0
87/10/08 15	20.3	20.1	21.9	22.6	20.7	21.2	22.8	20.6	19.6	19.0	19.0
87/10/08 16	22.7	22.4	23.9	24.7	22.8	22.7	24.6	22.9	21.6	21.2	21.1
87/10/08 17	21.1	21.9	23.5	24.6	22.2	22.6	24.4	22.4	21.6	20.3	20.3
87/10/08 18	19.7	19.9	22.2	24.1	20.6	21.2	23.8	21.4	20.8	19.8	19.0
87/10/08 19	24.2	22.5	24.4	26.6	23.5	22.8	26.2	23.5	20.8	20.2	20.6
87/10/08 20	30.3	28.7	31.9	34.2	29.8	30.5	34.1	31.8	30.1	28.2	27.5
87/10/08 21	29.3	27.2	29.3	31.5	28.2	28.4	31.6	29.9	29.5	27.8	25.9
87/10/08 22	29.6	28.9	30.9	31.6	29.8	29.4	31.5	30.5	28.9	27.5	27.3
87/10/08 23	31.2	31.2	34.2	35.3	31.7	32.2	35.1	31.6	28.3	28.1	28.4
87/10/08 24	26.3	27.7	30.8	32.4	27.2	28.3	31.7	26.4	24.3	23.6	24.1

DOE FREE FLOW DATA - JESS RANCH

YY/MM/DD	HR	WSM2 MPH	WBM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WBN6 MPH	WSN8 MPH
87/10/09	01	28.5	27.6	29.3	30.6	29.3	28.5	31.0	30.1	28.9	27.7	28.0
87/10/09	02	27.3	27.1	28.7	29.4	28.0	28.0	30.1	29.5	28.9	27.3	26.7
87/10/09	03	23.3	25.0	26.5	27.8	25.8	26.1	28.1	24.0	23.9	22.6	24.3
87/10/09	04	13.8	16.1	18.7	19.7	15.6	17.6	19.4	14.6	14.7	13.1	13.6
87/10/09	05	10.0	10.8	12.2	13.5	10.2	11.6	13.3	10.9	10.5	10.0	9.3
87/10/09	06	17.1	18.0	19.3	20.8	18.0	18.4	20.7	17.2	16.1	15.5	16.3
87/10/09	07	22.2	22.2	23.4	23.8	22.6	22.8	24.0	22.6	21.2	21.0	21.0
87/10/09	08	24.7	25.2	27.2	28.0	25.7	26.3	28.1	25.8	24.1	23.6	23.7
87/10/09	09	23.9	24.4	26.1	27.8	24.7	25.1	28.0	23.9	22.1	21.8	22.5
87/10/09	10	24.2	24.4	26.3	26.6	25.1	25.4	26.7	24.5	24.3	22.7	23.6
87/10/09	11	23.1	23.4	25.0	25.6	24.4	24.5	25.9	24.6	25.0	22.7	22.8
87/10/09	12	22.7	22.9	24.6	25.3	24.0	24.2	25.5	25.3	24.6	23.3	22.5
87/10/09	13	21.0	21.6	23.7	24.2	22.3	22.8	24.3	22.8	22.5	21.0	20.4
87/10/09	14	21.7	21.7	22.9	23.8	22.5	22.2	23.7	23.1	22.1	21.2	20.8
87/10/09	15	20.6	20.5	22.1	23.1	21.4	21.6	23.2	22.2	21.3	20.6	19.6
87/10/09	16	19.6	19.9	21.8	22.6	20.6	21.1	22.8	20.8	20.4	19.0	18.9
87/10/09	17	19.5	19.0	20.7	21.7	19.7	19.6	22.0	20.3	19.2	18.3	18.1
87/10/09	18	19.4	19.6	21.1	21.9	19.6	19.4	21.2	18.4	16.7	16.6	17.2
87/10/09	19	23.3	22.7	24.6	25.1	23.0	23.3	25.1	23.1	21.4	21.0	20.8
87/10/09	20	24.8	23.8	25.9	27.3	25.0	24.5	27.1	25.1	23.5	23.0	22.9
87/10/09	21	26.6	26.4	27.9	28.8	27.3	26.9	29.0	27.1	25.8	25.5	25.6
87/10/09	22	24.3	25.0	27.0	27.8	25.5	26.2	28.5	26.1	24.5	24.0	24.0
87/10/09	23	21.2	22.2	22.8	23.2	22.4	22.4	23.6	21.1	20.1	19.5	20.6
87/10/09	24	20.2	20.8	22.6	23.6	21.2	21.7	23.8	20.9	19.2	19.2	19.4
87/10/10	01	20.2	21.1	23.1	24.0	21.3	22.2	24.2	21.0	19.8	19.3	19.4
87/10/10	02	20.6	21.2	22.2	23.0	21.8	22.1	23.3	20.7	19.4	19.3	19.9
87/10/10	03	15.7	17.7	19.9	21.2	17.1	18.6	20.6	17.1	17.5	16.0	15.2
87/10/10	04	19.6	20.3	22.4	23.6	20.6	21.4	23.6	19.8	18.8	18.2	18.6
67/10/10	05	16.2	17.6	19.2	20.1	17.7	18.4	20.0	17.6	17.3	16.2	15.5
87/10/10	06	16.4	16.8	17.6	17.7	17.2	17.0	17.8	17.2	15.9	15.9	15.3
87/10/10	07	14.0	15.4	16.5	17.7	15.4	15.7	17.5	14.2	13.5	13.0	13.1
87/10/10	08	14.4	15.2	16.2	17.5	15.2	15.8	17.1	14.8	13.5	13.5	13.4
87/10/10	09	13.5	14.3	15.5	16.9	14.5	14.9	16.5	13.8	12.8	12.6	12.7

Appendix D

Souza Regression-Correlations

SOUZA FREE-FLOW STUDY, SEPTEMBER 10-14, 1987
STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.998	6.5	25.1	46.8
(Y)SITE S-13 35-ft							6.3	23.9	43.7

Y = 0.98 TIMES X - 0.67 SPEED RATIO (Y/X) = 0.952 INVERSE RATIO = 1.051
ENERGY RATIO (Y/X) = 0.934 INVERSE RATIO = 1.071

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-27 80-ft	09/10/87	09/14/87			94	0.999	6.0	23.7	43.2
(Y)SITE S-27 45-ft							6.0	23.6	43.2

Y = 0.99 TIMES X + 0.22 SPEED RATIO (Y/X) = 0.999 INVERSE RATIO = 1.001
ENERGY RATIO (Y/X) = 1.001 INVERSE RATIO = 0.999

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.975	6.5	25.1	46.8
(Y)SITE S-29 50-ft							5.8	24.1	44.3

Y = 0.87 TIMES X + 2.18 SPEED RATIO (Y/X) = 0.958 INVERSE RATIO = 1.044
ENERGY RATIO (Y/X) = 0.946 INVERSE RATIO = 1.057

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.977	6.5	25.1	46.8
(Y)TURBINE D2							5.9	24.2	44.7

Y = 0.89 TIMES X + 1.90 SPEED RATIO (Y/X) = 0.962 INVERSE RATIO = 1.040
ENERGY RATIO (Y/X) = 0.954 INVERSE RATIO = 1.048

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.970	6.5	25.1	46.8
(Y)TURBINE D4							5.9	23.6	43.4

Y = 0.88 TIMES X + 1.57 SPEED RATIO (Y/X) = 0.940 INVERSE RATIO = 1.064
ENERGY RATIO (Y/X) = 0.927 INVERSE RATIO = 1.079

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.952	6.5	25.1	46.8
(Y)TURBINE D6							5.9	23.3	42.7

Y = 0.87 TIMES X + 1.33 SPEED RATIO (Y/X) = 0.925 INVERSE RATIO = 1.081
ENERGY RATIO (Y/X) = 0.912 INVERSE RATIO = 1.097

SITE	START DATE	STOP DATE	CLOCK HOURS	MONTH USED	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE S-13 70-ft	09/10/87	09/14/87			94	0.967	6.5	25.1	46.8
(Y)TURBINE D7							5.9	23.6	43.5

Y = 0.88 TIMES X + 1.44 SPEED RATIO (Y/X) = 0.940 INVERSE RATIO = 1.063
ENERGY RATIO (Y/X) = 0.929 INVERSE RATIO = 1.076

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.970	6.5	25.1	46.8
(Y)TURBINE D11					6.8	27.2	51.4

Y = 1.02 TIMES X + 1.49 SPEED RATIO (Y/X) = 1.081 INVERSE RATIO = 0.925
ENERGY RATIO (Y/X) = 1.098 INVERSE RATIO = 0.911

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.952	6.5	25.1	46.8
(Y)TURBINE D13					6.9	27.5	52.1

Y = 1.01 TIMES X + 2.03 SPEED RATIO (Y/X) = 1.096 INVERSE RATIO = 0.913
ENERGY RATIO (Y/X) = 1.112 INVERSE RATIO = 0.899

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.965	6.5	25.1	46.8
(Y)TURBINE E2					6.4	25.8	48.8

Y = 0.96 TIMES X + 1.72 SPEED RATIO (Y/X) = 1.026 INVERSE RATIO = 0.975
ENERGY RATIO (Y/X) = 1.043 INVERSE RATIO = 0.959

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.976	6.5	25.1	46.8
(Y)TURBINE E4					5.8	23.8	44.2

Y = 0.88 TIMES X + 1.59 SPEED RATIO (Y/X) = 0.945 INVERSE RATIO = 1.058
ENERGY RATIO (Y/X) = 0.944 INVERSE RATIO = 1.060

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.985	6.5	25.1	46.8
(Y)TURBINE E6					6.0	24.0	44.4

Y = 0.91 TIMES X + 1.16 SPEED RATIO (Y/X) = 0.955 INVERSE RATIO = 1.047
ENERGY RATIO (Y/X) = 0.950 INVERSE RATIO = 1.053

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.944	6.5	25.1	46.8
(Y)TURBINE E10					6.5	24.8	46.5

Y = 0.95 TIMES X + 0.94 SPEED RATIO (Y/X) = 0.985 INVERSE RATIO = 1.015
ENERGY RATIO (Y/X) = 0.994 INVERSE RATIO = 1.006

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.974	6.5	25.1	46.8
(Y)TURBINE E14					5.6	23.1	42.5

Y = 0.84 TIMES X + 2.00 SPEED RATIO (Y/X) = 0.919 INVERSE RATIO = 1.089
ENERGY RATIO (Y/X) = 0.907 INVERSE RATIO = 1.103

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.975	6.5	25.1	46.8
(Y)TURBINE G7					6.5	23.0	41.3

Y = 0.98 TIMES X − 1.63 SPEED RATIO (Y/X) = 0.915 INVERSE RATIO = 1.093
ENERGY RATIO (Y/X) = 0.883 INVERSE RATIO = 1.133

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.955	6.5	25.1	46.8
(Y)TURBINE E12 35-					5.9	23.3	43.3

Y = 0.87 TIMES X + 1.39 SPEED RATIO (Y/X) = 0.927 INVERSE RATIO = 1.079
ENERGY RATIO (Y/X) = 0.925 INVERSE RATIO = 1.081

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.993	6.5	25.1	46.8
(Y)TURBINE G2 35-ft					6.7	26.3	49.6

Y = 1.03 TIMES X + 0.47 SPEED RATIO (Y/X) = 1.046 INVERSE RATIO = 0.956
ENERGY RATIO (Y/X) = 1.060 INVERSE RATIO = 0.943

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.997	6.5	25.1	46.8
(Y)TURBINE G4 35-ft					6.5	24.6	45.5

Y = 1.01 TIMES X − 0.77 SPEED RATIO (Y/X) = 0.978 INVERSE RATIO = 1.022
ENERGY RATIO (Y/X) = 0.971 INVERSE RATIO = 1.030

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.946	6.5	25.1	46.8
(Y)TURBINE G9 35-ft					5.5	19.4	31.3

Y = 0.80 TIMES X − 0.84 SPEED RATIO (Y/X) = 0.771 INVERSE RATIO = 1.296
ENERGY RATIO (Y/X) = 0.668 INVERSE RATIO = 1.497

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.961	6.5	25.1	46.8
(Y)TURBINE F2 35-ft					6.3	26.4	50.0

Y = 0.94 TIMES X + 2.68 SPEED RATIO (Y/X) = 1.048 INVERSE RATIO = 0.954
ENERGY RATIO (Y/X) = 1.068 INVERSE RATIO = 0.936

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.984	6.5	25.1	46.8
(Y)TURBINE F4 35-ft					6.3	26.6	50.8

Y = 0.96 TIMES X + 2.44 SPEED RATIO (Y/X) = 1.057 INVERSE RATIO = 0.946
ENERGY RATIO (Y/X) = 1.084 INVERSE RATIO = 0.922

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.985	6.5	25.1	46.8
(Y)TURBINE F6 35-ft					6.9	27.8	52.9

Y = 1.05 TIMES X + 1.56 SPEED RATIO (Y/X) = 1.107 INVERSE RATIO = 0.903
ENERGY RATIO (Y/X) = 1.131 INVERSE RATIO = 0.884

(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.983	6.5	25.1	46.8
(Y)TURBINE F8 35-ft					6.8	26.7	50.5

Y = 1.03 TIMES X + 0.88 SPEED RATIO (Y/X) = 1.062 INVERSE RATIO = 0.941
ENERGY RATIO (Y/X) = 1.078 INVERSE RATIO = 0.928

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.995	6.5	25.1	46.8
(Y)TURBINE F10 35-					6.4	24.6	45.5

Y = 0.98 TIMES X - 0.02 SPEED RATIO (Y/X) = 0.980 INVERSE RATIO = 1.020
ENERGY RATIO (Y/X) = 0.971 INVERSE RATIO = 1.030

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.992	6.5	25.1	46.8
(Y)TURBINE F12 35-					6.8	25.5	47.5

Y = 1.04 TIMES X - 0.60 SPEED RATIO (Y/X) = 1.016 INVERSE RATIO = 0.984
ENERGY RATIO (Y/X) = 1.014 INVERSE RATIO = 0.986

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.984	6.5	25.1	46.8
(Y)TURBINE F14 35-					6.7	24.5	44.7

Y = 1.02 TIMES X - 1.17 SPEED RATIO (Y/X) = 0.975 INVERSE RATIO = 1.026
ENERGY RATIO (Y/X) = 0.955 INVERSE RATIO = 1.047

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.965	6.5	25.1	46.8
(Y)SITE S-27 45-ft					6.0	23.6	43.2

Y = 0.89 TIMES X + 1.27 SPEED RATIO (Y/X) = 0.941 INVERSE RATIO = 1.063
ENERGY RATIO (Y/X) = 0.923 INVERSE RATIO = 1.084

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE S-13 70-ft	09/10/87	09/14/87	94	0.971	6.5	25.1	46.8
(Y)SITE S-27 80-ft					6.0	23.7	43.2

Y = 0.90 TIMES X + 0.96 SPEED RATIO (Y/X) = 0.942 INVERSE RATIO = 1.062
ENERGY RATIO (Y/X) = 0.922 INVERSE RATIO = 1.084

Appendix E

Jess Regression-Correlations

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA
JESS FREE-FLOW STUDY; CORRELATION OF ALL SITES TO J-08 50-ft

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.900	6.2	25.0	47.7
(Y)SITE J-04 120-ft					6.5	24.8	46.6

Y = 0.95 TIMES X + 1.01 SPEED RATIO (Y/X) = 0.990 INVERSE RATIO = 1.010
ENERGY RATIO (Y/X) = 0.977 INVERSE RATIO = 1.023

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.874	6.2	25.0	47.7
(Y)SITE J-19 40-ft					6.7	24.1	44.2

Y = 0.94 TIMES X + 0.58 SPEED RATIO (Y/X) = 0.963 INVERSE RATIO = 1.039
ENERGY RATIO (Y/X) = 0.928 INVERSE RATIO = 1.077

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.955	6.2	25.0	47.7
(Y)SITE J-17 35-ft					5.3	20.0	33.0

Y = 0.81 TIMES X - 0.32 SPEED RATIO (Y/X) = 0.800 INVERSE RATIO = 1.250
ENERGY RATIO (Y/X) = 0.692 INVERSE RATIO = 1.445

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.954	6.2	25.0	47.7
(Y)SITE J-17 70-ft					5.8	21.6	37.4

Y = 0.89 TIMES X - 0.82 SPEED RATIO (Y/X) = 0.862 INVERSE RATIO = 1.160
ENERGY RATIO (Y/X) = 0.785 INVERSE RATIO = 1.274

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.850	6.2	25.0	47.7
(Y)SITE J-18 35-ft					6.2	18.1	27.9

Y = 0.86 TIMES X - 3.37 SPEED RATIO (Y/X) = 0.722 INVERSE RATIO = 1.385
ENERGY RATIO (Y/X) = 0.585 INVERSE RATIO = 1.708

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.849	6.2	25.0	47.7
(Y)SITE J-18 70-ft					6.4	19.4	31.7

Y = 0.88 TIMES X - 2.60 SPEED RATIO (Y/X) = 0.774 INVERSE RATIO = 1.292
ENERGY RATIO (Y/X) = 0.666 INVERSE RATIO = 1.501

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.894	6.2	25.0	47.7
(Y)TURBINE C1 50-ft					5.9	23.4	43.1

Y = 0.86 TIMES X + 1.93 SPEED RATIO (Y/X) = 0.935 INVERSE RATIO = 1.070
ENERGY RATIO (Y/X) = 0.905 INVERSE RATIO = 1.105

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.873	6.2	25.0	47.7
(Y)TURBINE C3 50-ft					6.2	23.0	41.6

Y = 0.87 TIMES X + 1.16 SPEED RATIO (Y/X) = 0.917 INVERSE RATIO = 1.090
ENERGY RATIO (Y/X) = 0.873 INVERSE RATIO = 1.146

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.892	6.2	25.0	47.7
(Y)TURBINE C5 50-ft					5.7	20.8	35.3

Y = 0.83 TIMES X + 0.09 SPEED RATIO (Y/X) = 0.830 INVERSE RATIO = 1.204
ENERGY RATIO (Y/X) = 0.741 INVERSE RATIO = 1.349

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.870	6.2	25.0	47.7
(Y)TURBINE C7 50-ft					5.3	19.1	30.3

Y = 0.75 TIMES X + 0.43 SPEED RATIO (Y/X) = 0.763 INVERSE RATIO = 1.310
ENERGY RATIO (Y/X) = 0.637 INVERSE RATIO = 1.571

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.857	6.2	25.0	47.7
(Y)TURBINE C9 50-ft					5.9	19.5	31.5

Y = 0.81 TIMES X - 0.82 SPEED RATIO (Y/X) = 0.780 INVERSE RATIO = 1.282
ENERGY RATIO (Y/X) = 0.661 INVERSE RATIO = 1.513

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.905	6.2	25.0	47.7
(Y)TURBINE C12 50-ft					6.4	23.2	42.4

Y = 0.93 TIMES X - 0.13 SPEED RATIO (Y/X) = 0.927 INVERSE RATIO = 1.079
ENERGY RATIO (Y/X) = 0.891 INVERSE RATIO = 1.123

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.897	6.2	25.0	47.7
(Y)TURBINE C14 50-ft					7.2	25.6	47.8

Y = 1.05 TIMES X - 0.62 SPEED RATIO (Y/X) = 1.022 INVERSE RATIO = 0.979
ENERGY RATIO (Y/X) = 1.003 INVERSE RATIO = 0.997

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.874	6.2	25.0	47.7
(Y)TURBINE C16 50-ft					6.2	20.6	34.7

Y = 0.88 TIMES X - 1.49 SPEED RATIO (Y/X) = 0.823 INVERSE RATIO = 1.215
ENERGY RATIO (Y/X) = 0.727 INVERSE RATIO = 1.375

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.860	6.2	25.0	47.7
(Y)TURBINE C18 50-ft					6.0	19.9	32.4

Y = 0.84 TIMES X - 1.08 SPEED RATIO (Y/X) = 0.796 INVERSE RATIO = 1.256
ENERGY RATIO (Y/X) = 0.680 INVERSE RATIO = 1.471

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.855	6.2	25.0	47.7
(Y)TURBINE D2 50-ft					5.5	19.3	30.6

Y = 0.76 TIMES X + 0.21 SPEED RATIO (Y/X) = 0.769 INVERSE RATIO = 1.301
ENERGY RATIO (Y/X) = 0.643 INVERSE RATIO = 1.556

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.827	6.2	25.0	47.7
(Y)TURBINE D4 50-ft					5.3	18.8	29.4

Y = 0.71 TIMES X + 1.12 SPEED RATIO (Y/X) = 0.751 INVERSE RATIO = 1.331
ENERGY RATIO (Y/X) = 0.618 INVERSE RATIO = 1.619

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.798	6.2	25.0	47.7
(Y)TURBINE D6 50-ft					5.2	18.2	27.8

Y = 0.67 TIMES X + 1.39 SPEED RATIO (Y/X) = 0.727 INVERSE RATIO = 1.375
ENERGY RATIO (Y/X) = 0.583 INVERSE RATIO = 1.716

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.827	6.2	25.0	47.7
(Y)TURBINE D13 50-ft					5.3	19.0	29.8

Y = 0.71 TIMES X + 1.13 SPEED RATIO (Y/X) = 0.757 INVERSE RATIO = 1.321
ENERGY RATIO (Y/X) = 0.626 INVERSE RATIO = 1.597

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.804	6.2	25.0	47.7
(Y)TURBINE D15 50-ft					5.2	18.2	27.8

Y = 0.67 TIMES X + 1.42 SPEED RATIO (Y/X) = 0.729 INVERSE RATIO = 1.372
ENERGY RATIO (Y/X) = 0.583 INVERSE RATIO = 1.716

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.849	6.2	25.0	47.7
(Y)TURBINE D21 50-ft					5.2	17.5	25.5

Y = 0.71 TIMES X - 0.40 SPEED RATIO (Y/X) = 0.697 INVERSE RATIO = 1.434
ENERGY RATIO (Y/X) = 0.535 INVERSE RATIO = 1.870

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.857	6.2	25.0	47.7
(Y)TURBINE E2 50-ft					5.2	18.2	27.9

Y = 0.72 TIMES X + 0.06 SPEED RATIO (Y/X) = 0.727 INVERSE RATIO = 1.376
ENERGY RATIO (Y/X) = 0.585 INVERSE RATIO = 1.710

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.890	6.2	25.0	47.7
(Y)TURBINE E4 50-ft					5.3	17.6	26.0

Y = 0.76 TIMES X - 1.46 SPEED RATIO (Y/X) = 0.704 INVERSE RATIO = 1.420
ENERGY RATIO (Y/X) = 0.546 INVERSE RATIO = 1.832

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.857	6.2	25.0	47.7
(Y)TURBINE E6 50-ft					5.0	15.8	20.8

Y = 0.69 TIMES X - 1.43 SPEED RATIO (Y/X) = 0.632 INVERSE RATIO = 1.581
ENERGY RATIO (Y/X) = 0.436 INVERSE RATIO = 2.291

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.902	6.2	25.0	47.7
(Y)TURBINE E8 50-ft					5.7	17.7	26.4

Y = 0.84 TIMES X - 3.26 SPEED RATIO (Y/X) = 0.706 INVERSE RATIO = 1.417
ENERGY RATIO (Y/X) = 0.554 INVERSE RATIO = 1.805

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.915	6.2	25.0	47.7
(Y)TURBINE E10 50-ft					6.1	19.1	30.5

Y = 0.90 TIMES X - 3.51 SPEED RATIO (Y/X) = 0.764 INVERSE RATIO = 1.309
ENERGY RATIO (Y/X) = 0.640 INVERSE RATIO = 1.562

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.841	6.2	25.0	47.7
(Y)TURBINE E11 50-ft					4.7	17.1	24.3

Y = 0.63 TIMES X + 1.25 SPEED RATIO (Y/X) = 0.683 INVERSE RATIO = 1.463
ENERGY RATIO (Y/X) = 0.511 INVERSE RATIO = 1.957

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.852	6.2	25.0	47.7
(Y)TURBINE E13 50-ft					5.3	17.9	27.0

Y = 0.73 TIMES X - 0.35 SPEED RATIO (Y/X) = 0.713 INVERSE RATIO = 1.402
ENERGY RATIO (Y/X) = 0.566 INVERSE RATIO = 1.766

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.892	6.2	25.0	47.7
(Y)TURBINE E15 50-ft					5.1	17.7	26.2

Y = 0.73 TIMES X - 0.60 SPEED RATIO (Y/X) = 0.706 INVERSE RATIO = 1.417
ENERGY RATIO (Y/X) = 0.549 INVERSE RATIO = 1.820

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.881	6.2	25.0	47.7
(Y)TURBINE E18 50-ft					5.4	17.6	25.7

Y = 0.77 TIMES X - 1.66 SPEED RATIO (Y/X) = 0.702 INVERSE RATIO = 1.425
ENERGY RATIO (Y/X) = 0.540 INVERSE RATIO = 1.851

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.904	6.2	25.0	47.7
(Y)TURBINE E20 50-ft					5.7	18.7	29.5

Y = 0.84 TIMES X - 2.27 SPEED RATIO (Y/X) = 0.747 INVERSE RATIO = 1.338
ENERGY RATIO (Y/X) = 0.618 INVERSE RATIO = 1.617

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.932	6.2	25.0	47.7
(Y)TURBINE E22 50-ft					6.1	20.9	35.5

Y = 0.91 TIMES X - 2.00 SPEED RATIO (Y/X) = 0.833 INVERSE RATIO = 1.201
ENERGY RATIO (Y/X) = 0.746 INVERSE RATIO = 1.341

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.847	6.2	25.0	47.7
(Y)TURBINE F1 35-f					5.5	17.0	24.4

Y = 0.76 TIMES X - 1.90 SPEED RATIO (Y/X) = 0.680 INVERSE RATIO = 1.471
ENERGY RATIO (Y/X) = 0.512 INVERSE RATIO = 1.955

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.883	6.2	25.0	47.7
(Y)TURBINE F3 35-f					5.8	15.9	21.7

Y = 0.83 TIMES X - 4.80 SPEED RATIO (Y/X) = 0.634 INVERSE RATIO = 1.578
ENERGY RATIO (Y/X) = 0.455 INVERSE RATIO = 2.198

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.853	6.2	25.0	47.7
(Y)TURBINE H2 50-ft					7.0	24.4	44.6

Y = 0.96 TIMES X + 0.36 SPEED RATIO (Y/X) = 0.973 INVERSE RATIO = 1.027
ENERGY RATIO (Y/X) = 0.937 INVERSE RATIO = 1.067

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.829	6.2	25.0	47.7
(Y)TURBINE F7 35-f					5.9	17.8	26.8

Y = 0.80 TIMES X - 2.20 SPEED RATIO (Y/X) = 0.709 INVERSE RATIO = 1.410
ENERGY RATIO (Y/X) = 0.563 INVERSE RATIO = 1.777

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.784	6.2	25.0	47.7
(Y)TURBINE F9 35-f					5.2	15.6	20.4

Y = 0.65 TIMES X - 0.77 SPEED RATIO (Y/X) = 0.623 INVERSE RATIO = 1.606
ENERGY RATIO (Y/X) = 0.427 INVERSE RATIO = 2.340

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.763	6.2	25.0	47.7
(Y)TURBINE F12 35-					5.8	15.8	21.6

Y = 0.72 TIMES X - 2.25 SPEED RATIO (Y/X) = 0.629 INVERSE RATIO = 1.589
ENERGY RATIO (Y/X) = 0.454 INVERSE RATIO = 2.202

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.844	6.2	25.0	47.7
(Y)TURBINE G1 35-f					4.8	14.6	17.6

Y = 0.66 TIMES X - 1.88 SPEED RATIO (Y/X) = 0.583 INVERSE RATIO = 1.715
ENERGY RATIO (Y/X) = 0.369 INVERSE RATIO = 2.709

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.902	6.2	25.0	47.7
(Y)TURBINE G3 35-f					4.4	14.1	16.2

Y = 0.64 TIMES X - 1.84 SPEED RATIO (Y/X) = 0.563 INVERSE RATIO = 1.776
ENERGY RATIO (Y/X) = 0.341 INVERSE RATIO = 2.934

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.974	6.2	25.0	47.7
(Y)TURBINE G5 35-f					5.6	18.6	28.8

Y = 0.88 TIMES X - 3.31 SPEED RATIO (Y/X) = 0.743 INVERSE RATIO = 1.346
ENERGY RATIO (Y/X) = 0.604 INVERSE RATIO = 1.657

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.988	6.2	25.0	47.7
(Y)TURBINE G7 35-f					5.9	21.1	36.4

Y = 0.94 TIMES X - 2.45 SPEED RATIO (Y/X) = 0.841 INVERSE RATIO = 1.189
ENERGY RATIO (Y/X) = 0.763 INVERSE RATIO = 1.310

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.805	6.2	25.0	47.7
(Y)TURBINE G8 35-f					5.4	14.5	17.8

Y = 0.70 TIMES X - 3.05 SPEED RATIO (Y/X) = 0.578 INVERSE RATIO = 1.731
ENERGY RATIO (Y/X) = 0.374 INVERSE RATIO = 2.676

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.877	6.2	25.0	47.7
(Y)TURBINE G10 35-					5.7	15.7	21.3

Y = 0.81 TIMES X - 4.58 SPEED RATIO (Y/X) = 0.628 INVERSE RATIO = 1.592
ENERGY RATIO (Y/X) = 0.447 INVERSE RATIO = 2.239

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.943	6.2	25.0	47.7
(Y)TURBINE G12 35-					5.4	17.5	25.5

Y = 0.82 TIMES X - 3.02 SPEED RATIO (Y/X) = 0.699 INVERSE RATIO = 1.431
ENERGY RATIO (Y/X) = 0.536 INVERSE RATIO = 1.867

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.850	6.2	25.0	47.7
(Y)TURBINE H1 50-ft					7.2	25.5	47.1

Y = 0.98 TIMES X + 0.89 SPEED RATIO (Y/X) = 1.018 INVERSE RATIO = 0.982
ENERGY RATIO (Y/X) = 0.988 INVERSE RATIO = 1.012

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.856	6.2	25.0	47.7
(Y)TURBINE H7 50-ft					5.9	21.0	35.4

Y = 0.82 TIMES X + 0.37 SPEED RATIO (Y/X) = 0.837 INVERSE RATIO = 1.194
ENERGY RATIO (Y/X) = 0.744 INVERSE RATIO = 1.345

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.834	6.2	25.0	47.7
(Y)TURBINE H10 50-ft					5.8	20.6	34.7

Y = 0.78 TIMES X + 1.07 SPEED RATIO (Y/X) = 0.823 INVERSE RATIO = 1.215
ENERGY RATIO (Y/X) = 0.728 INVERSE RATIO = 1.374

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.829	6.2	25.0	47.7
(Y)TURBINE H12 50-ft					6.1	21.0	35.5

Y = 0.81 TIMES X + 0.64 SPEED RATIO (Y/X) = 0.837 INVERSE RATIO = 1.195
ENERGY RATIO (Y/X) = 0.744 INVERSE RATIO = 1.344

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.833	6.2	25.0	47.7
(Y)TURBINE H15 50-ft					5.7	19.8	32.4

Y = 0.76 TIMES X + 0.69 SPEED RATIO (Y/X) = 0.789 INVERSE RATIO = 1.267
ENERGY RATIO (Y/X) = 0.680 INVERSE RATIO = 1.471

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.833	6.2	25.0	47.7
(Y)TURBINE I1 50-ft					5.8	20.1	33.3

Y = 0.78 TIMES X + 0.66 SPEED RATIO (Y/X) = 0.802 INVERSE RATIO = 1.247
ENERGY RATIO (Y/X) = 0.698 INVERSE RATIO = 1.432

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.823	6.2	25.0	47.7
(Y)TURBINE I3 50-ft					5.9	20.4	34.4

Y = 0.78 TIMES X + 0.83 SPEED RATIO (Y/X) = 0.815 INVERSE RATIO = 1.227
ENERGY RATIO (Y/X) = 0.722 INVERSE RATIO = 1.386

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.832	6.2	25.0	47.7
(Y)TURBINE I5 50-ft					5.9	20.1	33.6

Y = 0.79 TIMES X + 0.25 SPEED RATIO (Y/X) = 0.802 INVERSE RATIO = 1.247
ENERGY RATIO (Y/X) = 0.704 INVERSE RATIO = 1.420

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.807	6.2	25.0	47.7
(Y)TURBINE I9 50-ft					6.0	19.2	31.1

Y = 0.79 TIMES X - 0.49 SPEED RATIO (Y/X) = 0.768 INVERSE RATIO = 1.303
ENERGY RATIO (Y/X) = 0.653 INVERSE RATIO = 1.531

(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.822	6.2	25.0	47.7
(Y)TURBINE I14 50-ft					6.5	21.0	36.7

Y = 0.87 TIMES X - 0.73 SPEED RATIO (Y/X) = 0.838 INVERSE RATIO = 1.194
ENERGY RATIO (Y/X) = 0.770 INVERSE RATIO = 1.299

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.873	6.2	25.0	47.7
(Y)TURBINE J6 50-ft					6.4	20.1	33.6

Y = 0.90 TIMES X - 2.47 SPEED RATIO (Y/X) = 0.803 INVERSE RATIO = 1.245
ENERGY RATIO (Y/X) = 0.706 INVERSE RATIO = 1.416

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.864	6.2	25.0	47.7
(Y)TURBINE J8 50-ft					6.9	19.9	33.4

Y = 0.97 TIMES X - 4.31 SPEED RATIO (Y/X) = 0.794 INVERSE RATIO = 1.260
ENERGY RATIO (Y/X) = 0.700 INVERSE RATIO = 1.428

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.858	6.2	25.0	47.7
(Y)TURBINE J11 50-ft					6.4	20.4	34.6

Y = 0.88 TIMES X - 1.73 SPEED RATIO (Y/X) = 0.814 INVERSE RATIO = 1.228
ENERGY RATIO (Y/X) = 0.726 INVERSE RATIO = 1.377

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.839	6.2	25.0	47.7
(Y)TURBINE J13 50-ft					6.6	20.2	34.4

Y = 0.90 TIMES X - 2.36 SPEED RATIO (Y/X) = 0.806 INVERSE RATIO = 1.241
ENERGY RATIO (Y/X) = 0.722 INVERSE RATIO = 1.385

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.819	6.2	25.0	47.7
(Y)TURBINE K1 35-f					5.6	17.1	24.6

Y = 0.74 TIMES X - 1.32 SPEED RATIO (Y/X) = 0.683 INVERSE RATIO = 1.465
ENERGY RATIO (Y/X) = 0.517 INVERSE RATIO = 1.935

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.839	6.2	25.0	47.7
(Y)TURBINE K3 35-f					5.6	17.9	26.8

Y = 0.75 TIMES X - 1.05 SPEED RATIO (Y/X) = 0.713 INVERSE RATIO = 1.403
ENERGY RATIO (Y/X) = 0.562 INVERSE RATIO = 1.780

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.901	6.2	25.0	47.7
(Y)TURBINE K5 35-f					4.9	17.7	25.5

Y = 0.71 TIMES X - 0.12 SPEED RATIO (Y/X) = 0.706 INVERSE RATIO = 1.417
ENERGY RATIO (Y/X) = 0.536 INVERSE RATIO = 1.866

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.948	6.2	25.0	47.7
(Y)TURBINE K7 35-f					4.8	16.8	23.4

Y = 0.73 TIMES X - 1.48 SPEED RATIO (Y/X) = 0.672 INVERSE RATIO = 1.487
ENERGY RATIO (Y/X) = 0.490 INVERSE RATIO = 2.040

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

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SITE                       START     STOP              HOURS   (r)   DEV.   MEAN   kW

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.973  6.2   25.0  47.7
(Y)TURBINE K9  35-f                                               5.0   19.0  29.8

 Y =  0.78 TIMES X -  0.69   SPEED RATIO (Y/X) = 0.757   INVERSE RATIO = 1.321
                            ENERGY RATIO (Y/X) = 0.626   INVERSE RATIO = 1.598

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.944  6.2   25.0  47.7
(Y)TURBINE K12  35-                                               4.8   17.9  26.5

 Y =  0.74 TIMES X -  0.51   SPEED RATIO (Y/X) = 0.715   INVERSE RATIO = 1.399
                            ENERGY RATIO (Y/X) = 0.556   INVERSE RATIO = 1.798

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.957  6.2   25.0  47.7
(Y)TURBINE K14  35-                                               5.5   20.4  34.0

 Y =  0.85 TIMES X -  1.01   SPEED RATIO (Y/X) = 0.814   INVERSE RATIO = 1.229
                            ENERGY RATIO (Y/X) = 0.713   INVERSE RATIO = 1.403

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.991  6.2   25.0  47.7
(Y)TURBINE L1  35-f                                               5.6   21.5  37.5

 Y =  0.89 TIMES X -  0.77   SPEED RATIO (Y/X) = 0.859   INVERSE RATIO = 1.164
                            ENERGY RATIO (Y/X) = 0.787   INVERSE RATIO = 1.270

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.999  6.2   25.0  47.7
(Y)TURBINE L3  35-f                                               5.8   22.8  41.3

 Y =  0.93 TIMES X -  0.58   SPEED RATIO (Y/X) = 0.911   INVERSE RATIO = 1.098
                            ENERGY RATIO (Y/X) = 0.866   INVERSE RATIO = 1.154

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.995  6.2   25.0  47.7
(Y)TURBINE L5  35-f                                               6.1   23.9  44.3

 Y =  0.98 TIMES X -  0.75   SPEED RATIO (Y/X) = 0.954   INVERSE RATIO = 1.048
                            ENERGY RATIO (Y/X) = 0.929   INVERSE RATIO = 1.076

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.989  6.2   25.0  47.7
(Y)TURBINE L8  35-f                                               5.6   21.6  37.8

 Y =  0.90 TIMES X -  1.00   SPEED RATIO (Y/X) = 0.862   INVERSE RATIO = 1.161
                            ENERGY RATIO (Y/X) = 0.792   INVERSE RATIO = 1.262

(X)SITE J-08  50-ft   10/01/87  10/10/87             102   0.995  6.2   25.0  47.7
(Y)TURBINE L10  35-                                               6.0   23.1  41.8

 Y =  0.96 TIMES X -  0.89   SPEED RATIO (Y/X) = 0.921   INVERSE RATIO = 1.086
                            ENERGY RATIO (Y/X) = 0.877   INVERSE RATIO = 1.140
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STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.991	6.2	25.0	47.7
(Y)TURBINE L12 35-					6.0	24.1	44.8

Y = 0.96 TIMES X + 0.07 SPEED RATIO (Y/X) = 0.961 INVERSE RATIO = 1.040
ENERGY RATIO (Y/X) = 0.941 INVERSE RATIO = 1.063

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.971	6.2	25.0	47.7
(Y)TURBINE M2 35-f					5.5	20.9	35.5

Y = 0.87 TIMES X - 0.78 SPEED RATIO (Y/X) = 0.834 INVERSE RATIO = 1.199
ENERGY RATIO (Y/X) = 0.746 INVERSE RATIO = 1.341

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.980	6.2	25.0	47.7
(Y)TURBINE M4 35-f					5.4	21.1	36.3

Y = 0.85 TIMES X - 0.16 SPEED RATIO (Y/X) = 0.844 INVERSE RATIO = 1.185
ENERGY RATIO (Y/X) = 0.762 INVERSE RATIO = 1.312

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.985	6.2	25.0	47.7
(Y)TURBINE M6 35-f					5.8	22.8	41.4

Y = 0.92 TIMES X - 0.20 SPEED RATIO (Y/X) = 0.912 INVERSE RATIO = 1.097
ENERGY RATIO (Y/X) = 0.868 INVERSE RATIO = 1.152

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.981	6.2	25.0	47.7
(Y)TURBINE M8 35-f					5.9	24.0	44.7

Y = 0.94 TIMES X + 0.53 SPEED RATIO (Y/X) = 0.957 INVERSE RATIO = 1.045
ENERGY RATIO (Y/X) = 0.937 INVERSE RATIO = 1.067

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.963	6.2	25.0	47.7
(Y)TURBINE M9 35-f					5.5	21.5	37.3

Y = 0.86 TIMES X - 0.04 SPEED RATIO (Y/X) = 0.857 INVERSE RATIO = 1.167
ENERGY RATIO (Y/X) = 0.783 INVERSE RATIO = 1.277

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.960	6.2	25.0	47.7
(Y)TURBINE M11 35-					5.5	21.9	38.7

Y = 0.85 TIMES X + 0.69 SPEED RATIO (Y/X) = 0.873 INVERSE RATIO = 1.145
ENERGY RATIO (Y/X) = 0.812 INVERSE RATIO = 1.232

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.969	6.2	25.0	47.7
(Y)TURBINE M13 35-					5.8	23.9	44.6

Y = 0.92 TIMES X + 0.98 SPEED RATIO (Y/X) = 0.954 INVERSE RATIO = 1.048
ENERGY RATIO (Y/X) = 0.935 INVERSE RATIO = 1.070

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.939	6.2	25.0	47.7
(Y)TURBINE N1 35-f					5.7	21.3	36.5

Y = 0.86 TIMES X - 0.32 SPEED RATIO (Y/X) = 0.850 INVERSE RATIO = 1.177
ENERGY RATIO (Y/X) = 0.766 INVERSE RATIO = 1.306

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.892	6.2	25.0	47.7
(Y)TURBINE N4 35-f					5.5	20.1	33.2

Y = 0.79 TIMES X + 0.20 SPEED RATIO (Y/X) = 0.802 INVERSE RATIO = 1.247
ENERGY RATIO (Y/X) = 0.697 INVERSE RATIO = 1.434

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.900	6.2	25.0	47.7
(Y)TURBINE N6 35-f					5.1	19.4	31.0

Y = 0.75 TIMES X + 0.67 SPEED RATIO (Y/X) = 0.775 INVERSE RATIO = 1.291
ENERGY RATIO (Y/X) = 0.651 INVERSE RATIO = 1.537

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-08 50-ft	10/01/87	10/10/87	102	0.926	6.2	25.0	47.7
(Y)TURBINE N8 35-f					5.2	19.5	31.2

Y = 0.77 TIMES X + 0.08 SPEED RATIO (Y/X) = 0.777 INVERSE RATIO = 1.287
ENERGY RATIO (Y/X) = 0.656 INVERSE RATIO = 1.525

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA
JESS FREE-FLOW STUDY; CORRELATION OF ALL SITES TO J-04 120-ft

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.900	6.5	24.8	46.6
(Y)SITE J-08 50-ft					6.3	25.5	48.8

Y = 0.87 TIMES X + 3.96 SPEED RATIO (Y/X) = 1.028 INVERSE RATIO = 0.972
ENERGY RATIO (Y/X) = 1.048 INVERSE RATIO = 0.954

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.925	6.5	24.8	46.6
(Y)SITE J-19 80-ft					7.1	25.1	46.2

Y = 1.00 TIMES X + 0.30 SPEED RATIO (Y/X) = 1.013 INVERSE RATIO = 0.987
ENERGY RATIO (Y/X) = 0.992 INVERSE RATIO = 1.008

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.831	6.5	24.8	46.6
(Y)SITE J-17 35-f					5.3	20.0	33.0

Y = 0.67 TIMES X + 3.41 SPEED RATIO (Y/X) = 0.808 INVERSE RATIO = 1.238
ENERGY RATIO (Y/X) = 0.708 INVERSE RATIO = 1.413

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	79	0.866	7.0	24.3	45.0
(Y)SITE J-17 70-ft					6.0	21.4	36.6

Y = 0.75 TIMES X + 3.20 SPEED RATIO (Y/X) = 0.877 INVERSE RATIO = 1.140
ENERGY RATIO (Y/X) = 0.813 INVERSE RATIO = 1.230

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.842	6.5	24.8	46.6
(Y)SITE J-18 35-ft					6.2	18.1	27.9

Y = 0.80 TIMES X - 1.85 SPEED RATIO (Y/X) = 0.729 INVERSE RATIO = 1.372
ENERGY RATIO (Y/X) = 0.599 INVERSE RATIO = 1.669

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.851	6.5	24.8	46.6
(Y)SITE J-18 70-ft					6.4	19.4	31.7

Y = 0.83 TIMES X - 1.29 SPEED RATIO (Y/X) = 0.782 INVERSE RATIO = 1.279
ENERGY RATIO (Y/X) = 0.681 INVERSE RATIO = 1.467

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.982	6.5	24.8	46.6
(Y)TURBINE C1 50-ft					5.9	23.4	43.1

Y = 0.89 TIMES X + 1.25 SPEED RATIO (Y/X) = 0.944 INVERSE RATIO = 1.059
ENERGY RATIO (Y/X) = 0.926 INVERSE RATIO = 1.080

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.981	6.5	24.8	46.6
(Y)TURBINE C3 50-ft					6.2	23.0	41.6

Y = 0.93 TIMES X - 0.05 SPEED RATIO (Y/X) = 0.926 INVERSE RATIO = 1.080
ENERGY RATIO (Y/X) = 0.893 INVERSE RATIO = 1.120

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.976	6.5	24.8	46.6
(Y)TURBINE C5 50-ft					5.7	20.8	35.3

Y = 0.86 TIMES X - 0.48 SPEED RATIO (Y/X) = 0.839 INVERSE RATIO = 1.192
ENERGY RATIO (Y/X) = 0.758 INVERSE RATIO = 1.319

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.961	6.5	24.8	46.6
(Y)TURBINE C7 50-ft					5.3	19.1	30.3

Y = 0.78 TIMES X - 0.25 SPEED RATIO (Y/X) = 0.771 INVERSE RATIO = 1.297
ENERGY RATIO (Y/X) = 0.651 INVERSE RATIO = 1.535

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.948	6.5	24.8	46.6
(Y)TURBINE C9 50-ft					5.9	19.5	31.5

Y = 0.85 TIMES X - 1.58 SPEED RATIO (Y/X) = 0.788 INVERSE RATIO = 1.269
ENERGY RATIO (Y/X) = 0.676 INVERSE RATIO = 1.479

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.994	6.5	24.8	46.6
(Y)TURBINE C12 50-ft					6.4	23.2	42.4

Y = 0.97 TIMES X - 0.85 SPEED RATIO (Y/X) = 0.936 INVERSE RATIO = 1.068
ENERGY RATIO (Y/X) = 0.911 INVERSE RATIO = 1.098

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.987	6.5	24.8	46.6
(Y)TURBINE C14 50-ft					7.2	25.6	47.8

Y = 1.09 TIMES X - 1.48 SPEED RATIO (Y/X) = 1.032 INVERSE RATIO = 0.969
ENERGY RATIO (Y/X) = 1.026 INVERSE RATIO = 0.975

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.966	6.5	24.8	46.6
(Y)TURBINE C16 50-ft					6.2	20.6	34.7

Y = 0.92 TIMES X - 2.31 SPEED RATIO (Y/X) = 0.831 INVERSE RATIO = 1.203
ENERGY RATIO (Y/X) = 0.744 INVERSE RATIO = 1.344

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.950	6.5	24.8	46.6
(Y)TURBINE C18 50-ft					6.0	19.9	32.4

Y = 0.88 TIMES X - 1.84 SPEED RATIO (Y/X) = 0.804 INVERSE RATIO = 1.244
ENERGY RATIO (Y/X) = 0.696 INVERSE RATIO = 1.437

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.937	6.5	24.8	46.6
(Y)TURBINE D2 50-ft					5.5	19.3	30.6

Y = 0.77 TIMES X - 0.34 SPEED RATIO (Y/X) = 0.776 INVERSE RATIO = 1.288
ENERGY RATIO (Y/X) = 0.658 INVERSE RATIO = 1.521

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.900	6.5	24.8	46.6
(Y)TURBINE D4 50-ft					5.3	18.8	29.4

Y = 0.73 TIMES X + 0.74 SPEED RATIO (Y/X) = 0.758 INVERSE RATIO = 1.318
ENERGY RATIO (Y/X) = 0.632 INVERSE RATIO = 1.582

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.868	6.5	24.8	46.6
(Y)TURBINE D6 50-ft					5.2	18.2	27.8

Y = 0.69 TIMES X + 1.04 SPEED RATIO (Y/X) = 0.734 INVERSE RATIO = 1.362
ENERGY RATIO (Y/X) = 0.596 INVERSE RATIO = 1.677

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.897	6.5	24.8	46.6
(Y)TURBINE D13 50-ft					5.3	19.0	29.8

Y = 0.73 TIMES X + 0.81 SPEED RATIO (Y/X) = 0.765 INVERSE RATIO = 1.308
ENERGY RATIO (Y/X) = 0.641 INVERSE RATIO = 1.561

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.868	6.5	24.8	46.6
(Y)TURBINE D15 50-ft					5.2	18.2	27.8

Y = 0.69 TIMES X + 1.20 SPEED RATIO (Y/X) = 0.736 INVERSE RATIO = 1.359
ENERGY RATIO (Y/X) = 0.596 INVERSE RATIO = 1.677

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.901	6.5	24.8	46.6
(Y)TURBINE D21 50-ft					5.2	17.5	25.5

Y = 0.72 TIMES X - 0.31 SPEED RATIO (Y/X) = 0.704 INVERSE RATIO = 1.420
ENERGY RATIO (Y/X) = 0.547 INVERSE RATIO = 1.828

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.910	6.5	24.8	46.6
(Y)TURBINE E2 50-ft					5.2	18.2	27.9

Y = 0.73 TIMES X + 0.12 SPEED RATIO (Y/X) = 0.734 INVERSE RATIO = 1.362
ENERGY RATIO (Y/X) = 0.598 INVERSE RATIO = 1.672

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        STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA
   SITE                    START      STOP                HOURS    (r)  DEV.    MEAN    kW

(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.928  6.5    24.8  46.6
(Y)TURBINE E4  50-ft                                                5.3    17.6  26.0

 Y =  0.75 TIMES X -  1.04   SPEED RATIO (Y/X) = 0.711   INVERSE RATIO = 1.406
                            ENERGY RATIO (Y/X) = 0.559   INVERSE RATIO = 1.790


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.897  6.5    24.8  46.6
(Y)TURBINE E6  50-ft                                                5.0    15.8  20.8

 Y =  0.68 TIMES X -  1.13   SPEED RATIO (Y/X) = 0.639   INVERSE RATIO = 1.566
                            ENERGY RATIO (Y/X) = 0.447   INVERSE RATIO = 2.239


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.927  6.5    24.8  46.6
(Y)TURBINE E10  50-ft                                               6.1    19.1  30.5

 Y =  0.87 TIMES X -  2.38   SPEED RATIO (Y/X) = 0.771   INVERSE RATIO = 1.296
                            ENERGY RATIO (Y/X) = 0.655   INVERSE RATIO = 1.526


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.881  6.5    24.8  46.6
(Y)TURBINE E8  50-ft                                                5.7    17.7  26.4

 Y =  0.77 TIMES X -  1.51   SPEED RATIO (Y/X) = 0.712   INVERSE RATIO = 1.404
                            ENERGY RATIO (Y/X) = 0.567   INVERSE RATIO = 1.764


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.892  6.5    24.8  46.6
(Y)TURBINE E11  50-ft                                               4.7    17.1  24.3

 Y =  0.64 TIMES X +  1.31   SPEED RATIO (Y/X) = 0.690    INVERSE RATIO = 1.449
                            ENERGY RATIO (Y/X) = 0.523    INVERSE RATIO = 1.913


(X)SITE J-04 120-ft  10/01/87  10/10/87                100    0.912  6.4    25.0  47.3
(Y)TURBINE E13  50-ft                                               5.3    18.0  27.3

 Y =  0.75 TIMES X -  0.89   SPEED RATIO (Y/X) = 0.719   INVERSE RATIO = 1.392
                            ENERGY RATIO (Y/X) = 0.578   INVERSE RATIO = 1.730


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.929  6.5    24.8  46.6
(Y)TURBINE E15  50-ft                                               5.1    17.7  26.2

 Y =  0.72 TIMES X -  0.18   SPEED RATIO (Y/X) = 0.713   INVERSE RATIO = 1.403
                            ENERGY RATIO (Y/X) = 0.562   INVERSE RATIO = 1.779


(X)SITE J-04 120-ft  10/01/87  10/10/87                102    0.917  6.5    24.8  46.6
(Y)TURBINE E18  50-ft                                               5.4    17.6  25.7

 Y =  0.76 TIMES X -  1.20   SPEED RATIO (Y/X) = 0.709   INVERSE RATIO = 1.411
                            ENERGY RATIO (Y/X) = 0.553   INVERSE RATIO = 1.809
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STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.901	6.5	24.8	46.6
(Y)TURBINE E20 50-ft					5.7	18.7	29.5

Y = 0.79 TIMES X - 0.91 SPEED RATIO (Y/X) = 0.755 INVERSE RATIO = 1.325
ENERGY RATIO (Y/X) = 0.633 INVERSE RATIO = 1.581

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.943	6.5	24.8	46.6
(Y)TURBINE E22 50-ft					6.1	20.9	35.5

Y = 0.88 TIMES X - 0.85 SPEED RATIO (Y/X) = 0.841 INVERSE RATIO = 1.189
ENERGY RATIO (Y/X) = 0.763 INVERSE RATIO = 1.310

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.866	6.5	24.8	46.6
(Y)TURBINE F1 35-ft					5.5	17.0	24.4

Y = 0.73 TIMES X - 1.13 SPEED RATIO (Y/X) = 0.686 INVERSE RATIO = 1.457
ENERGY RATIO (Y/X) = 0.523 INVERSE RATIO = 1.910

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.878	6.5	24.8	46.6
(Y)TURBINE F3 35-ft					5.8	15.9	21.7

Y = 0.78 TIMES X - 3.43 SPEED RATIO (Y/X) = 0.640 INVERSE RATIO = 1.562
ENERGY RATIO (Y/X) = 0.466 INVERSE RATIO = 2.148

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.882	6.5	24.8	46.6
(Y)TURBINE F7 35-ft					5.9	17.8	26.8

Y = 0.80 TIMES X - 2.17 SPEED RATIO (Y/X) = 0.716 INVERSE RATIO = 1.396
ENERGY RATIO (Y/X) = 0.576 INVERSE RATIO = 1.737

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.840	6.5	24.8	46.6
(Y)TURBINE F9 35-ft					5.2	15.6	20.4

Y = 0.66 TIMES X - 0.86 SPEED RATIO (Y/X) = 0.629 INVERSE RATIO = 1.590
ENERGY RATIO (Y/X) = 0.437 INVERSE RATIO = 2.287

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	89	0.834	6.5	25.2	47.6
(Y)TURBINE F12 35-ft					5.9	15.8	21.8

Y = 0.75 TIMES X - 3.13 SPEED RATIO (Y/X) = 0.626 INVERSE RATIO = 1.598
ENERGY RATIO (Y/X) = 0.458 INVERSE RATIO = 2.182

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.858	6.5	24.8	46.6
(Y)TURBINE G1 35-ft					4.8	14.6	17.6

Y = 0.63 TIMES X - 1.11 SPEED RATIO (Y/X) = 0.589 INVERSE RATIO = 1.698
ENERGY RATIO (Y/X) = 0.378 INVERSE RATIO = 2.648

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.865	6.5	24.8	46.6
(Y)TURBINE G3 35-ft					4.4	14.1	16.2

Y = 0.58 TIMES X - 0.25 SPEED RATIO (Y/X) = 0.569 INVERSE RATIO = 1.759
ENERGY RATIO (Y/X) = 0.349 INVERSE RATIO = 2.867

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.865	6.5	24.8	46.6
(Y)TURBINE G5 35-ft					5.6	18.6	28.8

Y = 0.74 TIMES X + 0.35 SPEED RATIO (Y/X) = 0.751 INVERSE RATIO = 1.332
ENERGY RATIO (Y/X) = 0.618 INVERSE RATIO = 1.619

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.874	6.5	24.8	46.6
(Y)TURBINE G7 35-ft					5.9	21.1	36.4

Y = 0.79 TIMES X + 1.55 SPEED RATIO (Y/X) = 0.850 INVERSE RATIO = 1.177
ENERGY RATIO (Y/X) = 0.781 INVERSE RATIO = 1.280

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.812	6.5	24.8	46.6
(Y)TURBINE G8 35-ft					5.4	14.5	17.8

Y = 0.67 TIMES X - 2.12 SPEED RATIO (Y/X) = 0.583 INVERSE RATIO = 1.714
ENERGY RATIO (Y/X) = 0.382 INVERSE RATIO = 2.615

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.836	6.5	24.8	46.6
(Y)TURBINE G10 35-ft					5.7	15.7	21.3

Y = 0.73 TIMES X - 2.45 SPEED RATIO (Y/X) = 0.634 INVERSE RATIO = 1.576
ENERGY RATIO (Y/X) = 0.457 INVERSE RATIO = 2.189

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.867	6.5	24.8	46.6
(Y)TURBINE G12 35-ft					5.4	17.5	25.5

Y = 0.71 TIMES X - 0.22 SPEED RATIO (Y/X) = 0.706 INVERSE RATIO = 1.417
ENERGY RATIO (Y/X) = 0.548 INVERSE RATIO = 1.825

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.943	6.5	24.8	46.6
(Y)TURBINE H1 50-ft					7.2	25.5	47.1

Y = 1.03 TIMES X - 0.09 SPEED RATIO (Y/X) = 1.028 INVERSE RATIO = 0.972
ENERGY RATIO (Y/X) = 1.011 INVERSE RATIO = 0.989

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.945	6.5	24.8	46.6
(Y)TURBINE H2 50-ft					7.0	24.4	44.6

Y = 1.01 TIMES X - 0.60 SPEED RATIO (Y/X) = 0.983 INVERSE RATIO = 1.017
ENERGY RATIO (Y/X) = 0.959 INVERSE RATIO = 1.043

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.926	6.5	24.8	46.6
(Y)TURBINE H7 50-ft					5.9	21.0	35.4

Y = 0.84 TIMES X + 0.08 SPEED RATIO (Y/X) = 0.846 INVERSE RATIO = 1.183
ENERGY RATIO (Y/X) = 0.761 INVERSE RATIO = 1.314

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.882	6.5	24.8	46.6
(Y)TURBINE H10 50-ft					5.8	20.6	34.7

Y = 0.78 TIMES X + 1.21 SPEED RATIO (Y/X) = 0.831 INVERSE RATIO = 1.203
ENERGY RATIO (Y/X) = 0.745 INVERSE RATIO = 1.343

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.907	6.5	24.8	46.6
(Y)TURBINE H12 50-ft					6.1	21.0	35.5

Y = 0.84 TIMES X + 0.11 SPEED RATIO (Y/X) = 0.845 INVERSE RATIO = 1.183
ENERGY RATIO (Y/X) = 0.761 INVERSE RATIO = 1.313

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.884	6.5	24.8	46.6
(Y)TURBINE H15 50-ft					5.7	19.8	32.4

Y = 0.77 TIMES X + 0.76 SPEED RATIO (Y/X) = 0.797 INVERSE RATIO = 1.254
ENERGY RATIO (Y/X) = 0.696 INVERSE RATIO = 1.438

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.871	6.5	24.8	46.6
(Y)TURBINE I1 50-ft					5.8	20.1	33.3

Y = 0.77 TIMES X + 1.02 SPEED RATIO (Y/X) = 0.810 INVERSE RATIO = 1.234
ENERGY RATIO (Y/X) = 0.714 INVERSE RATIO = 1.400

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.858	6.5	24.8	46.6
(Y)TURBINE I3 50-ft					5.9	20.4	34.4

Y = 0.77 TIMES X + 1.25 SPEED RATIO (Y/X) = 0.823 INVERSE RATIO = 1.215
ENERGY RATIO (Y/X) = 0.738 INVERSE RATIO = 1.354

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.868	6.5	24.8	46.6
(Y)TURBINE I5 50-ft					5.9	20.1	33.6

Y = 0.78 TIMES X + 0.67 SPEED RATIO (Y/X) = 0.810 INVERSE RATIO = 1.235
ENERGY RATIO (Y/X) = 0.721 INVERSE RATIO = 1.387

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.857	6.5	24.8	46.6
(Y)TURBINE I9 50-ft					6.0	19.2	31.1

Y = 0.79 TIMES X - 0.43 SPEED RATIO (Y/X) = 0.775 INVERSE RATIO = 1.290
ENERGY RATIO (Y/X) = 0.668 INVERSE RATIO = 1.496

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.847	6.5	24.8	46.6
(Y)TURBINE I14 50-ft					6.5	21.0	36.7

Y = 0.85 TIMES X - 0.01 SPEED RATIO (Y/X) = 0.846 INVERSE RATIO = 1.182
ENERGY RATIO (Y/X) = 0.788 INVERSE RATIO = 1.270

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.863	6.5	24.8	46.6
(Y)TURBINE J6 50-ft					6.4	20.1	33.6

Y = 0.85 TIMES X - 0.84 SPEED RATIO (Y/X) = 0.811 INVERSE RATIO = 1.233
ENERGY RATIO (Y/X) = 0.722 INVERSE RATIO = 1.384

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.875	6.5	24.8	46.6
(Y)TURBINE J8 50-ft					6.9	19.9	33.4

Y = 0.93 TIMES X - 3.14 SPEED RATIO (Y/X) = 0.802 INVERSE RATIO = 1.248
ENERGY RATIO (Y/X) = 0.717 INVERSE RATIO = 1.395

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.858	6.5	24.8	46.6
(Y)TURBINE J11 50-ft					6.4	20.4	34.6

Y = 0.84 TIMES X - 0.36 SPEED RATIO (Y/X) = 0.822 INVERSE RATIO = 1.216
ENERGY RATIO (Y/X) = 0.743 INVERSE RATIO = 1.346

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.852	6.5	24.8	46.6
(Y)TRUBINE J13 50-ft					6.6	20.2	34.4

Y = 0.87 TIMES X - 1.30 SPEED RATIO (Y/X) = 0.814 INVERSE RATIO = 1.229
ENERGY RATIO (Y/X) = 0.739 INVERSE RATIO = 1.354

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	85	0.841	7.0	25.1	47.2
(Y)TURBINE K1 35-ft					6.0	17.1	25.0

Y = 0.72 TIMES X - 0.95 SPEED RATIO (Y/X) = 0.683 INVERSE RATIO = 1.464
ENERGY RATIO (Y/X) = 0.530 INVERSE RATIO = 1.886

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.865	6.5	24.8	46.6
(Y)TURBINE K3 35-ft					5.6	17.9	26.8

Y = 0.74 TIMES X - 0.44 SPEED RATIO (Y/X) = 0.720 INVERSE RATIO = 1.389
ENERGY RATIO (Y/X) = 0.575 INVERSE RATIO = 1.740

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.859	6.5	24.8	46.6
(Y)TURBINE K5 35-ft					4.9	17.7	25.5

Y = 0.64 TIMES X + 1.75 SPEED RATIO (Y/X) = 0.713 INVERSE RATIO = 1.403
ENERGY RATIO (Y/X) = 0.548 INVERSE RATIO = 1.824

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.838	6.5	24.8	46.6
(Y)TURBINE K7 35-ft					4.8	16.8	23.4

Y = 0.61 TIMES X + 1.64 SPEED RATIO (Y/X) = 0.679 INVERSE RATIO = 1.473
ENERGY RATIO (Y/X) = 0.502 INVERSE RATIO = 1.993

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.848	6.5	24.8	46.6
(Y)TURBINE K9 35-ft					5.0	19.0	29.8

Y = 0.65 TIMES X + 2.88 SPEED RATIO (Y/X) = 0.764 INVERSE RATIO = 1.308
ENERGY RATIO (Y/X) = 0.640 INVERSE RATIO = 1.561

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.836	6.5	24.8	46.6
(Y)TURBINE K12 35-ft					4.8	17.9	26.5

Y = 0.62 TIMES X + 2.61 SPEED RATIO (Y/X) = 0.722 INVERSE RATIO = 1.385
ENERGY RATIO (Y/X) = 0.569 INVERSE RATIO = 1.757

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.821	6.5	24.8	46.6
(Y)TURBINE K14 35-ft					5.5	20.4	34.0

Y = 0.69 TIMES X + 3.17 SPEED RATIO (Y/X) = 0.822 INVERSE RATIO = 1.217
ENERGY RATIO (Y/X) = 0.729 INVERSE RATIO = 1.371

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.877	6.5	24.8	46.6
(Y)TURBINE L1 35-ft					5.6	21.5	37.5

Y = 0.75 TIMES X + 3.00 SPEED RATIO (Y/X) = 0.867 INVERSE RATIO = 1.153
ENERGY RATIO (Y/X) = 0.806 INVERSE RATIO = 1.241

(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.898	6.5	24.8	46.6
(Y)TURBINE L3 35-ft					5.8	22.8	41.3

Y = 0.80 TIMES X + 3.07 SPEED RATIO (Y/X) = 0.920 INVERSE RATIO = 1.087
ENERGY RATIO (Y/X) = 0.886 INVERSE RATIO = 1.128

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

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SITE                    START     STOP                HOURS   (r)    DEV.   MEAN    kW

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.909   6.5    24.8   46.6
(Y)TURBINE L5  35-ft                                                 6.1    23.9   44.3

 Y =  0.85 TIMES X +  2.77   SPEED RATIO (Y/X) = 0.963    INVERSE RATIO = 1.038
                            ENERGY RATIO (Y/X) = 0.951    INVERSE RATIO = 1.052

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.877   6.5    24.8   46.6
(Y)TURBINE L8  35-ft                                                 5.6    21.6   37.8

 Y =  0.76 TIMES X +  2.78   SPEED RATIO (Y/X) = 0.870    INVERSE RATIO = 1.149
                            ENERGY RATIO (Y/X) = 0.811    INVERSE RATIO = 1.233

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.891   6.5    24.8   46.6
(Y)TURBINE L10  35-ft                                                6.0    23.1   41.8

 Y =  0.81 TIMES X +  2.92   SPEED RATIO (Y/X) = 0.930    INVERSE RATIO = 1.075
                            ENERGY RATIO (Y/X) = 0.898    INVERSE RATIO = 1.114

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.893   6.5    24.8   46.6
(Y)TURBINE L12  35-ft                                                6.0    24.1   44.8

 Y =  0.82 TIMES X +  3.77   SPEED RATIO (Y/X) = 0.971    INVERSE RATIO = 1.030
                            ENERGY RATIO (Y/X) = 0.962    INVERSE RATIO = 1.039

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.849   6.5    24.8   46.6
(Y)TURBINE M2  35-ft                                                 5.5    20.9   35.5

 Y =  0.72 TIMES X +  3.10   SPEED RATIO (Y/X) = 0.843    INVERSE RATIO = 1.187
                            ENERGY RATIO (Y/X) = 0.763    INVERSE RATIO = 1.310

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.878   6.5    24.8   46.6
(Y)TURBINE M4  35-ft                                                 5.4    21.1   36.3

 Y =  0.72 TIMES X +  3.23   SPEED RATIO (Y/X) = 0.852    INVERSE RATIO = 1.174
                            ENERGY RATIO (Y/X) = 0.780    INVERSE RATIO = 1.283

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.886   6.5    24.8   46.6
(Y)TURBINE M6  35-ft                                                 5.8    22.8   41.4

 Y =  0.78 TIMES X +  3.39   SPEED RATIO (Y/X) = 0.921    INVERSE RATIO = 1.086
                            ENERGY RATIO (Y/X) = 0.888    INVERSE RATIO = 1.126

(X)SITE J-04 120-ft   10/01/87  10/10/87               102   0.888   6.5    24.8   46.6
(Y)TURBINE M8  35-ft                                                 5.9    24.0   44.7

 Y =  0.80 TIMES X +  4.06   SPEED RATIO (Y/X) = 0.966    INVERSE RATIO = 1.035
                            ENERGY RATIO (Y/X) = 0.959    INVERSE RATIO = 1.043
```

STATISTICAL COMPARISON SUMMARY OF CONCURRENT WIND SPEED DATA

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.856	6.5	24.8	46.6
(Y)TURBINE M9 35-ft					5.5	21.5	37.3

Y = 0.72 TIMES X + 3.53 SPEED RATIO (Y/X) = 0.865 INVERSE RATIO = 1.156
ENERGY RATIO (Y/X) = 0.801 INVERSE RATIO = 1.248

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.863	6.5	24.8	46.6
(Y)TURBINE M11 35-ft					5.5	21.9	38.7

Y = 0.72 TIMES X + 4.01 SPEED RATIO (Y/X) = 0.882 INVERSE RATIO = 1.134
ENERGY RATIO (Y/X) = 0.830 INVERSE RATIO = 1.204

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.870	6.5	24.8	46.6
(Y)TURBINE M13 35-ft					5.8	23.9	44.6

Y = 0.78 TIMES X + 4.58 SPEED RATIO (Y/X) = 0.964 INVERSE RATIO = 1.038
ENERGY RATIO (Y/X) = 0.957 INVERSE RATIO = 1.045

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.827	6.5	24.8	46.6
(Y)TURBINE N1 35-ft					5.7	21.3	36.5

Y = 0.72 TIMES X + 3.44 SPEED RATIO (Y/X) = 0.858 INVERSE RATIO = 1.165
ENERGY RATIO (Y/X) = 0.784 INVERSE RATIO = 1.276

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.807	6.5	24.8	46.6
(Y)TURBINE N4 35-ft					5.5	20.1	33.2

Y = 0.68 TIMES X + 3.19 SPEED RATIO (Y/X) = 0.810 INVERSE RATIO = 1.235
ENERGY RATIO (Y/X) = 0.713 INVERSE RATIO = 1.402

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.786	6.5	24.8	46.6
(Y)TURBINE N6 35-ft					5.1	19.4	31.0

Y = 0.62 TIMES X + 4.05 SPEED RATIO (Y/X) = 0.782 INVERSE RATIO = 1.278
ENERGY RATIO (Y/X) = 0.666 INVERSE RATIO = 1.502

SITE	START	STOP	HOURS	(r)	DEV.	MEAN	kW
(X)SITE J-04 120-ft	10/01/87	10/10/87	102	0.814	6.5	24.8	46.6
(Y)TURBINE N8 35-ft					5.2	19.5	31.2

Y = 0.64 TIMES X + 3.47 SPEED RATIO (Y/X) = 0.785 INVERSE RATIO = 1.274
ENERGY RATIO (Y/X) = 0.671 INVERSE RATIO = 1.491

JESS RANCH FREE-FLOW ANALYSIS, CORRELATION OF SITES WITH LOW CORRELATION COEFFICIENTS TO J-08 AND J-04, TO SITE J-18 70-FT

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.942	6.4	19.4	31.7
(Y)TURBINE F9 35-f					5.2	15.6	20.4

Y = 0.76 TIMES X + 0.88 SPEED RATIO (Y/X) = 0.805 INVERSE RATIO = 1.243
ENERGY RATIO (Y/X) = 0.642 INVERSE RATIO = 1.559

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.928	6.4	19.4	31.7
(Y)TURBINE F12 35-					5.8	15.8	21.6

Y = 0.85 TIMES X - 0.63 SPEED RATIO (Y/X) = 0.813 INVERSE RATIO = 1.230
ENERGY RATIO (Y/X) = 0.682 INVERSE RATIO = 1.467

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.965	6.4	19.4	31.7
(Y)TURBINE G8 35-f					5.4	14.5	17.8

Y = 0.81 TIMES X - 1.25 SPEED RATIO (Y/X) = 0.746 INVERSE RATIO = 1.340
ENERGY RATIO (Y/X) = 0.561 INVERSE RATIO = 1.782

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.904	6.4	19.4	31.7
(Y)TURBINE I3 50-ft					5.9	20.4	34.4

Y = 0.83 TIMES X + 4.31 SPEED RATIO (Y/X) = 1.053 INVERSE RATIO = 0.950
ENERGY RATIO (Y/X) = 1.084 INVERSE RATIO = 0.923

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.905	6.4	19.4	31.7
(Y)TURBINE I9 50-ft					6.0	19.2	31.1

Y = 0.85 TIMES X + 2.68 SPEED RATIO (Y/X) = 0.992 INVERSE RATIO = 1.008
ENERGY RATIO (Y/X) = 0.981 INVERSE RATIO = 1.020

SITE	START DATE	STOP DATE	HOURS USED	COREL COEFF	STD DEV (MPH)	MEAN SPEED (MPH)	MEAN 65 (KW)
(X)SITE J-18 70-ft	10/01/87	10/10/87	102	0.925	6.4	19.4	31.7
(Y)TURBINE K1 35-f					5.6	17.1	24.6

Y = 0.80 TIMES X + 1.54 SPEED RATIO (Y/X) = 0.882 INVERSE RATIO = 1.134
ENERGY RATIO (Y/X) = 0.776 INVERSE RATIO = 1.289

Appendix F

Diurnal Mean Speed Summaries

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - SOUZA RANCH

09/10/87 - 09/14/87

HOUR	WS13 MPH	WS12 MPH	WS27 MPH	WS26 MPH	WD13 DEG	WS29 MPH	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD7 MPH	WSD1 MPH	WSD3 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE0 MPH	WSE3 MPH	WS07 MPH
1	29.5	28.0	27.9	28.0	226.6	28.5	29.0	28.2	27.7	28.9	32.3	33.3	30.7	27.9	27.5	30.3	27.2	27.6
2	26.9	26.0	26.7	26.8	219.7	26.8	27.4	27.0	27.7	27.6	31.5	32.9	29.5	26.5	26.9	29.7	25.8	26.0
3	25.5	24.5	24.5	24.6	222.5	24.6	25.5	24.6	24.8	25.2	28.5	29.9	28.1	26.0	25.0	27.4	25.3	24.8
4	24.5	23.6	24.2	24.2	225.8	23.9	23.9	23.9	24.5	24.1	28.1	28.9	26.2	23.5	23.8	25.9	22.8	23.5
5	24.6	23.6	24.3	24.3	221.8	24.3	24.0	24.5	24.9	24.1	28.5	29.6	27.3	24.6	24.0	26.7	23.9	23.5
6	24.8	23.9	24.0	23.9	222.4	23.8	24.2	23.9	23.9	24.4	27.8	28.3	26.2	24.0	24.1	25.6	23.1	24.1
7	23.7	22.6	22.3	22.1	225.9	22.3	23.2	22.2	22.4	23.2	25.7	27.0	25.3	22.7	22.6	24.3	22.1	22.8
8	23.7	22.6	21.9	21.8	225.9	21.9	22.1	21.8	21.9	22.3	25.4	26.1	24.4	22.2	22.5	23.5	21.6	22.5
9	23.4	22.2	22.1	22.2	226.4	22.3	22.4	22.1	22.2	22.0	25.7	26.4	25.0	22.6	22.9	23.8	21.9	21.3
10	22.6	21.4	21.1	21.2	227.0	21.6	21.5	20.9	20.4	20.6	23.8	24.1	23.0	21.6	22.1	21.7	20.9	20.1
11	19.6	18.5	18.8	19.0	228.7	19.1	19.3	18.8	18.2	18.5	21.2	21.4	20.1	18.7	19.3	19.4	18.3	17.2
12	18.3	17.4	16.8	17.0	227.1	17.3	17.3	16.7	16.4	16.5	19.0	19.4	18.6	17.4	18.1	17.3	17.0	16.0
13	18.3	17.6	17.4	17.5	224.0	17.8	17.8	17.3	16.6	17.0	19.5	19.7	18.6	17.2	17.5	17.6	16.7	16.2
14	18.8	17.9	17.7	17.9	230.7	18.5	18.4	17.6	17.1	17.5	20.1	20.1	19.1	17.8	18.2	17.8	17.3	16.4
15	20.6	19.1	19.6	19.5	236.9	20.5	20.2	19.1	18.2	19.0	21.8	21.6	20.7	19.3	19.8	19.2	18.9	17.3
16	20.7	19.5	19.7	19.7	236.4	21.3	21.1	20.1	19.1	19.7	22.8	22.5	21.5	19.9	20.2	19.9	19.6	17.8
17	21.3	20.0	20.2	20.2	231.5	21.2	21.1	20.5	19.8	20.2	23.3	23.4	22.1	20.5	21.2	20.7	20.1	18.7
18	24.8	23.2	22.3	22.3	229.2	23.6	23.4	22.8	21.8	22.4	25.8	25.6	24.3	22.7	23.1	23.2	22.1	21.7
19	27.6	25.9	24.1	23.9	230.8	25.2	25.3	24.5	23.8	24.4	28.2	28.3	27.1	25.2	25.4	25.3	24.8	23.9
20	32.8	31.2	28.8	28.3	229.7	29.8	30.0	28.8	28.1	28.9	33.3	33.3	31.9	29.9	30.5	30.2	29.4	28.7
21	34.5	33.0	32.5	32.0	229.2	32.4	32.2	31.7	30.5	31.2	36.3	35.6	32.9	30.3	30.8	31.9	29.4	31.6
22	32.4	31.0	31.5	31.4	227.0	31.6	31.9	31.4	30.2	31.1	35.6	34.9	32.7	30.3	30.5	31.7	29.1	30.4
23	30.7	29.3	29.2	29.2	225.4	29.4	29.0	28.8	28.0	28.6	33.0	33.1	31.1	28.7	29.0	29.8	27.6	28.4
24	31.3	29.6	28.3	28.2	229.5	28.6	28.2	27.9	27.6	27.7	32.6	32.5	30.0	28.2	28.9	28.8	27.2	28.8
MEAN	25.1	23.9	23.7	23.6	227.3	24.1	24.2	23.6	23.3	23.6	27.2	27.5	25.8	23.8	24.0	24.8	23.1	23.0
VALID HRS	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94

NAME	SITE LOCATION:
WS13	SITE S-13 70-ft reference
WS27	SITE S-27 80-ft reference
WD13	SITE S-13 70-ft
WSD2	TURBINE D2
WSD6	TURBINE D6
WSD1	TURBINE D11
WSE2	TURBINE E2
WSE6	TURBINE E6
WSE3	TURBINE E14

NAME	SITE LOCATION:
WS12	SITE S-13 35-ft
WS26	SITE S-27 35-ft
WS29	SITE S-29 50-ft
WSD4	TURBINE D4
WSD7	TURBINE D7
WSD3	TURBINE D13
WSE4	TURBINE E4
WSE0	TURBINE E10
WS07	TURBINE 07

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - BOUZA RANCH

09/10/87 - 09/14/87

HOUR	WS13 MPH	WD13 DEG	WSE1 MPH	WSF2 MPH	WSF4 MPH	WSF6 MPH	WSF8 MPH	WSF0 MPH	WSF1 MPH	WSF3 MPH	WSQ2 MPH	WSQ4 MPH	WSQ7 MPH	WSQ9 MPH
1	29.5	226.6	28.2	30.8	30.3	31.3	30.9	28.8	30.3	29.1	30.6	28.9	27.6	23.7
2	26.9	219.7	27.2	29.7	28.7	30.4	29.9	27.0	28.2	27.5	28.8	26.9	26.0	22.6
3	25.5	222.5	25.3	28.3	28.2	28.6	27.5	24.9	26.2	25.8	26.5	25.3	24.8	21.4
4	24.5	225.8	24.2	26.6	25.9	27.5	26.2	23.9	25.2	24.5	25.4	24.3	23.5	20.0
5	24.6	221.8	24.9	27.4	26.4	27.3	26.5	24.0	25.4	24.7	25.7	24.4	23.5	20.3
6	24.8	222.4	24.0	26.5	26.1	27.6	26.7	24.2	25.6	24.8	25.7	24.6	24.1	20.9
7	23.7	225.9	23.1	25.6	24.9	26.1	25.8	23.3	24.2	23.4	24.9	23.3	22.8	19.7
8	23.7	225.9	22.2	24.8	24.4	26.0	25.2	23.2	24.2	23.2	24.5	23.2	22.5	19.3
9	23.4	226.4	22.5	25.4	25.2	26.5	25.4	23.2	23.9	22.4	24.8	22.9	21.3	17.8
10	22.6	227.0	20.6	23.7	24.3	25.8	24.6	22.3	22.8	21.3	24.0	22.0	20.1	16.9
11	19.6	228.7	18.0	21.2	21.6	22.6	21.6	19.5	19.8	18.4	21.2	19.2	17.2	14.2
12	18.3	227.1	16.5	19.7	20.3	21.3	20.1	18.2	18.3	17.0	20.0	18.0	16.0	13.3
13	18.3	224.0	16.4	19.6	20.0	20.8	19.8	18.1	18.1	17.4	19.7	18.1	16.2	13.5
14	18.8	230.7	16.9	20.2	20.7	21.6	20.4	18.7	19.0	18.1	20.3	18.4	16.4	13.7
15	20.6	236.9	18.3	22.5	23.0	24.0	22.1	20.2	20.5	19.5	22.0	19.5	17.3	14.4
16	20.7	236.4	19.0	22.8	23.3	23.9	22.3	20.6	21.3	20.3	22.0	19.8	17.8	14.9
17	21.3	231.5	19.8	23.2	23.7	24.7	23.4	21.3	21.5	20.4	22.6	20.6	18.7	15.6
18	24.8	229.2	21.8	25.1	25.7	27.1	25.8	24.0	24.6	23.3	25.6	23.8	21.7	18.0
19	27.6	230.8	24.4	27.4	28.2	29.8	28.5	26.7	27.0	26.3	28.6	26.4	23.9	19.7
20	32.8	229.7	28.7	32.1	33.2	35.1	33.7	31.9	32.3	31.4	34.0	31.8	28.7	23.5
21	34.5	229.2	29.8	33.0	33.8	35.5	34.6	33.4	35.0	33.3	35.1	33.8	31.6	25.7
22	32.4	227.0	29.7	32.9	33.6	34.9	33.5	31.6	33.3	32.2	33.5	31.9	30.4	25.5
23	30.7	225.4	28.1	31.4	32.2	33.8	31.9	30.0	31.5	30.3	31.5	30.2	28.4	23.8
24	31.3	229.5	27.0	30.4	31.9	33.6	32.0	30.2	32.0	31.0	31.8	30.4	28.8	24.4
MEAN	25.1	227.3	23.3	26.4	26.6	27.8	26.7	24.6	25.5	24.5	26.3	24.6	23.0	19.4
VALID HRS	94	94	94	94	94	94	94	94	94	94	94	94	94	94

NAME	SITE LOCATION:
WS13	SITE S-13 70-ft reference
WSE1	TURBINE E12
WSF4	TURBINE F4
WSF8	TURBINE F8
WSF1	TURBINE F12
WSQ2	TURBINE Q2
WSQ7	TURBINE Q7

NAME	SITE LOCATION:
WD13	SITE S-13 70-ft
WSF2	TURBINE F2
WSF6	TURBINE F6
WSF0	TURBINE F10
WSF3	TURBINE F14
WSQ4	TURBINE Q4
WSQ9	TURBINE Q9

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WS08 MPH	WD08 DEG	WS14 MPH	WS15 MPH	WS16 MPH	WS17 MPH	WS18 MPH	WS19 MPH	TT01 DEG F	WSC1 MPH	WSC3 MPH	WSC5 MPH	WSC7 MPH	WSC9 MPH	WSC2 MPH	WSC4 MPH	WSC6 MPH	WSC8 MPH
1	27.0	247.8	26.7	28.3	22.4	24.0	18.5	19.9	70.7	25.2	25.2	23.1	21.2	22.1	25.4	28.3	22.9	22.3
2	25.4	246.1	24.3	25.5	20.1	21.5	16.4	17.8	69.6	23.9	24.0	21.7	20.2	20.9	23.4	25.8	21.5	20.7
3	24.6	245.6	24.9	24.4	18.8	20.1	14.5	15.9	68.5	24.0	24.2	21.9	20.3	21.3	23.6	26.1	21.8	20.8
4	21.7	247.5	24.3	22.2	16.8	17.9	13.8	15.0	67.0	23.8	23.7	20.8	19.3	19.5	22.5	24.5	19.7	19.9
5	19.9	247.2	21.4	20.8	15.8	16.8	13.9	15.5	66.7	20.8	20.4	18.0	16.6	16.5	17.7	21.6	17.3	17.2
6	21.9	248.2	23.1	22.0	17.2	18.5	13.5	15.1	65.1	22.0	21.9	19.5	18.4	18.4	21.4	23.7	19.2	17.9
7	20.9	248.1	22.3	20.8	16.3	17.5	12.9	14.1	63.8	21.0	20.2	17.7	16.4	16.6	20.2	22.5	18.1	16.9
8	21.5	248.8	23.1	21.8	17.2	18.7	14.0	15.4	65.8	20.7	20.9	18.2	17.0	17.4	21.4	23.4	18.9	17.9
9	23.2	243.6	26.8	22.3	16.4	17.6	17.2	18.8	67.3	24.5	24.4	20.9	19.6	18.6	24.7	26.9	21.8	19.3
10	26.6	244.0	28.8	27.4	20.6	21.4	20.8	22.2	68.5	27.3	27.0	24.2	22.9	22.7	27.3	30.1	25.0	23.0
11	26.0	244.1	27.0	23.7	20.5	22.1	20.4	21.7	69.6	25.2	24.8	22.2	20.5	20.4	25.2	27.5	22.5	20.9
12	25.6	251.3	25.5	23.8	20.6	22.2	20.2	21.3	72.5	24.1	23.3	21.1	19.5	19.2	23.8	26.1	20.8	19.6
13	24.8	249.0	23.6	22.2	20.1	21.1	19.4	20.3	75.0	22.3	21.0	19.1	17.7	17.3	21.8	23.4	18.7	17.7
14	25.6	249.2	22.3	21.9	20.7	22.5	19.5	20.4	76.3	21.3	19.9	18.6	17.2	17.5	20.8	22.6	18.0	17.7
15	25.5	248.9	23.3	22.8	21.0	22.8	20.3	21.2	77.2	21.8	20.3	18.7	17.1	17.0	21.2	22.9	18.0	17.3
16	26.1	251.5	23.8	22.4	21.4	23.2	20.8	21.7	77.7	22.6	21.1	19.4	17.5	17.6	22.1	23.8	18.4	18.0
17	24.7	250.9	22.2	21.7	19.9	21.5	19.1	20.0	77.4	20.8	19.3	17.9	15.9	16.0	20.3	22.0	17.0	16.3
18	26.0	246.9	25.4	23.0	20.6	22.3	19.4	20.6	75.7	23.5	22.8	20.4	17.7	18.3	23.9	25.9	18.8	18.7
19	25.6	248.5	24.6	24.1	20.5	22.4	19.3	20.7	72.3	23.0	21.9	20.6	17.6	18.7	22.8	25.6	19.4	19.3
20	26.1	247.8	23.4	22.0	21.3	23.2	19.6	21.1	69.6	21.5	21.2	19.4	17.9	17.5	22.1	25.0	19.3	18.5
21	27.3	248.4	26.5	26.2	23.1	25.2	20.6	21.8	67.0	24.5	24.3	22.1	20.2	21.7	24.7	27.5	22.5	22.4
22	28.1	248.3	27.6	29.4	22.9	24.9	21.2	22.5	66.4	26.0	25.6	23.6	22.0	24.2	26.1	28.8	24.5	25.4
23	28.7	248.2	27.6	27.9	23.4	25.3	21.7	23.2	67.0	26.7	26.5	24.1	22.5	23.8	26.5	29.5	24.9	24.4
24	27.4	247.2	26.3	28.0	21.9	23.7	19.5	20.9	67.1	24.5	25.4	23.5	21.9	22.3	25.4	28.4	23.6	22.7
MEAN	25.0	247.8	24.8	24.1	20.0	21.6	18.1	19.4	69.7	23.4	23.0	20.8	19.1	19.5	23.2	25.6	20.6	19.9
VALID HRS	102	102	102	102	102	102	102	102	140	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WS08	SITE J-08 50-ft reference
WS14	SITE J-04 120-ft reference
WS16	SITE J-17 35-ft level
WS18	SITE J-18 35-ft level
TT01	TEMPERATURE
WSC3	TURBINE C3 50-ft
WSC7	TURBINE C7 50-ft
WSC2	TURBINE C12 50-ft
WSC6	TURBINE C16 50-ft

NAME	SITE LOCATION:
WD08	SITE J-08 DIRECTION
WS15	SITE J-19 40-ft level
WS17	SITE J-17 70-ft tower
WS19	SITE J-18 70-ft tower
WSC1	TURBINE C1 50-ft
WSC5	TURBINE C5 50-ft
WSC9	TURBINE C9 50-ft
WSC4	TURBINE C14 50-ft
WSC8	TURBINE C18 50-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSD2 MPH	WSD4 MPH	WSD6 MPH	WSD3 MPH	WSD5 MPH	WSD1 MPH	WSE2 MPH	WSE4 MPH	WSE6 MPH	WSE8 MPH	WSE0 MPH	WSE1 MPH	WSE3 MPH	WSE5 MPH	WSEA MPH	WSEB MPH	WSEC MPH	WSF1 MPH
1	21.6	21.7	21.3	21.6	21.1	19.4	20.3	19.1	16.7	18.9	21.4	18.8	20.0	19.2	18.2	19.8	23.2	17.8
2	20.0	19.3	18.9	19.4	18.9	17.0	18.6	16.9	15.1	16.1	18.1	17.2	17.8	17.7	17.0	17.3	20.1	15.8
3	20.2	18.8	17.8	18.2	17.6	16.2	18.2	16.2	13.8	14.0	17.1	17.0	18.2	17.3	15.3	15.5	19.3	14.4
4	18.9	18.3	18.0	18.8	18.4	14.6	17.7	15.4	13.3	14.2	15.4	17.2	17.7	17.0	15.6	15.5	18.3	13.1
5	16.1	16.1	16.0	16.8	16.2	15.1	16.5	15.0	13.5	12.8	15.8	15.4	16.2	15.6	15.1	14.5	17.4	13.9
6	17.0	16.2	16.3	17.6	17.0	14.9	16.2	15.3	13.8	13.8	16.5	16.2	15.9	15.5	15.3	15.2	18.2	14.0
7	15.7	14.7	13.8	14.8	14.2	13.3	13.7	13.1	11.8	12.2	13.7	13.6	13.9	13.3	12.9	13.6	15.3	12.8
8	17.2	17.1	16.3	17.3	16.3	15.0	15.5	15.2	13.2	14.5	16.5	15.0	14.9	14.8	15.0	15.8	18.5	13.7
9	18.0	17.9	16.8	18.4	17.1	17.3	17.4	17.6	16.2	17.6	18.5	16.3	17.5	17.5	17.9	19.3	20.6	17.1
10	22.0	21.1	20.2	21.1	20.1	20.4	21.0	20.4	18.4	20.4	21.8	19.4	20.4	20.0	20.3	21.5	23.5	19.7
11	19.6	18.8	18.3	18.9	18.2	19.0	19.3	19.1	17.8	19.8	20.9	17.3	18.5	18.7	19.4	20.7	22.3	19.3
12	18.9	18.5	17.8	18.2	17.7	18.4	18.6	18.5	17.2	19.4	20.4	17.4	18.2	18.2	18.5	20.1	21.6	19.0
13	17.0	16.8	16.7	16.3	16.4	16.8	16.3	16.5	15.8	18.4	18.9	16.3	15.5	15.9	15.8	18.7	20.4	17.8
14	17.9	17.8	17.2	17.4	17.0	17.6	17.4	17.5	16.2	18.2	18.7	16.3	16.2	16.9	16.9	18.8	20.0	18.1
15	17.9	18.1	17.5	17.8	17.4	17.9	17.8	18.2	17.0	19.2	19.5	16.3	17.2	17.4	18.4	19.9	20.7	18.9
16	18.1	18.2	17.9	17.6	17.9	18.3	18.6	18.8	16.9	19.6	19.8	17.1	17.9	18.2	18.9	20.3	21.1	18.9
17	16.5	16.0	15.8	15.9	15.8	16.8	16.6	17.2	15.6	18.3	18.4	15.4	16.1	16.4	17.4	18.9	19.8	17.4
18	18.1	17.0	16.6	16.9	16.2	16.9	17.3	17.1	15.7	19.3	20.0	16.0	17.0	17.4	17.9	20.0	21.6	17.4
19	18.4	17.7	16.7	18.4	17.1	16.4	17.3	16.9	15.5	19.1	19.6	16.4	16.8	17.5	17.8	19.9	21.3	17.1
20	18.3	17.4	16.7	18.3	17.2	16.8	17.3	17.2	15.9	19.3	19.7	16.7	17.7	17.3	18.3	20.3	21.4	17.4
21	21.6	21.4	20.3	21.6	20.3	19.4	19.3	19.9	17.0	20.4	21.0	18.4	19.3	19.1	18.9	20.7	22.7	18.2
22	24.5	24.2	23.8	24.5	23.5	21.3	22.7	21.7	18.9	20.3	22.6	21.1	22.3	21.9	21.2	21.4	24.3	19.9
23	23.0	22.8	22.2	23.5	22.4	21.3	21.6	21.2	19.3	20.5	23.0	20.3	21.5	20.8	20.8	22.0	24.6	20.8
24	22.1	21.9	20.9	21.4	20.4	19.2	19.8	19.3	16.8	19.6	21.9	17.8	19.4	19.0	18.8	20.7	23.6	18.1
MEAN	19.3	18.8	18.2	19.0	18.2	17.5	18.2	17.6	15.8	17.7	19.1	17.1	17.9	17.7	17.6	18.7	20.9	17.0
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSD2	TURBINE D2 50-ft
WSD6	TURBINE D6 50-ft
WSD5	TURBINE D15 50-ft
WSE2	TURBINE E2 50-ft
WSE6	TURBINE E6 50-ft
WSE0	TURBINE E10 50-ft
WSE3	TURBINE E13 50-ft
WSEA	TURBINE E18 50-ft
WSEC	TURBINE E22 50-ft

NAME	SITE LOCATION:
WSD4	TURBINE D4 50-ft
WSD3	TURBINE D13 50-ft
WSD1	TURBINE D21 50-ft
WSE4	TURBINE E4 50-ft
WSE8	TURBINE E8 50-ft
WSE1	TURBINE E11 50-ft
WSE5	TURBINE E15 50-ft
WSEB	TURBINE E20 50-ft
WSF1	TURBINE F1 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSF3 MPH	WSF5 MPH	WSF7 MPH	WSF9 MPH	WSF2 MPH	WSQ1 MPH	WSQ3 MPH	WSQ5 MPH	WSQ7 MPH	WSQ8 MPH	WSQ0 MPH	WSQ2 MPH	WSH1 MPH	WSH7 MPH	WSH0 MPH	WSH2 MPH	WSH5 MPH	WSI1 MPH
1	17.0	28.2	19.6	16.0	16.5	15.0	14.8	20.0	22.5	14.5	16.4	18.3	29.4	23.4	23.4	24.0	22.1	22.7
2	14.2	26.5	17.7	15.8	14.8	14.8	14.2	18.2	21.4	13.7	15.0	17.0	27.6	22.0	20.6	23.0	20.0	19.7
3	12.1	26.5	15.7	14.2	13.9	13.2	13.2	17.0	20.4	11.0	12.2	15.8	27.8	22.2	20.3	23.2	20.5	18.9
4	12.3	24.7	13.8	12.3	12.5	11.4	11.2	14.5	16.9	10.8	10.6	13.2	26.4	19.9	18.8	20.9	18.0	17.7
5	11.1	21.5	14.7	12.6	12.6	10.8	10.0	13.4	16.1	10.1	10.9	12.6	22.8	17.5	17.1	17.9	15.4	16.8
6	12.1	23.6	15.7	13.3	14.5	10.2	9.5	15.2	17.6	10.3	10.7	12.3	24.8	18.8	17.6	19.9	17.1	17.0
7	11.1	21.3	13.5	12.3	12.5	11.4	11.3	14.0	16.8	10.8	11.3	13.1	22.2	17.1	15.7	17.2	15.1	15.0
8	12.7	21.7	15.6	14.5	13.8	13.0	12.7	16.0	17.7	12.0	13.3	15.0	22.4	18.5	18.4	17.9	17.2	17.7
9	15.3	24.3	17.8	15.8	16.6	14.9	13.5	17.7	19.9	15.4	15.7	16.6	25.4	19.1	18.6	18.7	17.5	18.0
10	19.0	28.6	20.7	18.7	18.8	17.6	17.0	20.4	22.8	17.7	18.9	20.2	29.3	23.4	22.6	22.8	21.4	22.5
11	18.1	25.4	19.9	17.4	17.5	16.2	14.9	19.5	22.0	16.3	17.2	18.7	26.0	20.8	21.0	20.3	19.9	20.7
12	18.0	24.0	18.7	16.5	17.3	15.9	15.2	18.9	21.1	15.7	17.3	18.8	24.5	20.5	20.9	20.2	20.3	20.8
13	16.9	21.4	17.2	15.6	16.3	14.4	14.4	18.6	21.3	14.8	15.9	18.0	22.0	18.7	20.0	18.7	19.9	19.9
14	16.7	21.0	17.8	16.3	16.5	15.3	14.6	19.3	21.7	15.5	16.9	18.5	21.5	20.0	20.7	20.0	20.3	20.4
15	17.6	20.8	17.8	15.9	15.5	15.3	15.2	19.8	22.0	15.5	16.9	18.9	21.8	20.2	21.0	19.5	20.7	20.8
16	18.0	21.6	18.4	16.2	15.8	15.3	15.0	19.9	22.5	15.9	17.2	19.0	22.5	20.4	21.7	20.3	21.3	21.6
17	16.7	19.7	16.6	14.3	14.5	14.2	14.8	19.4	21.3	14.4	16.5	18.7	20.9	18.1	18.8	17.7	18.4	18.9
18	17.3	22.3	18.1	15.4	15.8	15.0	14.3	20.3	22.1	15.4	17.5	19.1	23.2	19.5	19.9	19.0	19.4	19.7
19	16.8	23.0	17.8	15.6	15.6	15.4	14.9	19.8	22.6	16.2	17.9	19.2	24.4	20.0	19.4	19.3	18.4	19.1
20	16.8	22.6	17.4	15.3	16.0	15.2	15.2	20.5	22.5	15.7	17.4	18.9	24.1	19.8	19.1	19.0	18.5	19.0
21	18.5	26.0	19.1	16.3	16.6	16.0	15.5	21.1	23.5	16.2	17.7	19.6	27.2	23.4	23.4	22.8	22.1	22.6
22	18.8	28.2	21.0	18.1	18.1	16.6	16.2	21.1	23.6	17.1	18.5	20.2	29.5	26.6	26.2	26.5	24.5	25.4
23	18.6	29.1	21.8	19.1	19.4	17.7	16.6	21.8	24.2	17.7	19.2	20.4	30.6	25.2	24.3	25.5	22.8	23.8
24	17.6	28.6	20.4	17.8	18.5	16.5	15.0	20.2	22.9	16.3	18.0	19.3	30.0	24.1	23.3	24.3	22.3	22.5
MEAN	15.9	24.4	17.8	15.6	13.8	14.6	14.1	18.6	21.1	14.5	15.7	17.5	25.5	21.0	20.6	21.0	19.8	20.1
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSF3	TURBINE F3 35-ft
WSF7	TURBINE F7 35-ft
WSF2	TURBINE F12 35-ft
WSQ3	TURBINE Q3 35-ft
WSQ7	TURBINE Q7 35-ft
WSQ0	TURBINE Q10 35-ft
WSH1	TURBINE H1 50-ft
WSH0	TURBINE H10 50-ft
WSH5	TURBINE H15 50-ft

NAME	SITE LOCATION:
WSF5	TURBINE H2 50-ft
WSF9	TURBINE F9 35-ft
WSQ1	TURBINE Q1 35-ft
WSQ5	TURBINE Q5 35-ft
WSQ8	TURBINE Q8 35-ft
WSQ2	TURBINE Q12 35-ft
WSH7	TURBINE H7 50-ft
WSH2	TURBINE H12 50-ft
WSI1	TURBINE I1 50-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSI3 MPH	WSI5 MPH	WSI9 MPH	WSI4 MPH	WSJ6 MPH	WSJ8 MPH	WSJ1 MPH	WSJ3 MPH	WSK1 MPH	WSK3 MPH	WSK5 MPH	WSK7 MPH	WSK9 MPH	WSK2 MPH	WSK4 MPH	WSL1 MPH	WSL3 MPH	WSL5 MPH
1	23.4	22.9	22.2	23.1	21.4	22.2	22.1	22.0	18.4	18.4	18.3	17.5	20.9	18.8	22.4	23.4	24.8	26.1
2	19.9	19.4	18.5	20.3	19.4	20.3	20.3	20.7	17.8	18.4	17.8	16.5	19.0	17.5	19.9	21.8	23.1	24.0
3	18.4	17.9	18.2	18.3	16.4	17.5	17.3	18.5	16.3	17.3	16.9	15.1	17.6	16.4	18.5	21.0	22.2	23.6
4	17.1	16.9	15.8	16.0	15.5	14.9	15.5	15.5	13.6	14.7	15.1	13.8	15.7	14.9	16.6	18.2	19.8	21.1
5	17.1	17.1	14.9	17.5	15.8	16.9	16.6	15.9	14.3	13.4	12.8	12.2	14.5	13.1	15.6	16.9	17.9	18.9
6	17.2	17.0	15.5	16.6	15.5	16.4	16.0	15.7	14.3	13.1	12.3	12.6	16.0	14.0	17.3	18.3	19.8	20.5
7	15.0	15.3	14.5	15.8	14.3	15.3	15.3	15.8	13.8	14.6	14.7	13.2	14.8	14.3	16.0	17.4	18.8	19.4
8	18.0	17.5	16.6	17.7	17.9	17.2	19.1	19.1	16.1	17.0	16.1	14.6	16.3	15.4	17.6	18.0	19.4	20.3
9	18.5	18.6	17.6	20.3	18.9	18.6	18.7	18.4	16.0	17.5	16.9	15.1	16.9	15.9	17.4	19.2	20.9	23.1
10	23.4	23.1	21.7	24.3	22.5	22.2	22.3	22.6	19.0	21.2	20.8	19.2	20.2	20.1	21.6	22.9	24.4	25.8
11	21.0	21.3	19.7	22.8	21.9	22.1	22.0	21.6	15.7	19.4	18.5	17.5	19.8	18.5	21.1	22.5	24.1	25.2
12	21.7	21.3	20.5	22.4	21.4	20.9	21.1	21.0	16.6	19.0	18.8	17.8	19.4	18.8	21.0	22.1	23.5	24.4
13	19.8	19.6	18.8	21.1	20.3	20.2	20.8	20.2	17.4	17.6	18.4	17.4	19.4	18.4	20.8	21.9	22.9	23.9
14	20.8	20.6	19.8	21.9	20.7	21.0	21.3	21.3	18.3	18.6	18.5	17.9	19.8	19.0	21.4	22.2	23.5	24.2
15	21.1	21.0	20.1	22.5	21.1	20.8	21.2	20.8	17.9	18.4	18.8	18.3	20.1	19.3	21.7	22.4	23.4	24.4
16	22.1	21.7	20.8	23.0	22.0	21.5	21.9	21.2	18.0	18.4	18.9	18.6	20.3	19.7	21.9	22.7	24.1	24.8
17	19.5	18.8	18.3	20.9	20.1	19.4	19.8	19.3	15.7	17.0	18.1	17.7	19.4	19.0	20.9	21.2	22.7	23.6
18	20.2	19.5	19.4	21.0	21.3	20.6	21.1	20.4	16.4	17.9	17.7	17.8	19.8	18.7	21.2	22.1	23.8	25.3
19	20.0	19.4	18.5	20.2	21.2	20.3	21.0	21.0	17.0	18.4	18.5	17.9	19.4	18.4	20.9	22.6	23.1	23.8
20	20.7	20.6	19.4	21.0	21.2	19.4	21.1	21.0	17.6	18.4	19.0	18.7	20.2	19.9	22.3	23.1	23.7	24.6
21	22.6	21.9	21.1	23.7	23.2	20.6	22.8	22.0	18.7	19.2	19.3	19.2	21.1	20.3	23.5	24.0	24.8	25.8
22	25.3	24.8	24.0	25.3	24.0	23.0	24.3	23.4	20.2	20.2	19.9	19.1	21.5	20.2	23.3	24.0	25.5	26.7
23	24.3	24.1	23.0	25.7	24.3	23.5	24.7	24.5	20.8	21.7	20.5	19.3	22.0	20.4	23.7	24.6	26.2	27.4
24	22.5	21.9	22.0	23.0	22.9	23.0	23.5	22.5	19.2	19.7	18.6	17.9	20.7	19.3	22.3	23.1	25.0	26.5
MEAN	20.4	20.1	19.2	21.0	20.1	19.9	20.4	20.2	17.1	17.9	17.7	16.8	19.0	17.9	20.4	21.5	22.8	23.9
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSI3	TURBINE I3 50-ft
WSI9	TURBINE I9 50-ft
WSJ6	TURBINE J6 50-ft
WSJ1	TURBINE J11 50-ft
WSK1	TURBINE K1 35-ft
WSK5	TURBINE K5 35-ft
WSK9	TURBINE K9 35-ft
WSK4	TURBINE K14 35-ft
WSL3	TURBINE L3 35-ft

NAME	SITE LOCATION:
WSI5	TURBINE I5 50-ft
WSI4	TURBINE I14 50-ft
WSJ8	TURBINE J8 50-ft
WSJ3	TURBINE J13 50-ft
WSK3	TURBINE K3 35-ft
WSK7	TURBINE K7 35-ft
WSK2	TURBINE K12 35-ft
WSL1	TURBINE L1 35-ft
WSL5	TURBINE L5 35-ft

DIURNAL SUMMARY BY PARAMETER

DOE FREE FLOW DATA - JESS RANCH

OCTOBER 1-3 plus 7-10, 1987

HOUR	WSL8 MPH	WSL0 MPH	WSL2 MPH	WSM2 MPH	WSM4 MPH	WSM6 MPH	WSM8 MPH	WSM9 MPH	WSM1 MPH	WSM3 MPH	WSN1 MPH	WSN4 MPH	WSN6 MPH	WSN8 MPH
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1	23.7	25.3	26.5	23.3	23.6	25.4	26.7	24.1	24.5	26.8	23.4	21.6	21.9	22.4
2	22.0	23.3	24.2	21.3	21.8	23.3	24.3	22.0	22.6	24.5	21.1	20.5	19.6	20.0
3	20.9	22.4	23.7	19.7	20.6	22.4	23.7	20.6	21.6	23.6	19.8	19.9	18.5	18.7
4	18.4	20.2	21.3	17.6	18.5	20.3	21.4	18.5	19.5	21.2	17.7	16.4	15.9	16.4
5	16.9	18.2	19.2	16.4	16.9	18.3	19.5	17.1	17.7	19.4	16.6	15.5	15.6	15.6
6	18.8	19.8	20.5	18.0	18.4	19.5	20.4	18.7	18.8	20.3	17.9	16.0	16.4	16.5
7	17.6	18.8	19.4	17.0	17.6	18.5	19.3	17.8	18.0	19.5	17.0	15.8	15.8	15.8
8	18.3	19.5	20.0	17.7	18.0	18.9	19.5	18.3	18.3	20.0	18.3	17.4	16.9	16.6
9	18.5	20.7	22.5	17.5	17.8	20.0	22.1	17.5	17.9	20.6	17.8	16.4	15.2	15.1
10	22.8	24.8	25.7	22.0	22.4	24.5	25.4	22.2	23.1	25.0	22.2	20.9	19.1	19.4
11	22.5	24.1	25.2	21.6	21.9	23.9	24.9	22.0	22.7	24.6	21.7	20.2	19.0	19.3
12	22.2	23.5	24.5	21.3	21.5	23.4	24.2	21.8	22.5	24.2	22.1	20.6	19.9	19.7
13	21.5	23.2	24.2	20.9	21.0	23.0	23.8	21.5	22.1	23.8	21.8	20.8	19.8	19.7
14	22.2	23.5	24.3	21.6	21.6	23.1	24.1	22.1	22.2	23.9	22.4	21.3	20.4	20.3
15	22.4	23.7	24.7	21.9	21.7	23.4	24.6	22.2	22.5	24.6	22.7	21.6	20.7	20.2
16	22.8	24.1	25.0	22.3	22.2	23.9	24.8	22.8	22.9	24.8	23.0	21.9	21.1	21.1
17	21.4	22.9	23.8	20.7	20.7	22.5	23.8	21.2	21.6	23.9	21.8	20.9	19.5	19.3
18	22.3	24.8	25.6	21.5	21.7	23.8	25.1	22.1	22.5	24.9	21.8	20.6	19.9	20.1
19	22.0	23.0	24.2	21.6	20.8	22.6	24.0	21.3	21.6	23.9	21.3	19.6	19.1	19.2
20	22.7	24.1	24.8	22.2	21.9	23.5	24.6	22.4	22.3	24.6	22.7	21.7	20.6	20.5
21	24.0	25.3	26.4	23.9	23.4	25.1	26.4	24.1	24.2	26.5	24.5	23.4	22.8	22.2
22	24.3	25.9	26.7	23.6	23.9	25.7	26.7	24.4	24.7	26.8	24.4	22.9	22.3	22.5
23	25.0	27.0	27.6	24.3	24.8	26.6	27.5	25.2	25.6	27.6	24.8	23.3	22.7	22.9
24	23.7	25.6	26.9	22.7	23.4	25.5	27.0	23.7	24.4	26.9	23.4	22.1	21.6	21.7
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MEAN	21.6	23.1	24.1	20.9	21.1	22.8	24.0	21.5	21.9	23.9	21.3	20.1	19.4	19.5
VALID HRS	102	102	102	102	102	102	102	102	102	102	102	102	102	102

NAME	SITE LOCATION:
WSL8	TURBINE L8 35-ft
WSL2	TURBINE L12 35-ft
WSM4	TURBINE M4 35-ft
WSM8	TURBINE M8 35-ft
WSM1	TURBINE M11 35-ft
WSN1	TURBINE N1 35-ft
WSN6	TURBINE N6 35-ft

NAME	SITE LOCATION:
WSL0	TURBINE L10 35-ft
WSM2	TURBINE M2 35-ft
WSM6	TURBINE M6 35-ft
WSM9	TURBINE M9 35-ft
WSM3	TURBINE M13 35-ft
WSN4	TURBINE N4 35-ft
WSN8	TURBINE N8 35-ft

SUMMARY

The objective of the Free-Flow study was to collect a sufficient wind data base to describe the general spring-summer (high wind season) wind flow over the Jess and Souza Ranch Study areas. In order to do this, a central monitoring computer was installed on each ranch. The computers were connected by communication cables to 50 turbines on the Souza Ranch and 150 turbines on the Jess Ranch. Anemometers were installed on every other turbine on 12-foot booms at 35 feet above ground level (AGL). Spacing between anemometers was approximately 200 feet in the crosswind direction by 500 feet in the parallel direction. A total of 23 turbines on the Souza Ranch was instrumented in this fashion, as well as two multi-level meteorological towers. On the Jess Ranch, 77 turbines were instrumented; about half at 35 feet AGL and half at 50 feet AGL, plus four additional towers.

Wind data were collected for approximately a 100 hour period on each ranch. All turbines were shut down during these periods so that no turbine wakes would be present. The data periods were selected by the meteorologist to insure that they occurred during typical spring-summer flow regimes.

There were several purposes for collecting this free-flow data. First, the data were to be analyzed to determine the flow variability over the study area. The high density of sensors which was nearly unprecedented in previous publically funded micro-siting studies, allowed a micro-scale examination of the spatial flow variability. Large variations in energy production had been observed previously within these turbine arrays and at other similar arrays. The free-flow dataset allowed determination of how much of this variability was due to differences in ambient flow conditions, without turbine wakes. Second, the two ranches have different levels of terrain complexity, which would allow comparison of terrain influences on the two ranches. Third, the variations in available energy would be compared to subsequent wake energy deficit measurements to be made on the same ranches. And fourth, the dataset would be useful to other researchers, especially those interested in computer modelling of flow over complex terrain.

The raw data collected by the central computer consisted of 10-minute averages. These 10-minute averages were processed into hourly averages. The hourly averages were screened to assure the quality of the data. When that process was complete, the data from all turbines were correlated to a designated upwind reference anemometer. Correlation coefficients (r) and speed ratios were calculated between the turbines and the reference site. The ratios were then plotted on topographic maps, and isopleths were drawn around areas of equal speed ratios. By observation, patterns in the flow were quite apparent.

On the Souza Ranch, speed ratios to the reference tower ranged from 77% to 110%, for a range of 33%. On the Jess Ranch, ratios ranged from 60% to 100%, for a range of 40%. On both ranches flow variations over very small areas were present. For example, within a distance of 400 feet, changes in speed of 20% and changes in theoretical energy of 35%, were measured.

Elevation enhances flow, as expected. However, upstream terrain features appear to play the most significant role in flow variability in these study areas. Several valleys oriented parallel to the predominant flow appear to channel the flow to a great extent. Turbine anemometers downwind of the valleys had enhanced wind speeds, relative to other turbines not near these valleys. Small hills approximately 100 feet higher than surrounding terrain had the opposite effects of the valleys. Turbines 600 to 1000 feet downwind of these hills had lower speed ratios than surrounding turbines. Thus the terrain features upwind of the site appear to play as significant a role in the flow variability as terrain features within the site.

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