A STUDY OF WIND AND OF THE EFFECTS OF WIND AND CHEMICAL APPLICATION ON SURFACE FILM COVER AT LAKE HEFNER FOR 1966

By

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A STUDY OF WIND AND OF THE EFFECTS OF WIND AND CHEMICAL APPLICATION ON SURFACE FILM COVER AT LAKE HEFNER FOR 1966

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PREFACE

This thesis was one part of an overall evaporation suppression research project conducted at Lake Hefner, Oklahoma. The research study was conducted by the Agricultural Engineering Department, Oklahoma State University, under contract with the Bureau of Reclamation. This thesis was restricted to an analysis of the wind, film cover, and chemical application.

The author expresses appreciation to Franklin R. Crow, Associate Professor of Agricultural Engineering, for guidance in performing the research and in writing this thesis.

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CHAPTER I

INTRODUCTION

Evaporation suppression is by no means an original concept of the 1966 Lake Hefner Investigation. In 1891, Agnes Pockles of Germany discovered that certain fatty alcohols would spread in thin layers on the surface of water. She used a primitive tin trough for her experiments. Rideal (1925) concluded that certain fatty alcohols could reduce evaporation as much as 52%. Mansfield in 1952 experimented with monomolecular alcohol films for reducing evaporation of water under natural conditions. He cast doubt on widespread use of the films for large reservoirs. Since that time much work has been done in several countries studying chemical monolayers as a method of reducing evaporation.

Since monolayers are so readily transported by wind the reduction of this adverse effect should provide a higher percentage of evaporation reduction. After extensive research, Crow (1964) concluded that some method of continuous application was the only feasible approach to the wind problem on large reservoirs. In the past several years the Bureau of Reclamation conducted exhaustive tests on continuous distribution systems. They experimented with automatic shore line dispensers, boat sprayers and, or dusters, pellet dispensers, and airplane dusters. The method of continuous application used in the 1966 Lake Hefner Study was a submerged sprinkler system paralleling the south shore of the lake.

The research reported in this thesis was one phase of an overall research project on evaporation suppression at Lake Hefner. The principal investigating agencies were the Agricultural Engineering Department of Oklahoma State University and the Water Conservation Branch of the United States Bureau of Reclamation. The project was initiated in 1965 by Oklahoma State University under contract with the Bureau of Reclamation and continued through the summer of 1966. Water budget and energy budget methods of calculating evaporation were researched. Also studied were the USBR Simplified Method and the Combined Methods of computing evaporation reduction. The Bureau financed and instrumented the project while Oklahoma State acquired and evaluated the data.

This thesis was limited to a study of the physical parameters influencing the chemical monolayer. Lake wind speed received primary consideration. Also studied were the effects of wind direction and chemical application rate on the monolayer.

Research Location

Lake Hefner is located in northwest Oklahoma City. The lake, shown in Figure 1, is an approximately circular-shaped reservoir. It is situated on high ground where it has good exposure to the prevailing southerly winds. The main instrument stations were the south station, the intake tower, the observation tower, and the batching plant.

The south station was the main instrument station for the 1966 study. It was located near the shoreline on the southernmost portion of the lake. It has good exposure to the southerly winds. A thicket of trees prevented good exposure to northeasterly winds. The instrument

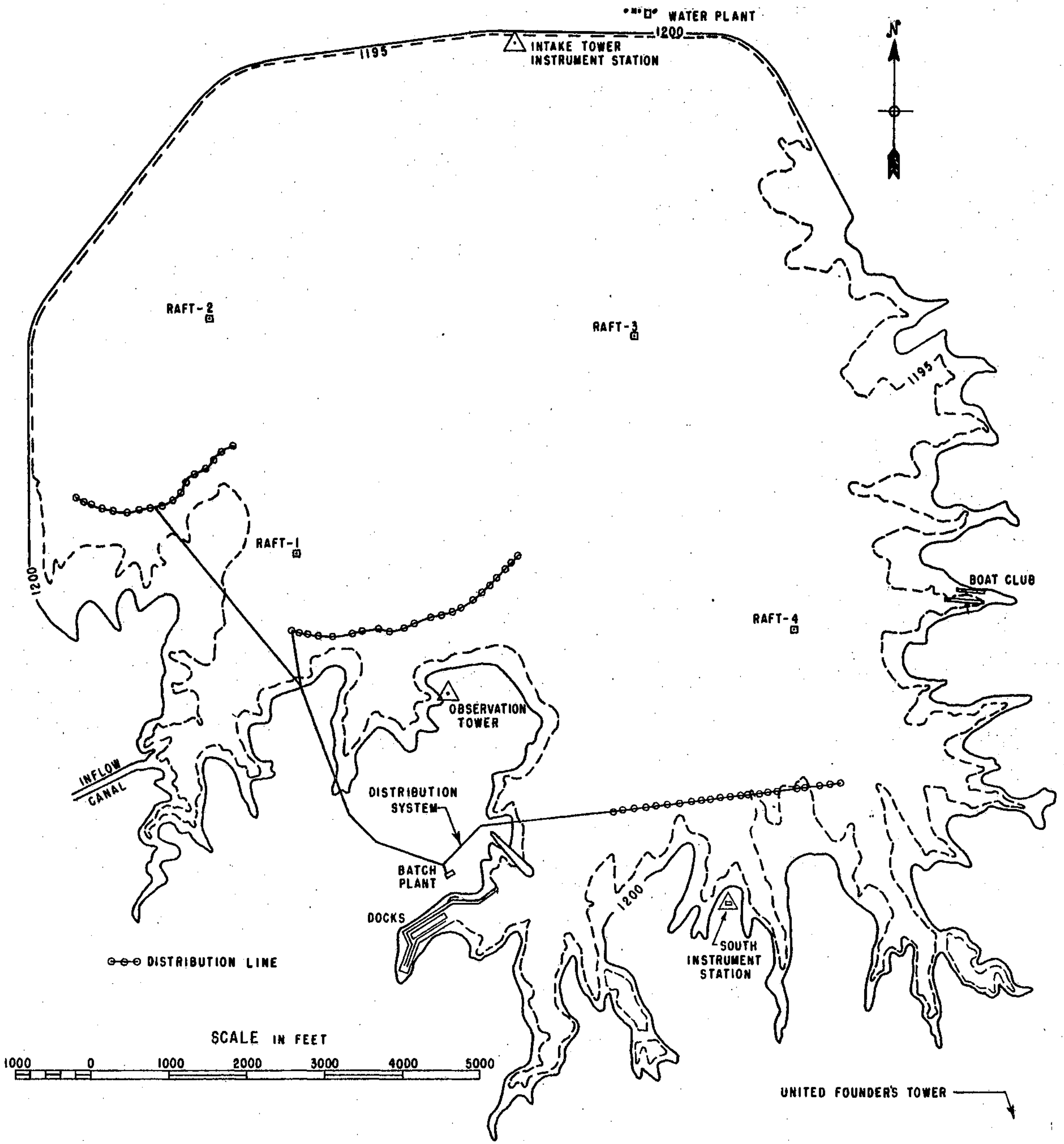


Figure 1. Map of Lake Hefner Showing the Instrumentation Stations, the Rafts, the Batch Plant, the Observation Tower, and the Distribution System for the 1966 Investigation.

trailer distorted the true readings of easterly winds at the 2-meter level.

The intake tower had excellent exposure to southerly winds. It was located near the dam at the northernmost portion of the lake. The anemometer mast was positioned on the south side of the tower. The dam and the intake tower prevented good exposure to northerly winds, especially at the 2-meter level.

The observation tower had excellent exposure to wind from any direction. It was located almost due south of the intake tower and adjacent to the shoreline on the south side of the lake. The anemometers were positioned on the south side of the tower. For this reason the readings for northerly wind speeds were not accurate.

The batching plant served as a regulating station for the chemical distribution system. It was located just north of the docks and due south of the observation tower.

CHAPTER II

OBJECTIVES

The three objectives set for this thesis were to:

1. Determine the effects of the lake wind speed and direction on the movement and surface coverage of a chemical film applied to suppress evaporation.
2. Determine the variation of wind speed with height, with distance across the lake, and with time.
3. Determine the equation expressing film cover on the lake surface as a function of wind speed and chemical application rate.

CHAPTER III

REVIEW OF LITERATURE

Wind Movement

Webster (1961) defined wind as "air in motion with any degree of velocity." The forces acting on wind, or air in motion, are gravity, friction, and hydrostatic pressure, according to Petterssen (1940). Wind is probably more affected by the immediate surroundings of the observation station than by any other meteorological elements, Milham (1929) concluded. He stated that wind gusts are the result of surface roughness.

Winds are caused by slight pressure differences. Atmospheric pressure distribution is represented by isobars. Isobars are lines connecting places having the same atmospheric pressure at a given elevation. The pressure gradient is the measure of the rate and direction of the change in atmospheric pressure. The pressure gradient acts at right angles to the isobars. Wind speed is inversely proportional to the distance between isobars and directly proportional to the pressure gradient. Petterssen wrote that wind approaches the geostrophic wind or gradient wind upon good vertical mixing. Trewartha (1954) reported that the geostrophic wind blows parallel with the isobars in the northern hemisphere, with the high pressure isobar to the right.

Wind speed and direction vary seasonally. The wind speed is usually greater in winter and spring than in summer and fall. The highest average wind speed is usually observed in March. The predominant wind direction varies seasonally at Oklahoma City, as shown by the Decennial Census of the United States for 1951-60 (1963). For the decade from 1951 to 1960, the predominant wind direction was northerly for January and February. The remaining ten months had predominantly southerly winds. A standard sixteen sector compass was used in recording the wind directions.

Wind speed varies diurnally. Blair and Fite (1965) reported that wind speed is greater by day than by night in most cases, especially in the summer. The highest wind speed during the day usually occurs from 1300 to 1500. The minimum wind speed usually occurs about sunrise. Fry (1965) found that the maximum diurnal wind speed occurred at 1000 and the minimum at 2000 for Lake Hefner, Oklahoma during the 1965 tests. Milham stated that the maximum diurnal wind speed occurs between 1200 and 1600, while the minimum occurs at sunrise. He explained the variation as being due to convection. During the day layers of air near the ground become heated. As they rise, the colder air comes down by convection to replace the rising air. This colder air brings with it the higher wind speeds of the upper atmosphere. Zingg (1949) wrote that the higher daylight wind speeds were due to adiabatic conditions during this time. At higher levels, the wind speed is a maximum at night because the energy is radiated upward at night. (Geiger, 1966)

A slight diurnal variation in wind direction also exists. The winds shifts slightly in a clockwise direction during daylight hours and shifts back in a counter-clockwise direction during the night. Milham explained this as due to convection. The upper air currents always blow in a direction turned somewhat clockwise as contrasted with the surface winds. When the upper air masses descend during daylight hours, they bring with them a wind direction turned in a slightly clockwise manner.

Wind Profiles

Schwab, Frevert, Edminister, and Barnes (1965-66) maintained that

> "In immediate contact with the soil surface the air is nearly at rest because of the drag forces between the air and the soil surface. Internal shear of the air allows an increased velocity with height above the soil until all effect of the soil surface is dissipated."

Petterssen generalized that the friction layer extends from 500 to 1000 meters above the ground. The thickness of the friction layer depends on the wind speed, the air stability, and the curvature of the wind path. Trewartha maintained that winds are geostrophic above 1000 meters, or above the friction layer as defined by Petterssen. Marciano and Harbeck (1954) concluded that the boundary layer over Lake Hefner extended as high as 47.4 meters. They felt that the influence of the boundary layer was not readily detectable above 16 meters however. Linsley, Kohler, and Paulhus (1958) continued in this line of thought by stating

> "Wind speeds are reduced and directions deflected in the lower layers of the atmosphere because of friction produced by trees, buildings, and other obstacles. These effects become negligible above about 2000 ft, and this lower layer is referred to as the friction layer. Over land the surface wind speed averages about 40 percent of that just above the friction layer, and at sea about 70 per cent. The relationship between wind speed at anemometer height and that at some higher level in the friction layer may be expressed by the empirical formula

$$\frac{v}{v_o} = \left(\frac{z}{z_o}\right)^k \qquad (1)$$

where

v = Wind speed at height z

v_o = Wind speed at height z_o

z = Anemometer height

z_o = Base anemometer height above the surface, dependent on surface roughness

k = Empirical coefficient, approximately 1/7."

Sutton (1953) wrote that a k value of 0.143 was the generally accepted power-law profile for the turbulent boundary layer of a flat plate in a wind tunnel. He added that this k value was probably a satisfactory approximation to the profile in a fairly deep layer. Depending on temperature stability throughout the profile, k generally varied between 0 and 1. High k values were obtained under exceptional stability.

Geiger wrote that a z_o height of 1 meter was considered normal. He further stated that the value of the exponent k is the tangent of the angle at which the straight line is inclined to the ordinate. The straight line is the resultant line from the plot of the logarithm of wind speed versus the logarithm of height. The value of k decreases with height due to decreasing ground friction. For the lowest 1.5 meters above the ground, k may be considered constant. Geiger pointed out that the laws governing wind increase with height applied to mean values over a long period of time.

In a study completed at the Agricultural Engineering Ponds at Stillwater, Perry (1965) found the k value in (1) to vary from 0.07 to 0.119 for air movement over water. The pond was 0.28 acres in area. The anemometer levels used were 2 and 4-meters above the water surface.

Blair and Fite pointed out the general variation in wind speed with height. At 33 ft above the ground the wind speed is approximately twice that at 11.5 ft. At 100 ft the wind speed is approximately 1.2

times the speed at 33 ft.

According to Cermak (1954), the Prandtl-von Karman relationships indicated that for turbulent flow near a boundary u_z is a linear function of log z.

where u_z = Wind speed at height z

z = Anemometer height

According to Marciano and Harbeck, the velocity in a fully established boundary layer over a plane surface varies with the logarithm of height for turbulent flow without density gradients. Johnson (1965) stated that wind speed is proportional to the logarithm of height, but the exact manner in which wind speed changes with the logarithm of height depends on air temperature conditions. When the air temperature is uniform with height, or thoroughly mixed, the log height-wind speed curve approaches a straight line. He further concluded that the wind profile from the log height-wind speed curve is convex upward at night when the air is cooled from below by contact with the ground. In the afternoon when the air is warmed from below, the wind profile is concave upwards.

Harbeck and others (1958) found no deviation from the logarithmic wind law between 2 and 8-meters at Lake Hefner. This conclusion was reached from data over periods of three hours or longer, and regardless of stability conditions. They found the 8 to 2-meter arithmetic wind speed ratio to be 1.237 for Lake Hefner.

Film Movement

Much research has been done concerning the effect of the wind speed on the surface film. Mansfield (1953) of Australia studied the continuous loss of the film due to wind. Keulegan (1951), using a 60 ft wind tunnel, measured the speed of the water surface to be approximately 0.033 that of the wind speed for turbulent conditions. Turbulent conditions were defined as those times when the Reynolds Number exceed 30,000. He defined the Reynolds Number for his study as

$$R = \frac{vd}{\mu} \tag{2}$$

where
R = Reynolds Number, dimensionless
v = Surface speed, LT^{-1}
d = Depth of fluid, L
μ = Fluid Kinematic viscosity, L^2T^{-1}

Van Dorn (1953), using an 800 ft pond, verified the results of Keulegan concerning surface movement under turbulent conditions. His study was closely modeled after Keulegan's experiments. Vines (1962) of Australia found the film speed-wind speed ratio was 0.036 for his lake study. His studies were restricted to distances of 20 ft. He admitted that his measurements were not very accurate, however. McArthur (1962) conducted tests at Lock Laggan, Scotland. He found the ratio of film speed to wind speed to vary from 0.04 to 0.07 for lake distances from 2,500 to 6,700 ft.

Keulegan and Van Dorn discounted any effects from wave action on the water surface, whether the rate measurement was taken from the leading or the retreating edge of the film. Fitzgerald (1963) found that at wind speeds within the range of 3.50 to 7.50 meters/sec, the ratio of film speed to wind speed was markedly affected by the damping out of the surface waves. McArthur found that only in the first tests of film speed was the ratio relatively constant at 0.045. Consecutive tests showed the ratio to increase progressively to 0.07. McArthur concluded that the rate of film acceleration was proportional to the water temperature, and was independent of the method used to spread the film. Davies (1962) gave the following explanation for film acceleration

> "When a patch or 'slick' of a surface film of hexadecanol is present, the surface of the water is no longer rippling, and the energy transferred from the wind becomes converted into the kinetic energy of laminar flow of the underlying water. Under such conditions the drag coefficient of the wind on the surface is virtually the same as for a clean, smooth surface, and, since there is no slippage between the monolayer and the underlying water, the water will flow along the surface, and return near the bottom or at the sides. If the lake is deep, a considerable time (and length of travel) will be necessary to reach a steady state, when, however, the monolayer should be moving quite rapidly because the underlying water is also moving."

From this explanation Davies concluded that

> "The slick should accelerate to velocities considerably in excess of Keulegan's limit of (0.033 x wind speed), because the underlying water gains momentum if there is no turbulence. The whole lake will tend to become 'stirred' by the wind in the presence of the monolayer: the warmer (and aerated) water near the surface will be carried down at the end of the reservoir if the wind energy can offset the density differences..."

Fitzgerald (1964) questioned the explanation by Davies. He suggested that the increase in the ratio of film speed to wind speed was due to differing conditions at the points of measurement. He cited Vines' measurements as being on the trailing edge of the film while McArthur's measurements were on the advancing edge. Vines' measurements were unaffected by surface damping. Fitzgerald also stated that the laminar flow conditions near the surface did not extend down into the body of water. Davies did not allow for acceleration due to the spreading rate of the film, he concluded.

Fitzgerald maintained that for a wavy surface, as obtained with clean water, the film speed-wind speed ratio had a constant value of

0.03. With addition of a chemical detergent, comprox, the ratio increased to 0.045. For a fully damped surface the speed ratio increased linearly with the wind speed for low wind speeds and tended to remain at 0.045 for wind speeds greater than 550 cm/sec. (12.3 mph)

Wind speed was measured at different heights above the water surface for the studies of surface and film movements. Marciano and Harbeck concluded that the vapor blanket extended up to 8-meters above the water surface at Lake Hefner. The standard measurement location for relative humidity and for wind has been taken as 2-meters, however. Keulegan measured the wind speed at 10-centimeters for his wind-tunnel study, while Van Dorn recorded wind speed at 10-meters for his pond study. Vines used 2-meter wind speed record for his lake research. McArthur took his wind speed readings at 0.5 meters above the lake surface. Fitzgerald measured wind speed at the 2-centimeter height for his 9 ft wind tunnel research.

From this previous research, it is obvious that the ratio of film speed to wind speed does vary. However, the reason or reasons for this variation are still subject to debate.

Chemical Distribution

Work has been done to determine the relationship among the variables film cover, application rate, and wind speed. Relationships have been derived between chemical application rate and wind speed, between film cover and wind speed, and between film cover and the two variables of wind speed and application rate.

For large lakes, Timblin and Florey (1959) concluded that a correlation did not exist between the application rate and the wind speed.

They discounted a direct relationship between these two variables because of the several factors influencing the application rate. For the 1958 Lake Hefner study, the application rate varied from 0.1 to 0.5 lbs/acre/day.

Crow (1961) determined an empirical equation which expressed the relationship between the wind speed and the application rate per foot of surface width necessary to maintain a film cover on small ponds.

$$R = 0.0000093\ U^{2.02} \tag{3}$$

where R = Application rate in lbs per hour per foot of surface width, normal to wind direction

U = Wind speed in mph at the 2-meter level

In the 1958 Lake Hefner study, a linear regression analysis was made in an attempt to correlate film cover and wind speed. The scatter of points showed a definite trend, although the correlation coefficient was only 0.56 and the standard deviation was 12%. The Bureau of Reclamation concluded that the limiting wind speed for chemical application and resulting film cover was 15 mph. The resulting equation was

$$Y = 58.8 - 3.05\ X \tag{4}$$

where Y = Film cover expressed as a percent of the lake surface area

X = Lake wind speed at the 2-meter level in mph

Grundy (1962), in East Africa, found that the width of the film, perpendicular to the wind direction, varied with the rate of chemical application and with the wind speed. He also concluded that the film was damaged by waves. The extent of the damage varied with the wind speed and the wind fetch. Several types of chemical application were tried for these tests. The wind speed range was 4 to 20 knots.

Numerous methods of applying the alcohol have been tried. The original method of application was the beads in raft system, where solid alcohol was floated on rafts with wire gauze sides. The laboratory method consisted of a solvent application. The alcohol was dissolved in a volatile petroleum fraction and ethyl alcohol for application. Boat application of the chemical showed the merits of the powder method. The powdered alcohol was dusted onto the lake from a boat duster. The emulsion method consisted of an alcohol-water slurry, continuously agitated to retain consistency. The emulsion, or slurry, was sprayed onto the water surface. Little success was realized in using a hot spray application. The alcohol was melted, then sprayed into the air where it solidified before hitting the water. The spreading ability of the hot sprayed alcohol was inferior to that of the cooled dusting powder.

Extensive work has been done in several countries evaluating the different methods of chemical application. A comprehensive review by Frenkiel (1965) gave a critique of the research completed in this area.

CHAPTER IV

INSTRUMENTATION AND PROCEDURES

Measurement of the pertinent quantities needed for this study required two instrument stations, an observation tower, four rafts, and a batching plant. The station locations are shown in Figure 1. The parameters measured were:

1. Wind Speed and Direction
2. Film Cover
3. Chemical Application Rate

Wind Speed and Direction

The main instrument station was the south station, as shown in Figure 2. Three-cup totalizing anemometers were used to acquire the wind speed records at the 2 and 8-meter levels. A direction vane located at the 4-meter level of the instrument mast registered wind direction. Wind speed at the 2 and 8-meter levels and wind direction were recorded continuously on a ten channel event recorder. Two channels were used to record wind speed and eight channels were used for wind direction as shown in Figure 4. Wind speed was recorded in miles while wind direction was recorded in 45° increments. The recorder paper was time scaled so that wind speed in mph could be read from the recorder. Wind direction was read to the nearest 22.5° by interpolation.

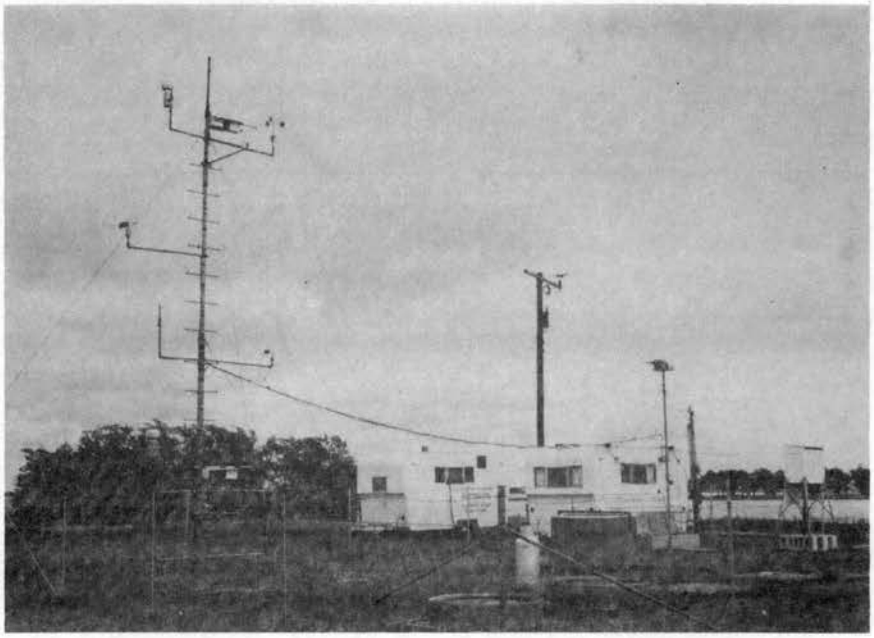


Figure 2. South Station Instrument Site.

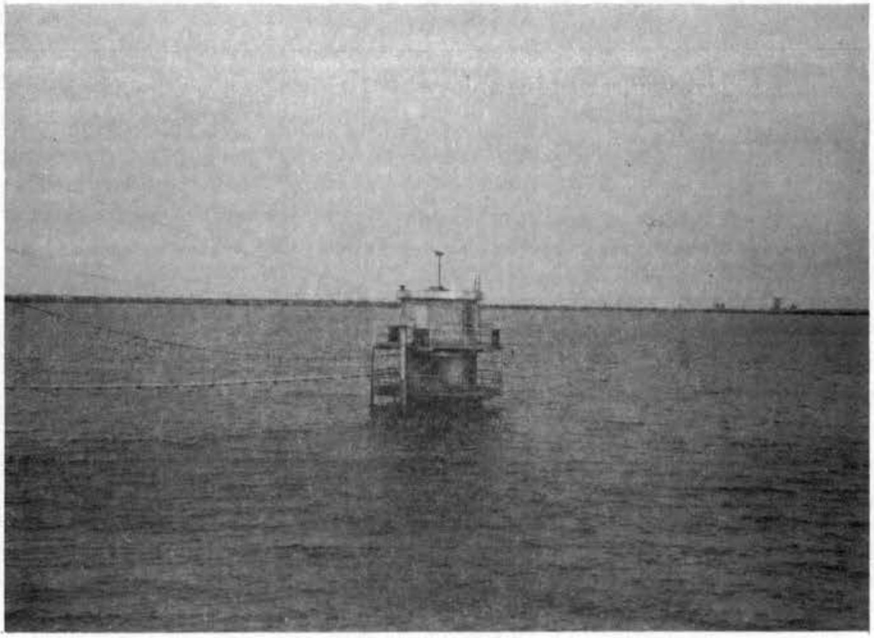


Figure 3. Intake Tower Instrument Site.

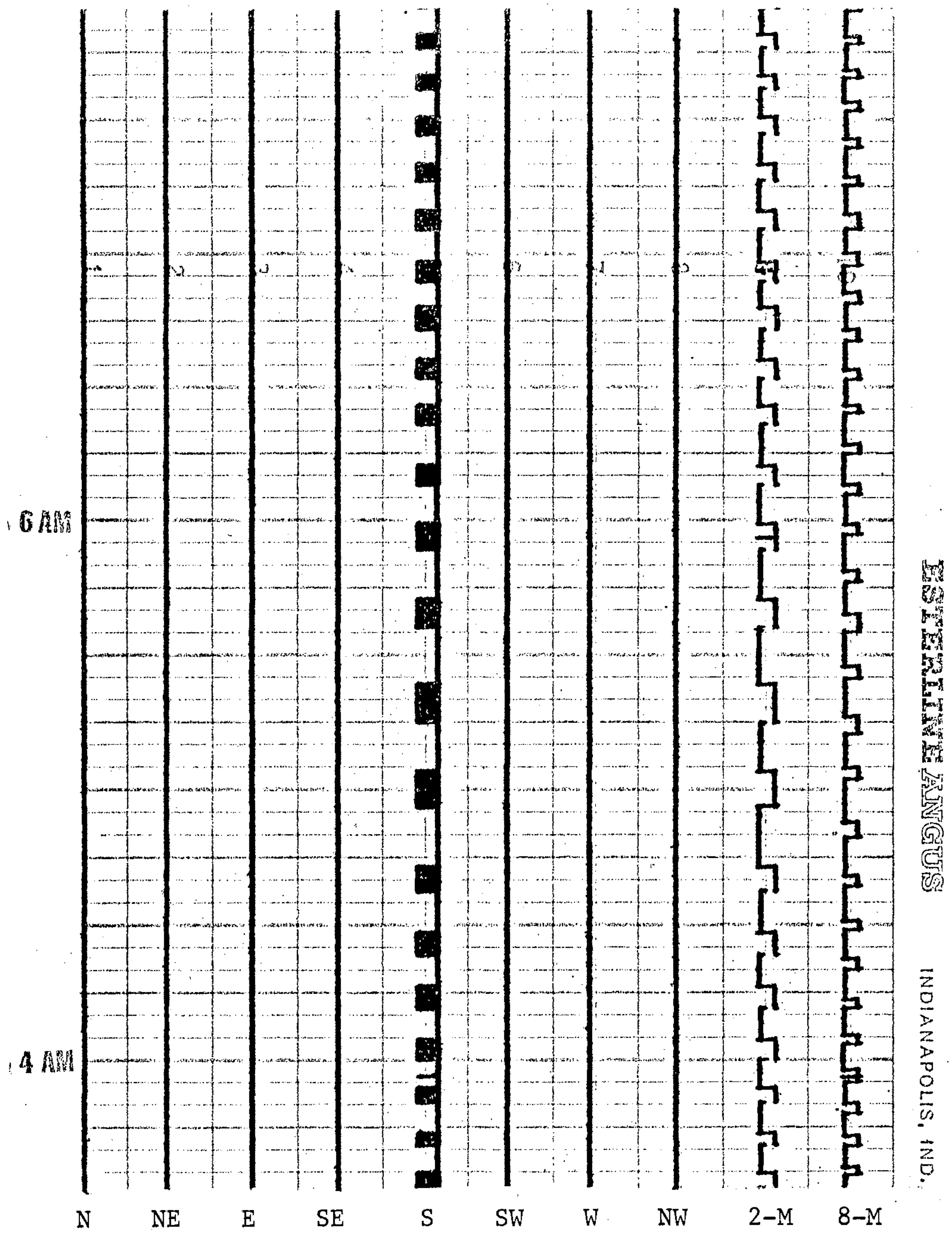


Figure 4. Typical Chart Record Showing Wind Direction From Due South and 2 and 8-Meter South Station Wind Travel in Miles From 0400 to 0800 on August 6, 1966.

With the exception of wind direction data, a duplicate record of wind travel was maintained at the intake tower, shown in Figure 3. Totalizing anemometers were used to take the data at the 2 and 8-meter levels. A printer-recorder was used to record the hourly wind speeds at the 2 levels.

Four anemometers were installed on the observation tower, shown in Figure 5. Until July 28, 1966, the anemometers were positioned at the 2, 4, 8, and 25-meter levels. On July 28, they were re-installed at the 2, 8, 16, and 25-meter levels. When maps were being made, the 25-meter anemometer was read every hour. The remaining ones were read no more than twice a day, on the average.

Lake wind was measured at four locations. A typical instrument raft used in measuring 2-meter lake wind speed is shown in Figure 6. No hourly record of wind travel was made, although the anemometers were read during each raft check. Since raft checks were usually made each day, a record of total daily raft wind was maintained.

Film Cover

An example of film cover on the lake surface is shown in Figure 7. Hourly film cover was mapped from the 92 ft observation tower. A plane table with alidade was used for mapping. The map scale was 1 inch = 1067 ft and a distance scale was calibrated to give distances on the map corresponding to the alidade readings. A different scale was used for each foot of change in lake stage. The lake area covered by film was planimetered upon completion of each map to determine the percentage of film cover. The film cover was recorded as a decimal fraction of the lake surface area. Since mapping was started at 0600

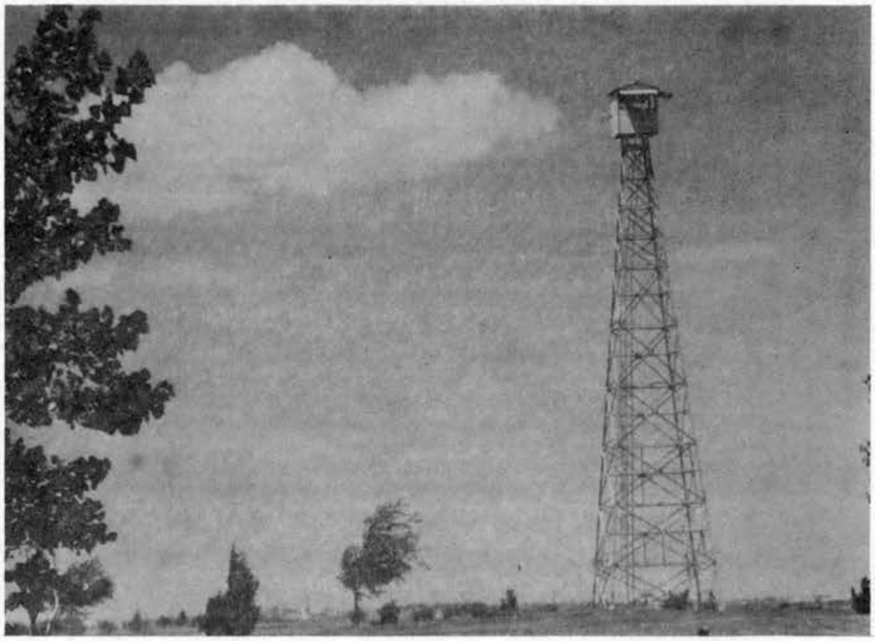


Figure 5. Observation Tower.

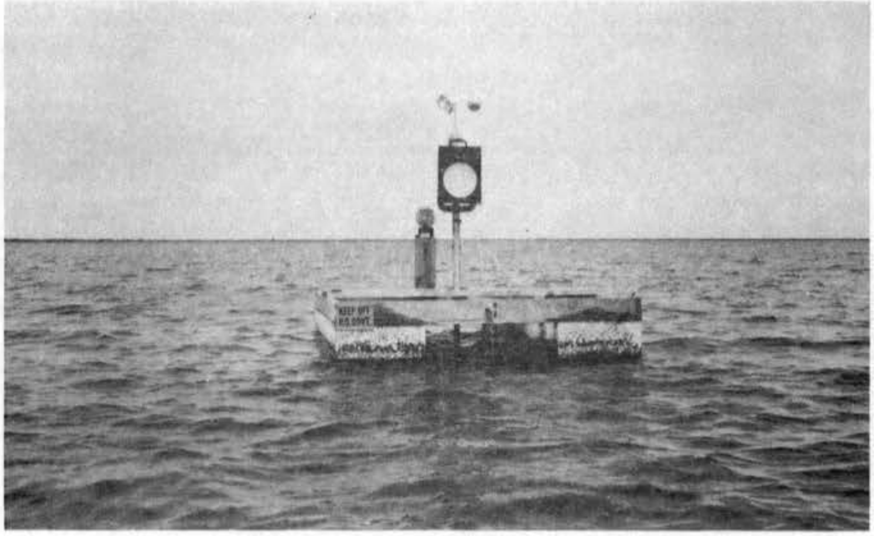


Figure 6. Instrument Raft Measuring Wind Travel.

each day and terminated at 1900, nightly film cover was estimated. The estimate depended on wind speed, wind direction, and chemical application rate.

Chemical Application

The chemical distribution system was designed by the Bureau of Reclamation. Analagous to a sprinkler irrigation system, the system incorporated two dock pumps of 50 and 100 gpm capacity, a branching mainline, three laterals, and floating sprinklers. Alcohol was injected into the mainline flow at the batching plant. From the batching plant the mainline divided with one line going to the east lateral and another line going to the middle and west laterals.

The three laterals were located on the lake bed near the south shore, as shown in Figure 1. They had the following length and number of sprinklers: East, 3150 ft, 22 sprinklers; Middle, 3000 ft, 21 sprinklers; West, 2250 ft, 17 sprinklers. Styrofoam floats supported the sprinklers on the lake surface. Plastic, 3/4-inch risers connected the sprinklers to the laterals.

The alcohol injection system consisted of a 1155 gallon capacity vat, a continuous duty mixer, and a low capacity, high pressure injection pump. The vat and the mixer are shown in Figure 8. The alcohol, in 50-lb cardboard boxes, was sifted through a window screen into the batching tank. The mixer kept the alcohol in a water suspension for uniform application. A variable speed electric motor drove the pump, which injected the slurry into the mainline against a line pressure of 40-45 psi.

The chemical application rate was controlled manually by changing

Figure 7. Formation of Film Cover on Lake Hefner from a Distribution Lateral.

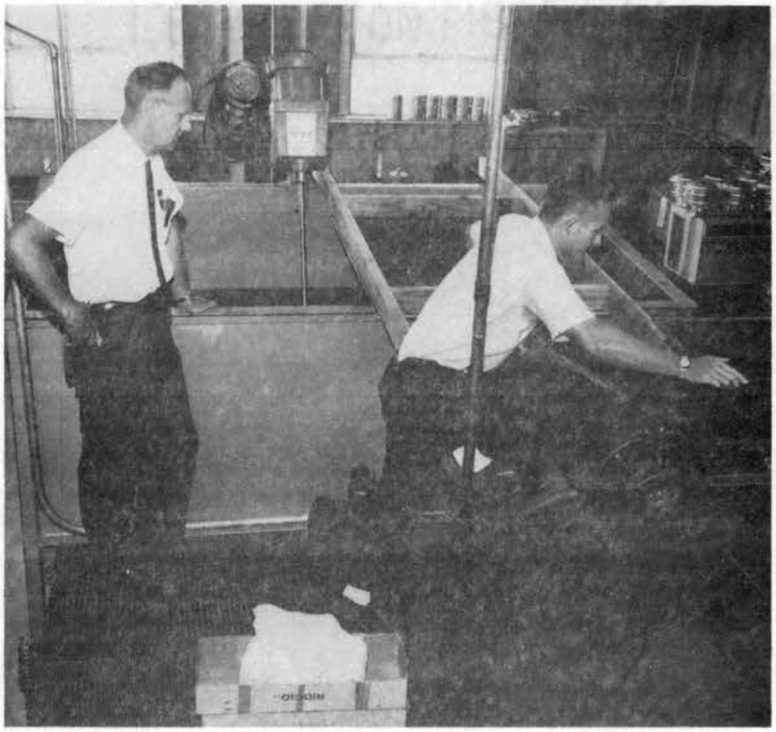


Figure 8. Chemical Batching Tank and Slurry Mix.

the voltage on the variable speed pump motor. Adjustment in the application rate was also made by varying the standard mix ratio of one lb of alcohol per gallon of water to as low as 0.5 lbs/gal, or as high as 2.0 lbs/gal. A written log was kept of the inches of slurry pumped from the tank, and the application rate in pounds per hour was computed from this data.

The alcohol used in this study had the following chemical analysis: 2% C_{14}, 29% C_{16}, 61% C_{18}, 5% C_{20}, and 3% non-alcohol. The maximum particle size was 250 microns.

CHAPTER V

ANALYSIS OF DATA

Wind Speed

For the 1966 chemical application season, a total of 2784 hours of wind speed records was taken. This period covered 116 days from June 21 to October 14, divided into 15 thermal survey periods, as shown in Table 1. The thermal survey periods, or TSP's, were those time intervals between lake temperature profile readings.

All wind speed data were punched on computer cards, with one card for each 12 hours of record. South Station 2 and 8-meter wind speed charts were read and hourly wind speeds were recorded. Intake tower 2 and 8-meter wind speeds were read from the printer-recorder by computing the difference between total mileage readings punched hourly by the recorder. Daily total wind travel at the four rafts was computed from the difference in daily odometer readings. The average hourly wind speed by TSP's was computed using the total miles of wind travel at each of the four rafts, as shown in Table 2. Observation tower wind speeds were obtained from the odometers of four totalizing anemometers. These odometers, though read infrequently, furnished wind profile data, shown in Tables 3 and 4.

TABLE 1

THERMAL SURVEY PERIOD DATES AND TIME INTERVALS FOR THE 1966 LAKE HEFNER INVESTIGATION

TSP	Starting Time		Ending Time		Hours	Days
1	June 14	0815	June 21	0730	167.2	6.969
2	June 21	0730	June 28	0800	168.5	7.021
3	June 28	0800	July 6	1030	194.5	8.104
4	July 6	1030	July 12	0800	141.5	5.896
5	July 12	0800	July 25	1000	314.0	13.083
6	July 25	1000	Aug. 2	1230	194.5	8.104
7	Aug. 3	0930	Aug. 10	1130	170.0	7.083
8	Aug. 12	0930	Aug. 19	1400	172.5	7.188
9	Aug. 19	1400	Aug. 28	0800	210.0	8.750
10	Aug. 28	0800	Sept. 3	1700	153.0	6.375
11	Sept. 4	1730	Sept.12	1700	191.5	7.979
12	Sept.12	1700	Sept.21	1600	215.0	8.958
13	Sept.21	1600	Sept.29	1530	191.5	7.979
14	Sept.29	1530	Oct. 6	1500	167.5	6.979
15	Oct. 6	1500	Oct. 15	1130	212.5	8.854

TABLE 2

AVERAGE HOURLY WIND SPEED AT RAFTS BY TSP, 1966

	Wind Speed (mph) at Raft				
TSP	1	2	3	4	Average
1966					
1	-	10.3	-	9.7	10.0
2	-	14.6	-	-	14.6
3	9.3	9.6	9.4	9.2	9.3
4	12.6	13.2	13.2	12.9	13.0
5	10.1	10.4	10.1	9.8	10.1
6	10.7	11.0	10.9	10.7	10.8
7	7.3	7.7	7.4	7.1	7.4
8	-	12.3	12.1	11.6	12.0
9	-	10.3	10.4	10.0	10.2
10	11.1	11.8	11.6	11.1	11.4
11	6.3	6.7	6.5	6.1	6.4
12	8.2	7.9	8.2	8.1	8.1
13	8.3	8.2	8.3	8.3	8.3
14	12.5	12.6	13.1	12.8	12.8
15	14.6	15.0	15.1	14.8	14.9

TABLE 3

AVERAGE WIND SPEEDS AT VARIOUS ANEMOMETER LEVELS AT THE OBSERVATION TOWER FOR THE PERIOD JULY 11 - 28, 1966

Date and Time Interval	Average Hourly Wind Speeds in MPH at Height			
	2-meters	4-meters	8-meters	25-meters
7/11/1800 - 7/12/0835	11.69	13.00	14.70	18.20
7/12/0835 - 7/13/1520	11.92	13.20	14.70	17.80
7/13/1520 - 7/14/1248	8.55	9.50	10.80	13.70
7/14/1248 - 7/14/1500	8.77	9.60	10.50	11.50
7/14/1500 - 7/15/0600	7.90	8.80	9.90	12.30
7/15/0600 - 7/15/0740	3.19	3.40	3.30	3.90
7/19/1515 - 7/20/0816	6.74	7.44	8.03	9.06
7/20/0816 - 7/21/0905	7.09	7.96	8.52	9.12
7/21/0905 - 7/21/1549	8.93	10.50	10.78	11.12
7/21/1549 - 7/22/0825	7.40	8.46	9.44	9.75
7/22/0825 - 7/24/1315	8.38	9.38	10.36	11.23
7/24/1315 - 7/25/0815	6.77	7.66	8.60	9.37
7/25/0815 - 7/25/1012	9.69	11.38	12.26	12.93
7/25/1012 - 7/25/1327	10.46	10.98	12.09	13.35
7/25/1327 - 7/25/1650	13.64	15.15	16.77	18.16
7/25/1650 - 7/26/0605	9.99	11.13	12.46	14.52
7/26/0605 - 7/26/1005	13.40	14.85	16.30	18.42
7/26/1005 - 7/26/1224	16.35	18.07	19.87	23.00
7/26/1224 - 7/26/1536	12.56	13.90	15.31	17.40
7/26/1536 - 7/27/0600	10.50	11.85	13.42	15.53
7/27/0600 - 7/27/1100	6.72	7.36	7.86	9.28
7/27/1100 - 7/27/1330	7.14	8.16	8.84	9.92
7/27/1330 - 7/28/0834	9.87	11.14	12.54	14.22
7/28/0834 - 7/28/0950	6.59	6.75	6.02	7.86
7/28/1200 - 7/28/1315	4.72	5.12	5.44	6.64

TABLE 4

AVERAGE WIND SPEEDS AT VARIOUS ANEMOMETER LEVELS AT THE OBSERVATION TOWER FOR THE PERIOD JULY 29 - AUGUST 14, 1966

	Average Hourly Wind Speeds in MPH at Height			
Time Interval	2-meters	8-meters	16-meters	25-meters
7/29/0600 - 7/29/1034	7.27	8.57	9.80	10.86
7/29/1034 - 7/29/1116	12.29	15.43	17.00	18.57
7/29/1116 - 7/30/0600	6.07	7.79	9.17	9.24
7/31/1315 - 8/1/0600	9.68	12.27	13.83	13.98
8/1/0600 - 8/1/1200	11.27	13.85	14.90	15.81
8/1/1200 - 8/1/1927	11.17	14.24	15.64	16.01
8/1/1927 - 8/2/0600	10.56	11.67	13.79	14.30
8/3/1200 - 8/3/1930	5.96	6.74	7.42	7.27
8/3/1930 - 8/4/0645	3.13	4.13	4.96	4.58
8/4/0645 - 8/4/1500	2.73	2.59	3.14	3.32
8/4/1500 - 8/4/1815	7.24	8.34	8.96	8.74
8/4/1815 - 8/5/0600	4.78	6.27	7.22	6.73
8/5/0600 - 8/5/0930	2.97	3.89	4.31	4.48
8/5/0930 - 8/6/0610	4.07	5.21	6.40	7.12
8/6/0610 - 8/6/1500	4.57	5.27	5.96	6.15
8/6/1500 - 8/6/1930	6.94	8.62	9.83	8.92
8/6/1930 - 8/7/0610	6.64	7.97	9.50	9.29
8/7/0610 - 8/8/0600	5.04	4.99	6.02	5.92
8/8/0600 - 8/8/1610	7.64	7.78	8.86	8.99
8/8/1610 - 8/8/1925	3.26	3.41	4.41	4.53
8/8/1925 - 8/9/0600	6.43	8.07	9.73	11.48
8/9/0600 - 8/9/1930	8.56	10.18	11.14	11.65
8/9/1930 - 8/10/0600	10.20	11.71	13.15	13.95
8/10/0600 - 8/10/1855	6.67	7.27	7.99	8.32
8/10/1855 - 8/11/0610	9.72	10.87	11.52	11.25
8/11/0610 - 8/11/1210	6.48	7.25	7.75	7.53
8/11/1210 - 8/12/0810	7.34	9.13	10.16	9.54
8/12/0810 - 8/12/1410	7.98	9.55	10.40	9.97
8/12/1410 - 8/12/1624	8.17	9.73	10.54	10.13
8/12/1624 - 8/13/0600	7.87	10.04	11.16	11.10
8/13/0600 - 8/13/1845	7.39	9.45	9.57	10.77
8/13/1845 - 8/14/0600	5.59	7.25	8.23	8.99

Wind Direction

Wind direction, in 22.5° increments from 0 to 360°, was read from the event recorder at the south station. Some 2784 hourly values of wind direction in degrees were punched on computer cards.

Film Cover

The initial film cover for 1966 was generated on July 6. Intermittent film cover was maintained on the lake until September 29. Hourly values of film cover were punched on computer cards to facilitate the analysis.

Chemical Application Rate

The hourly application rate was determined by computing the stage changes between alcohol additions to the batching tank. The pounds of alcohol used per hour was derived by multiplying the stage change in gallons by the mix ratio of pounds alcohol to gallons water. Since the stage change was not recorded at regular hourly intervals, some interpolation had to be done to gain application rates for each hour.

In total, approximately 63,330 lbs of alcohol was applied to the lake from July 6 to September 29, as shown in Table 5. A check was made on August 28 to determine the exact weight of alcohol per box. The figure gained was used in computing the total alcohol used. From 0303 until 2310 on August 28, each box was weighed. For this 20-hour period, the alcohol weight per box was 44.3 lbs.

TABLE 5

SUMMARY OF ALCOHOL APPLIED AT LAKE HEFNER, 1966

Date	Alcohol (lbs)* Added To Batching Tank on Given Date in		
	July 1966	August 1966	September 1966
1		930	3,990
2		270	3,230
3		440	2,820
4		400	310
5	890	180	1,200
6	440	310	2,090
7	180	440	470
8	890	840	1,320
9	720	1,060	980
10	670	930	990
11	780	350	890
12		800	820
13		1,240	690
14	580	1,330	
15	220	1,860	
16		2,480	
17		2,080	
18		1,150	
19			
20			
21			
22	440		
23		40	
24			2,540
25	440		2,320
26	800		1,170
27	840		
28	750	1,490	590
29	890	1,880	710
30	930	2,690	
31	930	1,610	
Total per month	11,390	24,800	27,130
Total		63,320	

*Figures listed denote the alcohol which was added to the batching tank and do not indicate the amount of alcohol applied to the lake on the data shown

Completeness of Data

Failure of the wind speed recorders to function properly resulted in several hours of missing wind data for the 1966 chemical application season. The per cent total missing data for the season was 21.1%. The bulk of the missing data was due to the faulty 8-meter anemometer at the intake tower. The data lost from this anemometer was 78.2%. The south station 2-meter record showed only 3.0% of missing data. Also showing little missing data were the 8-meter south station record with 4.8% and the wind direction record with 4.7%. The 2-meter intake tower wind speed record had 14.8% of missing data.

To have complete wind data for the entire season, a method of estimating the missing hourly wind speeds was needed. Since daily odometer readings were taken during instrument checks, a record of daily wind travel was maintained which proved beneficial for estimating the missing hourly values. The missing hourly wind speeds were estimated from the daily wind travel by the weighting technique described below.

South Station 2-Meter Wind Speed

For each day of missing data in the 1966 season, a ratio was formed between the total miles of wind travel at the 2-meter level for the south station and the intake tower. Adjustments were made in the wind travel for the time differentials which existed between the daily odometer readings of the two stations. The ratio gained was multiplied by the hourly wind speed at the intake tower to estimate the south station 2-meter record. Fortunately, the missing record from the two stations was not concurrent.

Intake Tower 2-Meter Wind Speed

Again a ratio was formed from the total miles of wind travel at the 2-meter level for both stations. The ratio used here was intake tower total miles over south station total miles. The daily empirical constant gained from this ratio was multiplied by the south station hourly wind record to estimate the intake tower 2-meter missing record.

South Station 8-Meter Wind Speed

A linear regression analysis yielded an equation which closely correlated the 8-meter wind speed to the 2-meter wind speed at the south station. The 2-meter hourly wind speeds were used in the equation

$$U_{ss-8} = 0.9458 + 1.1770\ U_{ss-2} \tag{5}$$

to estimate the missing 8-meter hourly wind speeds, from Figure 9.

Intake Tower 8-Meter Wind Speed

Due to the faulty anemometer at the 8-meter level, hourly wind speeds were not recorded correctly until September 21. The only missing data after this time occurred on three consecutive days, and this missing record was not estimated.

Wind Direction

The Weather Bureau Climatological Data at Will Rogers World Airport in Oklahoma City was used to supply the missing wind direction values.

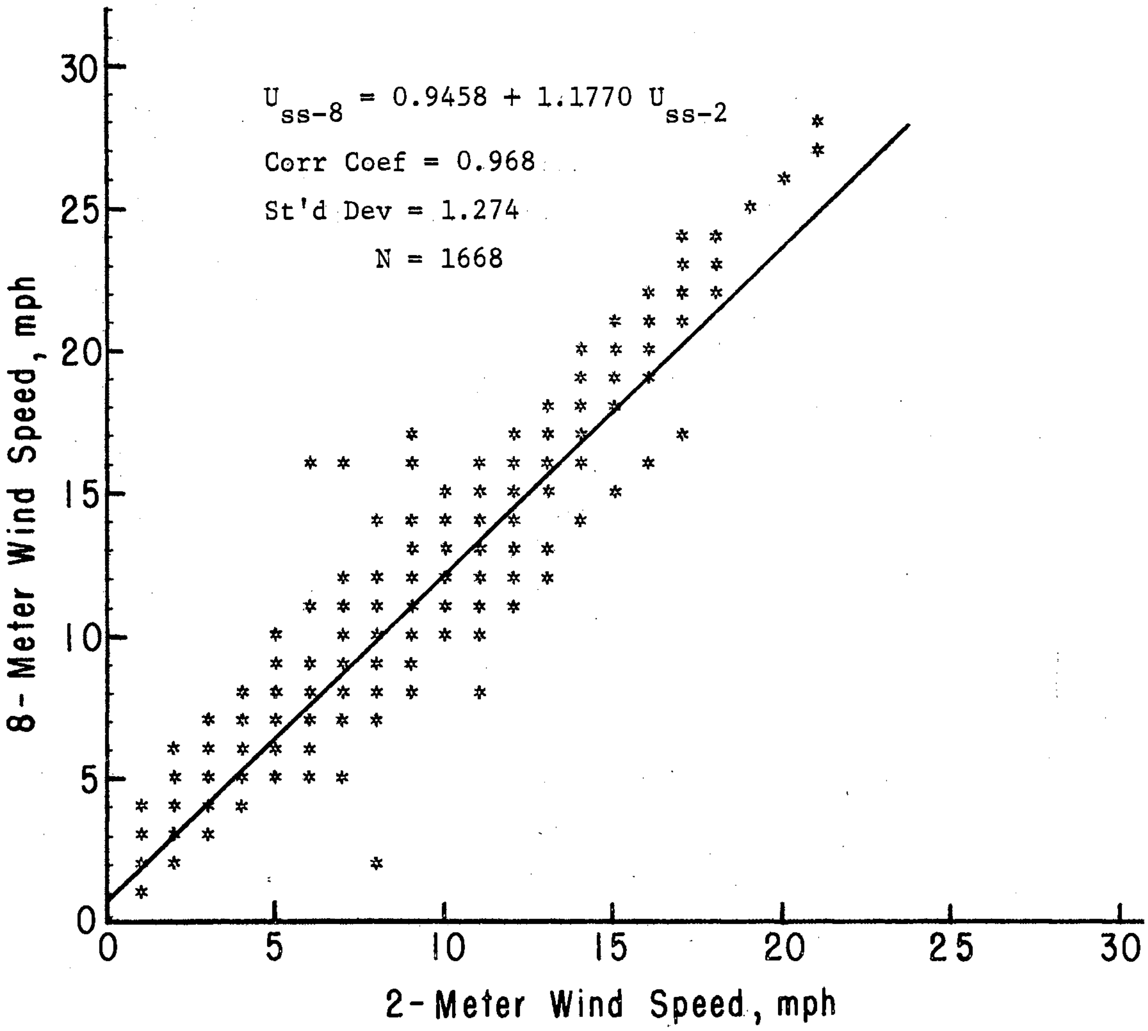


Figure 9. Comparison of the 8-Meter Wind Speed With the 2-Meter Wind Speed for Southerly Winds at the South Station, 1966. (Due to the magnitude of data, each point on the graph represents one or more data points.)

Estimation of Hourly Raft Wind

The wind speed recorded hourly by the south station 8-meter anemometer was used as the basis for estimating the hourly 2-meter lake wind speed. The reason for using this data rather than the other anemometer records was that this record more closely estimated the daily raft wind than did any other anemometer data. A correlative study of daily raft wind and south station 8-meter wind showed raft wind travel to be 1.10 times the 8-meter wind travel. Since no hourly record of lake wind was made, the 8-meter south station wind speeds were used in all studies requiring 2-meter lake wind speeds. For example, the 2-meter lake wind speeds are usually used in film movement studies. The 8-meter south station wind speed was also used in the film cover prediction equation.

Wind Favorability

The wind favorability analysis was a summary of those periods when film cover could be maintained on the lake surface. The study was made to determine the percentage of operable time during the season. Due to the extensive amount of data, a computer program was written to facilitate the wind favorability analysis. The program, essentially a sorting program, was used for three studies: a wind speed favorability study, a wind direction favorability study, and a correlative speed and direction favorability study.

Theoretical Film Cover

To accurately define the percentage of film cover which was possible for the various increments of wind direction, a study was made of the theoretical film cover. Straight lines paralleling the more common wind directions were extended to the leeward shore from each of the three headers. The wind directions studied varied from 22 to 337°. The area bounded by the parallel lines, the headers, and the shore was planimetered to gain the acreage of film coverage. This theoretical film acreage was then compared to the film acreage shown on the maps.

Film Movement

A study was made of the rates of film movement. These film movements were plotted while maps were being made. Stringent requirements were maintained for the analysis of these film movements. The advancing film boundary had to be perpendicular to the wind direction. The film had to be compressed uniformly, and the film boundary had to be as smooth as possible.

Variation of Wind Speeds

Wind Profiles

Linear regression analyses were made to show the increase in wind speed with height. Correlation studies were made between the south station and intake tower wind speed data.

Wind profiles were studied in more detail at the observation tower. Here the wind profiles were plotted on arithmetic as well as semi-logarithmic paper. Linear regression analyses were also made to show the increase in wind speed with height at the observation tower.

Wind Speed Variation Across the Lake

A study was made of the wind speed variation among the rafts, using the average TSP hourly wind speed for each raft. Also, a linear regression was made between the intake tower and south station 2-meter wind speeds. This regression included only southerly winds, to show the wind speed variation across the lake.

Film Cover Prediction Equation

An extensive study was made to develop a prediction equation relating the dependent parameter, film cover, to the independent parameters, wind speed and chemical application rate. This study was restricted to those periods which followed the initiation of chemical application by at least 2 hours. This study was also restricted to those periods of prevailing southerly winds.

An interaction term was included in the prediction equation because of the relationship between the application rate and the wind speed. These parameters were not independent. The application rate was adjusted for changes in the wind speed.

Adjustments in the alcohol application rate did not noticeably affect film cover until approximately one hour after such an adjustment. Therefore, the film cover hourly record was read one hour behind the other records to give a more accurate account of the actual effects of the other two influencing parameters.

CHAPTER VI

RESULTS

Wind Favorability Analysis

The results of a wind speed favorability analysis, considering single hour time increments without regard for direction, are shown in Figure 10. Taking the Bureau of Reclamation's estimate of 15 mph to be the maximum wind speed for chemical application and resulting film cover, application could have been maintained 86.2% of the time during the 1966 study. From observations by the author, it appeared that approximately 12 mph was the limiting wind speed on the lake. Wind speeds below 12 mph existed only 67.0% of the season. Maximum film cover was observed during those times when the wind speed dipped below 5 mph. This limiting condition was satisfied 14.6% of the time.

The chemical distribution system was designed for prevailing south winds. A study of 1966 wind data was made to determine whether an extension of the distribution laterals would increase the number of time periods when film could be successfuly applied. For the existing system the favorable operating range for wind direction consisted of a 90° sector from 135° to 225°. A computer analysis showed the wind to be within this sector 67.2% of the time. By extending a lateral along the eastern lake perimeter, application could have been maintained 79.9% of the time. A supplementary lateral along the western

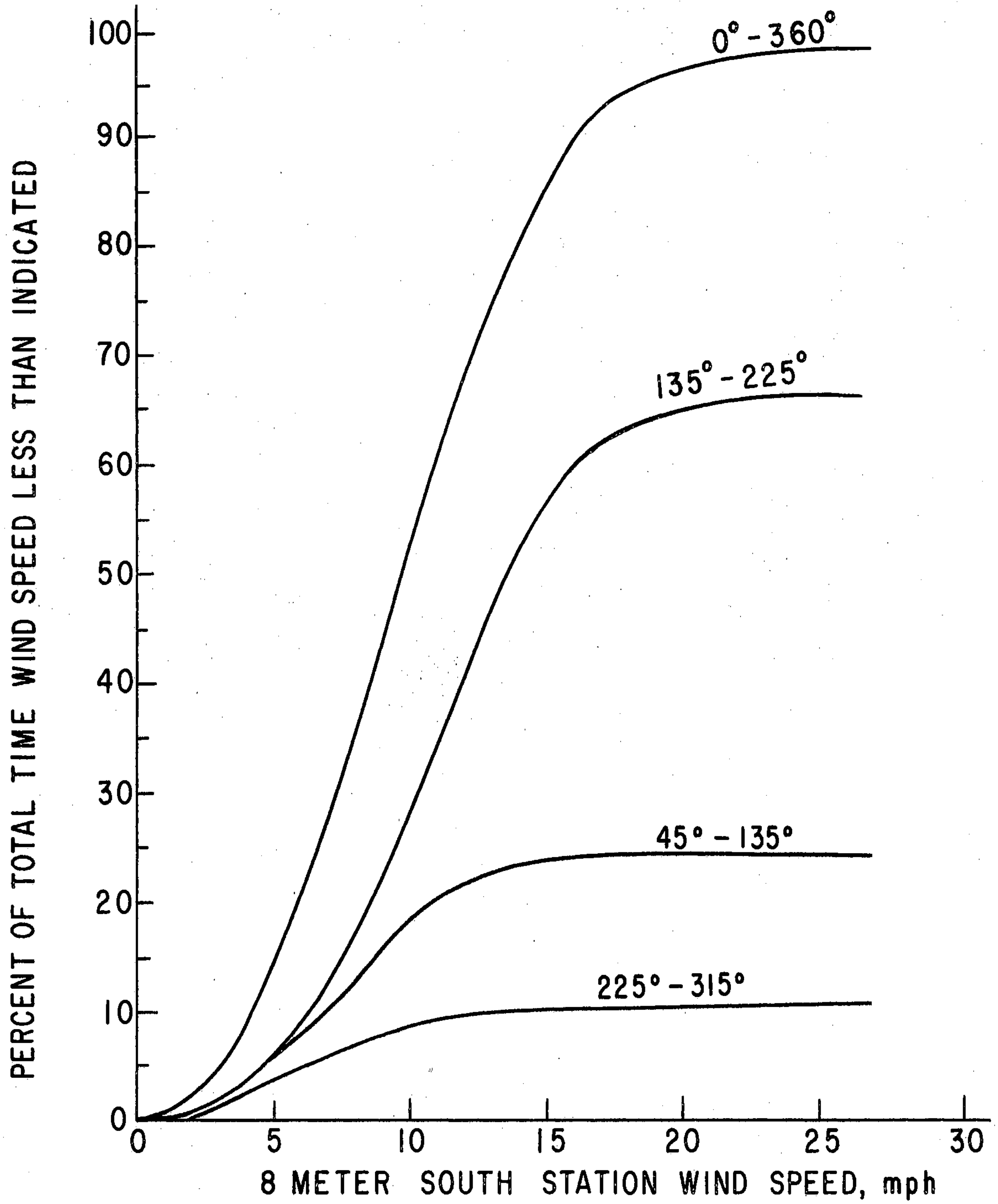


Figure 10. Wind Speed and Direction Favorability Curves for Chemical Application During 1966.

lake perimeter would have extended the operational period to only 74.6% of the time.

A wind speed and direction correlation study was made. This analysis determined the favorable periods for chemical application and resulting film cover. For example, for wind speeds in excess of 12 mph, a south wind was of little consequence. Film cover was lost at these excessive wind speeds. For a northerly wind, the maximum film cover which could have been generated was approximately 10%, except at wind speeds below 3 mph. Favorable conditions of wind speed, less than 12 mph, and wind direction, 135 to 225°, existed only 39.3% of the season, as shown in Figure 10.

A wind favorability analysis, shown in Table 6, was made for periods consisting of 24-hour increments in length. Considering only the favorable wind speed range of less than 15 mph, sixty-five 24-hour periods, twenty-six 48-hour periods, and one 216-hour period met this limitation. The wind direction stayed within the 135-225° sector for fifty-two 24-hour periods, nineteen 48-hour periods, and two 264-hour periods. Seventeen 24-hour periods, four 48-hour periods, and only one 72-hour period met both wind speed and wind direction requirements. An analysis considering favorable wind less than 12 mph showed fewer favorable periods for chemical application. Five 24-hour periods and one 48-hour period met those requirements for wind speed and direction.

Film Cover as Influenced by Wind Direction

Since the chemical distribution system for Lake Hefner was designed for operation on the basis of prevailing southerly winds, the film cover generated by a northerly wind was not appreciable. For

TABLE 6

ANALYSIS OF WINDS FAVORABLE FOR CHEMICAL APPLICATION AT LAKE HEFNER, JUNE 21 - OCTOBER 15, 1966

	Number of Periods of Specified Length With Favorable Wind				
Length of Period Hr	Speed Less Than 15 mph & Direction 0-360° No	Speed Less Than 12 mph & Direction 0-360° No	Direction 135-225° & Wind Speed 0-35 mph No	Speed Less Than 15 mph & Direction 135-225° No	Speed Less Than 12 mph & Direction 135-225° No
24	65	37	52	17	5
48	26	10	19	4	1
72	13	5	11	1	0
96	7	2	5	0	0
120	3	1	5	0	0
144	2	1	2	0	0
168	1	0	2	0	0
192	1	0	2	0	0
216	1	0	2	0	0
240	0	0	2	0	0
264	0	0	2	0	0
288	0	0	0	0	0

example, a northerly wind could spread the film from the sprinklers to form an 8% theoretical film cover, as shown in Figure 11. A southerly wind could spread the film to form a 52% theoretical film cover, as mapped in Figure 12. As shown in Table 7, actual film cover agreed closely with theoretical film cover for the various wind directions. A wind speed of 5 mph or more from any direction other than due south usually decreased the percentage of film cover.

The observed film cover agreed closely with the theoretical film cover except for the directional range of 240-330°, as shown in Figure 11. In this range the observed cover was over 10% higher than the theoretical cover. This discrepancy may be explained in part by shifting wind direction during chemical application. Some film usually existed on the lake before the wind shifted to this range. This supplemental film, when added to the film spread on the downwind side of the sprinklers by the wind, caused the observed film cover to be higher than the theoretical cover.

Graphical Description of Film Cover

Many times during the 1966 season, a film was generated on the lake during the morning hours only to be lost in the afternoon due to high winds. The maps in Figure 13 depicted this occurrence graphically. From 0700 until 1300 on August 9, the wind speed fluctuated between 6 and 8 mph. The application rate varied from 43 to 64 lbs/hour, and the percentage of film cover increased from 6 to 54%. Then from 1300 to 1600, the wind speed increased from 7 to 14 mph. The application rate fluctuated between 43 and 75 lbs/hour and the percentage of film cover decreased from 54 to 8%. These maps illustrate

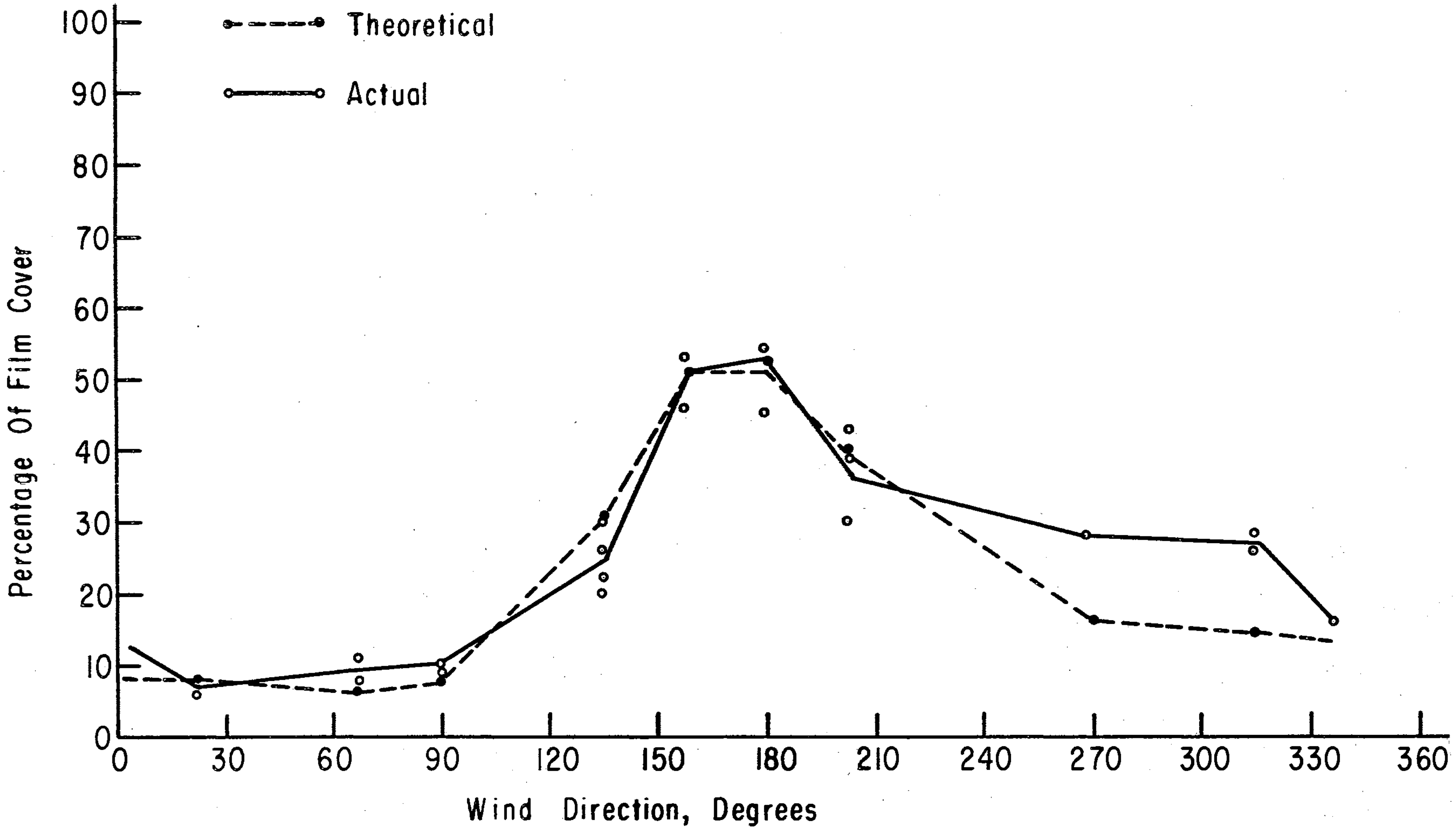


Figure 11. Comparison of Maximum Theoretical Percentage of Film Cover and the Actual Percentage of Film Cover for Various Wind Directions During 1966.

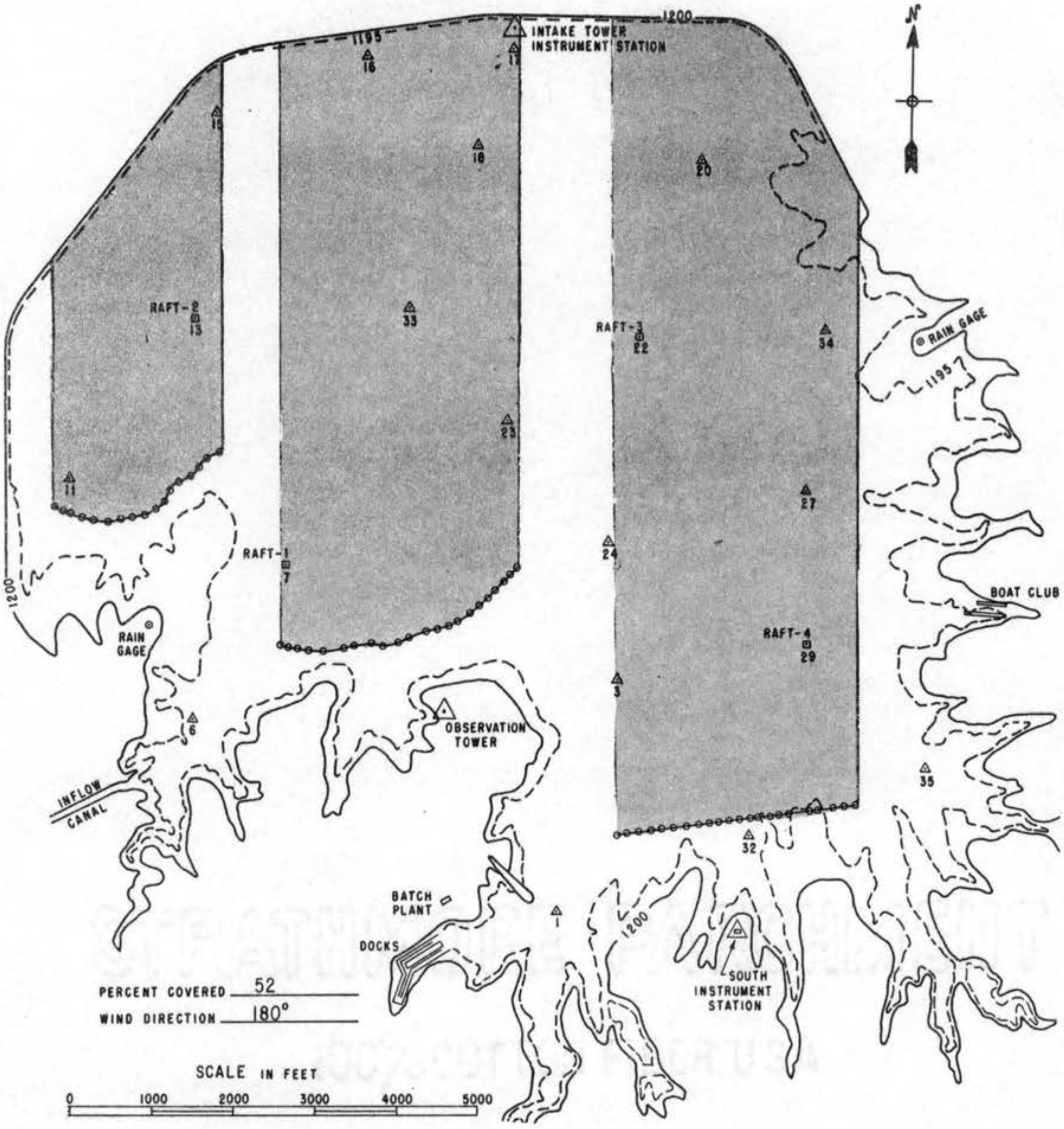
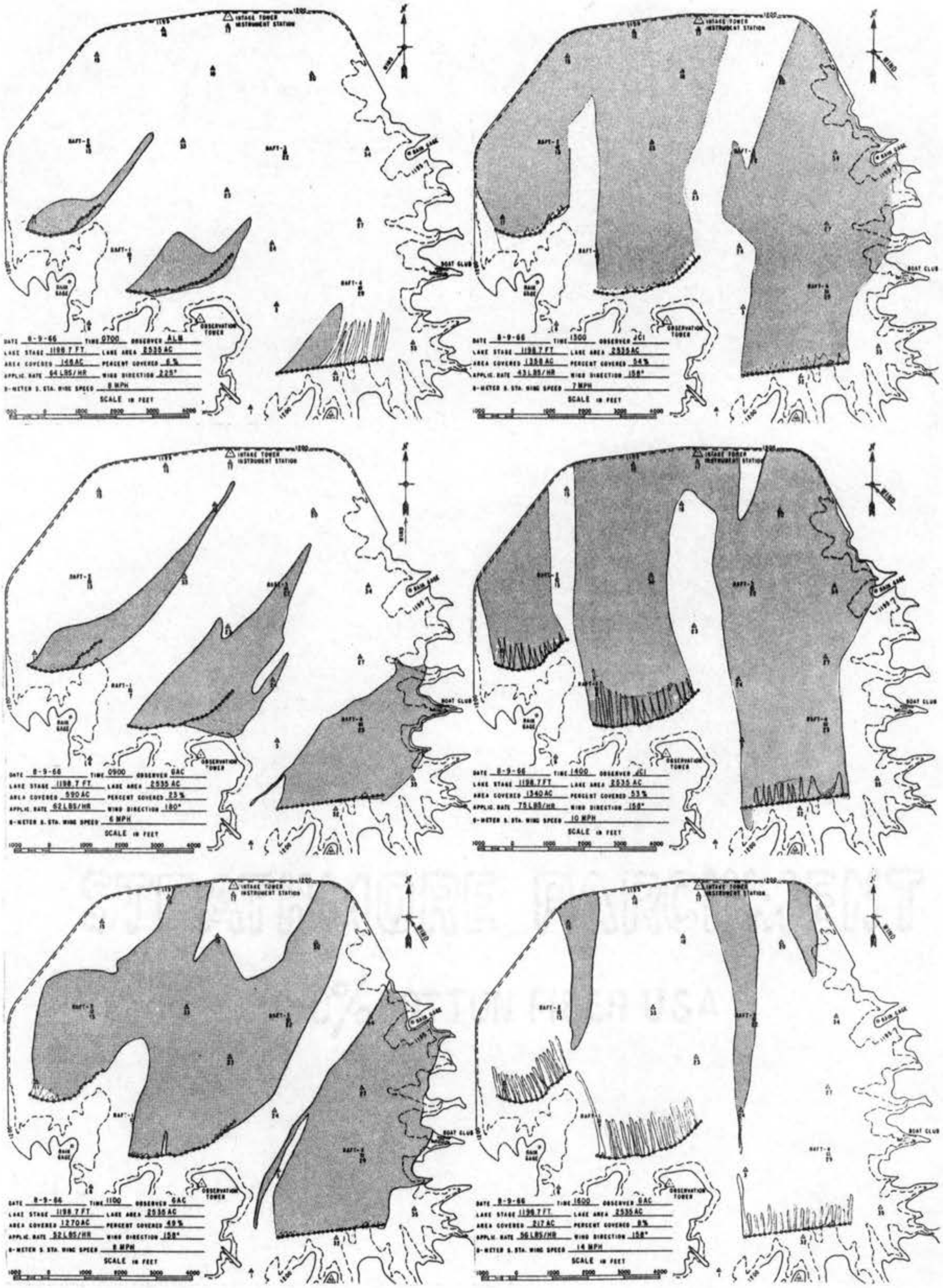


Figure 12. Map of Lake Hefner Showing the Highest Theoretical Percentage of Film Cover Possible for the Chemical Distribution System.

TABLE 7

COMPARISON OF MAXIMUM THEORETICAL PERCENTAGE OF FILM COVER AND THE ACTUAL PERCENTAGE OF FILM COVER FOR VARIOUS WIND DIRECTIONS DURING 1966

Date	Time	Wind Dir °	Wind Spd mph	App Rate lb/hr	Actual Film Cover %	Theoretical Film Cover %
7/30/66	1100	22	10	60	8	8
8/10/66	1600		9	43	6	
9/7/66	0900	67	7	58	11	6
9/7/66	1100		7	51	8	
9/7/66	0600	90	4	62	9	8
9/7/66	0800		5	66	10	
8/29/66	1800	135	9	115	20	30
9/8/66	1600		8	44	30	
9/9/66	0700		7	58	26	
8/9/66	1300	158	7	43	54	51
8/12/66	1200		9	50	46	
8/13/66	0900	180	7	51	54	52
8/14/66	1700		13	84	45	
7/29/66	0800	203	9	41	39	40
8/14/66	0800		11	62	43	
8/16/66	1500		13	193	30	
9/2/66	1400		12	145	39	
7/28/66	0900	270	6	65	28	16
9/5/66	0700		4	55	28	
8/13/66	1500	315	6	40	28	14
9/29/66	0800		7	79	26	



DATE 8-9-66 TIME 0700 OBSERVER ALB
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 148 AC PERCENT COVERED 6%
APPLIC. RATE 64 LBS/HR WIND DIRECTION 225°
8-METER S. STA. WIND SPEED 8 MPH

DATE 8-9-66 TIME 1300 OBSERVER JCI
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 1358 AC PERCENT COVERED 54%
APPLIC. RATE 43 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 7 MPH

DATE 8-9-66 TIME 0900 OBSERVER GAC
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 590 AC PERCENT COVERED 23%
APPLIC. RATE 62 LBS/HR WIND DIRECTION 180°
8-METER S. STA. WIND SPEED 6 MPH

DATE 8-9-66 TIME 1400 OBSERVER JCI
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 1340 AC PERCENT COVERED 53%
APPLIC. RATE 75 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 10 MPH

DATE 8-9-66 TIME 1100 OBSERVER GAC
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 1270 AC PERCENT COVERED 49%
APPLIC. RATE 52 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 8 MPH

DATE 8-9-66 TIME 1600 OBSERVER GAC
LAKE STAGE 1198.7 FT LAKE AREA 2535 AC
AREA COVERED 217 AC PERCENT COVERED 9%
APPLIC. RATE 56 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 14 MPH

Figure 13. Variation in Film Coverage on Lake Hefner During Evaporation Suppression Operations on August 9, 1966.

what happened when an increase in wind speed was not compensated by an adequate increase in chemical application rate.

Figure 14 illustrates film cover conditions for August 28, 1966. Starting at 1000, alcohol was applied continuously for 4 hours and then application was stopped for 2 hours, cooperating with tests conducted on the lake by ESSA. By 1400, when application was temporarily stopped, a 43% film cover existed. The film cover remained at approximately 40% while being blown across the lake between 1400 and 1600. The receding edge of the film reached the north shore by 1700, aided by a wind speed increase from 10 to 12 mph. An excessive application rate of 195 lbs/hr generated new film strips at the laterals by this time. This graphically illustrated how rapidly the film was blown off the lake after application was stopped.

Film Movement

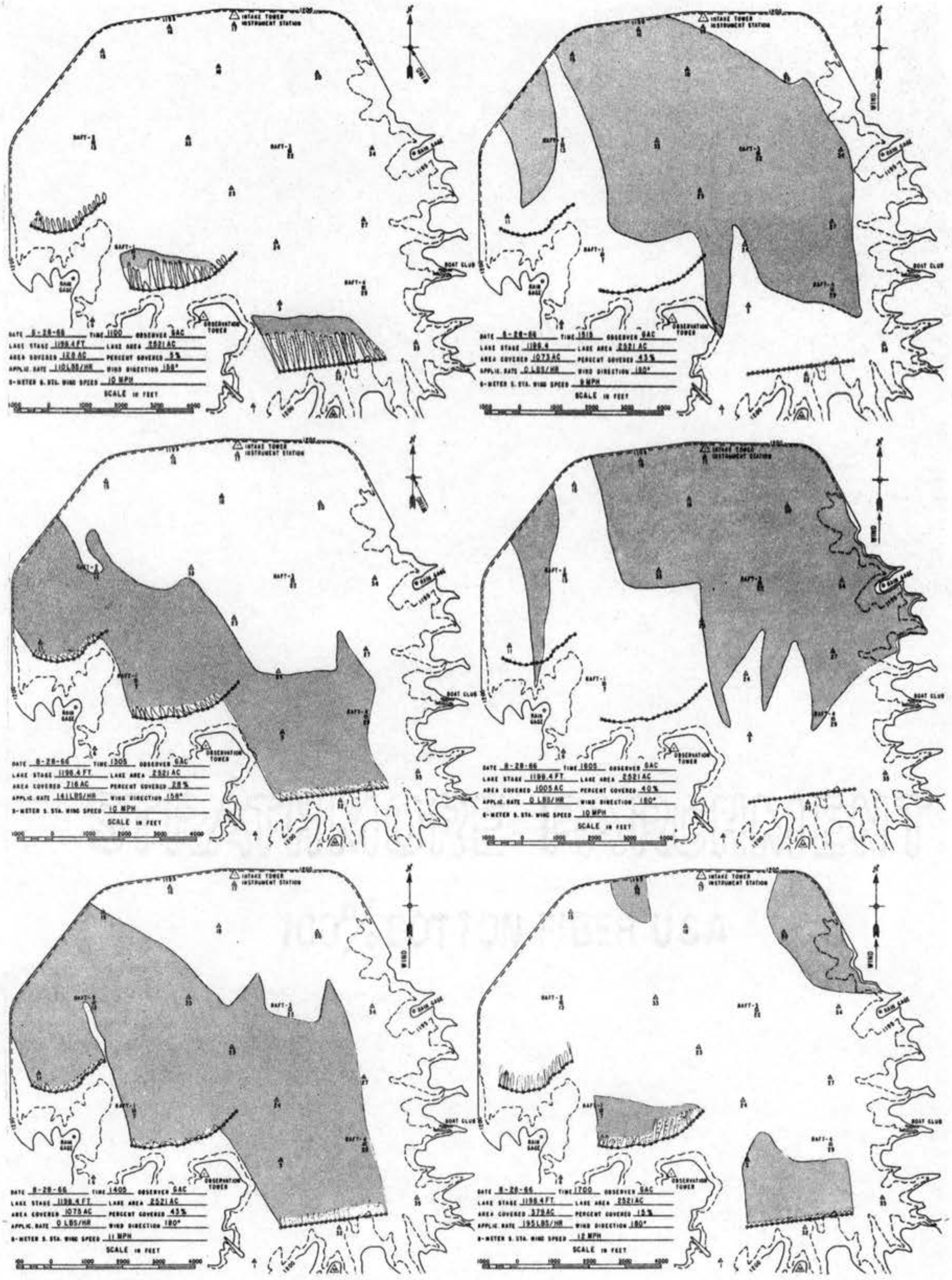
The average rate of film movement as a ratio of wind speed is shown in Table 8. This ratio varied from 0.032 to 0.047. It was interesting to note that the 0.032 ratio was measured from the trailing edge of the film while all other measurements were made on the leading edge. A typical map showing the rate of film advance is shown in Figure 15. A linear regression analysis showed that the relationship between the film movement and the 8-meter south station wind speed was

$$M = 0.0371\, U_{ss-8} \qquad (6)$$

where M = Film movement in mph

U_{ss-8} = 8-meter south station wind speed in mph

A plot of film movement with respect to wind speed is shown in Figure 16. The correlation coefficient was 0.907 and the standard deviation



DATE 8-28-66 TIME 1100 OBSERVER GAC
LAKE STAGE 1198.4 FT LAKE AREA 2521 AC
AREA COVERED 128 AC PERCENT COVERED 5%
APPLIC. RATE 110 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 10 MPH

DATE 8-28-66 TIME 1515 OBSERVER GAC
LAKE STAGE 1198.4 LAKE AREA 2521 AC
AREA COVERED 1073 AC PERCENT COVERED 43%
APPLIC. RATE 0 LBS/HR WIND DIRECTION 180°
8-METER S. STA. WIND SPEED 9 MPH

DATE 8-28-66 TIME 1305 OBSERVER GAC
LAKE STAGE 1198.4 FT LAKE AREA 2521 AC
AREA COVERED 716 AC PERCENT COVERED 28%
APPLIC. RATE 141 LBS/HR WIND DIRECTION 158°
8-METER S. STA. WIND SPEED 10 MPH

DATE 8-28-66 TIME 1605 OBSERVER GAC
LAKE STAGE 1198.4 FT LAKE AREA 2521 AC
AREA COVERED 1005 AC PERCENT COVERED 40%
APPLIC. RATE 0 LBS/HR WIND DIRECTION 180°
8-METER S. STA. WIND SPEED 10 MPH

DATE 8-28-66 TIME 1405 OBSERVER GAC
LAKE STAGE 1198.4 FT LAKE AREA 2521 AC
AREA COVERED 1075 AC PERCENT COVERED 43%
APPLIC. RATE 0 LBS/HR WIND DIRECTION 180°
8-METER S. STA. WIND SPEED 11 MPH

DATE 8-28-66 TIME 1700 OBSERVER GAC
LAKE STAGE 1198.4 FT LAKE AREA 2521 AC
AREA COVERED 379 AC PERCENT COVERED 15%
APPLIC. RATE 195 LBS/HR WIND DIRECTION 180°
8-METER S. STA. WIND SPEED 12 MPH

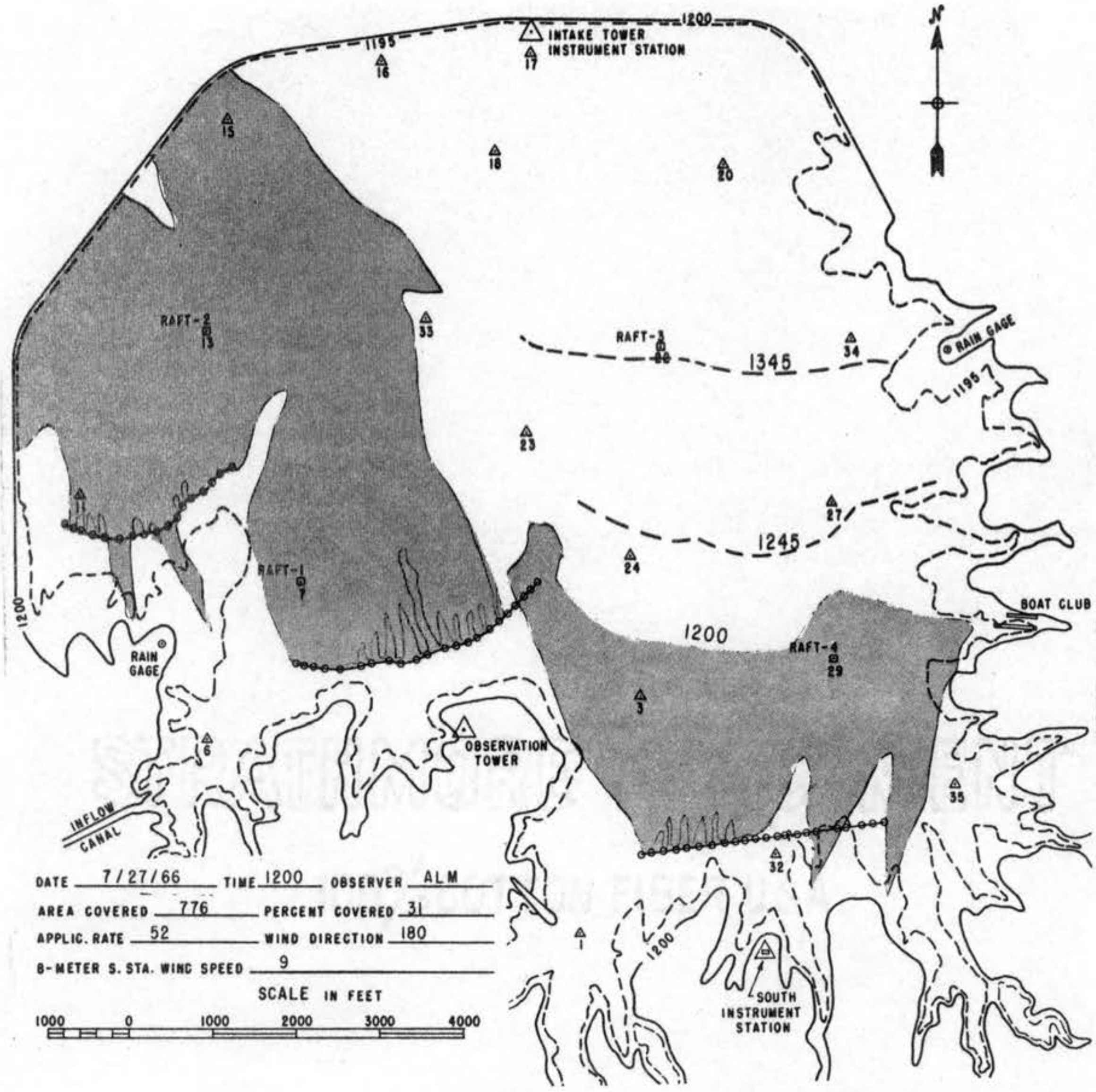
Figure 14. Variation in Film Coverage on Lake Hefner During "Pulsing" Operations by Environmental Science Services Administration on August 28, 1966.

TABLE 8

ANALYSIS OF THE RATE OF FILM MOVEMENT AS A FRACTION OF THE 8-METER SOUTH STATION WIND SPEED

Date	Time Interval	S. Sta. 8-Meter Wind Speed mph	Wind Dir °	Film Movement mph	Fraction* of Wind Speed
7/7/66	1100-1130	8	158	0.318	0.040
7/27/66	1215-1245	10	158	0.439	0.044
7/27/66	1245-1345	9	180	0.390	0.043
7/27/66	1410-1440	11	158	0.422	0.038
7/28/66	1000-1030	6	315	0.284	0.047
7/29/66	1825-1935	10	122	0.324	0.032
8/5/66	1027-1042	4	180	0.165	0.041
Average					0.041

*Computed by dividing film movement in mph by wind movement in mph



DATE 7/27/66 TIME 1200 OBSERVER ALM
AREA COVERED 776 PERCENT COVERED 31
APPLIC. RATE 52 WIND DIRECTION 180
8-METER S. STA. WIND SPEED 9

Figure 15. Map of Lake Hefner Showing the Rate of Film Advance Over the Lake From 1245-1345 on July 27, 1966.

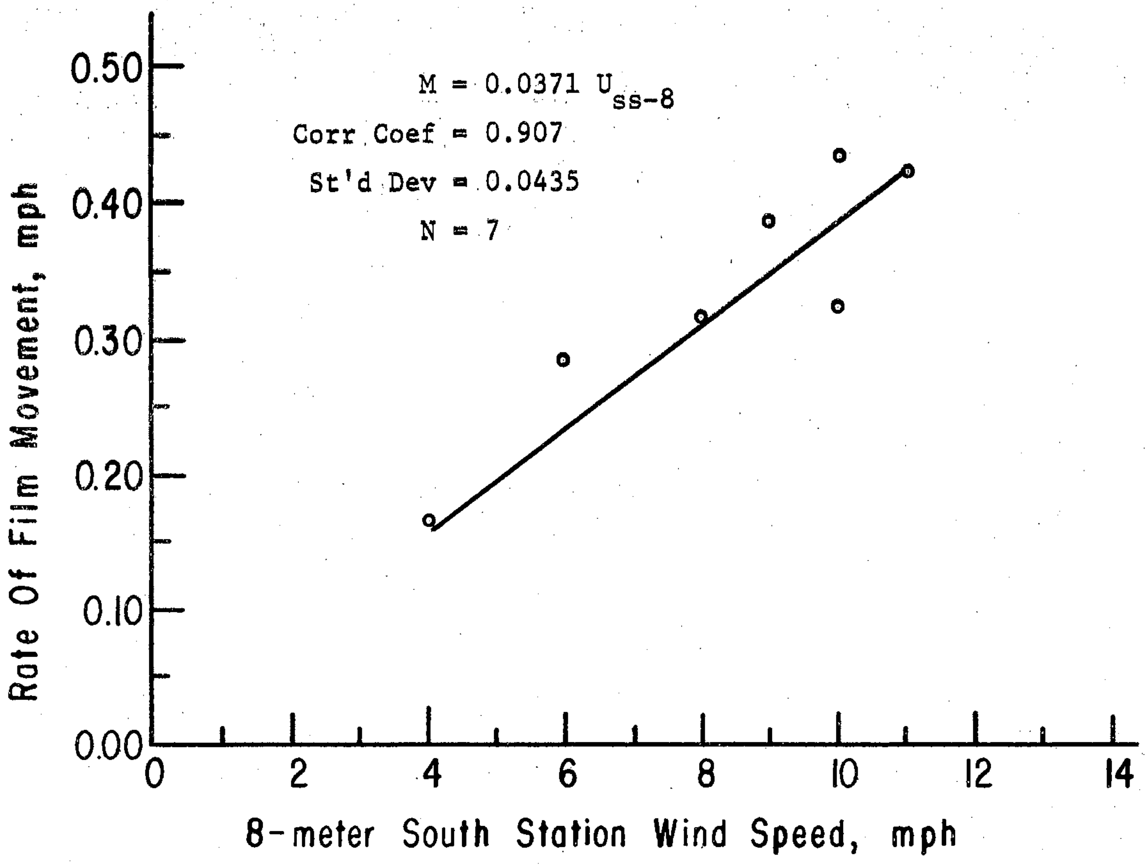


Figure 16. Relationship Between the Rate of Film Movement on the Lake and the 8-Meter South Station Wind Speed.

was 0.0435 for the regression line. The regression equation was forced through the origin so a comparison could be made with previous film movement ratios.

The 8-meter south station wind speed was multiplied by the 1.10 empirical constant to approximate the lake wind more closely. The rate of film movement was then 0.034 times the lake wind speed. This rate of film movement was slightly lower than McArthur's progressive ratio of 0.04 to 0.07. The Lake Hefner ratio compared favorably with the 0.033 ratio calculated by Keulegan and Van Dorn.

Wind Speed Variation With Height

South station and intake tower 2 and 8-meter wind speed records were analyzed to find the wind speed variation with height. The study included the period from September 21 to October 14, as this was the extent of the intake tower 8-meter wind record. This study was further restricted to data gained during periods of prevailing southerly winds. A linear regression analysis relating the wind speeds at the two levels showed the following results, from Figures 17 and 18.

$$U_{ss-8} = 1.1014 + 1.2372\ U_{ss-2} \tag{7}$$

$$U_{it-8} = 0.7459 + 1.2177\ U_{it-2} \tag{8}$$

where U_{ss-8} = South station 8-meter wind speed in mph

U_{ss-2} = South station 2-meter wind speed in mph

U_{it-8} = Intake tower 8-meter wind speed in mph

U_{it-2} = Intake tower 2-meter wind speed in mph

Correlation coefficients were 0.990 for the south station study and 0.977 for the intake tower. The standard deviation was 0.854 for the south station and 1.656 for the intake tower study.

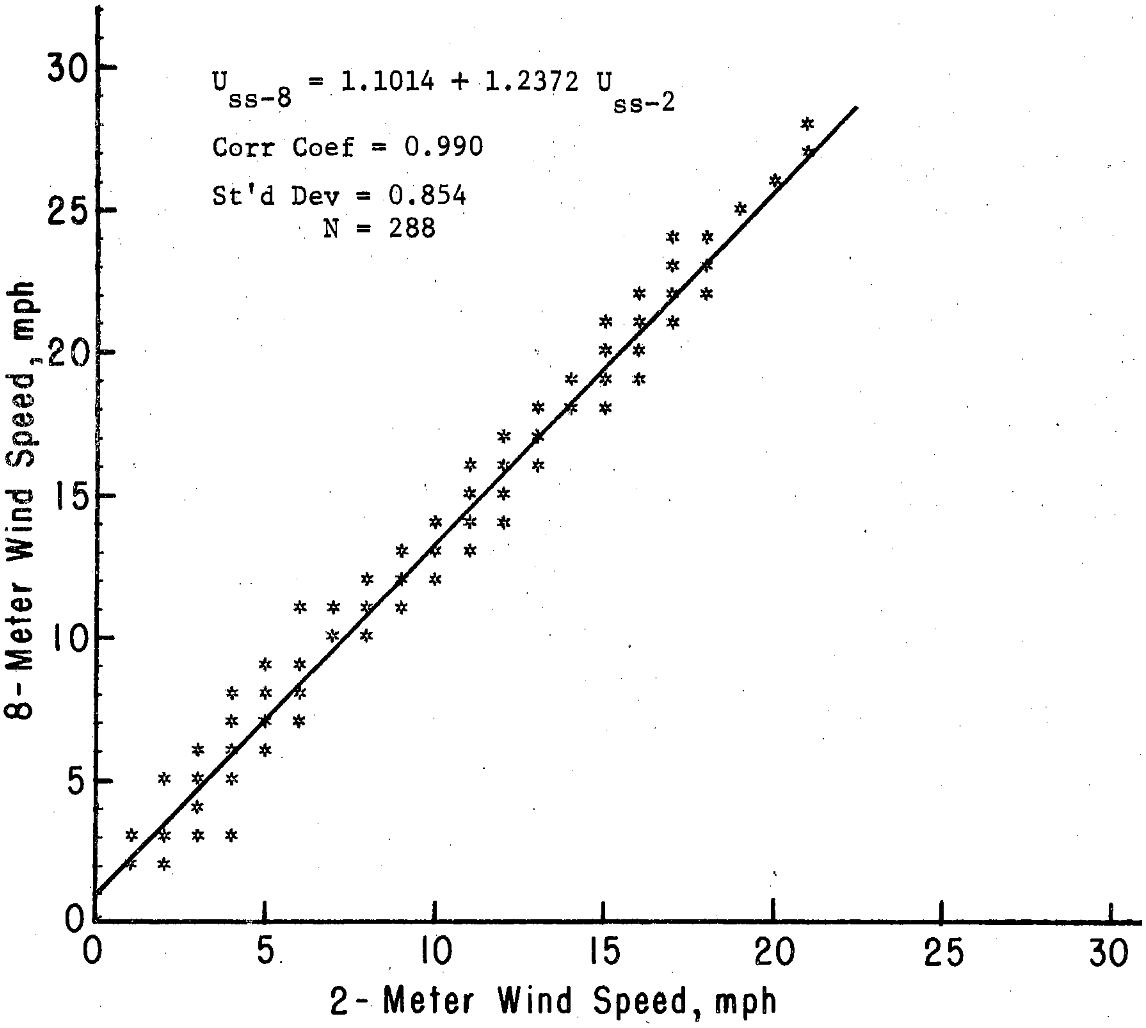


Figure 17. Comparison of the 8-Meter Wind Speed With the 2-Meter Wind Speed for Prevailing Southerly Winds at the South Station From September 21 - October 14, 1966. (Due to the magnitude of data, each point on the graph represents one or more data points.)

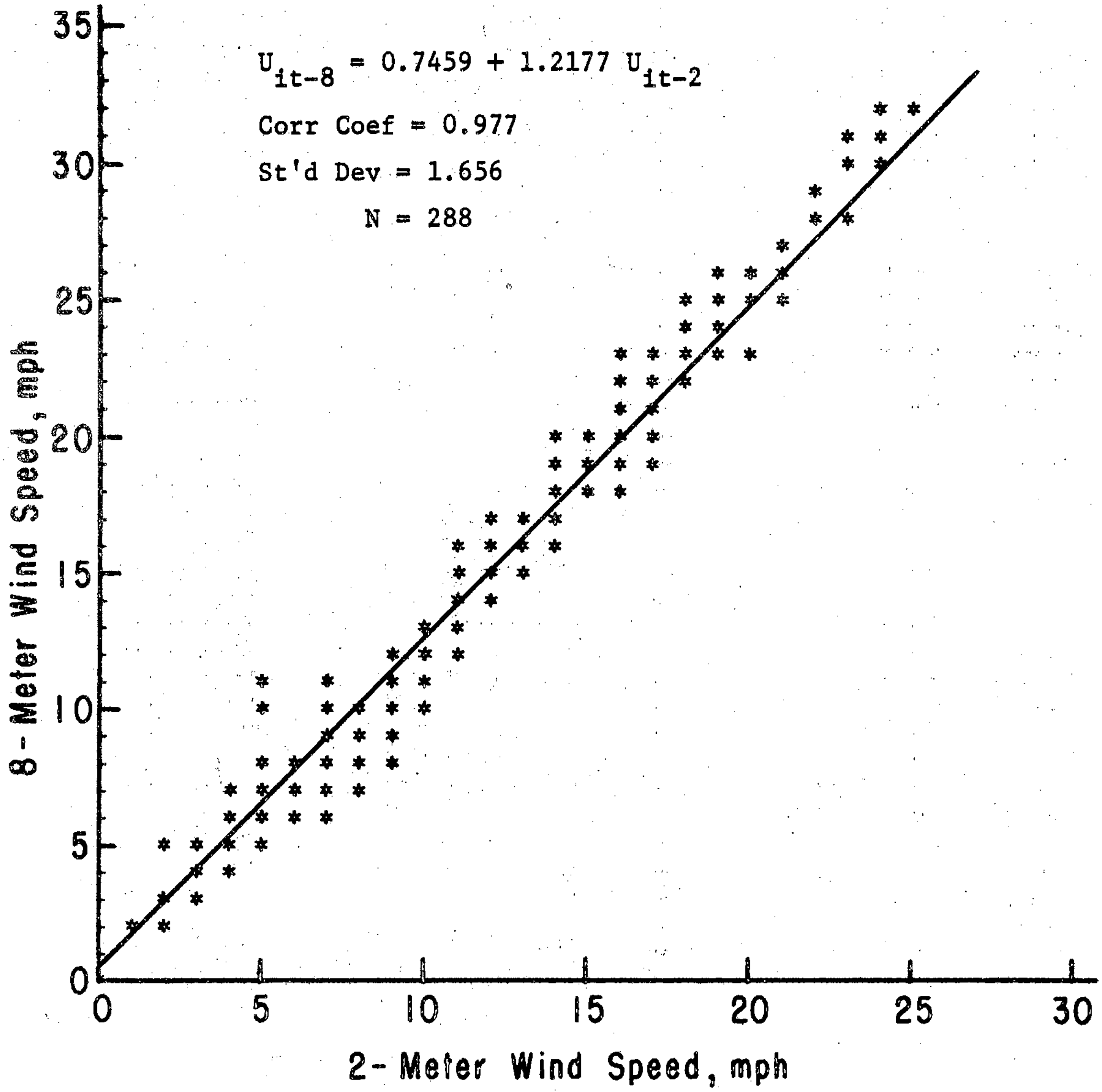


Figure 18. Comparison of the 8-Meter Wind Speed With the 2-Meter Wind Speed for Prevailing Southerly Winds at the Intake Tower From September 21 - October 14, 1966. (Due to the magnitude of data, each point on the graph represents one or more data points.)

By forcing the regression line through the origin, the equations became

$$U_{ss-8} = 1.3266\ U_{ss-2} \tag{9}$$

$$U_{it-8} = 1.2654\ U_{it-2} \tag{10}$$

The correlation coefficient for the intake tower equation was 0.987 and the standard deviation changed to 1.083. The south station correlation coefficient and the standard deviation remained the same. The results pointed out more clearly that the wind profile becomes more nearly vertical across the lake.

With no consideration of wind direction the ratio of 8-meter to 2-meter wind speed at the south station was 1.307. This empirical ratio was higher than the 1.237 ratio calculated in the 1950-51 Lake Hefner Study. A probable reason for this ratio discrepancy was the difference in terrain at the south station between 1950-51 and 1966. In 1966 a thicket of trees approximately 125 ft northeast of the instrument site blocked the northerly winds at the 2-meter level. Also an instrument trailer blocked much of the easterly wind at this lower level. No instrument trailer was used in 1950-51, and the trees were not tall enough to affect the wind significantly.

Typical wind profiles at the observation tower are plotted in Figures 19 and 20. Wind profiles for the 2, 4, 8, and 25-meter wind speed records are plotted in Figure 19. The remaining wind profiles plotted in Figure 20 were gained from the 2, 8, 16, and 25-meter wind records. Each set of wind profiles was plotted on semi-logarithmic paper. As shown in Figures 21 and 22, the profiles were linearized by this transformation. The variation of wind speed with the logarithm of height at the observation tower was approximately linear. Inconclusive

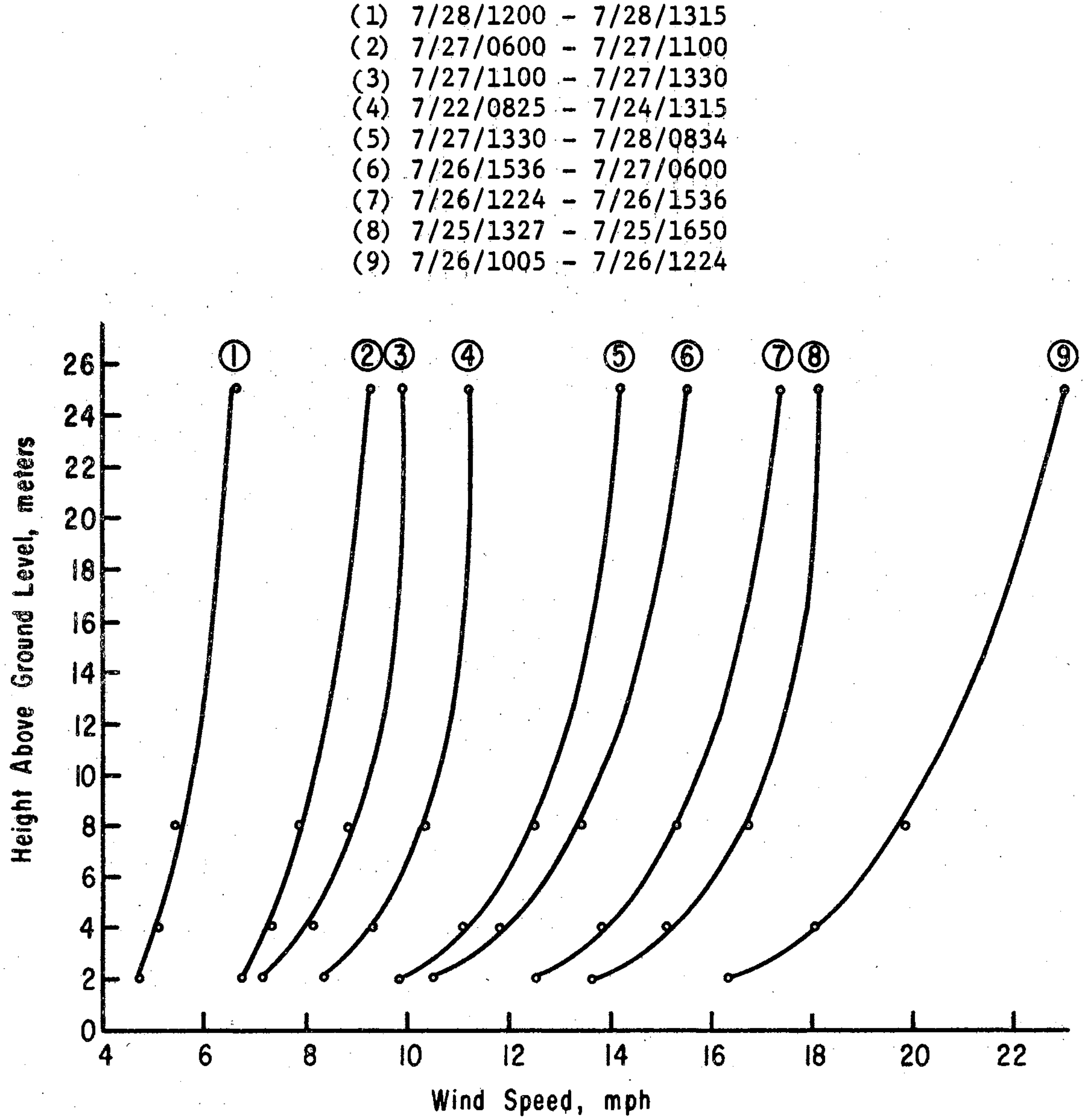


Figure 19. Typical Wind Profiles at the Observation Tower From July 22-28, 1966.

(10) 8/05/0600 - 8/05/0930
(11) 8/05/0930 - 8/06/0610
(12) 8/13/1845 - 8/14/0600
(13) 7/29/0600 - 7/29/1034
(14) 8/09/0600 - 8/09/1930
(15) 8/09/1930 - 8/10/0600
(16) 8/01/0600 - 8/01/1200
(17) 7/29/1034 - 7/29/1116

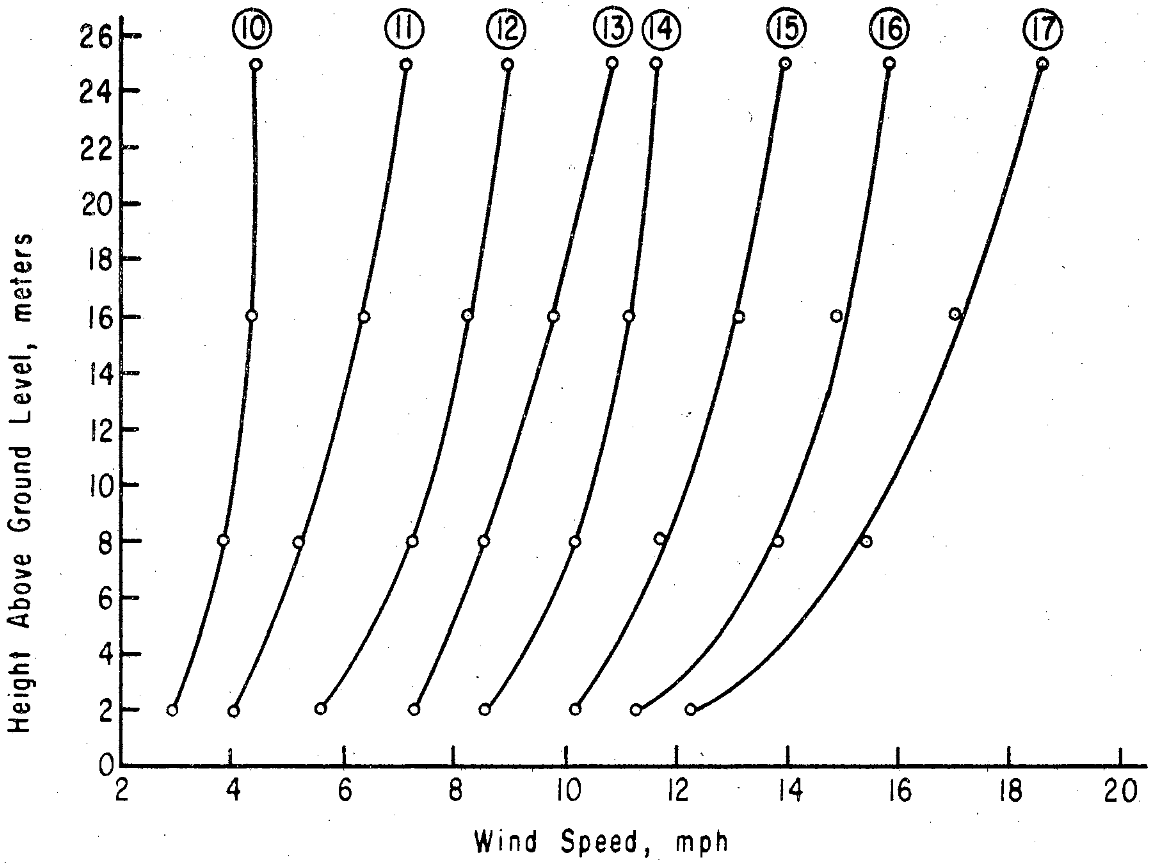


Figure 20. Typical Wind Profiles at the Observation Tower From July 29 - August 13, 1966.

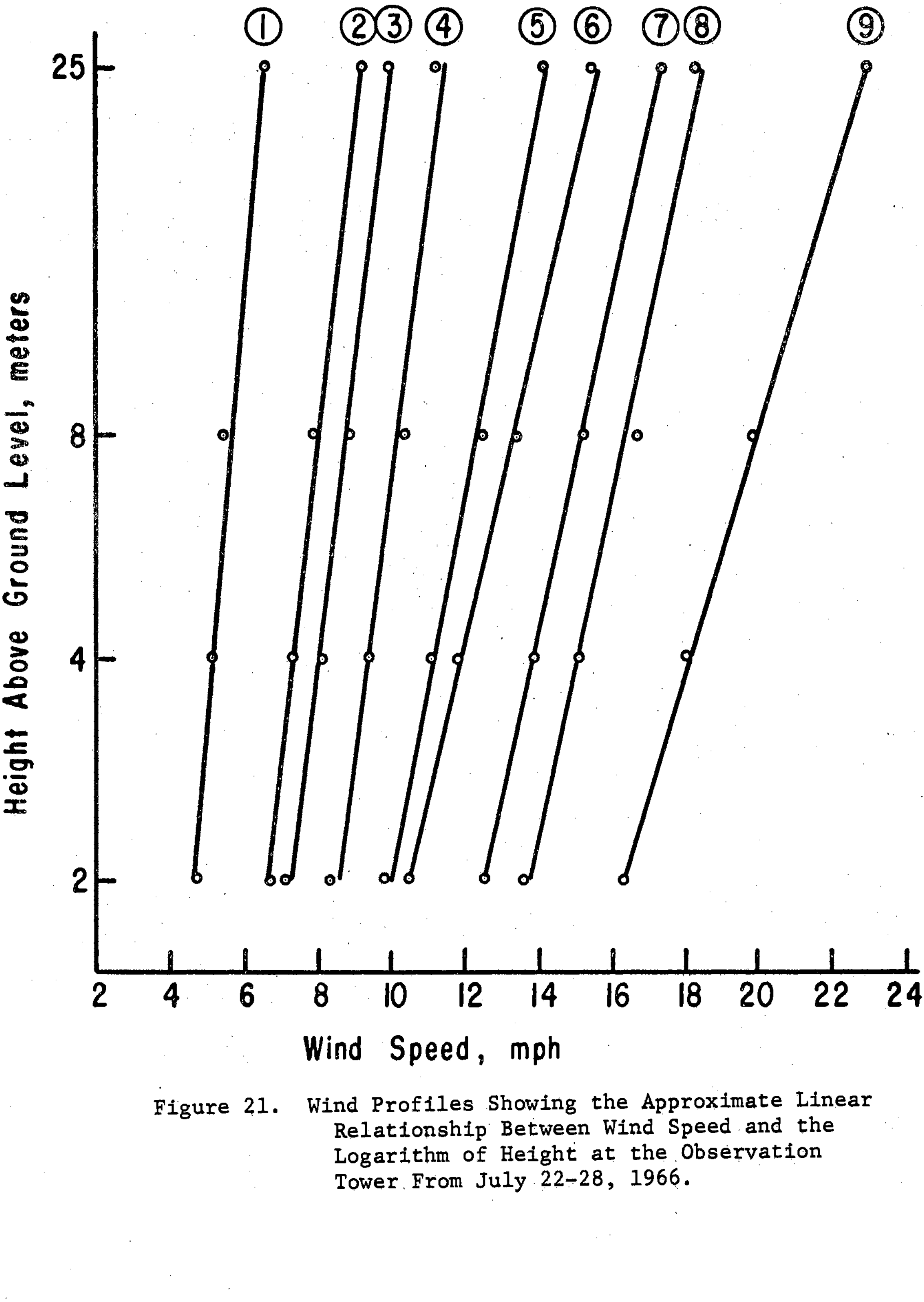


Figure 21. Wind Profiles Showing the Approximate Linear Relationship Between Wind Speed and the Logarithm of Height at the Observation Tower From July 22-28, 1966.

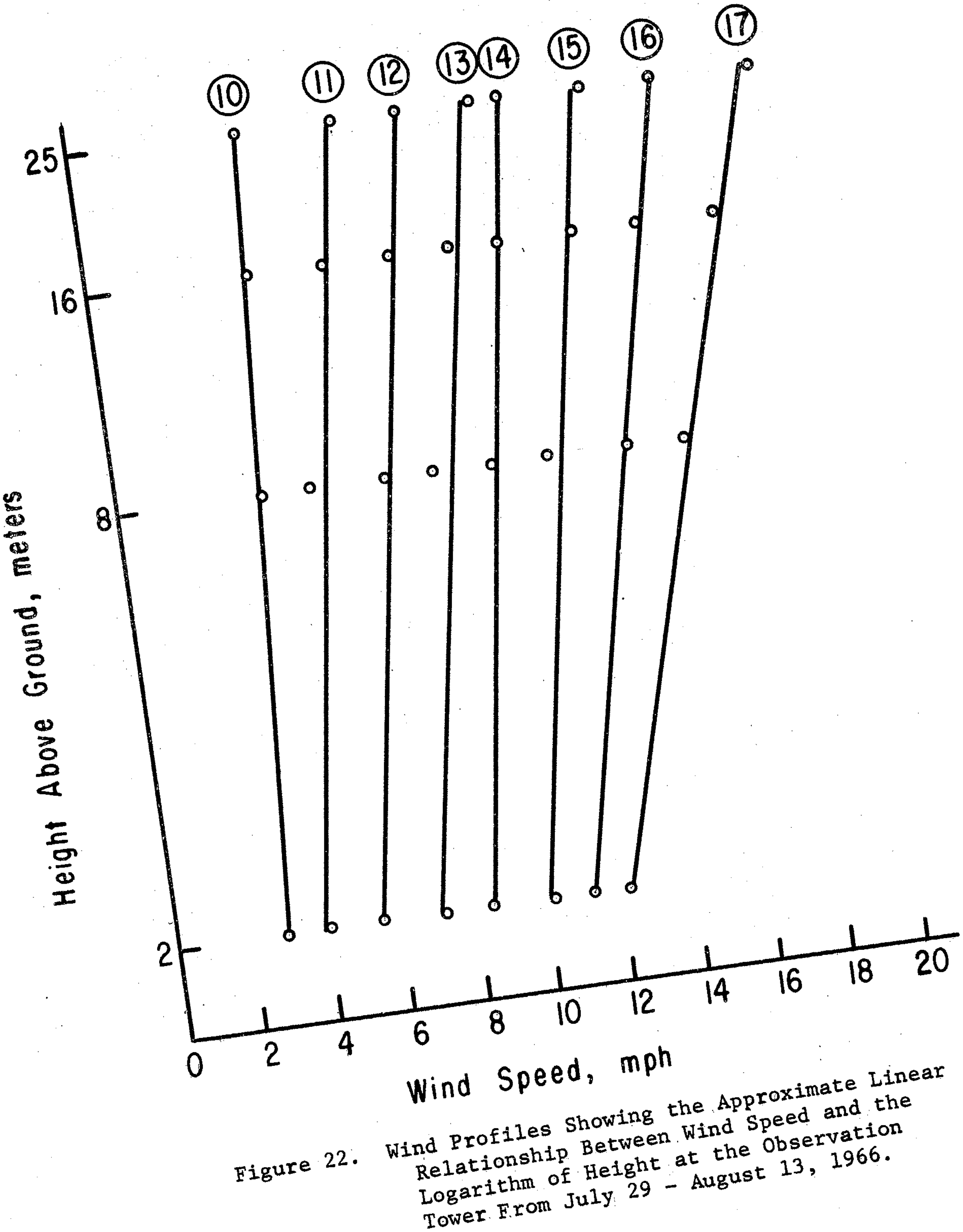


Figure 22. Wind Profiles Showing the Approximate Linear Relationship Between Wind Speed and the Logarithm of Height at the Observation Tower From July 29 - August 13, 1966.

data prevented an attempt to check the results of Johnson. He stated that the wind profile was convex upward at night and concave upward during the afternoon.

Computed "k" values from the 1966 study are shown in Table 9. The reason for using average wind speed ratios rather than daily ratios from wind profiles was that the laws governing wind increase with height apply to mean values over a long period of time. The observation tower k values were lower than the commonly accepted k value of 0.143. The intake tower k value was slightly higher than this k value and the south station value was much higher.

Wind Speed Variation Across the Lake

When the wind was from the 135-225° sector, the 2-meter wind speed increased across the lake. A regression analysis of the data plotted in Figure 23 showed that the relation between the intake tower and south station 2-meter wind speeds was

$$U_{it-2} = 3.0150 + 0.9027\ U_{ss-2} \tag{18}$$

The correlation coefficient for the regression was 0.862. The standard deviation was 1.821.

With no consideration of wind direction, the relation, as shown in Figure 24, was

$$U_{it-2} = 1.8939 + 0.8913\ U_{ss-2} \tag{19}$$

The standard deviation increased to 2.722 and the correlation coefficient decreased to 0.789. The main reason for the discrepancy between the two regressions was the difference in terrain at the points of measurement. For southerly winds, the intake tower wind speed was higher than the south station wind speed because the wind speed

TABLE 9

AVERAGE "k" VALUES FOR LAKE HEFNER

Location	Dates	Z_o (meters)	Z (meters)	V/V_o	k
South Sta	(1950-51)	2	8	1.237	0.153
South Sta	(1966)*	2	8	1.307	0.193
South Sta	(1966)**	2	8	1.327	0.203
Intake Tower	(1966)**	2	8	1.265	0.169
Obs Tower	(1966)***	2	4	1.101	0.139
Obs Tower	(1966)***	2	8	1.197	0.129
Obs Tower	(1966)***	2	16	1.337	0.140
Obs Tower	(1966)***	2	25	1.368	0.123
Commonly Accepted "k" Value					0.143

*Inclusive of all data from June 21 to October 14, 1966

**Period from September 24 to October 14, 1966 inclusive of those days when southerly winds prevailed

***Inclusive of all data taken from July 11 to August 14, 1966

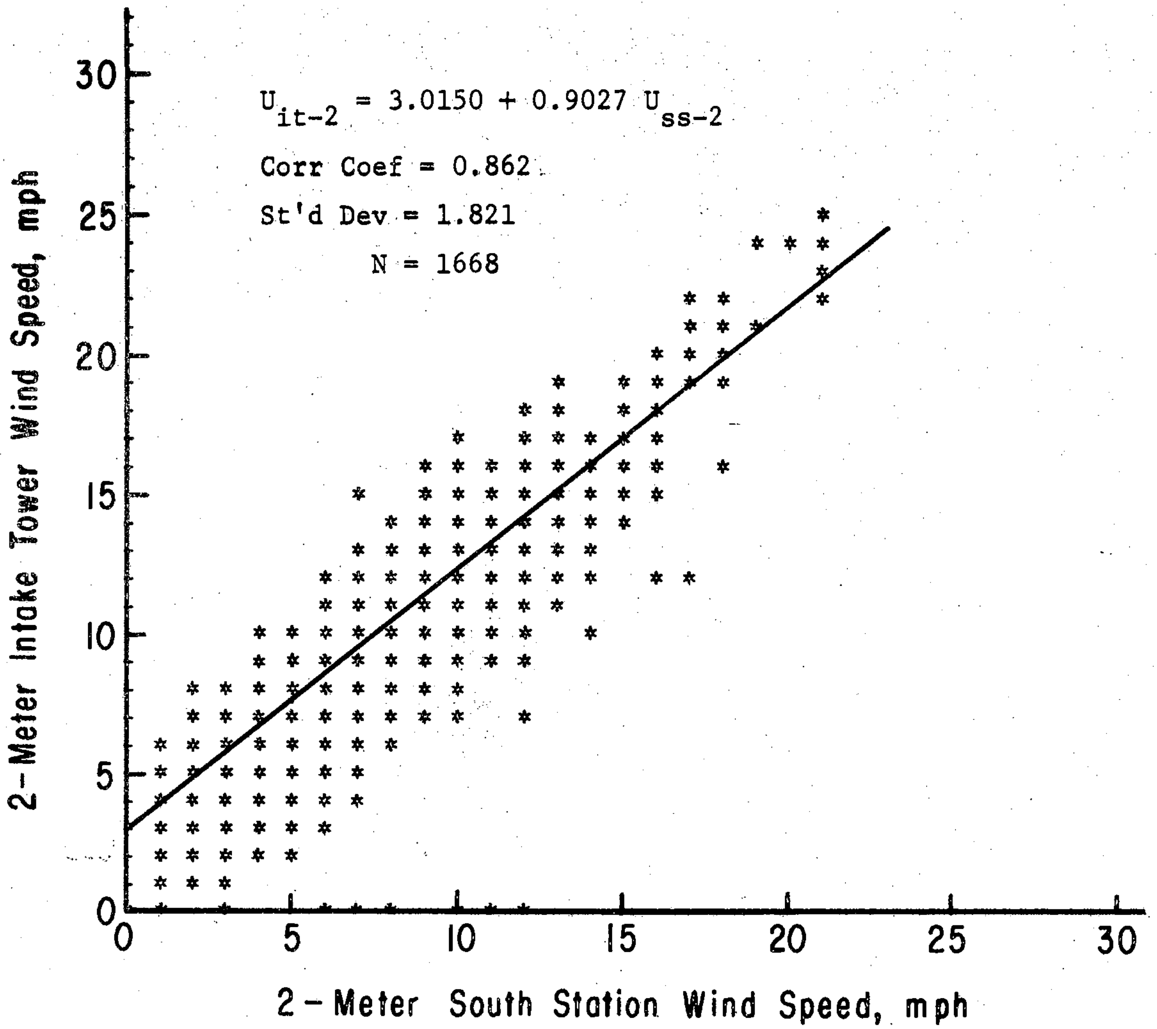


Figure 23. Comparison of Intake Tower 2-Meter Wind Speed With South Station 2-Meter Wind Speed for Prevailing Southerly Winds, 1966. (Due to the magnitude of data, each point on the graph represents one or more data points.

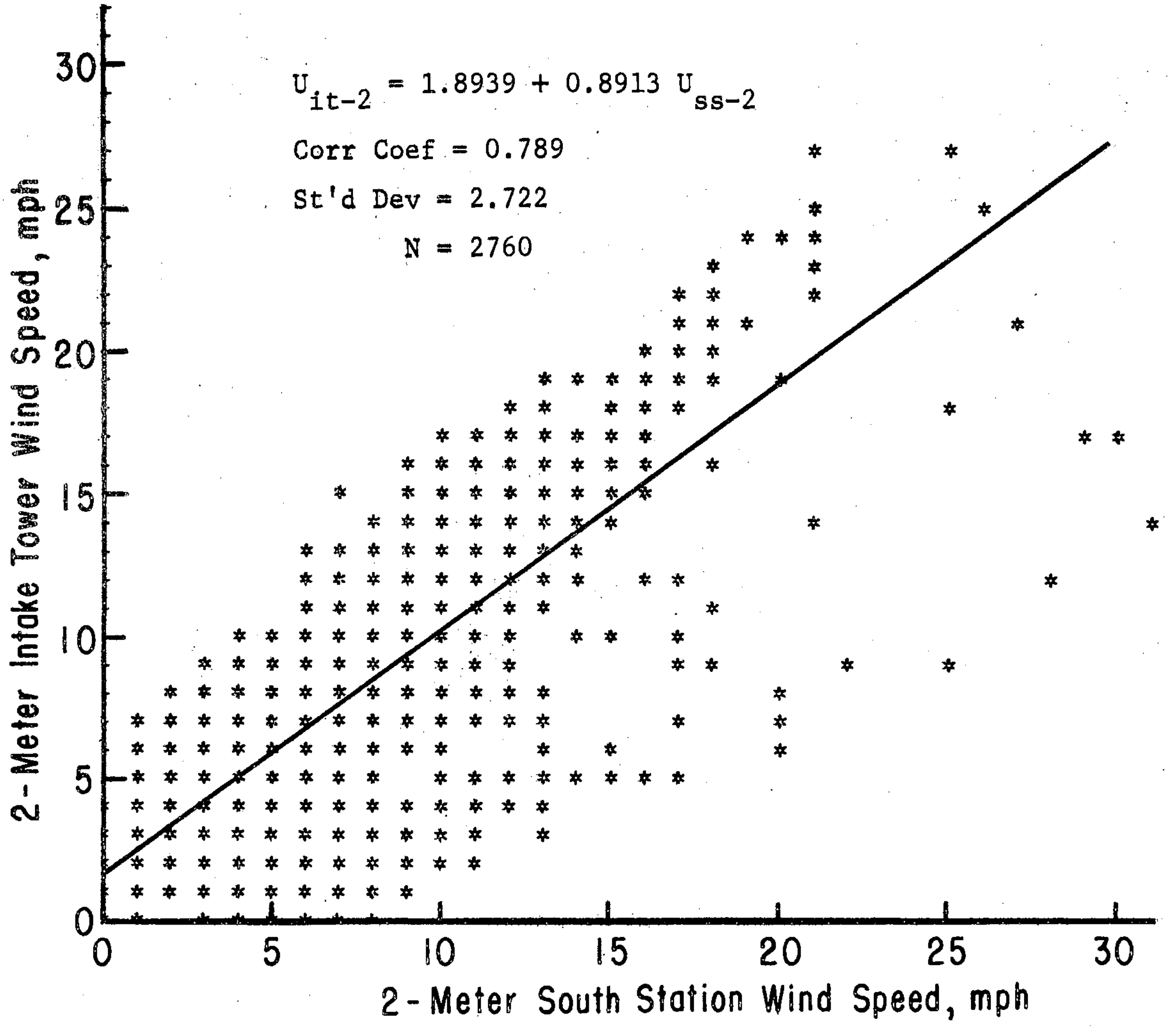


Figure 24. Comparison of Intake Tower 2-Meter Wind Speed With South Station 2-Meter Wind Speed for the Entire 1966 Season. (Due to the magnitude of data, each point on the graph represents one or more data points.)

increased across the lake. The terrain south of the south station was gently rolling land. For wind from any direction, the intake tower wind speed was not always higher than the south station wind speed. Both the intake tower and the dam blocked the northerly wind from the 2-meter anemometer. For northerly winds the south station wind speed was usually higher than the intake tower wind speed. The instrument trailer blocked easterly winds at the south station. This was not the case at the intake tower. Since the terrain at the two stations had varying effects on the wind speed for different wind directions, the correlation coefficient for (19) was lower than for (18).

During TSP's with prevailing southerly winds, the wind speed at rafts two and three was higher than the wind speed at rafts one and four, shown in Table 2. For example, during TSP 6 in 1966, the wind speed increase from raft four to raft three was 0.2 mph.

Without prevailing southerly winds, the raft wind speeds for each TSP were approximately the same. For example, TSP 13 in 1966 had average hourly wind speeds of 8.3 mph at raft one, 8.2 mph at raft two, 8.3 mph at raft three, and 8.3 mph at raft four.

Wind Speed Variation With Time

The average hourly lake wind speed varied markedly by TSP's for 1966. Until September the 1966 wind speeds compared similarly with the 1965 wind speeds, as shown by Crow and others (1967). In 1966 the lake wind decreased to a seasonal low in early September and then increased to a seasonal high in early October, as shown in Figure 25. This reversed the 1965 lake wind speed trend. This discrepancy in wind

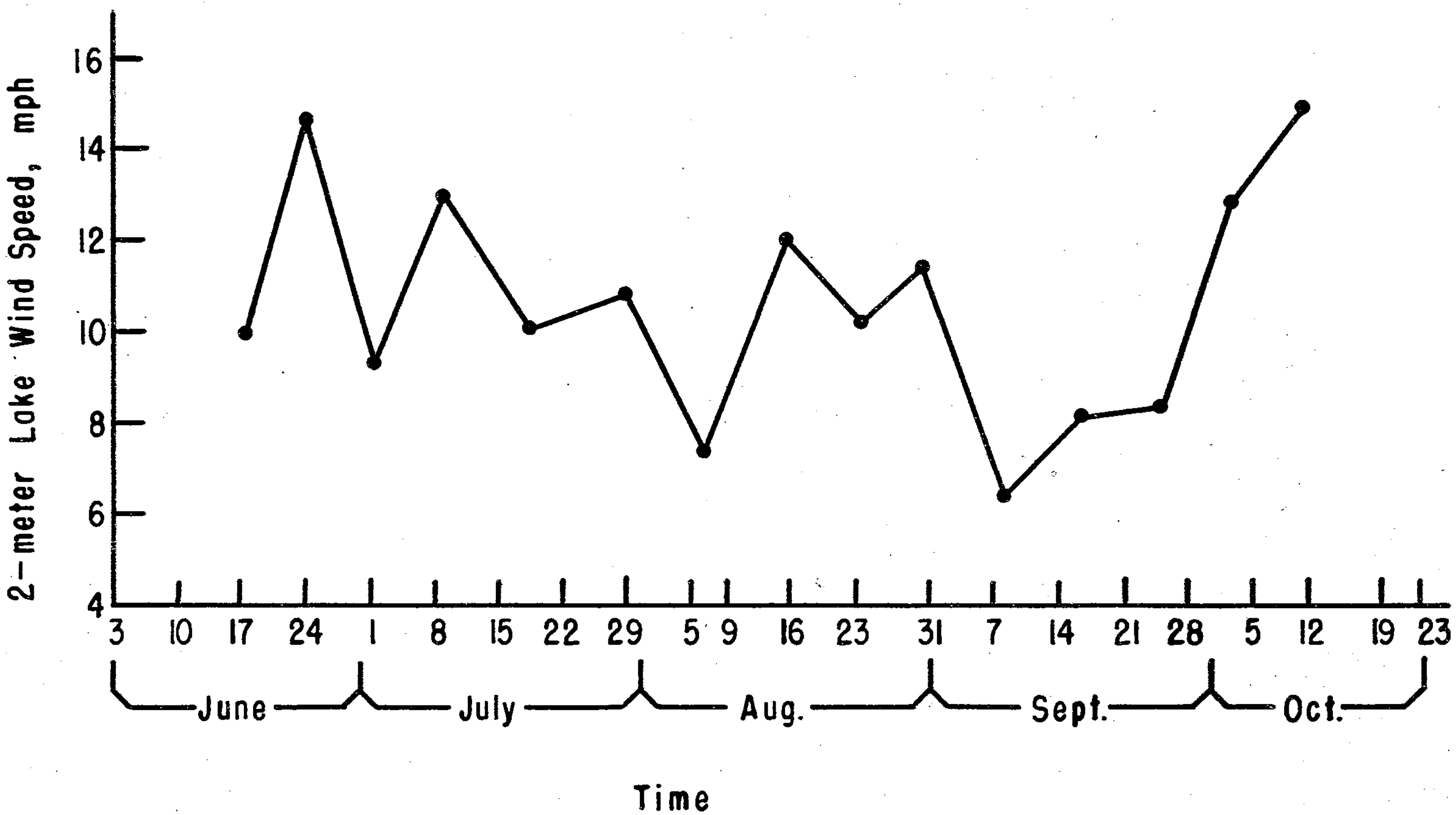


Figure 25. Variation of the Raft Wind Speed With Time When Averaged Over Thermal Survey Periods for 1966.

travel from year to year is typical of the wind in the Great Plains during September.

An average diurnal variation in wind speed was computed for the south station 2 and 8-meter wind speeds. The daily peak wind speed occurred at approximately 1500 each day, as shown in Figure 26. The minimum daily wind speed occurred at approximately 0400 each day. Again the analysis did not correlate with Fry's 1965 work. The 1965 south station wind record showed a wind speed peak at 1000 and a daily minimum at 2000.

Effect of Wind and Application Rate on Film Cover

When the lake wind speed dipped below 3 mph after several hours of continuous chemical application, good film coverage usually resulted. When these conditions were accompanied by a continually shifting wind, a 100% film cover was maintained. For example, on July 28, from 1400 to 1900, the film cover increased from 56 to 100%. The wind speed decreased from 9 mph between 1400 and 1500 to 2 mph between 1800 and 1900 and the wind direction varied between 158 and 225°.

Lake wind within the range of 3 to 13 mph, when matched with an adequate application rate, spread the film over large areas of the lake. This wind speed range was the normal working range for chemical application.

When the lake wind speed reached 13 mph, only a chemical application rate in excess of 150 lbs/hr kept a film body on the lake. For example, from 1500 to 1600 on August 14, the film cover increased from 41% at 1500 to 51% at 1600. The increase in film cover was due to an increase in chemical application from 60 to 180 lbs/hr at 1500. The

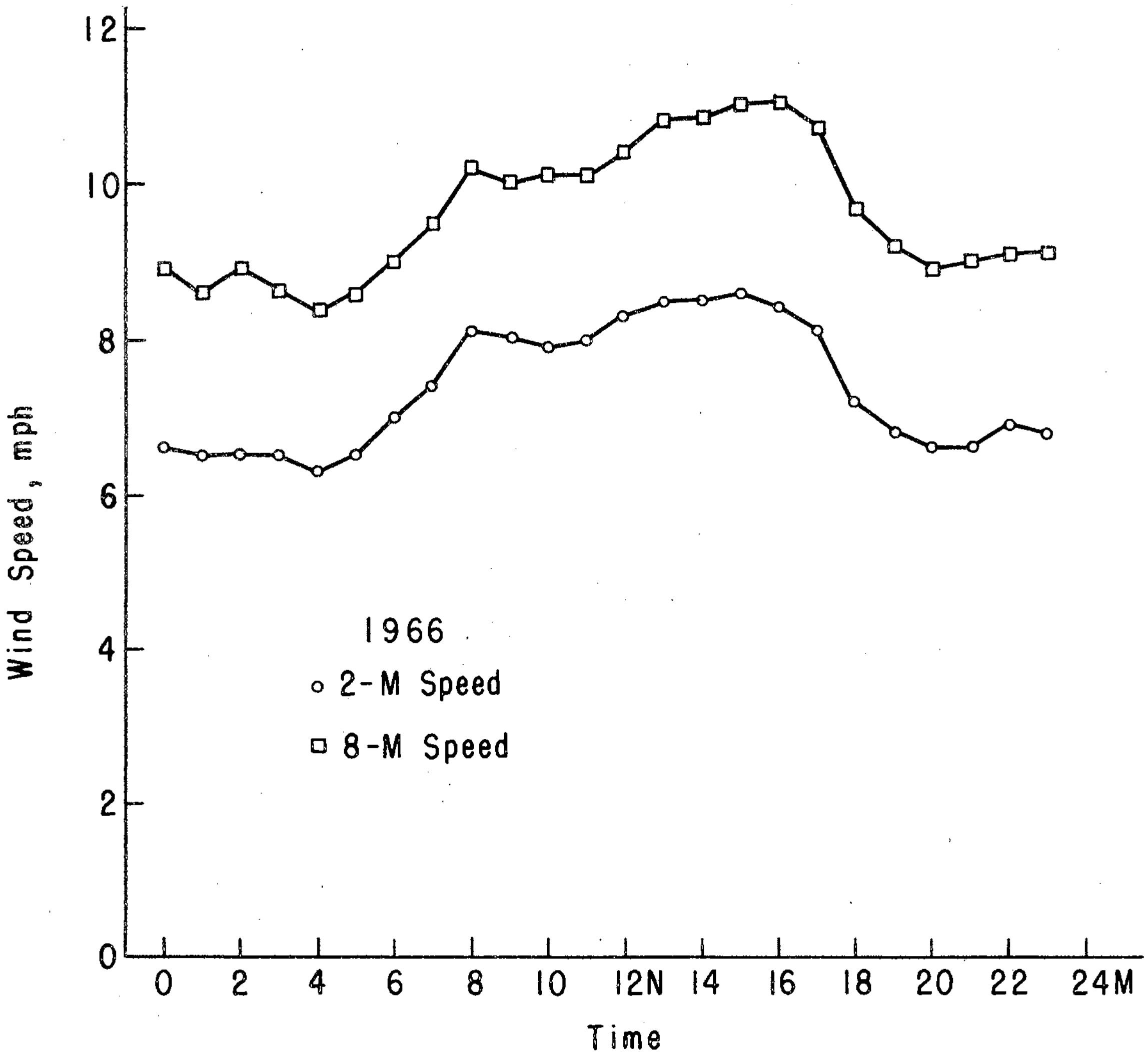


Figure 26. Average Diurnal Variation of Wind Speed at the South Station for the 1966 Lake Hefner Investigation.

wind speed increased from 10 to 13 mph between 1400 and 1600, and the wind direction varied from 158 to 180°. When the lake wind reached 15 mph, the film was blown off the lake in almost all cases regardless of the chemical application rate. For example, on September 1, from 0800-1100, the wind speed increased from 10 to 15 mph, and the application rate increased from 180 to 215 lbs/hr. The film cover decreased from 40 to 9%.

The attempt to gain a prediction equation expressing film cover as a function of wind speed and chemical application rate was fairly successful. A quadratic model with interaction gave the relationship

$$F = 0.8645 - 0.09518\ U + 0.002306\ U^2 + 0.000889\ R - 0.000004\ R^2 + 0.000063\ (U*R) \qquad (20)$$

where F = Film cover expressed as a decimal fraction of the lake surface

U = 8-meter south station wind speed in mph

R = Application rate in lbs/hr

A total of 408 hourly values of data were used in obtaining the prediction equation. The correlation coefficient was 0.732 and the standard deviation was 0.119. In reviewing the equation, the most significant of the parameters affecting film cover was the wind speed. The interaction between the wind speed and application rate was notable when considering the magnitude of their product. A response surface, shown in Figure 27, was developed from the prediction equation. The range of wind speed was from 1 to 19 mph and the range of application rate was from 8 to 220 lbs/hr. The equation was derived from data taken during periods of prevailing southerly winds.

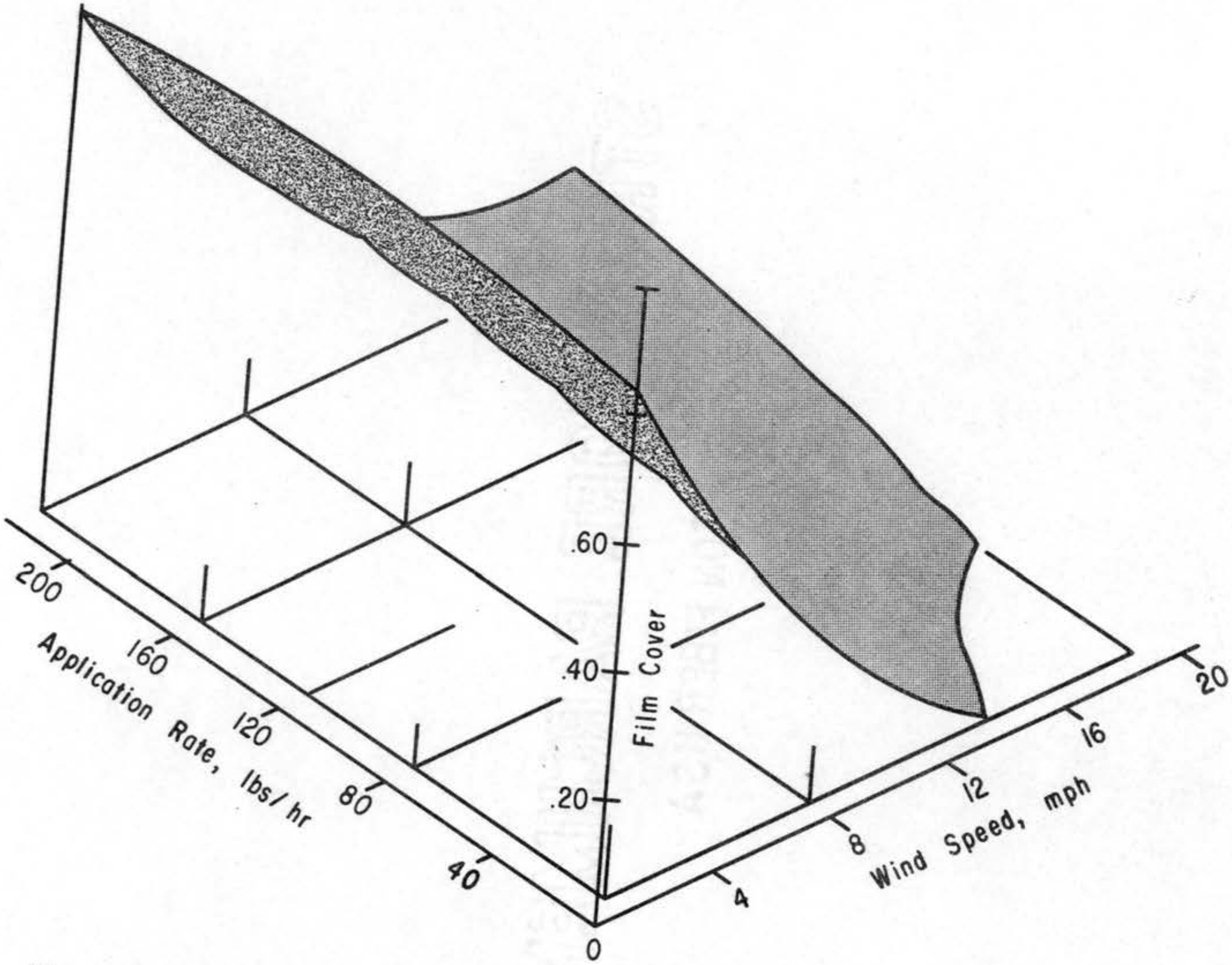


Figure 27. Response Surface Expressing Film Cover as a Function of Wind Speed and Chemical Application Rate for the 1966 Lake Hefner Study.

Effect of Sprinkler Spacing on Film Cover

The design sprinkler spacing was 150 feet, and the design operating pressure was 75 psi for each riser. The design spacing was met in constructing the system, although the operating pressure at the batching plant was only 45 psi. Due to the inadequate water pressure, the sprinkler application patterns were not adjoining. Each sprinkler produced a separate film strip, with the individual film strips gradually merging at a distance beyond the lateral to form a film body.

The merging of the separate strips was dependent on the application rate. The application rates used grossly exceed the empirical relation for small experimental ponds derived by Crow, Equation (3), as discussed in the Review of Literature. For example, on August 9 at 1100, the wind speed was 8 mph. The application rate was 52 lbs/hr, and the film cover was increasing. From the above formula, the predicted application rate R was .000595 lbs/ft/hr, or 6.8 lbs/hr for the 11,500 foot reservoir width. The actual application rate necessary to maintain a complete film exceeded this calculated rate by an approximate factor of eight.

Either increasing the nozzle pressure or reducing the sprinkler spacing would have improved the film distribution. If one or both of these stipulations had been met, the observed application rates might have agreed more closely with the calculated rates.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

The research for this thesis was performed as part of a large evaporation suppression project. This project was staffed by Oklahoma State University, under contract with the Bureau of Reclamation.

Objectives of this study were as follows: determine the effects of the lake wind speed and direction on the film cover; determine the variation of wind speed with height, distance across the lake, and time; and determine the film cover prediction equation from the variables wind speed and chemical application rate.

The rate of film movement over the lake surface was measured for various wind speeds. The equation expressing film movement as a function of wind speed was

$$M = 0.0371\ U_{ss-8}$$

The correlation coefficient was 0.907.

A wind speed and direction favorability analysis showed that only five 24-hour periods were favorable for chemical application and resulting film cover. Favorable wind speeds were defined as being less that 12 mph, and favorable wind direction was between 135 and 225°. Considering single hour periods, favorable operating conditions existed only 39.3% of the 1966 season.

The wind speed at the intake tower was higher than the south station wind speed for southerly winds. Also, the wind profile was more nearly vertical at the intake tower than at the south station for southerly winds.

The wind profiles at the observation tower were approximately linearized by plotting wind speed versus the logarithm of height. Average "k" values at the observation tower were lower than the commonly accepted value of 0.143.

A multivariate response surface was obtained which expressed film cover as a function of the wind speed and chemical application rate. The equation of the response surface was

$$F = 0.8645 - 0.09518\ U + 0.002306\ U^2 + 0.000889\ R - 0.000004\ R^2 + 0.000063\ (U*R)$$

The correlation coefficient was 0.732.

The application rate required to maintain a film grossly exceeded the rate calculated from Crow's empirical equation for small ponds.

For the chemical distribution system, the maximum possible theoretical film cover was 52%. This film cover was generated by winds from 180°.

Conclusions

1. The rate of film movement as a function of lake wind speed was approximately the same for Lake Hefner as it was in previous studies.

2. Wind speed increased across the lake from the south station to the intake tower.

3. The wind speed variation with the logarithm of height at the observation tower was approximately linear.

4. Lake surface film cover was predicted with a fair degree of accuracy from the equation involving the variables wind speed and chemical application rate.

5. The design sprinkler spacing was too wide for the observed line pressure.

Recommendations

1. It is recommended that either the line pressure should be increased for the distribution system or the sprinklers should be spaced closer together on the lake.

2. After satisfying the first recommendation, it is recommended that a study be initiated to determine an equation giving the application rate as a function of the lake wind speed for the sprinkler distribution system on Lake Hefner.

3. It is recommended that an attempt be made to use the 1966 Lake Hefner film cover prediction equation in future tests while keeping in mind the range of data from which the equation was derived.

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APPENDIX A

TABLE A-I

SOUTH STATION 2-METER WIND SPEED IN MPH AT LAKE HEFNER, 1956

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
7.0	8.0	7.0	6.0	6.0	6.0	7.0	10.0	12.0	12.0	11.0	11.0	11.0	11.0	11.0	12.0	11.0	11.0	8.0	6.0	6.0	6.0	7.0	7.0	8.8	6	21
8.0	8.0	8.0	8.0	8.0	8.0	9.0	11.0	12.0	12.0	13.0	12.0	11.0	11.0	12.0	11.0	13.0	12.0	12.0	9.0	8.0	8.0	9.0	9.0	10.1	6	22
10.0	9.0	11.0	10.0	8.0	10.0	12.0	11.0	12.0	12.0	12.0	12.0	12.0	12.0	11.0	12.0	12.0	11.0	12.0	10.0	9.0	10.0	9.0	9.0	10.8	6	23
9.0	9.0	8.0	8.0	8.0	10.0	12.0	12.0	11.0	14.0	13.0	14.0	15.0	14.0	13.0	14.0	15.0	12.0	13.0	10.0	12.0	12.0	11.0	12.0	11.7	6	24
12.0	12.0	10.0	9.0	10.0	10.0	13.0	13.0	13.0	15.0	15.0	15.0	16.0	14.0	14.0	14.0	14.0	13.0	11.0	7.0	5.0	5.0	4.0	5.0	11.2	6	25
8.0	10.0	9.0	10.0	9.0	10.0	10.0	10.0	11.0	9.0	8.0	9.0	9.0	12.0	11.0	10.0	11.0	9.0	7.0	6.0	7.0	7.0	8.0	7.0	9.0	6	26
5.0	5.0	5.0	6.0	8.0	9.0	9.0	10.0	12.0	11.0	12.0	11.0	12.0	10.0	11.0	12.0	11.0	9.0	9.0	9.0	10.0	9.0	9.0	9.0	9.3	6	27
9.0	8.0	9.0	8.0	9.0	9.0	10.0	12.0	12.0	11.0	11.0	9.0	7.0	11.0	9.0	10.0	9.0	8.0	5.0	4.0	6.0	6.0	6.0	8.0	8.6	6	28
7.0	7.0	6.0	6.0	6.0	6.0	6.0	7.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	8.0	7.0	5.0	4.0	4.0	4.0	6.0	5.0	6.8	6	29
6.0	4.0	4.0	3.0	2.0	2.0	1.0	5.0	6.0	5.0	4.0	3.0	6.0	5.0	5.0	5.0	5.0	4.0	4.0	3.0	2.0	1.0	3.0	4.0	3.8	6	30
3.0	1.0	3.0	4.0	4.0	3.0	3.0	6.0	7.0	6.0	6.0	4.0	5.0	6.0	5.0	6.0	13.0	13.0	9.0	7.0	8.0	9.0	9.0	8.0	6.2	7	1
6.0	8.0	7.0	6.0	5.0	6.0	6.0	7.0	8.0	8.0	7.0	7.0	7.0	7.0	7.0	8.0	7.0	6.0	6.0	7.0	9.0	8.0	7.0	6.0	6.9	7	2
6.0	7.0	6.0	7.0	6.0	6.0	6.0	6.0	6.0	5.0	3.0	5.0	5.0	6.0	5.0	4.0	4.0	5.0	6.0	8.0	10.0	10.0	9.0	9.0	6.3	7	3
7.0	7.0	6.0	7.0	6.0	4.0	6.0	6.0	8.0	7.0	6.0	6.0	6.0	5.0	6.0	5.0	5.0	12.0	12.0	11.0	9.0	9.0	11.0	10.0	7.4	7	4
9.0	9.0	9.0	8.0	8.0	7.0	8.0	9.0	8.0	8.0	6.0	7.0	9.0	9.0	8.0	8.0	11.0	11.0	11.0	10.0	9.0	8.0	9.0	9.0	8.7	7	5
9.0	9.0	12.0	10.0	10.0	9.0	12.0	11.0	11.0	11.0	11.0	10.0	9.0	8.0	7.0	8.0	7.0	8.0	7.0	7.0	9.0	9.0	9.0	8.0	9.2	7	6
10.0	9.0	11.0	8.0	5.0	2.0	2.0	2.0	6.0	9.0	7.0	7.0	6.0	8.0	8.0	7.0	7.0	7.0	9.0	12.0	10.0	8.0	10.0	10.0	7.5	7	7
10.0	10.0	8.0	8.0	9.0	9.0	11.0	11.0	13.0	11.0	12.0	12.0	12.0	12.0	13.0	15.0	14.0	11.0	11.0	8.0	8.0	10.0	9.0	9.0	10.7	7	8
9.0	10.0	11.0	9.0	9.0	11.0	11.0	13.0	11.0	11.0	11.0	13.0	12.0	12.0	10.0	11.0	9.0	9.0	10.0	8.0	9.0	10.0	11.0	9.0	10.4	7	9
9.0	10.0	7.0	6.0	6.0	7.0	9.0	11.0	14.0	14.0	13.0	14.0	13.0	13.0	13.0	14.0	13.0	11.0	10.0	7.0	4.0	5.0	8.0	8.0	10.0	7	10
9.0	10.0	10.0	9.0	9.0	8.0	12.0	12.0	14.0	13.0	12.0	13.0	12.0	13.0	13.0	12.0	13.0	12.0	13.0	10.0	11.0	10.0	12.0	11.0	11.4	7	11
11.0	9.0	10.0	10.0	10.0	8.0	10.0	11.0	13.0	13.0	12.0	11.0	12.0	12.0	13.0	12.0	12.0	11.0	11.0	11.0	9.0	9.0	8.0	8.0	10.7	7	12
8.0	7.0	10.0	8.0	8.0	8.0	10.0	11.0	13.0	14.0	14.0	13.0	12.0	11.0	11.0	11.0	10.0	10.0	10.0	10.0	8.0	7.0	7.0	6.0	9.9	7	13
6.0	7.0	4.0	7.0	7.0	8.0	8.0	9.0	9.0	10.0	9.0	7.0	8.0	8.0	9.0	7.0	6.0	7.0	7.0	7.0	8.0	10.0	10.0	9.0	7.8	7	14
8.0	7.0	6.0	6.0	6.0	5.0	2.0	4.0	5.0	3.0	3.0	4.0	4.0	4.0	6.0	10.0	10.0	7.0	3.0	6.0	4.0	6.0	5.0	3.0	5.3	7	15
4.0	6.0	3.0	4.0	3.0	3.0	6.0	5.0	10.0	10.0	11.0	9.0	8.0	7.0	3.0	3.0	3.0	4.0	4.0	3.0	7.0	6.0	7.0	7.0	5.7	7	16
5.0	4.0	3.0	2.0	3.0	4.0	5.0	6.0	4.0	4.0	5.0	6.0	6.0	7.0	7.0	11.0	9.0	7.0	7.0	8.0	9.0	9.0	9.0	8.0	6.2	7	17
7.0	6.0	6.0	5.0	7.0	8.0	9.0	10.0	8.0	6.0	5.0	4.0	5.0	7.0	8.0	9.0	9.0	12.0	12.0	12.0	12.0	11.0	10.0	9.0	8.2	7	18
9.0	9.0	10.0	9.0	8.0	8.0	12.0	10.0	8.0	8.0	6.0	7.0	6.0	6.0	8.0	8.0	7.0	8.0	12.0	10.0	2.0	3.0	4.0	5.0	7.6	7	19
4.0	5.0	2.0	4.0	9.0	11.0	5.0	4.0	5.0	4.0	4.0	5.0	6.0	7.0	7.0	7.0	6.0	7.0	6.0	4.0	3.0	4.0	4.0	5.0	5.3	7	20
4.0	4.0	6.0	6.0	4.0	5.0	12.0	7.0	8.0	6.0	5.0	7.0	9.0	9.0	9.0	8.0	8.0	6.0	5.0	4.0	3.0	5.0	4.0	6.0	6.3	7	21
7.0	5.0	8.0	7.0	8.0	8.0	7.0	9.0	9.0	9.0	10.0	10.0	12.0	11.0	10.0	8.0	9.0	9.0	9.0	8.0	8.0	10.0	12.0	11.0	8.9	7	22
8.0	8.0	8.0	6.0	9.0	9.0	9.0	8.0	9.0	10.0	8.0	7.0	7.0	6.0	7.0	5.0	4.0	5.0	6.0	3.0	3.0	4.0	5.0	4.0	6.6	7	23
4.0	2.0	4.0	4.0	4.0	4.0	7.0	6.0	5.0	3.0	7.0	7.0	8.0	7.0	5.0	7.0	7.0	4.0	5.0	6.0	7.0	7.0	5.0	5.0	5.4	7	24
6.0	6.0	6.0	6.0	5.0	6.0	8.0	9.0	10.0	10.0	9.0	11.0	12.0	14.0	17.0	16.0	13.0	12.0	14.0	12.0	12.0	12.0	12.0	11.0	10.4	7	25
11.0	11.0	10.0	10.0	11.0	12.0	15.0	12.0	11.0	12.0	13.0	13.0	12.0	11.0	11.0	10.0	10.0	11.0	9.0	9.0	9.0	9.0	8.0	9.0	10.8	7	26
10.0	10.0	9.0	9.0	8.0	8.0	8.0	6.0	6.0	5.0	8.0	8.0	7.0	9.0	9.0	9.0	9.0	10.0	8.0	8.0	8.0	8.0	7.0	8.0	8.1	7	27
7.0	9.0	9.0	9.0	10.0	10.0	8.0	7.0	7.0	5.0	4.0	5.0	6.0	7.0	4.0	5.0	2.0	2.0	1.0	2.0	1.0	3.0	5.0	7.0	5.6	7	28
7.0	7.0	9.0	9.0	8.0	7.0	3.0	6.0	9.0	8.0	10.0	13.0	12.0	11.0	9.0	8.0	8.0	7.0	8.0	6.0	5.0	3.0	2.0	2.0	7.4	7	29
1.0	1.0	1.0	2.0	5.0	4.0	6.0	6.0	5.0	5.0	6.0	7.0	8.0	8.0	7.0	8.0	7.0	6.0	6.0	11.0	5.0	2.0	3.0	4.0	5.2	7	30
2.0	1.0	1.0	3.0	1.0	4.0	3.0	3.0	5.0	3.0	2.0	4.0	5.0	5.0	7.0	7.0	7.0	8.0	9.0	7.0	5.0	9.0	10.0	10.0	5.0	7	31
9.0	11.0	10.0	10.0	10.0	9.0	11.0	11.0	11.0	9.0	10.0	10.0	9.0	10.0	11.0	11.0	10.0	11.0	10.0	10.0	10.0	10.0	9.0	12.0	10.2	8	1
11.0	9.0	7.0	9.0	8.0	10.0	10.0	8.0	8.0	10.0	10.0	9.0	10.0	9.0	11.0	13.0	13.0	12.0	9.0	7.0	6.0	4.0	1.0	2.0	8.6	8	2
1.0	2.0	2.0	1.0	4.0	4.0	4.0	3.0	2.0	2.0	2.0	5.0	6.0	4.0	5.0	4.0	5.0	5.0	5.0	2.0	0.0	1.0	2.0	4.0	3.1	8	3
4.0	3.0	3.0	1.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	5.0	6.0	7.0	5.0	4.0	3.0	1.0	2.0	3.4	8	4
3.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	4.0	4.0	3.0	2.0	3.0	3.0	2.0	2.0	3.0	3.0	5.0	4.0	3.0	4.0	3.0	4.0	2.8	8	5
4.0	5.0	5.0	7.0	4.0	3.0	5.0	6.0	6.0	6.0	4.0	3.0	4.0	3.0	3.0	5.0	6.0	7.0	7.0	7.0	7.0	6.0	5.0	6.0	5.2	8	6
11.0	6.0	6.0	7.0	2.0	1.0	4.0	8.0	7.0	8.0	8.0	7.0	6.0	6.0	5.0	4.0	2.0	1.0	4.0	6.0	3.0	1.0	2.0	0.0	4.8	8	7
4.0	6.0	5.0	3.0	3.0	3.0	3.0	3.0	7.0	11.0	7.0	8.0	11.0	10.0	8.0	6.0	5.0	3.0	2.0	7.0	8.0	6.0	5.0	1.0	5.6	8	8
1.0	1.0	7.0	7.0	6.0	7.0	8.0	8.0	5.0	4.0	5.0	6.0	6.0	5.0	8.0	10.0	10.0	13.0	11.0	12.0	11.0	11.0	11.0	11.0	7.7	8	9
21.0	20.0	17.0	7.0	4.0	4.0	3.0	3.0	4.0	4.0	5.0	3.0	5.0	6.0	7.0	7.0	6.0	5.0	6.0	7.0	8.0	6.0	6.0	5.0	7.0	8	10
4.0	6.0	6.0	5.0	6.0	4.0	5.0	6.0	4.0	3.0	3.0	5.0	4.0	4.0	6.0	4.0	6.0	8.0	8.0	8.0	6.0	7.0	5.0	3.0	5.3	8	11
2.0	3.0	6.0	9.0	7.0	7.0	6.0	6.0	7.0	7.0	7.0	9.0	8.0	8.0	7.0	8.0	9.0	10.0	9.0	8.0	7.0	7.0	6.0	6.0	7.0	8	12
7.0	8.0	6.0	6.0	4.0	5.0	3.0	7.0	10.0	6.0	6.0	6.0	2.0	2.0	5.0	5.0	10.0	8.0	5.0	5.0	3.0	2.0	3.0	5.0	5.4	8	13
6.0	3.0	5.0	6.0	7.0	8.0	5.0	9.0	9.0	6.0	4.0	2.0	6.0	8.0	10.0	11.0	10.0	10.0	12.0	10.0	10.0	10.0	10.0	10.0	7.8	8	14
10.0	12.0	10.0	11.0	10.0	10.0	9.0	10.0	13.0	14.0	14.0	13.0	14.0	15.0	15.0	14.0	14.0	15.0	12.0	10.0	10.0	10.0	10.0	10.0	11.9	8	15
9.0	9.0	10.0	9.0	9.0	10.0	11.0	11.0	12.0	11.0	11.0	10.0	11.0	10.0	10.0	11.0	10.0	9.0	10.0	9.0	8.0	9.0	9.0	10.0	9.9	8	16
10.0	9.0	10.0	9.0	8.0	7.0	7.0	10.0	9.0	10.0	10.0	8.0	8.0	8.0	9.0	11.0	11.0	11.0	9.0	10.0	9.0	9.0	9.0	11.0	9.3	8	17
9.0	8.0	9.0	7.0	7.0	6.0	7.0	9.0	7.0	5.0	10.0	10.0	11.0	9.0	9.0	10.0	9.0	9.0	11.0	17.0	16.0	5.0	4.0	6.0	8.8	8	18

TABLE A-I (CONTINUED)

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
5.0	5.0	8.0	7.0	4.0	3.0	5.0	5.0	4.0	7.0	8.0	9.0	7.0	9.0	6.0	6.0	6.0	16.0	10.0	7.0	8.0	7.0	8.0	10.0	7.1	8	19
9.0	9.0	9.0	11.0	7.0	7.0	8.0	8.0	10.0	11.0	12.0	12.0	12.0	11.0	10.0	11.0	11.0	12.0	12.0	10.0	7.0	8.0	8.0	11.0	9.8	8	20
10.0	11.0	11.0	10.0	8.0	9.0	9.0	7.0	7.0	8.0	7.0	5.0	7.0	9.0	6.0	8.0	8.0	7.0	8.0	10.0	11.0	7.0	5.0	6.0	8.1	8	21
4.0	5.0	5.0	5.0	4.0	2.0	3.0	3.0	5.0	4.0	6.0	5.0	6.0	6.0	6.0	8.0	10.0	7.0	7.0	4.0	4.0	6.0	5.0	4.0	5.2	8	22
5.0	4.0	7.0	7.0	2.0	5.0	3.0	7.0	6.0	7.0	6.0	3.0	8.0	7.0	6.0	4.0	7.0	7.0	5.0	3.0	3.0	4.0	3.0	4.0	5.1	8	23
4.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0	3.0	2.0	3.0	2.0	3.0	3.0	4.0	4.0	5.0	5.0	3.0	3.0	3.0	3.0	4.0	3.8	8	24
2.0	3.0	2.0	2.0	1.0	2.0	1.0	4.0	3.0	4.0	4.0	4.0	5.0	6.0	6.0	7.0	7.0	7.0	4.0	4.0	3.0	3.0	4.0	4.0	3.8	8	25
3.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	7.0	10.0	12.0	12.0	10.0	11.0	11.0	11.0	11.0	11.0	8.0	4.0	6.0	7.0	6.0	8.0	7.4	8	26
7.0	7.0	8.0	8.0	9.0	9.0	8.0	9.0	11.0	11.0	10.0	10.0	8.0	8.0	8.0	9.0	7.0	6.0	6.0	5.0	6.0	9.0	7.0	7.0	8.0	8	27
9.0	7.0	8.0	8.0	6.0	7.0	7.0	9.0	11.0	10.0	9.0	8.0	6.0	9.0	7.0	8.0	9.0	7.0	5.0	5.0	5.0	7.0	7.0	7.0	7.5	8	28
7.0	7.0	6.0	7.0	6.0	6.0	7.0	8.0	9.0	10.0	5.0	6.0	9.0	9.0	9.0	7.0	7.0	8.0	7.0	6.0	6.0	6.0	5.0	4.0	7.0	8	29
4.0	5.0	4.0	5.0	4.0	4.0	4.0	5.0	6.0	7.0	7.0	8.0	7.0	9.0	9.0	9.0	10.0	10.0	9.0	7.0	6.0	6.0	6.0	6.0	6.5	8	30
5.0	7.0	8.0	7.0	8.0	5.0	7.0	8.0	9.0	9.0	9.0	9.0	9.0	8.0	10.0	9.0	10.0	9.0	7.0	6.0	8.0	7.0	7.0	8.0	7.9	8	31
6.0	7.0	5.0	6.0	5.0	6.0	6.0	8.0	9.0	12.0	11.0	11.0	12.0	15.0	13.0	10.0	10.0	9.0	7.0	5.0	6.0	7.0	9.0	8.0	8.5	9	1
9.0	10.0	10.0	11.0	11.0	11.0	7.0	6.0	11.0	10.0	13.0	13.0	12.0	14.0	13.0	11.0	9.0	9.0	7.0	9.0	8.0	8.0	8.0	6.0	9.8	9	2
4.0	3.0	2.0	2.0	5.0	8.0	9.0	7.0	3.0	3.0	4.0	8.0	10.0	10.0	8.0	8.0	6.0	4.0	5.0	7.0	7.0	7.0	16.0	5.0	6.3	9	3
5.0	2.0	3.0	4.0	5.0	4.0	7.0	8.0	8.0	5.0	6.0	4.0	4.0	7.0	9.0	10.0	6.0	5.0	4.0	2.0	1.0	1.0	0.0	1.0	4.6	9	4
3.0	1.0	2.0	1.0	2.0	2.0	4.0	4.0	4.0	3.0	2.0	2.0	3.0	1.0	2.0	2.0	1.0	1.0	2.0	3.0	2.0	3.0	4.0	6.0	2.5	9	5
5.0	6.0	4.0	3.0	6.0	4.0	7.0	11.0	10.0	9.0	10.0	10.0	7.0	6.0	6.0	6.0	8.0	8.0	5.0	3.0	3.0	4.0	3.0	3.0	6.1	9	6
2.0	5.0	5.0	5.0	2.0	2.0	3.0	3.0	3.0	5.0	6.0	5.0	4.0	5.0	4.0	5.0	5.0	7.0	5.0	2.0	1.0	2.0	2.0	2.0	3.8	9	7
2.0	1.0	3.0	3.0	4.0	4.0	3.0	6.0	8.0	8.0	6.0	5.0	5.0	4.0	6.0	7.0	6.0	6.0	5.0	4.0	5.0	3.0	4.0	2.0	4.6	9	8
4.0	3.0	2.0	1.0	1.0	3.0	2.0	3.0	8.0	7.0	6.0	2.0	2.0	2.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	4.0	3.0	5.0	4.0	9	9
3.0	1.0	4.0	2.0	2.0	3.0	1.0	2.0	6.0	5.0	3.0	4.0	3.0	4.0	5.0	7.0	7.0	7.0	6.0	5.0	3.0	3.0	3.0	3.0	3.8	9	10
1.0	1.0	2.0	1.0	1.0	2.0	2.0	0.0	1.0	1.0	1.0	2.0	2.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	2.2	9	11
1.0	2.0	2.0	3.0	3.0	2.0	3.0	3.0	4.0	4.0	3.0	3.0	2.0	5.0	6.0	8.0	6.0	7.0	4.0	3.0	2.0	2.0	3.0	3.0	3.5	9	12
2.0	4.0	5.0	6.0	7.0	6.0	4.0	7.0	10.0	10.0	10.0	12.0	12.0	12.0	11.0	13.0	10.0	10.0	8.0	10.0	9.0	10.0	14.0	15.0	9.0	9	13
6.0	3.0	6.0	7.0	4.0	8.0	7.0	4.0	10.0	14.0	11.0	13.0	12.0	13.0	11.0	10.0	7.0	8.0	5.0	6.0	6.0	7.0	6.0	6.0	7.9	9	14
5.0	5.0	5.0	5.0	5.0	7.0	10.0	9.0	7.0	8.0	5.0	3.0	3.0	5.0	4.0	6.0	7.0	5.0	2.0	2.0	2.0	1.0	2.0	0.0	4.7	9	15
2.0	1.0	0.0	1.0	4.0	5.0	5.0	4.0	3.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	1.0	3.0	4.0	5.0	4.0	3.0	4.0	4.0	2.9	9	16
2.0	2.0	2.0	3.0	3.0	1.0	1.0	4.0	3.0	3.0	4.0	4.0	3.0	3.0	5.0	7.0	6.0	5.0	1.0	2.0	1.0	1.0	1.0	1.0	2.8	9	17
2.0	1.0	1.0	1.0	3.0	5.0	9.0	4.0	1.0	5.0	7.0	9.0	13.0	14.0	13.0	12.0	10.0	9.0	6.0	6.0	7.0	10.0	8.0	7.0	6.8	9	18
6.0	8.0	8.0	7.0	7.0	10.0	10.0	8.0	8.0	9.0	11.0	11.0	13.0	13.0	12.0	12.0	11.0	9.0	7.0	7.0	5.0	8.0	9.0	9.0	9.1	9	19
10.0	9.0	11.0	11.0	10.0	10.0	11.0	10.0	11.0	10.0	11.0	13.0	12.0	13.0	11.0	12.0	10.0	9.0	6.0	3.0	1.0	2.0	2.0	1.0	8.7	9	20
1.0	1.0	2.0	2.0	1.0	3.0	1.0	2.0	2.0	3.0	3.0	3.0	2.0	3.0	1.0	1.0	0.0	0.0	1.0	2.0	3.0	3.0	5.0	4.0	2.0	9	21
6.0	6.0	5.0	7.0	8.0	7.0	13.0	13.0	12.0	11.0	11.0	13.0	12.0	13.0	9.0	9.0	8.0	6.0	1.0	1.0	2.0	0.0	1.0	1.0	7.3	9	22
2.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	3.0	1.0	2.0	2.0	3.0	2.0	4.0	5.0	2.0	9	23
4.0	5.0	4.0	6.0	5.0	2.0	3.0	5.0	7.0	9.0	11.0	11.0	13.0	12.0	11.0	12.0	11.0	10.0	9.0	9.0	11.0	12.0	13.0	12.0	8.6	9	24
12.0	11.0	11.0	12.0	12.0	14.0	11.0	13.0	12.0	8.0	6.0	5.0	7.0	8.0	8.0	7.0	7.0	4.0	3.0	4.0	5.0	4.0	7.0	6.0	8.2	9	25
6.0	4.0	2.0	2.0	0.0	3.0	7.0	8.0	4.0	1.0	2.0	2.0	7.0	6.0	7.0	6.0	7.0	5.0	5.0	4.0	4.0	4.0	6.0	5.0	4.5	9	26
5.0	3.0	6.0	5.0	7.0	7.0	8.0	7.0	8.0	7.0	8.0	4.0	8.0	11.0	7.0	6.0	8.0	6.0	7.0	5.0	5.0	5.0	5.0	4.0	6.3	9	27
7.0	6.0	5.0	5.0	3.0	7.0	5.0	4.0	4.0	4.0	5.0	3.0	2.0	2.0	4.0	5.0	5.0	6.0	2.0	3.0	3.0	5.0	8.0	9.0	4.7	9	28
9.0	11.0	12.0	9.0	5.0	5.0	4.0	5.0	6.0	3.0	2.0	1.0	3.0	4.0	6.0	8.0	9.0	9.0	6.0	6.0	8.0	10.0	11.0	12.0	6.8	9	29
11.0	11.0	10.0	18.0	22.0	16.0	18.0	20.0	17.0	15.0	13.0	17.0	17.0	20.0	20.0	17.0	15.0	9.0	6.0	4.0	5.0	6.0	7.0	6.0	13.3	9	30
3.0	3.0	3.0	2.0	3.0	3.0	4.0	2.0	3.0	1.0	2.0	3.0	2.0	4.0	5.0	6.0	6.0	5.0	4.0	5.0	6.0	6.0	6.0	7.0	3.9	10	1
10.0	13.0	13.0	13.0	15.0	15.0	15.0	13.0	17.0	19.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	20.0	19.0	17.0	18.0	17.0	17.0	16.0	17.3	10	2
16.0	16.0	13.0	13.0	10.0	10.0	13.0	11.0	17.0	18.0	17.0	16.0	16.0	13.0	12.0	10.0	4.0	4.0	4.0	8.0	4.0	3.0	6.0	12.0	11.1	10	3
13.0	10.0	9.0	11.0	13.0	10.0	9.0	10.0	10.0	7.0	11.0	8.0	9.0	8.0	7.0	6.0	5.0	4.0	5.0	5.0	6.0	6.0	6.0	6.0	8.1	10	4
5.0	3.0	2.0	3.0	2.0	6.0	3.0	4.0	3.0	2.0	2.0	4.0	2.0	3.0	3.0	3.0	0.0	1.0	2.0	2.0	2.0	2.0	3.0	3.0	2.7	10	5
3.0	3.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	5.0	7.0	8.0	9.0	9.0	8.0	9.0	8.0	6.0	4.0	5.0	5.0	5.0	4.0	6.0	5.2	10	6
6.0	4.0	4.0	5.0	6.0	7.0	8.0	10.0	12.0	12.0	12.0	11.0	12.0	12.0	12.0	11.0	10.0	9.0	8.0	8.0	10.0	8.0	8.0	10.0	9.0	10	7
8.0	10.0	9.0	11.0	10.0	10.0	10.0	12.0	12.0	13.0	12.0	13.0	11.0	11.0	16.0	14.0	12.0	10.0	7.0	6.0	4.0	7.0	8.0	8.0	10.2	10	8
9.0	10.0	11.0	11.0	12.0	11.0	10.0	10.0	10.0	6.0	6.0	6.0	6.0	4.0	4.0	5.0	15.0	16.0	10.0	8.0	6.0	6.0	4.0	4.0	8.3	10	9
5.0	7.0	7.0	5.0	3.0	2.0	1.0	2.0	4.0	7.0	7.0	6.0	6.0	5.0	5.0	4.0	4.0	2.0	1.0	2.0	3.0	3.0	3.0	0.0	3.9	10	10
3.0	3.0	1.0	4.0	2.0	4.0	6.0	7.0	8.0	10.0	11.0	11.0	10.0	11.0	11.0	11.0	12.0	11.0	10.0	10.0	12.0	12.0	12.0	13.0	8.5	10	11
14.0	11.0	10.0	9.0	8.0	9.0	8.0	9.0	12.0	14.0	18.0	18.0	18.0	18.0	17.0	16.0	16.0	15.0	12.0	12.0	14.0	15.0	16.0	16.0	13.5	10	12
14.0	14.0	12.0	12.0	13.0	12.0	13.0	12.0	15.0	14.0	14.0	14.0	14.0	16.0	14.0	14.0	13.0	12.0	10.0	11.0	13.0	15.0	17.0	15.0	13.5	10	13
15.0	14.0	15.0	16.0	17.0	17.0	18.0	17.0	18.0	16.0	15.0	18.0	20.0	21.0	21.0	25.0	26.0	27.0	25.0	29.0	30.0	31.0	28.0	25.0	21.3	10	14

TABLE A-II

SOUTH STATION 8-METER WIND SPEED IN MPH AT LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
9.0	9.0	9.0	8.0	8.0	7.0	8.0	11.0	12.0	15.0	12.0	12.0	13.0	13.0	12.0	13.0	14.0	12.0	9.0	7.0	7.0	7.0	7.0	8.0	10.1	6	21
9.0	7.0	9.0	9.0	8.0	9.0	8.0	8.0	11.0	15.0	16.0	16.0	13.0	15.0	14.0	14.0	17.0	16.0	14.0	12.0	11.0	11.0	11.0	12.0	11.9	6	22
13.0	13.0	13.0	13.0	11.0	12.0	15.0	14.0	15.0	14.0	15.0	15.0	16.0	15.0	14.0	15.0	15.0	15.0	15.0	13.0	13.0	12.0	12.0	12.0	13.8	6	23
12.0	12.0	10.0	11.0	11.0	12.0	15.0	15.0	15.0	17.0	16.0	18.0	18.0	18.0	17.0	18.0	18.0	16.0	16.0	15.0	15.0	15.0	15.0	15.0	15.0	6	24
16.0	14.0	13.0	13.0	12.0	13.0	15.0	17.0	16.0	19.0	18.0	19.0	19.0	19.0	16.0	19.0	17.0	17.0	14.0	9.0	8.0	7.0	6.0	7.0	14.3	6	25
10.0	13.0	13.0	12.0	12.0	12.0	13.0	13.0	13.0	11.0	10.0	12.0	12.0	15.0	14.0	13.0	14.0	12.0	9.0	8.0	9.0	9.0	10.0	9.0	11.6	6	26
7.0	7.0	7.0	8.0	10.0	12.0	12.0	13.0	15.0	14.0	15.0	14.0	15.0	13.0	14.0	15.0	14.0	12.0	12.0	12.0	13.0	12.0	12.0	12.0	12.1	6	27
12.0	10.0	12.0	10.0	12.0	12.0	13.0	15.0	15.0	14.0	14.0	12.0	9.0	12.0	12.0	12.0	12.0	10.0	7.0	7.0	8.0	9.0	8.0	10.0	11.1	6	28
9.0	10.0	7.0	9.0	8.0	8.0	7.0	9.0	10.0	10.0	10.0	12.0	11.0	12.0	12.0	11.0	10.0	8.0	8.0	5.0	6.0	6.0	7.0	7.0	8.8	6	29
9.0	7.0	7.0	7.0	5.0	4.0	2.0	7.0	7.0	6.0	5.0	4.0	7.0	7.0	6.0	6.0	6.0	4.0	6.0	5.0	4.0	2.0	5.0	7.0	5.6	6	30
5.0	3.0	5.0	6.0	7.0	5.0	4.0	7.0	8.0	7.0	8.0	6.0	5.0	8.0	6.0	8.0	16.0	16.0	11.0	10.0	11.0	12.0	11.0	10.0	8.1	7	1
9.0	11.0	9.0	8.0	7.0	8.0	8.0	9.0	9.0	11.0	9.0	8.0	8.0	9.0	9.0	10.0	8.0	9.0	7.0	10.0	11.0	10.0	9.0	8.0	8.9	7	2
9.0	8.0	9.0	9.0	8.0	8.0	8.0	8.0	7.0	6.0	5.0	5.0	7.0	7.0	7.0	5.0	5.0	7.0	8.0	11.0	13.0	13.0	12.0	11.0	8.2	7	3
10.0	9.0	9.0	9.0	8.0	6.0	8.0	8.0	10.0	9.0	7.0	7.0	7.0	7.0	7.0	6.0	6.0	15.0	15.0	15.0	11.0	13.0	13.0	13.0	9.5	7	4
12.0	12.0	12.0	10.0	10.0	9.0	10.0	11.0	10.0	9.0	8.0	8.0	11.0	12.0	10.0	10.0	13.0	14.0	14.0	13.0	11.0	11.0	12.0	12.0	11.0	7	5
12.0	12.0	16.0	12.0	12.0	13.0	14.0	15.0	13.0	14.0	13.0	12.0	11.0	10.0	9.0	9.0	9.0	9.0	10.0	10.0	12.0	12.0	11.0	11.0	11.7	7	6
13.0	12.0	13.0	11.0	6.0	3.0	3.0	3.0	7.0	10.0	9.0	8.0	8.0	10.0	10.0	9.0	9.0	8.0	11.0	16.0	13.0	11.0	13.0	13.0	9.5	7	7
13.0	12.0	11.0	11.0	12.0	12.0	13.0	15.0	15.0	15.0	14.0	15.0	14.0	15.0	16.0	18.0	19.0	14.0	13.0	10.0	10.0	14.0	11.0	12.0	13.5	7	8
13.0	13.0	13.0	12.0	13.0	13.0	13.0	16.0	14.0	14.0	13.0	16.0	15.0	14.0	13.0	13.0	12.0	11.0	12.0	12.0	12.0	12.0	14.0	13.0	13.2	7	9
12.0	12.0	9.0	8.0	8.0	10.0	11.0	15.0	16.0	18.0	16.0	16.0	17.0	16.0	16.0	17.0	16.0	14.0	12.0	9.0	7.0	7.0	10.0	11.0	12.6	7	10
12.0	13.0	12.0	12.0	11.0	12.0	14.0	16.0	17.0	16.0	16.0	17.0	15.0	16.0	16.0	15.0	16.0	15.0	13.0	14.0	14.0	14.0	15.0	14.0	14.4	7	11
13.0	13.0	13.0	12.0	13.0	11.0	12.0	14.0	16.0	16.0	14.0	15.0	14.0	15.0	15.0	15.0	15.0	14.0	14.0	13.0	13.0	11.0	11.0	10.0	13.4	7	12
10.0	10.0	13.0	10.0	11.0	11.0	12.0	14.0	15.0	17.0	14.0	15.0	15.0	14.0	14.0	13.0	13.0	13.0	13.0	12.0	10.0	9.0	9.0	9.0	12.3	7	13
9.0	8.0	7.0	9.0	10.0	10.0	10.0	12.0	11.0	11.0	11.0	8.0	9.0	11.0	10.0	8.0	9.0	8.0	9.0	11.0	14.0	12.0	12.0	11.0	10.0	7	14
10.0	9.0	8.0	8.0	8.0	6.0	4.0	4.0	7.0	3.0	4.0	4.0	6.0	6.0	6.0	13.0	16.0	9.0	6.0	8.0	6.0	8.0	6.0	5.0	7.1	7	15
6.0	7.0	5.0	7.0	6.0	5.0	7.0	7.0	12.0	12.0	14.0	11.0	9.0	9.0	4.0	3.0	4.0	5.0	6.0	5.0	9.0	8.0	10.0	9.0	7.5	7	16
6.0	5.0	3.0	4.0	5.0	5.0	7.0	5.0	5.0	6.0	7.0	8.0	8.0	7.0	10.0	13.0	11.0	9.0	9.0	10.0	10.0	12.0	12.0	10.0	7.8	7	17
9.0	8.0	7.0	8.0	5.0	2.0	12.0	13.0	10.0	8.0	7.0	8.0	10.0	11.0	11.0	16.0	17.0	16.0	14.0	15.0	15.0	12.0	12.0	12.0	10.8	7	18
12.0	12.0	12.0	10.0	10.0	14.0	13.0	10.0	10.0	7.0	8.0	8.0	7.0	9.0	10.0	5.0	4.0	7.0	12.0	4.0	4.0	5.0	5.0	2.0	8.3	7	19
2.0	7.0	3.0	6.0	12.0	14.0	7.0	6.0	6.0	5.0	6.0	5.0	7.0	9.0	10.0	11.0	10.0	9.0	11.0	9.0	7.0	6.0	6.0	5.0	7.5	7	20
7.0	6.0	6.0	8.0	7.0	6.0	7.0	13.0	12.0	11.0	7.0	8.0	9.0	11.0	12.0	12.0	11.0	9.0	8.0	6.0	4.0	6.0	6.0	6.0	8.3	7	21
9.0	7.0	10.0	9.0	11.0	10.0	9.0	11.0	12.0	12.0	13.0	13.0	15.0	13.0	13.0	11.0	12.0	11.0	11.0	10.0	11.0	14.0	15.0	14.0	11.5	7	22
12.0	10.0	11.0	7.0	12.0	12.0	11.0	10.0	12.0	12.0	10.0	8.0	8.0	8.0	7.0	7.0	5.0	6.0	8.0	5.0	4.0	6.0	7.0	5.0	8.5	7	23
5.0	6.0	6.0	5.0	5.0	5.0	10.0	9.0	6.0	5.0	9.0	9.0	10.0	8.0	7.0	9.0	9.0	6.0	6.0	8.0	10.0	8.0	7.0	6.0	7.3	7	24
8.0	8.0	9.0	8.0	6.0	7.0	11.0	11.0	13.0	11.0	9.0	11.0	12.0	14.0	17.0	16.0	13.0	12.0	14.0	12.0	12.0	12.0	12.0	11.0	11.2	7	25
11.0	11.0	10.0	10.0	11.0	12.0	15.0	15.0	14.0	13.0	12.0	16.0	15.0	13.0	13.0	13.0	13.0	14.0	11.0	10.0	12.0	13.0	11.0	11.0	12.5	7	26
13.0	12.0	12.0	11.0	11.0	10.0	10.0	8.0	7.0	6.0	10.0	9.0	9.0	11.0	11.0	12.0	12.0	12.0	10.0	11.0	12.0	10.0	10.0	9.0	10.3	7	27
9.0	12.0	12.0	12.0	13.0	12.0	11.0	9.0	8.0	6.0	4.0	7.0	6.0	9.0	5.0	6.0	3.0	2.0	4.0	4.0	2.0	4.0	7.0	9.0	7.3	7	28
9.0	11.0	11.0	12.0	10.0	9.0	4.0	8.0	9.0	11.0	14.0	15.0	14.0	10.0	10.0	10.0	9.0	10.0	9.0	6.0	5.0	4.0	4.0	4.0	9.1	7	29
4.0	2.0	2.0	4.0	8.0	7.0	9.0	10.0	7.0	8.0	8.0	10.0	11.0	10.0	11.0	10.0	11.0	9.0	9.0	14.0	7.0	4.0	4.0	6.0	7.7	7	30
3.0	1.0	3.0	4.0	4.0	5.0	4.0	4.0	6.0	4.0	3.0	5.0	6.0	7.0	9.0	8.0	10.0	10.0	11.0	8.0	8.0	11.0	14.0	13.0	6.7	7	31
12.0	14.0	13.0	13.0	12.0	12.0	14.0	14.0	14.0	11.0	12.0	12.0	11.0	13.0	14.0	14.0	13.0	14.0	14.0	13.0	13.0	12.0	13.0	14.0	13.0	8	1
14.0	11.0	9.0	10.0	8.0	11.0	14.0	13.0	13.0	13.0	13.0	14.0	14.0	16.0	17.0	18.0	18.0	17.0	13.0	10.0	8.0	6.0	2.0	3.0	11.9	8	2
1.0	3.0	3.0	2.0	6.0	6.0	6.0	4.0	3.0	3.0	4.0	5.0	6.0	6.0	6.0	6.0	8.0	8.0	7.0	4.0	1.0	0.0	3.0	5.0	4.4	8	3
6.0	5.0	4.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	7.0	7.0	10.0	11.0	8.0	4.0	5.0	3.0	4.0	5.0	8	4
4.0	3.0	4.0	2.0	2.0	3.0	2.0	2.0	6.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0	5.0	6.0	6.0	5.0	5.0	5.0	7.0	3.9	8	5
6.0	7.0	7.0	9.0	6.0	6.0	7.0	7.0	8.0	7.0	5.0	4.0	4.0	4.0	5.0	6.0	8.0	10.0	9.0	9.0	10.0	7.0	8.0	8.0	7.0	8	6
14.0	7.0	9.0	8.0	4.0	2.0	5.0	8.0	8.0	9.0	10.0	7.0	7.0	8.0	7.0	5.0	2.0	2.0	6.0	8.0	5.0	2.0	2.0	2.0	6.1	8	7
4.0	7.0	5.0	4.0	4.0	4.0	4.0	4.0	9.0	12.0	8.0	11.0	14.0	12.0	10.0	8.0	4.0	4.0	3.0	9.0	10.0	9.0	5.0	3.0	7.0	8	8
2.0	2.0	9.0	9.0	9.0	10.0	10.0	8.0	6.0	6.0	7.0	8.0	6.0	7.0	10.0	12.0	14.0	16.0	14.0	15.0	15.0	14.0	15.0	14.0	9.9	8	9
24.0	23.0	20.0	9.0	4.0	4.0	4.0	6.0	5.0	5.0	6.0	4.0	4.0	8.0	9.0	9.0	9.0	9.0	11.0	10.0	11.0	11.0	9.0	9.0	9.3	8	10
6.0	9.0	8.0	8.0	8.0	7.0	8.0	8.0	7.0	4.0	5.0	6.0	6.0	5.0	8.0	7.0	8.0	11.0	7.0	10.0	7.0	9.0	6.0	4.0	7.2	8	11
3.0	4.0	9.0	11.0	9.0	9.0	9.0	8.0	8.0	9.0	8.0	10.0	9.0	11.0	9.0	9.0	10.0	12.0	10.0	10.0	10.0	8.0	8.0	8.0	8.8	8	12
10.0	10.0	7.0	9.0	5.0	6.0	4.0	8.0	13.0	7.0	7.0	5.0	3.0	3.0	5.0	6.0	14.0	9.0	7.0	6.0	4.0	4.0	5.0	6.0	6.8	8	13
8.0	5.0	6.0	9.0	9.0	10.0	7.0	11.0	11.0	7.0	4.0	3.0	8.0	10.0	12.0	13.0	13.0	13.0	15.0	13.0	14.0	12.0	13.0	13.0	10.0	8	14
14.0	14.0	14.0	13.0	13.0	12.0	12.0	12.0	16.0	17.0	18.0	16.0	17.0	19.0	19.0	18.0	18.0	19.0	16.0	13.0	12.0	14.0	12.0	12.0	15.0	8	15
12.0	12.0	13.0	11.0	11.0	13.0	13.0	13.0	15.0	13.0	14.0	12.0	13.0	13.0	12.0	13.0	13.0	12.0	12.0	11.0	11.0	12.0	13.0	13.0	12.5	8	16
12.0	12.0	13.0	12.0	10.0	9.0	10.0	11.0	12.0	12.0	11.0	11.0	10.0	9.0	13.0	13.0	13.0	13.0	13.0	12.0	12.0	13.0	12.0	14.0	11.8	8	17
11.0	11.0	12.0	9.0	9.0	9.0	9.0	11.0	9.0	6.0	16.0	16.0	14.0	14.0	13.0	14.0	13.0	13.0	14.0	23.0	18.0	8.0	6.0	8.0	11.9	8	18

TABLE A-II (CONTINUED)

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
6.0	8.0	10.0	11.0	5.0	4.0	5.0	7.0	4.0	7.0	10.0	11.0	10.0	10.0	9.0	7.0	8.0	20.0	13.0	10.0	10.0	9.0	11.0	13.0	9.1	8	19
12.0	11.0	12.0	14.0	10.0	10.0	11.0	10.0	12.0	14.0	16.0	16.0	16.0	14.0	14.0	14.0	15.0	16.0	16.0	14.0	10.0	10.0	12.0	14.0	13.0	8	20
12.0	15.0	15.0	14.0	10.0	13.0	12.0	10.0	8.0	10.0	9.0	7.0	6.0	10.0	8.0	8.0	11.0	10.0	11.0	10.0	14.0	11.0	10.0	8.0	10.5	8	21
8.0	8.0	8.0	7.0	6.0	4.0	4.0	5.0	7.0	7.0	8.0	7.0	9.0	9.0	8.0	12.0	13.0	12.0	10.0	6.0	7.0	9.0	7.0	6.0	7.8	8	22
8.0	5.0	13.0	11.0	3.0	7.0	6.0	9.0	10.0	10.0	10.0	6.0	12.0	10.0	8.0	7.0	10.0	10.0	8.0	4.0	5.0	6.0	5.0	6.0	7.9	8	23
7.0	6.0	7.0	6.0	8.0	7.0	8.0	5.0	6.0	5.0	3.0	4.0	2.0	4.0	3.0	4.0	5.0	6.0	5.0	4.0	4.0	4.0	5.0	5.0	5.1	8	24
4.0	3.0	3.0	3.0	3.0	2.0	2.0	4.0	4.0	4.0	5.0	5.0	7.0	7.0	8.0	8.0	10.0	8.0	7.0	6.0	4.0	6.0	6.0	7.0	5.3	8	25
5.0	7.0	6.0	7.0	7.0	6.0	6.0	7.0	9.0	13.0	15.0	15.0	12.0	14.0	15.0	13.0	14.0	13.0	11.0	7.0	8.0	9.0	9.0	11.0	10.0	8	26
10.0	10.0	10.0	10.0	12.0	11.0	11.0	11.0	15.0	15.0	15.0	13.0	12.0	10.0	10.0	11.0	10.0	16.0	8.0	7.0	8.0	11.0	10.0	10.0	11.1	8	27
12.0	10.0	10.0	10.0	9.0	8.0	10.0	12.0	13.0	13.0	13.0	10.0	9.0	10.0	11.0	9.0	10.0	12.0	9.0	7.0	7.0	7.0	9.0	9.0	10.0	8	28
10.0	9.0	9.0	9.0	8.0	8.0	9.0	11.0	12.0	12.0	7.0	8.0	11.0	12.0	11.0	9.0	10.0	10.0	9.0	8.0	9.0	8.0	7.0	7.0	9.3	8	29
5.0	7.0	6.0	6.0	6.0	5.0	6.0	7.0	7.0	10.0	9.0	9.0	10.0	11.0	11.0	12.0	13.0	13.0	11.0	9.0	8.0	8.0	8.0	8.0	8.5	8	30
7.0	9.0	10.0	9.0	10.0	7.0	9.0	10.0	12.0	11.0	12.0	11.0	11.0	11.0	12.0	12.0	13.0	12.0	8.0	8.0	11.0	9.0	10.0	10.0	10.2	8	31
8.0	9.0	8.0	8.0	6.0	9.0	8.0	10.0	12.0	15.0	13.0	15.0	16.0	19.0	16.0	13.0	12.0	11.0	10.0	7.0	7.0	10.0	11.0	11.0	11.0	9	1
11.0	13.0	13.0	13.0	15.0	14.0	8.0	7.0	15.0	12.0	16.0	16.0	16.0	17.0	17.0	14.0	14.0	12.0	16.0	12.0	10.0	10.0	12.0	8.0	13.0	9	2
5.0	5.0	3.0	5.0	7.0	11.0	12.0	9.0	4.0	3.0	7.0	10.0	13.0	12.0	10.0	9.0	9.0	6.0	7.0	8.0	9.0	10.0	18.0	8.0	8.3	9	3
6.0	4.0	4.0	6.0	7.0	6.0	9.0	10.0	9.0	5.0	7.0	5.0	5.0	7.0	11.0	13.0	8.0	7.0	6.0	3.0	3.0	2.0	1.0	2.0	6.1	9	4
4.0	2.0	2.0	3.0	3.0	3.0	5.0	4.0	4.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	1.0	5.0	6.0	3.0	6.0	7.0	9.0	3.7	9	5
8.0	8.0	8.0	6.0	6.0	7.0	8.0	13.0	11.0	10.0	11.0	13.0	11.0	9.0	8.0	9.0	10.0	11.0	7.0	6.0	5.0	6.0	4.0	5.0	8.3	9	6
4.0	7.0	8.0	7.0	3.0	3.0	4.0	5.0	5.0	7.0	7.0	7.0	7.0	6.0	6.0	8.0	7.0	9.0	7.0	3.0	2.0	4.0	3.0	3.0	5.5	9	7
3.0	3.0	4.0	5.0	5.0	5.0	5.0	7.0	10.0	10.0	8.0	6.0	6.0	7.0	8.0	8.0	8.0	8.0	6.0	6.0	6.0	6.0	4.0	4.0	6.2	9	8
5.0	5.0	4.0	1.0	3.0	3.0	4.0	7.0	10.0	10.0	7.0	3.0	3.0	3.0	6.0	7.0	8.0	7.0	8.0	8.0	7.0	5.0	6.0	7.0	5.7	9	9
4.0	3.0	5.0	2.0	4.0	4.0	2.0	3.0	6.0	6.0	6.0	6.0	4.0	6.0	7.0	9.0	9.0	8.0	9.0	7.0	5.0	4.0	5.0	6.0	5.4	9	10
1.0	2.0	3.0	1.0	2.0	3.0	2.0	1.0	1.0	2.0	1.0	2.0	3.0	3.0	5.0	5.0	5.0	6.0	5.0	5.0	6.0	4.0	3.0	3.0	3.1	9	11
3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	3.0	3.0	4.0	5.0	8.0	9.0	8.0	9.0	6.0	4.0	4.0	5.0	5.0	4.0	4.9	9	12
5.0	6.0	8.0	8.0	9.0	8.0	6.0	9.0	14.0	12.0	13.0	15.0	15.0	16.0	14.0	16.0	14.0	13.0	11.0	12.0	13.0	13.0	20.0	19.0	12.0	9	13
8.0	4.0	8.0	10.0	6.0	9.0	8.0	6.0	12.0	18.0	15.0	17.0	18.0	18.0	16.0	15.0	11.0	12.0	8.0	8.0	9.0	9.0	8.0	7.0	10.8	9	14
7.0	7.0	7.0	9.0	8.0	9.0	13.0	11.0	10.0	11.0	6.0	5.0	5.0	5.0	7.0	8.0	8.0	8.0	3.0	3.0	3.0	2.0	3.0	1.0	6.6	9	15
2.0	1.0	1.0	2.0	5.0	8.0	6.0	6.0	4.0	4.0	4.0	2.0	3.0	3.0	4.0	2.0	1.0	6.0	7.0	7.0	4.0	5.0	5.0	5.0	4.0	9	16
4.0	3.0	2.0	4.0	5.0	2.0	5.0	5.0	5.0	3.0	6.0	4.0	4.0	5.0	6.0	10.0	8.0	5.0	3.0	3.0	3.0	2.0	1.0	3.0	4.2	9	17
2.0	3.0	4.0	1.0	4.0	7.0	10.0	4.0	2.0	6.0	7.0	11.0	14.0	16.0	15.0	13.0	11.0	11.0	8.0	6.0	8.0	11.0	10.0	8.0	8.0	9	18
7.0	8.0	10.0	7.0	8.0	11.0	11.0	8.0	10.0	11.0	12.0	13.0	15.0	15.0	13.0	15.0	13.0	12.0	10.0	7.0	7.0	8.0	10.0	10.0	10.5	9	19
10.0	11.0	12.0	12.0	10.0	11.0	12.0	11.0	12.0	11.0	12.0	14.0	16.0	15.0	15.0	14.0	13.0	10.0	7.0	5.0	1.0	3.0	3.0	3.0	10.1	9	20
2.0	2.0	3.0	1.0	2.0	4.0	2.0	3.0	2.0	4.0	3.0	3.0	3.0	4.0	1.0	1.0	0.0	0.0	2.0	4.0	5.0	6.0	8.0	8.0	3.0	9	21
9.0	9.0	8.0	10.0	9.0	9.0	15.0	14.0	14.0	13.0	14.0	15.0	16.0	15.0	12.0	12.0	10.0	8.0	2.0	1.0	3.0	0.0	0.0	1.0	9.1	9	22
2.0	2.0	2.0	2.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	4.0	3.0	2.0	3.0	2.0	4.0	3.0	3.0	5.0	5.0	6.0	7.0	8.0	3.3	9	23
8.0	7.0	8.0	9.0	9.0	5.0	6.0	7.0	10.0	11.0	14.0	15.0	16.0	16.0	16.0	14.0	15.0	14.0	11.0	13.0	15.0	14.0	18.0	16.0	12.0	9	24
16.0	14.0	15.0	15.0	16.0	18.0	15.0	16.0	16.0	10.0	9.0	7.0	9.0	10.0	10.0	9.0	9.0	7.0	6.0	7.0	7.0	6.0	7.0	7.0	10.9	9	25
7.0	5.0	4.0	3.0	1.0	3.0	8.0	10.0	5.0	2.0	3.0	3.0	9.0	7.0	9.0	9.0	8.0	5.0	7.0	6.0	5.0	4.0	5.0	5.0	5.5	9	26
7.0	3.0	8.0	6.0	8.0	8.0	9.0	9.0	8.0	7.0	8.0	5.0	7.0	10.0	8.0	9.0	9.0	9.0	9.0	8.0	7.0	8.0	7.0	7.0	7.7	9	27
9.0	8.0	8.0	7.0	4.0	10.0	7.0	5.0	5.0	5.0	7.0	4.0	2.0	3.0	5.0	6.0	7.0	8.0	5.0	5.0	5.0	9.0	10.0	13.0	6.5	9	28
12.0	15.0	16.0	11.0	8.0	6.0	6.0	6.0	7.0	3.0	2.0	2.0	4.0	6.0	8.0	10.0	12.0	13.0	9.0	11.0	12.0	14.0	14.0	16.0	9.3	9	29
14.0	15.0	15.0	21.0	28.0	25.0	25.0	27.0	24.0	22.0	20.0	25.0	24.0	26.0	24.0	23.0	19.0	14.0	8.0	6.0	6.0	8.0	10.0	7.0	18.2	9	30
5.0	4.0	4.0	4.0	4.0	4.0	5.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	7.0	8.0	8.0	8.0	6.0	8.0	9.0	9.0	8.0	11.0	5.5	10	1
13.0	17.0	18.0	16.0	19.0	21.0	19.0	18.0	22.0	25.0	27.0	27.0	28.0	27.0	27.0	28.0	28.0	26.0	25.0	23.0	24.0	24.0	22.0	22.0	22.8	10	2
21.0	21.0	18.0	18.0	14.0	14.0	17.0	15.0	22.0	23.0	23.0	22.0	19.0	18.0	16.0	14.0	6.0	7.0	7.0	10.0	8.0	6.0	8.0	16.0	15.1	10	3
19.0	15.0	15.0	17.0	17.0	17.0	15.0	16.0	15.0	13.0	15.0	14.0	14.0	13.0	11.0	10.0	9.0	7.0	8.0	8.0	8.0	9.0	9.0	8.0	12.6	10	4
7.0	3.0	4.0	4.0	3.0	6.0	4.0	5.0	3.0	2.0	3.0	4.0	3.0	3.0	3.0	3.0	1.0	2.0	3.0	3.0	5.0	5.0	6.0	5.0	3.8	10	5
6.0	5.0	6.0	5.0	6.0	4.0	5.0	4.0	3.0	6.0	10.0	10.0	11.0	12.0	10.0	12.0	11.0	8.0	7.0	8.0	8.0	7.0	6.0	8.0	7.4	10	6
9.0	7.0	6.0	6.0	9.0	11.0	11.0	13.0	15.0	16.0	16.0	14.0	16.0	15.0	16.0	15.0	13.0	12.0	11.0	11.0	13.0	11.0	11.0	13.0	12.1	10	7
12.0	13.0	13.0	14.0	12.0	14.0	13.0	16.0	16.0	17.0	16.0	17.0	14.0	15.0	20.0	18.0	15.0	13.0	11.0	7.0	7.0	10.0	11.0	11.0	13.5	10	8
12.0	14.0	14.0	16.0	15.0	15.0	14.0	13.0	12.0	7.0	9.0	7.0	6.0	6.0	7.0	8.0	20.0	21.0	16.0	16.0	9.0	10.0	6.0	8.0	11.7	10	9
6.0	10.0	10.0	8.0	6.0	3.0	2.0	2.0	6.0	9.0	10.0	9.0	9.0	7.0	7.0	6.0	5.0	4.0	4.0	4.0	4.0	6.0	4.0	2.0	6.0	10	10
6.0	4.0	3.0	7.0	5.0	7.0	8.0	10.0	11.0	12.0	15.0	13.0	13.0	14.0	14.0	15.0	16.0	15.0	13.0	14.0	15.0	17.0	16.0	17.0	11.7	10	11
18.0	15.0	14.0	12.0	11.0	12.0	11.0	11.0	16.0	19.0	23.0	23.0	23.0	24.0	21.0	22.0	21.0	20.0	16.0	17.0	19.0	21.0	21.0	21.0	18.0	10	12
19.0	13.0	17.0	15.0	18.0	15.0	17.0	16.0	19.0	18.0	19.0	18.0	19.0	20.0	19.0	18.0	18.0	15.0	13.0	16.0	18.0	20.0	22.0	21.0	17.8	10	13
19.0	19.0	20.0	21.0	22.0	22.0	23.0	23.0	22.0	22.0	18.0	23.0	26.0	26.0	27.0	30.0	32.0	31.0	29.0	34.0	35.0	35.0	33.0	28.0	25.8	10	14

TABLE A-III

INTAKE TOWER 2-METER WIND SPEED IN MPH AT LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
12.0	12.0	13.0	13.0	13.0	12.0	13.0	13.0	14.0	13.0	13.0	15.0	13.0	13.0	12.0	14.0	14.0	16.0	17.0	16.0	13.0	12.0	13.0	15.0	13.5	6	22
15.0	15.0	15.0	14.0	14.0	12.0	13.0	14.0	13.0	12.0	13.0	12.0	12.0	13.0	13.0	14.0	14.0	14.0	15.0	15.0	14.0	14.0	14.0	13.0	13.6	6	23
14.0	14.0	13.0	13.0	12.0	13.0	13.0	14.0	13.0	13.0	14.0	14.0	16.0	16.0	14.0	12.0	16.0	15.0	15.0	14.0	14.0	16.0	15.0	16.0	14.1	6	24
16.0	16.0	15.0	14.0	12.0	13.0	13.0	15.0	15.0	14.0	15.0	16.0	15.0	15.0	15.0	14.0	15.0	14.0	15.0	13.0	9.0	7.0	6.0	6.0	13.3	6	25
8.0	10.0	12.0	12.0	11.0	11.0	10.0	10.0	10.0	11.0	14.0	7.0	8.0	9.0	11.0	11.0	10.0	12.0	12.0	9.0	8.0	8.0	8.0	10.0	10.1	6	26
9.0	7.0	7.0	7.0	10.0	11.0	12.0	10.0	11.0	11.0	11.0	12.0	11.0	10.0	9.0	12.0	12.0	12.0	12.0	11.0	12.0	11.0	11.0	12.0	10.5	6	27
12.0	11.0	11.0	11.0	11.0	10.0	10.0	13.0	14.0	14.0	13.0	11.0	8.0	10.0	9.0	10.0	10.0	9.0	8.0	6.0	6.0	7.0	7.0	9.0	10.0	6	28
10.0	9.0	8.0	8.0	8.0	7.0	6.0	7.0	7.0	8.0	8.0	7.0	8.0	9.0	9.0	8.0	8.0	7.0	6.0	5.0	4.0	4.0	5.0	6.0	7.2	6	29
7.0	8.0	9.0	8.0	6.0	6.0	5.0	7.0	6.0	4.0	3.0	3.0	3.0	4.0	3.0	4.0	4.0	3.0	6.0	4.0	3.0	3.0	4.0	5.0	4.9	6	30
5.0	4.0	7.0	6.0	7.0	5.0	4.0	8.0	6.0	5.0	5.0	5.0	3.0	5.0	5.0	6.0	16.0	17.0	12.0	10.0	11.0	12.0	12.0	10.0	7.8	7	1
10.0	10.0	10.0	9.0	8.0	10.0	8.0	8.0	8.0	8.0	6.0	5.0	7.0	7.0	9.0	7.0	7.0	7.0	8.0	10.0	13.0	11.0	10.0	8.0	8.5	7	2
10.0	10.0	11.0	10.0	9.0	9.0	8.0	7.0	6.0	5.0	3.0	2.0	4.0	6.0	4.0	4.0	3.0	5.0	9.0	12.0	13.0	13.0	13.0	11.0	7.8	7	3
11.0	10.0	9.0	9.0	7.0	8.0	9.0	8.0	8.0	6.0	6.0	4.0	5.0	4.0	4.0	4.0	4.0	15.0	14.0	14.0	11.0	12.0	13.0	12.0	8.6	7	4
11.0	11.0	11.0	10.0	10.0	9.0	10.0	11.0	9.0	7.0	5.0	6.0	8.0	7.0	10.0	10.0	10.0	11.0	13.0	12.0	10.0	11.0	12.0	12.0	9.8	7	5
12.0	12.0	14.0	14.0	12.0	13.0	12.0	13.0	12.0	10.0	11.0	9.0	9.0	7.0	6.0	7.0	7.0	8.0	8.0	9.0	12.0	10.0	10.0	10.0	10.3	7	6
11.0	11.0	12.0	11.0	7.0	6.0	4.0	3.0	7.0	7.0	7.0	5.0	6.0	8.0	7.0	7.0	7.0	6.0	9.0	14.0	12.0	10.0	12.0	12.0	8.4	7	7
12.0	11.0	11.0	10.0	12.0	11.0	13.0	13.0	13.0	11.0	12.0	11.0	12.0	11.0	11.0	16.0	16.0	13.0	12.0	10.0	10.0	13.0	12.0	13.0	12.0	7	8
13.0	14.0	14.0	13.0	12.0	12.0	13.0	14.0	12.0	11.0	9.0	11.0	11.0	10.0	9.0	9.0	10.0	8.0	11.0	11.0	11.0	13.0	14.0	13.0	11.6	7	9
12.0	12.0	9.0	8.0	9.0	9.0	11.0	14.0	16.0	15.0	14.0	12.0	14.0	13.0	12.0	14.0	14.0	12.0	10.0	9.0	5.0	6.0	9.0	12.0	11.3	7	10
12.0	12.0	13.0	11.0	11.0	11.0	14.0	14.0	14.0	13.0	14.0	13.0	12.0	11.0	11.0	11.0	12.0	12.0	12.0	12.0	13.0	13.0	15.0	13.0	12.5	7	11
13.0	12.0	12.0	12.0	13.0	12.0	13.0	14.0	15.0	14.0	12.0	12.0	11.0	12.0	12.0	12.0	12.0	11.0	12.0	11.0	10.0	10.0	10.0	10.0	12.0	7	12
9.0	10.0	12.0	11.0	10.0	11.0	13.0	16.0	16.0	17.0	17.0	16.0	15.0	11.0	10.0	10.0	9.0	10.0	11.0	11.0	8.0	9.0	10.0	8.0	11.7	7	13
11.0	7.0	7.0	8.0	9.0	9.0	9.0	9.0	11.0	9.0	8.0	6.0	6.0	7.0	7.0	6.0	8.0	6.0	6.0	6.0	10.0	12.0	13.0	11.0	8.4	7	14
8.0	8.0	8.0	7.0	7.0	2.0	7.0	5.0	2.0	2.0	0.0	3.0	4.0	3.0	4.0	6.0	13.0	8.0	6.0	7.0	8.0	6.0	4.0	6.0	5.6	7	15
6.0	10.0	7.0	9.0	6.0	5.0	8.0	7.0	13.0	12.0	10.0	8.0	6.0	6.0	2.0	3.0	3.0	4.0	4.0	4.0	8.0	9.0	9.0	15.0	7.3	7	16
8.0	7.0	5.0	5.0	7.0	7.0	7.0	4.0	4.0	3.0	3.0	4.0	5.0	5.0	6.0	13.0	11.0	8.0	8.0	10.0	12.0	12.0	11.0	11.0	7.3	7	17
9.0	8.0	9.0	8.0	9.0	10.0	11.0	12.0	10.0	7.0	6.0	5.0	6.0	7.0	6.0	8.0	8.0	7.0	14.0	15.0	14.0	14.0	12.0	11.0	9.4	7	18
11.0	11.0	12.0	12.0	12.0	10.0	10.0	13.0	11.0	8.0	7.0	4.0	6.0	4.0	8.0	6.0	8.0	7.0	8.0	6.0	4.0	4.0	4.0	7.0	8.0	7	19
8.0	4.0	3.0	5.0	11.0	13.0	6.0	4.0	6.0	5.0	5.0	5.0	8.0	9.0	10.0	10.0	9.0	10.0	13.0	9.0	7.0	7.0	7.0	7.0	7.5	7	20
9.0	8.0	7.0	10.0	7.0	7.0	8.0	6.0	9.0	8.0	7.0	8.0	10.0	12.0	13.0	12.0	12.0	9.0	7.0	6.0	4.0	7.0	6.0	9.0	8.4	7	21
11.0	7.0	12.0	11.0	12.0	12.0	11.0	13.0	14.0	13.0	13.0	12.0	12.0	12.0	12.0	10.0	10.0	12.0	12.0	12.0	13.0	11.0	14.0	15.0	11.9	7	22
14.0	13.0	11.0	10.0	7.0	14.0	15.0	13.0	11.0	12.0	12.0	10.0	7.0	8.0	5.0	7.0	8.0	4.0	5.0	9.0	6.0	6.0	7.0	8.0	9.3	7	23
8.0	5.0	4.0	4.0	6.0	6.0	8.0	11.0	9.0	6.0	6.0	8.0	8.0	9.0	8.0	5.0	8.0	7.0	7.0	7.0	10.0	10.0	9.0	8.0	7.4	7	24
7.0	9.0	10.0	10.0	9.0	8.0	8.0	10.0	10.0	11.0	9.0	9.0	9.0	10.0	12.0	12.0	13.0	12.0	12.0	14.0	13.0	12.0	12.0	13.0	10.6	7	25
12.0	12.0	12.0	11.0	12.0	12.0	14.0	14.0	14.0	15.0	16.0	14.0	12.0	12.0	12.0	12.0	11.0	11.0	11.0	11.0	10.0	10.0	10.0	11.0	12.1	7	26
12.0	12.0	11.0	11.0	10.0	10.0	9.0	7.0	7.0	6.0	10.0	10.0	9.0	11.0	11.0	10.0	10.0	12.0	12.0	11.0	11.0	12.0	11.0	11.0	10.3	7	27
10.0	10.0	11.0	13.0	13.0	12.0	12.0	10.0	8.0	6.0	5.0	3.0	4.0	4.0	6.0	4.0	4.0	2.0	2.0	2.0	2.0	2.0	5.0	6.0	6.5	7	28
8.0	10.0	10.0	11.0	9.0	9.0	4.0	4.0	12.0	10.0	12.0	12.0	12.0	9.0	7.0	6.0	7.0	7.0	10.0	8.0	7.0	6.0	4.0	5.0	8.3	7	29
4.0	3.0	3.0	4.0	7.0	8.0	10.0	12.0	7.0	8.0	7.0	8.0	10.0	11.0	10.0	9.0	10.0	8.0	8.0	10.0	8.0	4.0	6.0	7.0	7.6	7	30
5.0	2.0	2.0	6.0	5.0	7.0	5.0	4.0	5.0	3.0	2.0	3.0	6.0	5.0	7.0	7.0	10.0	10.0	12.0	10.0	9.0	12.0	14.0	13.0	6.8	7	31
13.0	13.0	14.0	13.0	12.0	13.0	13.0	13.0	12.0	9.0	10.0	7.0	11.0	12.0	13.0	13.0	12.0	13.0	12.0	13.0	13.0	11.0	10.0	11.0	11.9	8	1
12.0	12.0	7.0	2.0	2.0	2.0	5.0	7.0	10.0	9.0	10.0	11.0	11.0	10.0	12.0	11.0	11.0	10.0	8.0	6.0	5.0	3.0	1.0	2.0	7.5	8	2
1.0	2.0	2.0	1.0	3.0	3.0	3.0	2.0	2.0	2.0	3.0	4.0	4.0	4.0	5.0	7.0	7.0	6.0	8.0	4.0	2.0	2.0	2.0	9.0	3.7	8	3
10.0	8.0	6.0	7.0	6.0	6.0	6.0	4.0	5.0	3.0	2.0	2.0	2.0	4.0	4.0	7.0	7.0	11.0	11.0	9.0	6.0	7.0	5.0	7.0	6.0	8	4
8.0	7.0	7.0	6.0	5.0	3.0	3.0	3.0	6.0	5.0	5.0	3.0	2.0	4.0	2.0	3.0	2.0	5.0	7.0	9.0	7.0	8.0	7.0	8.0	5.2	8	5
9.0	9.0	10.0	10.0	8.0	7.0	9.0	8.0	5.0	6.0	4.0	1.0	2.0	3.0	3.0	6.0	6.0	9.0	10.0	10.0	9.0	11.0	10.0	9.0	7.3	8	6
9.0	9.0	8.0	2.0	6.0	2.0	2.0	2.0	5.0	4.0	5.0	4.0	4.0	4.0	5.0	3.0	2.0	2.0	6.0	2.0	4.0	2.0	2.0	2.0	4.0	8	7
1.0	1.0	1.0	0.0	2.0	2.0	2.0	2.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	8.0	11.0	11.0	9.0	5.0	4.0	8	8
4.0	4.0	10.0	12.0	10.0	15.0	12.0	10.0	5.0	5.0	5.0	5.0	5.0	6.0	8.0	9.0	11.0	13.0	12.0	15.0	14.0	15.0	14.0	15.0	9.8	8	9
14.0	19.0	18.0	8.0	7.0	6.0	5.0	5.0	4.0	4.0	3.0	2.0	2.0	4.0	4.0	4.0	6.0	7.0	8.0	7.0	6.0	6.0	4.0	6.0	6.6	8	10
5.0	7.0	6.0	7.0	7.0	8.0	6.0	8.0	7.0	5.0	3.0	3.0	4.0	5.0	7.0	6.0	9.0	11.0	11.0	12.0	8.0	10.0	8.0	6.0	7.0	8	11
5.0	7.0	11.0	13.0	10.0	10.0	11.0	10.0	7.0	8.0	8.0	8.0	9.0	11.0	7.0	8.0	9.0	11.0	12.0	12.0	10.0	10.0	9.0	10.0	9.4	8	12
12.0	11.0	10.0	10.0	7.0	6.0	4.0	10.0	12.0	4.0	3.0	3.0	2.0	4.0	3.0	6.0	15.0	11.0	7.0	7.0	6.0	7.0	5.0	9.0	7.3	8	13
9.0	9.0	7.0	10.0	11.0	10.0	10.0	10.0	9.0	7.0	2.0	3.0	5.0	12.0	9.0	10.0	11.0	10.0	14.0	13.0	15.0	13.0	13.0	13.0	9.8	8	14
13.0	15.0	15.0	14.0	14.0	13.0	12.0	13.0	14.0	15.0	15.0	14.0	15.0	15.0	16.0	15.0	16.0	16.0	15.0	12.0	12.0	12.0	13.0	12.0	14.0	8	15
13.0	13.0	13.0	13.0	12.0	12.0	12.0	10.0	11.0	12.0	12.0	11.0	10.0	11.0	12.0	10.0	10.0	9.0	11.0	11.0	12.0	12.0	13.0	12.0	11.5	8	16
12.0	12.0	12.0	12.0	11.0	11.0	10.0	11.0	13.0	12.0	10.0	9.0	9.0	11.0	8.0	10.0	11.0	11.0	12.0	13.0	12.0	13.0	13.0	13.0	11.3	8	17
12.0	11.0	11.0	9.0	8.0	9.0	10.0	11.0	10.0	8.0	17.0	16.0	13.0	13.0	11.0	12.0	11.0	10.0	13.0	20.0	18.0	6.0	5.0	7.0	11.3	8	18
6.0	6.0	9.0	8.0	5.0	3.0	6.0	6.0	5.0	8.0	9.0	10.0	8.0	11.0	7.0	7.0	7.0	20.0	16.0	12.0	9.0	13.0	13.0	15.0	9.1	8	19

TABLE A-III (CONTINUED)

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
13.0	13.0	13.0	13.0	11.0	11.0	11.0	11.0	12.0	12.0	13.0	13.0	14.0	12.0	13.0	14.0	14.0	15.0	15.0	13.0	9.0	10.0	10.0	14.0	12.5	8	20
12.0	14.0	14.0	13.0	10.0	11.0	11.0	9.0	9.0	10.0	9.0	6.0	9.0	8.0	5.0	7.0	7.0	6.0	7.0	9.0	10.0	6.0	4.0	5.0	8.8	8	21
4.0	4.0	4.0	4.0	4.0	2.0	3.0	3.0	4.0	4.0	5.0	4.0	5.0	5.0	4.0	5.0	3.0	3.0	4.0	2.0	2.0	5.0	4.0	2.0	3.7	8	22
3.0	4.0	5.0	7.0	4.0	5.0	2.0	6.0	7.0	11.0	10.0	6.0	8.0	9.0	5.0	4.0	6.0	6.0	4.0	3.0	3.0	4.0	3.0	4.0	5.4	8	23
4.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	4.0	3.0	4.0	3.0	3.0	3.0	7.0	7.0	3.8	8	24
6.0	3.0	4.0	3.0	3.0	4.0	3.0	1.0	3.0	4.0	3.0	4.0	3.0	6.0	6.0	7.0	8.0	8.0	8.0	7.0	7.0	8.0	8.0	9.0	5.3	8	25
7.0	9.0	8.0	7.0	8.0	7.0	8.0	10.0	10.0	12.0	13.0	12.0	12.0	11.0	13.0	12.0	12.0	12.0	11.0	8.0	9.0	12.0	11.0	12.0	10.3	8	26
13.0	11.0	12.0	12.0	11.0	13.0	12.0	12.0	13.0	13.0	13.0	11.0	11.0	10.0	9.0	10.0	10.0	8.0	8.0	9.0	11.0	13.0	12.0	10.0	11.1	8	27
13.0	13.0	12.0	11.0	12.0	12.0	11.0	13.0	13.0	11.0	11.0	10.0	7.0	8.0	8.0	8.0	8.0	11.0	8.0	10.0	9.0	9.0	10.0	12.0	10.4	8	28
12.0	10.0	11.0	11.0	11.0	10.0	10.0	13.0	11.0	10.0	5.0	5.0	9.0	12.0	13.0	10.0	10.0	11.0	10.0	8.0	8.0	8.0	7.0	6.0	9.6	8	29
5.0	7.0	6.0	7.0	6.0	5.0	6.0	7.0	8.0	10.0	10.0	11.0	10.0	12.0	10.0	10.0	10.0	12.0	14.0	12.0	11.0	9.0	9.0	9.0	9.0	8	30
7.0	10.0	12.0	10.0	12.0	8.0	10.0	12.0	14.0	13.0	12.0	11.0	10.0	12.0	14.0	13.0	14.0	13.0	10.0	9.0	11.0	10.0	10.0	11.0	11.2	8	31
9.0	10.0	7.0	9.0	7.0	9.0	9.0	12.0	13.0	15.0	16.0	16.0	18.0	18.0	16.0	12.0	12.0	11.0	9.0	6.0	7.0	9.0	11.0	10.0	11.3	9	1
11.0	12.0	12.0	13.0	13.0	13.0	9.0	7.0	13.0	12.0	16.0	16.0	15.0	17.0	14.0	12.0	9.0	9.0	7.0	9.0	8.0	8.0	8.0	6.0	11.2	9	2
4.0	3.0	2.0	2.0	5.0	8.0	9.0	7.0	3.0	3.0	4.0	8.0	11.0	11.0	9.0	9.0	6.0	4.0	5.0	7.0	7.0	8.0	17.0	5.0	6.5	9	3
5.0	2.0	3.0	4.0	5.0	4.0	7.0	9.0	8.0	5.0	6.0	4.0	4.0	7.0	10.0	8.0	6.0	4.0	3.0	2.0	1.0	1.0	0.0	1.0	4.5	9	4
3.0	1.0	2.0	1.0	2.0	2.0	3.0	4.0	4.0	3.0	2.0	2.0	3.0	1.0	3.0	3.0	1.0	1.0	3.0	4.0	3.0	4.0	6.0	8.0	2.9	9	5
7.0	8.0	5.0	4.0	8.0	6.0	9.0	14.0	12.0	11.0	10.0	10.0	7.0	6.0	6.0	6.0	9.0	8.0	5.0	3.0	3.0	4.0	3.0	3.0	7.0	9	6
2.0	5.0	5.0	5.0	2.0	2.0	3.0	3.0	3.0	5.0	6.0	5.0	4.0	5.0	4.0	5.0	5.0	7.0	4.0	3.0	5.0	6.0	8.0	6.0	4.5	9	7
5.0	5.0	7.0	5.0	6.0	6.0	5.0	8.0	10.0	10.0	7.0	6.0	5.0	5.0	10.0	9.0	8.0	9.0	8.0	7.0	7.0	7.0	7.0	7.0	7.0	9	8
7.0	7.0	7.0	3.0	6.0	6.0	5.0	8.0	10.0	9.0	6.0	2.0	1.0	1.0	5.0	6.0	7.0	8.0	10.0	10.0	8.0	7.0	7.0	9.0	6.5	9	9
6.0	6.0	7.0	5.0	5.0	4.0	5.0	4.0	3.0	3.0	2.0	2.0	3.0	5.0	7.0	8.0	10.0	10.0	10.0	8.0	7.0	7.0	8.0	8.0	6.0	9	10
6.0	5.0	3.0	1.0	5.0	4.0	3.0	2.0	1.0	1.0	2.0	2.0	2.0	3.0	4.0	4.0	5.0	5.0	8.0	9.0	8.0	7.0	6.0	7.0	4.3	9	11
6.0	6.0	6.0	7.0	6.0	6.0	6.0	5.0	5.0	6.0	3.0	4.0	2.0	5.0	6.0	8.0	9.0	9.0	8.0	6.0	6.0	6.0	8.0	6.0	6.0	9	12
8.0	8.0	10.0	10.0	10.0	11.0	8.0	12.0	14.0	11.0	13.0	13.0	14.0	13.0	13.0	14.0	13.0	12.0	13.0	12.0	14.0	13.0	19.0	18.0	12.3	9	13
7.0	6.0	12.0	13.0	9.0	2.0	2.0	3.0	4.0	5.0	5.0	7.0	8.0	8.0	8.0	7.0	6.0	4.0	2.0	4.0	5.0	5.0	3.0	2.0	5.7	9	14
3.0	5.0	3.0	5.0	4.0	8.0	8.0	8.0	9.0	6.0	5.0	4.0	4.0	5.0	5.0	6.0	7.0	7.0	5.0	4.0	3.0	2.0	2.0	1.0	5.0	9	15
2.0	1.0	1.0	1.0	2.0	5.0	7.0	6.0	4.0	4.0	4.0	4.0	3.0	3.0	4.0	3.0	1.0	3.0	3.0	3.0	3.0	4.0	6.0	8.0	3.5	9	16
6.0	5.0	5.0	7.0	7.0	5.0	5.0	7.0	4.0	4.0	5.0	4.0	2.0	5.0	6.0	11.0	9.0	6.0	2.0	1.0	1.0	4.0	0.0	4.0	4.8	9	17
5.0	3.0	1.0	2.0	5.0	5.0	4.0	2.0	1.0	4.0	3.0	4.0	5.0	5.0	5.0	4.0	4.0	2.0	1.0	0.0	3.0	2.0	0.0	3.0	3.0	9	18
2.0	3.0	1.0	3.0	3.0	2.0	3.0	3.0	4.0	3.0	3.0	4.0	5.0	5.0	4.0	4.0	3.0	2.0	1.0	1.0	4.0	3.0	2.0	3.0	3.0	9	19
3.0	2.0	2.0	2.0	4.0	5.0	3.0	4.0	4.0	3.0	5.0	6.0	5.0	5.0	4.0	5.0	4.0	1.0	0.0	1.0	1.0	3.0	5.0	4.0	3.4	9	20
4.0	3.0	3.0	2.0	2.0	3.0	2.0	2.0	1.0	3.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	1.0	2.0	4.0	5.0	6.0	10.0	8.0	3.3	9	21
11.0	11.0	10.0	11.0	7.0	8.0	5.0	3.0	4.0	3.0	5.0	4.0	5.0	4.0	4.0	4.0	2.0	2.0	1.0	0.0	2.0	0.0	1.0	2.0	4.5	9	22
3.0	4.0	3.0	1.0	4.0	3.0	3.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	1.0	3.0	1.0	1.0	3.0	4.0	6.0	6.0	8.0	8.0	3.1	9	23
10.0	10.0	9.0	10.0	10.0	8.0	8.0	9.0	9.0	9.0	11.0	13.0	14.0	13.0	11.0	11.0	14.0	12.0	11.0	12.0	14.0	13.0	14.0	16.0	11.3	9	24
15.0	14.0	17.0	15.0	15.0	15.0	15.0	16.0	13.0	8.0	8.0	5.0	5.0	8.0	6.0	5.0	5.0	3.0	2.0	3.0	4.0	3.0	5.0	5.0	8.8	9	25
5.0	3.0	2.0	2.0	0.0	2.0	5.0	6.0	3.0	1.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	3.0	3.0	3.0	5.0	4.0	3.5	9	26
4.0	2.0	5.0	4.0	5.0	5.0	6.0	5.0	6.0	5.0	6.0	3.0	6.0	8.0	5.0	5.0	6.0	5.0	2.0	2.0	1.0	0.0	0.0	0.0	4.0	9	27
0.0	1.0	1.0	3.0	2.0	4.0	3.0	2.0	2.0	2.0	3.0	1.0	1.0	1.0	4.0	6.0	7.0	7.0	7.0	7.0	7.0	9.0	12.0	13.0	4.4	9	28
15.0	16.0	17.0	10.0	6.0	7.0	6.0	3.0	4.0	2.0	2.0	3.0	2.0	3.0	7.0	7.0	10.0	11.0	9.0	11.0	11.0	13.0	14.0	15.0	8.5	9	29
13.0	15.0	15.0	11.0	9.0	15.0	9.0	8.0	9.0	10.0	11.0	10.0	7.0	7.0	6.0	5.0	5.0	3.0	1.0	2.0	1.0	2.0	2.0	2.0	7.4	9	30
4.0	5.0	4.0	4.0	4.0	4.0	3.0	5.0	2.0	1.0	1.0	3.0	2.0	2.0	6.0	8.0	8.0	8.0	8.0	10.0	12.0	11.0	12.0	13.0	5.8	10	1
15.0	16.0	18.0	18.0	19.0	19.0	18.0	19.0	19.0	24.0	22.0	22.0	23.0	25.0	24.0	23.0	24.0	24.0	21.0	21.0	22.0	22.0	22.0	20.0	20.8	10	2
20.0	19.0	17.0	16.0	17.0	15.0	17.0	16.0	20.0	22.0	21.0	18.0	18.0	16.0	14.0	12.0	5.0	5.0	4.0	4.0	4.0	4.0	2.0	5.0	13.0	10	3
7.0	6.0	6.0	7.0	8.0	9.0	9.0	9.0	9.0	8.0	8.0	8.0	9.0	8.0	6.0	7.0	4.0	3.0	2.0	2.0	1.0	2.0	1.0	1.0	5.8	10	4
1.0	1.0	2.0	2.0	3.0	3.0	3.0	3.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0	2.0	4.0	4.0	4.0	5.0	6.0	7.0	2.7	10	5
8.0	9.0	8.0	7.0	6.0	5.0	6.0	5.0	4.0	5.0	7.0	9.0	9.0	9.0	9.0	10.0	9.0	7.0	7.0	7.0	8.0	9.0	8.0	10.0	7.5	10	6
8.0	8.0	8.0	8.0	11.0	12.0	13.0	14.0	16.0	15.0	15.0	12.0	14.0	13.0	13.0	13.0	11.0	13.0	11.0	11.0	12.0	11.0	11.0	12.0	11.9	10	7
12.0	12.0	12.0	13.0	12.0	13.0	12.0	14.0	14.0	15.0	14.0	14.0	11.0	13.0	16.0	12.0	13.0	12.0	9.0	6.0	7.0	10.0	12.0	13.0	12.1	10	8
14.0	13.0	13.0	12.0	12.0	13.0	14.0	12.0	8.0	5.0	6.0	6.0	4.0	5.0	3.0	4.0	6.0	5.0	6.0	2.0	1.0	3.0	2.0	2.0	7.1	10	9
2.0	4.0	7.0	7.0	7.0	3.0	0.0	2.0	3.0	9.0	9.0	8.0	8.0	8.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	5.0	4.0	4.0	5.0	10	10
6.0	5.0	5.0	7.0	7.0	10.0	10.0	11.0	11.0	11.0	11.0	10.0	11.0	10.0	11.0	13.0	12.0	14.0	11.0	13.0	14.0	16.0	16.0	16.0	10.9	10	11
16.0	16.0	12.0	13.0	13.0	12.0	12.0	11.0	12.0	15.0	16.0	20.0	21.0	19.0	19.0	18.0	18.0	17.0	14.0	16.0	17.0	18.0	19.0	19.0	16.0	10	12
17.0	14.0	16.0	16.0	15.0	16.0	16.0	15.0	16.0	16.0	14.0	15.0	15.0	17.0	14.0	15.0	14.0	14.0	12.0	14.0	17.0	19.0	19.0	19.0	15.6	10	13
17.0	17.0	17.0	19.0	20.0	21.0	22.0	21.0	23.0	20.0	17.0	21.0	24.0	25.0	27.0	27.0	25.0	21.0	18.0	17.0	17.0	14.0	12.0	9.0	19.5	10	14

TABLE A-IV

INTAKE TOWER 8-METER WIND SPEED IN MPH AT LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
4.0	3.0	4.0	2.0	3.0	4.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	4.0	2.0	2.0	2.0	3.0	5.0	6.0	6.0	11.0	10.0	3.9	9	21
11.0	12.0	11.0	11.0	8.0	9.0	7.0	7.0	8.0	9.0	10.0	10.0	11.0	11.0	9.0	8.0	6.0	5.0	3.0	1.0	2.0	1.0	1.0	3.0	7.3	9	22
3.0	6.0	3.0	3.0	4.0	4.0	4.0	3.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	2.0	4.0	5.0	6.0	8.0	8.0	10.0	3.6	9	23
11.0	11.0	11.0	11.0	11.0	10.0	9.0	9.0	11.0	11.0	14.0	17.0	18.0	16.0	15.0	15.0	18.0	16.0	14.0	15.0	18.0	16.0	19.0	19.0	14.0	9	24
3.0	2.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0	2.0	3.0	2.0	2.0	2.0	4.0	7.0	8.0	9.0	8.0	7.0	8.0	11.0	14.0	15.0	5.5	9	28
18.0	18.0	19.0	10.0	6.0	8.0	6.0	4.0	5.0	2.0	3.0	3.0	3.0	5.0	7.0	11.0	13.0	15.0	12.0	14.0	15.0	17.0	18.0	19.0	10.5	9	29
17.0	17.0	18.0	16.0	18.0	22.0	16.0	16.0	16.0	16.0	17.0	16.0	15.0	14.0	15.0	13.0	11.0	7.0	3.0	3.0	2.0	3.0	3.0	4.0	12.4	9	30
4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	2.0	1.0	2.0	3.0	2.0	3.0	6.0	8.0	10.0	10.0	10.0	11.0	14.0	13.0	14.0	17.0	6.8	10	1
19.0	23.0	23.0	24.0	24.0	23.0	24.0	24.0	24.0	30.0	29.0	29.0	30.0	32.0	31.0	31.0	32.0	30.0	27.0	26.0	29.0	29.0	28.0	26.0	27.0	10	2
25.0	25.0	21.0	20.0	21.0	20.0	20.0	20.0	25.0	28.0	26.0	22.0	23.0	20.0	16.0	16.0	10.0	8.0	7.0	6.0	6.0	7.0	5.0	11.0	17.0	10	3
13.0	10.0	11.0	11.0	13.0	15.0	13.0	14.0	14.0	11.0	11.0	13.0	12.0	12.0	10.0	9.0	8.0	5.0	5.0	4.0	3.0	4.0	3.0	3.0	9.5	10	4
2.0	1.0	2.0	3.0	4.0	3.0	3.0	3.0	3.0	1.0	2.0	2.0	2.0	1.0	3.0	2.0	2.0	3.0	4.0	4.0	5.0	5.0	8.0	7.0	3.1	10	5
8.0	8.0	7.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	9.0	11.0	11.0	12.0	11.0	13.0	12.0	9.0	9.0	9.0	10.0	10.0	10.0	12.0	8.8	10	6
10.0	10.0	9.0	10.0	12.0	15.0	16.0	18.0	20.0	19.0	18.0	16.0	18.0	16.0	16.0	17.0	14.0	17.0	14.0	14.0	15.0	14.0	14.0	16.0	14.9	10	7
14.0	15.0	15.0	15.0	15.0	16.0	15.0	17.0	18.0	18.0	19.0	17.0	14.0	17.0	20.0	17.0	17.0	15.0	12.0	8.0	10.0	13.0	16.0	16.0	15.4	10	8
16.0	16.0	16.0	15.0	16.0	16.0	17.0	15.0	9.0	6.0	8.0	8.0	6.0	5.0	6.0	6.0	14.0	13.0	10.0	6.0	5.0	6.0	5.0	4.0	10.2	10	9
5.0	6.0	8.0	8.0	8.0	4.0	2.0	3.0	4.0	10.0	10.0	9.0	9.0	9.0	6.0	5.0	6.0	5.0	6.0	5.0	5.0	6.0	5.0	5.0	6.2	10	10
6.0	7.0	6.0	8.0	9.0	11.0	13.0	12.0	13.0	13.0	13.0	13.0	14.0	13.0	15.0	15.0	17.0	18.0	16.0	16.0	18.0	20.0	21.0	21.0	13.7	10	11
20.0	20.0	16.0	16.0	15.0	15.0	15.0	14.0	15.0	19.0	20.0	26.0	27.0	26.0	23.0	25.0	22.0	22.0	19.0	21.0	21.0	24.0	24.0	24.0	20.4	10	12
22.0	18.0	19.0	20.0	20.0	20.0	20.0	19.0	20.0	22.0	18.0	19.0	20.0	21.0	19.0	20.0	20.0	18.0	17.0	20.0	22.0	25.0	25.0	25.0	20.4	10	13
22.0	22.0	23.0	24.0	25.0	27.0	28.0	26.0	28.0	23.0	22.0	25.0	27.0	32.0	31.0	31.0	26.0	23.0	21.0	21.0	23.0	21.0	21.0	18.0	24.6	10	14
20.0	20.0	15.0	17.0	14.0	12.0	8.0	9.0	14.0	13.0	11.0	12.0	12.0	11.0	9.0	7.0	8.0	4.0	2.0	3.0	1.0	0.0	0.0	2.0	9.3	10	15

TABLE A-V

HOURLY WIND DIRECTION IN DEGREES AT LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
158.	180.	180.	158.	158.	158.	158.	180.	180.	158.	135.	158.	158.	158.	158.	135.	135.	158.	158.	135.	135.	158.	135.	158.	156.	6	21
135.	135.	135.	135.	135.	135.	135.	135.	158.	158.	158.	158.	158.	158.	158.	135.	135.	135.	135.	158.	135.	135.	135.	135.	143.	6	22
135.	135.	158.	158.	158.	180.	158.	158.	158.	180.	180.	180.	158.	158.	158.	158.	158.	135.	135.	135.	135.	135.	135.	135.	153.	6	23
158.	158.	158.	158.	158.	158.	158.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	180.	180.	158.	158.	158.	158.	162.	6	24
158.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	180.	180.	158.	158.	180.	180.	175.	6	25
158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	135.	180.	158.	180.	158.	180.	158.	158.	158.	180.	180.	180.	180.	172.	6	26
180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	183.	6	27
180.	180.	180.	180.	180.	203.	180.	203.	203.	203.	203.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	187.	6	28
180.	180.	180.	180.	180.	203.	180.	203.	203.	203.	203.	180.	180.	180.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	184.	6	29
180.	203.	225.	203.	203.	180.	180.	225.	225.	225.	225.	180.	180.	180.	203.	203.	203.	180.	135.	135.	135.	135.	135.	180.	186.	6	30
180.	158.	180.	180.	180.	180.	158.	158.	180.	180.	180.	180.	180.	158.	135.	135.	135.	135.	135.	135.	135.	135.	135.	158.	159.	7	1
180.	180.	180.	158.	180.	180.	180.	180.	180.	180.	158.	158.	158.	135.	135.	113.	135.	113.	135.	135.	135.	135.	135.	135.	154.	7	2
135.	135.	135.	135.	158.	158.	158.	158.	158.	158.	135.	135.	135.	135.	90.	113.	135.	135.	90.	90.	135.	135.	135.	135.	134.	7	3
135.	135.	135.	180.	180.	135.	135.	135.	158.	180.	180.	158.	203.	158.	180.	180.	135.	135.	135.	158.	158.	158.	180.	180.	159.	7	4
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	180.	180.	180.	180.	180.	180.	180.	180.	178.	7	5
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	180.	158.	135.	158.	158.	180.	180.	180.	180.	174.	7	6
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	180.	180.	180.	180.	172.	7	7
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	180.	158.	180.	180.	180.	175.	7	8
158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	180.	180.	180.	180.	180.	158.	158.	158.	158.	180.	158.	158.	158.	174.	7	9
180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	180.	203.	203.	203.	180.	203.	180.	180.	180.	180.	180.	180.	180.	186.	7	10
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	180.	180.	158.	180.	178.	7	11
180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	184.	7	12
180.	180.	180.	180.	180.	180.	180.	180.	225.	203.	203.	180.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	186.	7	13
180.	180.	180.	180.	180.	180.	180.	180.	225.	203.	225.	203.	180.	203.	180.	180.	203.	180.	180.	180.	158.	158.	180.	180.	186.	7	14
180.	180.	180.	180.	180.	180.	225.	180.	180.	225.	203.	203.	180.	180.	158.	315.	45.	68.	68.	90.	113.	135.	135.	113.	162.	7	15
135.	135.	135.	135.	90.	90.	90.	90.	135.	158.	180.	180.	180.	180.	180.	180.	68.	180.	135.	135.	180.	135.	180.	158.	144.	7	16
180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	180.	158.	158.	158.	158.	135.	135.	135.	180.	180.	180.	180.	315.	315.	183.	7	17
180.	180.	180.	180.	180.	180.	158.	158.	158.	180.	180.	203.	180.	203.	158.	180.	180.	158.	158.	135.	180.	180.	180.	180.	175.	7	18
180.	180.	180.	180.	180.	180.	180.	180.	180.	225.	203.	203.	203.	180.	158.	180.	180.	180.	135.	135.	135.	315.	315.	315.	195.	7	19
90.	90.	90.	0.	0.	0.	90.	90.	90.	68.	68.	68.	90.	90.	68.	90.	90.	90.	90.	90.	90.	90.	90.	90.	75.	7	20
90.	113.	113.	113.	135.	135.	135.	270.	23.	338.	68.	90.	113.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	134.	7	21
135.	135.	135.	135.	135.	90.	135.	135.	135.	135.	135.	135.	158.	158.	180.	180.	158.	135.	135.	135.	135.	135.	135.	158.	141.	7	22
180.	113.	135.	135.	135.	135.	158.	180.	180.	180.	180.	203.	203.	270.	203.	180.	180.	203.	158.	158.	158.	0.	0.	0.	151.	7	23
113.	113.	113.	135.	135.	135.	90.	90.	90.	90.	90.	90.	90.	90.	90.	135.	135.	135.	180.	180.	180.	135.	135.	135.	121.	7	24
135.	135.	135.	135.	135.	135.	0.	0.	0.	158.	158.	158.	135.	135.	135.	158.	158.	180.	158.	158.	158.	158.	158.	158.	131.	7	25
158.	158.	158.	158.	158.	158.	158.	158.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	180.	180.	158.	135.	135.	158.	164.	7	26
180.	180.	180.	180.	180.	180.	180.	180.	180.	338.	23.	158.	180.	158.	158.	158.	158.	135.	135.	135.	135.	135.	135.	158.	163.	7	27
158.	158.	180.	158.	158.	180.	180.	158.	180.	270.	315.	315.	225.	180.	180.	158.	203.	225.	180.	180.	180.	158.	158.	180.	192.	7	28
180.	180.	180.	180.	180.	180.	203.	270.	203.	180.	180.	180.	180.	180.	158.	158.	158.	158.	135.	113.	113.	135.	113.	113.	167.	7	29
113.	113.	113.	68.	90.	90.	90.	90.	68.	90.	68.	23.	45.	68.	68.	45.	68.	68.	68.	203.	158.	158.	158.	135.	94.	7	30
135.	135.	135.	135.	135.	135.	135.	135.	158.	180.	158.	135.	135.	158.	135.	158.	135.	135.	135.	135.	135.	158.	158.	158.	144.	7	31
158.	158.	180.	180.	180.	158.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	135.	158.	158.	180.	270.	173.	8	1
248.	203.	248.	315.	315.	315.	315.	315.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	45.	45.	45.	45.	114.	8	2
45.	23.	23.	23.	23.	23.	23.	23.	23.	45.	45.	45.	0.	23.	23.	0.	0.	45.	45.	90.	90.	90.	90.	90.	40.	8	3
90.	90.	90.	90.	90.	90.	90.	113.	158.	180.	293.	270.	270.	315.	23.	0.	0.	45.	45.	90.	90.	90.	90.	90.	116.	8	4
90.	113.	113.	113.	113.	135.	135.	135.	158.	180.	180.	180.	135.	23.	23.	158.	248.	180.	158.	135.	135.	135.	158.	180.	138.	8	5
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	159.	8	6
225.	180.	180.	45.	90.	90.	23.	0.	0.	315.	0.	0.	0.	338.	0.	0.	293.	293.	0.	23.	45.	90.	90.	135.	102.	8	7
270.	315.	315.	225.	0.	23.	23.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	23.	0.	180.	180.	225.	203.	180.	109.	8	8
180.	180.	158.	180.	203.	225.	225.	225.	225.	180.	180.	158.	158.	158.	158.	158.	158.	158.	180.	158.	158.	158.	180.	180.	178.	8	9
315.	293.	293.	270.	180.	158.	158.	68.	23.	23.	23.	23.	0.	0.	0.	0.	23.	23.	23.	23.	45.	45.	23.	45.	87.	8	10
45.	45.	68.	90.	45.	68.	45.	68.	90.	90.	45.	23.	23.	23.	23.	45.	90.	90.	90.	113.	135.	135.	135.	135.	73.	8	11
135.	135.	135.	158.	158.	135.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	135.	135.	135.	135.	158.	158.	158.	180.	151.	8	12
158.	158.	180.	158.	158.	158.	225.	158.	158.	180.	248.	315.	338.	338.	315.	315.	90.	135.	158.	180.	180.	135.	158.	180.	199.	8	13
180.	180.	180.	180.	180.	180.	180.	203.	203.	225.	270.	180.	158.	158.	180.	180.	180.	180.	180.	158.	158.	158.	180.	180.	183.	8	14
180.	180.	180.	180.	180.	180.	180.	203.	203.	203.	203.	203.	203.	203.	203.	203.	203.	180.	180.	180.	180.	180.	180.	180.	190.	8	15
180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	225.	225.	203.	203.	203.	203.	180.	180.	180.	158.	158.	158.	180.	180.	187.	8	16
180.	180.	180.	180.	180.	180.	180.	203.	225.	225.	225.	225.	203.	203.	203.	180.	180.	180.	158.	135.	135.	158.	158.	158.	184.	8	17
180.	180.	180.	180.	180.	180.	180.	203.	225.	225.	68.	68.	90.	90.	90.	90.	90.	90.	90.	338.	0.	90.	135.	90.	139.	8	18
90.	90.	90.	23.	90.	45.	90.	90.	90.	90.	135.	113.	135.	158.	135.	135.	135.	180.	135.	135.	135.	135.	135.	158.	114.	8	19

TABLE A-V (CONTINUED)

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
158.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	135.	158.	158.	158.	158.	180.	158.	158.	166.	8	20
158.	180.	180.	180.	180.	180.	180.	203.	225.	225.	225.	248.	293.	315.	315.	0.	315.	315.	0.	0.	0.	0.	0.	0.	163.	8	21
45.	45.	45.	45.	45.	45.	68.	68.	68.	45.	45.	45.	68.	68.	68.	0.	0.	0.	0.	0.	0.	0.	0.	0.	34.	8	22
45.	45.	45.	90.	90.	90.	45.	45.	45.	45.	45.	45.	0.	0.	0.	45.	45.	45.	68.	68.	68.	90.	90.	90.	54.	8	23
135.	135.	135.	45.	45.	45.	293.	293.	293.	293.	293.	293.	270.	270.	270.	293.	293.	293.	315.	315.	315.	270.	270.	270.	239.	8	24
225.	180.	180.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	225.	225.	203.	203.	203.	189.	8	25
203.	203.	203.	203.	203.	203.	203.	180.	158.	158.	158.	158.	180.	180.	180.	180.	180.	203.	180.	180.	180.	203.	203.	180.	186.	8	26
180.	180.	180.	180.	180.	180.	135.	135.	135.	158.	158.	158.	180.	180.	180.	158.	158.	158.	135.	158.	180.	180.	180.	158.	165.	8	27
158.	158.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	180.	180.	165.	8	28
180.	180.	158.	135.	135.	113.	135.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	180.	180.	165.	8	29
180.	158.	158.	180.	135.	135.	135.	135.	158.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	158.	135.	135.	143.	8	30
158.	158.	158.	158.	158.	158.	135.	135.	135.	135.	135.	158.	158.	158.	158.	158.	158.	158.	180.	180.	203.	203.	180.	180.	161.	8	31
180.	180.	180.	180.	180.	180.	158.	158.	135.	135.	135.	158.	158.	180.	180.	180.	180.	180.	270.	203.	180.	180.	180.	180.	175.	9	1
180.	180.	203.	203.	203.	180.	180.	203.	180.	203.	180.	180.	180.	293.	90.	113.	225.	180.	180.	180.	180.	180.	180.	203.	186.	9	2
203.	225.	275.	248.	225.	225.	203.	203.	180.	225.	0.	135.	135.	135.	180.	225.	270.	270.	270.	270.	293.	315.	315.	315.	220.	9	3
315.	315.	315.	45.	45.	45.	90.	90.	90.	90.	90.	90.	45.	0.	0.	0.	0.	0.	0.	270.	0.	0.	0.	0.	81.	9	4
0.	0.	0.	315.	315.	315.	270.	180.	180.	180.	180.	180.	203.	203.	203.	203.	270.	248.	248.	270.	270.	270.	0.	0.	188.	9	5
23.	23.	23.	23.	45.	45.	45.	45.	45.	45.	68.	68.	68.	68.	68.	68.	90.	90.	90.	90.	90.	68.	68.	68.	59.	9	6
90.	90.	90.	90.	90.	68.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	45.	90.	90.	113.	135.	158.	135.	135.	78.	9	7
113.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	135.	90.	180.	180.	225.	140.	9	8
270.	248.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	225.	225.	270.	270.	270.	315.	315.	0.	0.	199.	9	9
0.	90.	90.	113.	135.	135.	135.	135.	158.	158.	158.	158.	158.	158.	158.	0.	0.	0.	113.	113.	135.	135.	270.	270.	124.	9	10
203.	180.	180.	180.	180.	158.	135.	135.	135.	135.	135.	135.	90.	180.	180.	180.	180.	225.	225.	180.	248.	225.	203.	180.	174.	9	11
203.	225.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	180.	9	12
158.	158.	158.	180.	180.	180.	158.	158.	158.	113.	113.	180.	180.	225.	225.	225.	225.	0.	0.	315.	180.	0.	0.	0.	145.	9	13
0.	0.	0.	0.	23.	23.	0.	45.	45.	45.	45.	45.	45.	45.	45.	23.	23.	23.	45.	45.	45.	45.	45.	45.	31.	9	14
45.	45.	45.	45.	45.	68.	90.	90.	90.	90.	90.	90.	180.	270.	270.	270.	45.	45.	45.	90.	45.	90.	90.	90.	98.	9	15
90.	90.	90.	225.	203.	45.	23.	45.	45.	45.	90.	113.	135.	135.	135.	0.	0.	0.	180.	180.	158.	135.	135.	135.	101.	9	16
180.	180.	158.	135.	135.	135.	135.	225.	275.	225.	225.	225.	225.	180.	225.	225.	225.	270.	315.	315.	225.	315.	338.	338.	224.	9	17
0.	338.	338.	338.	315.	338.	0.	0.	338.	338.	338.	338.	338.	0.	338.	0.	315.	315.	338.	338.	338.	0.	338.	338.	251.	9	18
338.	338.	338.	338.	338.	0.	0.	0.	0.	338.	338.	315.	338.	338.	338.	338.	315.	315.	315.	315.	0.	338.	315.	338.	262.	9	19
338.	0.	0.	338.	0.	0.	0.	0.	0.	338.	338.	338.	338.	338.	338.	338.	338.	338.	338.	338.	338.	338.	0.	0.	211.	9	20
338.	338.	338.	338.	338.	338.	338.	338.	203.	203.	225.	225.	225.	225.	225.	225.	270.	270.	315.	315.	338.	0.	0.	0.	249.	9	21
0.	0.	0.	0.	0.	0.	0.	0.	315.	315.	338.	338.	315.	315.	315.	315.	315.	315.	315.	315.	315.	315.	315.	315.	212.	9	22
315.	315.	315.	338.	338.	338.	338.	293.	225.	225.	225.	225.	225.	225.	225.	225.	225.	225.	225.	225.	203.	203.	203.	180.	253.	9	23
180.	180.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	203.	203.	203.	225.	225.	248.	193.	9	24
225.	225.	225.	203.	180.	180.	180.	180.	180.	180.	338.	0.	0.	23.	90.	113.	90.	68.	0.	0.	45.	45.	23.	23.	117.	9	25
203.	203.	203.	203.	203.	180.	180.	23.	23.	23.	45.	45.	23.	23.	23.	23.	45.	23.	23.	45.	45.	23.	23.	45.	79.	9	26
0.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	45.	23.	23.	23.	0.	0.	0.	293.	293.	293.	0.	0.	0.	51.	9	27
0.	0.	270.	248.	225.	225.	203.	203.	203.	203.	225.	225.	225.	225.	248.	248.	270.	270.	270.	293.	315.	315.	315.	0.	218.	9	28
135.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	225.	315.	0.	23.	23.	23.	23.	23.	23.	23.	133.	9	29
23.	0.	0.	0.	0.	0.	23.	23.	45.	23.	23.	23.	0.	338.	315.	315.	315.	315.	315.	315.	315.	315.	315.	338.	154.	9	30
45.	315.	270.	225.	225.	203.	180.	203.	225.	203.	203.	203.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	203.	203.	196.	10	1
203.	203.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	203.	203.	203.	169.	10	2
203.	203.	203.	203.	203.	203.	180.	293.	0.	0.	0.	0.	0.	0.	23.	0.	0.	0.	23.	0.	0.	23.	0.	23.	74.	10	3
0.	23.	23.	23.	0.	23.	23.	0.	0.	0.	0.	0.	0.	23.	0.	0.	0.	338.	315.	315.	315.	315.	315.	315.	99.	10	4
315.	315.	315.	315.	315.	315.	315.	315.	315.	270.	270.	270.	270.	270.	270.	270.	270.	203.	135.	135.	135.	158.	158.	180.	254.	10	5
180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	158.	158.	158.	173.	10	6
158.	158.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	158.	158.	160.	10	7
180.	180.	158.	180.	180.	180.	180.	180.	135.	158.	158.	158.	158.	158.	158.	180.	180.	180.	180.	180.	180.	203.	225.	225.	176.	10	8
248.	293.	315.	0.	338.	0.	0.	0.	0.	0.	0.	23.	23.	45.	45.	68.	90.	90.	90.	90.	90.	90.	90.	90.	88.	10	9
68.	68.	68.	68.	90.	90.	90.	90.	113.	135.	135.	135.	135.	135.	135.	135.	135.	180.	158.	180.	180.	180.	180.	180.	128.	10	10
203.	203.	203.	180.	180.	158.	158.	158.	158.	158.	158.	158.	180.	158.	158.	158.	135.	135.	135.	135.	158.	158.	158.	180.	163.	10	11
158.	180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	158.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	174.	10	12
180.	180.	180.	180.	180.	158.	158.	158.	158.	158.	158.	158.	158.	158.	180.	180.	180.	180.	180.	203.	203.	225.	248.	270.	182.	10	13
270.	270.	270.	270.	293.	293.	293.	315.	315.	315.	315.	315.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	180.	237.	10	14

APPENDIX B

TABLE B-I

FILM COVER EXPRESSED AS A DECIMAL FRACTION OF THE SURFACE OF LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.11	0.24	0.33	0.25	0.18	0.20	0.20	0.26	0.22	0.16	0.14	0.18	0.11	7	6
0.14	0.18	0.20	0.24	0.30	0.30	0.66	0.39	0.30	0.24	0.27	0.20	0.12	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	7	7
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.08	0.07	0.11	0.08	0.19	0.10	0.11	0.12	0.08	0.10	0.12	0.18	0.06	7	9
0.16	0.24	0.30	0.40	0.50	0.58	0.34	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	7	10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.04	0.04	0.07	0.06	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	7	11
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.33	0.31	0.26	0.43	0.15	0.17	0.20	0.24	0.26	0.22	0.28	0.13	7	14
0.30	0.32	0.36	0.30	0.26	0.24	0.48	0.42	0.70	0.67	0.83	0.65	0.76	0.65	0.27	0.12	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.31	7	15
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.09	0.09	0.05	0.02	0.01	0.02	0.01	0.03	0.03	0.03	0.04	0.02	0.04	0.04	0.02	7	25
0.06	0.04	0.06	0.08	0.10	0.05	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.04	0.06	0.04	0.04	0.03	7	26
0.06	0.04	0.06	0.09	0.12	0.11	0.12	0.72	0.71	0.68	0.33	0.31	0.37	0.31	0.09	0.06	0.04	0.06	0.04	0.04	0.02	0.04	0.08	0.10	0.19	7	27
0.16	0.16	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.66	0.62	0.55	0.56	0.65	0.73	0.78	1.00	1.00	0.98	1.00	1.00	0.90	0.74	0.49	7	28
0.60	0.48	0.38	0.30	0.28	0.28	0.45	0.39	0.32	0.16	0.04	0.02	0.02	0.20	0.35	0.48	0.50	0.49	0.48	0.52	0.56	0.58	0.60	0.64	0.38	7	29
0.70	0.74	0.70	0.50	0.30	0.03	0.03	0.03	0.09	0.07	0.09	0.08	0.05	0.04	0.05	0.05	0.06	0.04	0.11	0.08	0.06	0.06	0.06	0.30	0.18	7	30
0.60	0.66	0.80	0.70	0.64	0.59	0.54	0.59	0.62	0.81	0.75	0.77	0.67	0.49	0.45	0.44	0.36	0.26	0.17	0.10	0.08	0.06	0.06	0.06	0.47	7	31
0.06	0.08	0.06	0.08	0.09	0.09	0.02	0.01	0.06	0.16	0.11	0.13	0.14	0.08	0.06	0.04	0.04	0.03	0.02	0.02	0.02	0.04	0.06	0.08	0.07	8	1
0.12	0.16	0.24	0.36	0.40	0.42	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	8	2
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.32	0.69	0.18	0.17	0.15	0.12	0.09	0.07	0.06	0.05	0.05	0.08	0.12	0.30	0.34	0.34	0.13	8	3
0.34	0.34	0.38	0.40	0.40	0.38	0.40	0.42	0.57	0.76	0.88	0.89	0.68	0.84	0.40	0.25	0.16	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.36	8	4
0.02	0.02	0.02	0.04	0.10	0.22	0.31	0.15	0.10	0.13	0.20	0.56	0.59	0.78	0.65	0.80	0.24	0.28	0.24	0.18	0.12	0.04	0.00	0.00	0.24	8	5
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.21	0.53	0.34	0.48	0.48	0.48	0.46	0.35	0.28	0.10	0.10	0.08	0.10	0.14	0.16	0.18	8	6
0.10	0.06	0.08	0.10	0.12	0.31	0.26	0.13	0.11	0.03	0.08	0.14	0.14	0.16	0.17	0.63	0.77	0.20	0.13	0.10	0.12	0.20	0.30	0.40	0.20	8	7
0.40	0.36	0.36	0.32	0.32	0.32	0.32	0.25	0.15	0.11	0.13	0.08	0.06	0.10	0.13	0.18	0.24	0.45	0.35	0.30	0.20	0.20	0.30	0.40	0.25	8	8
0.50	0.60	0.50	0.40	0.10	0.05	0.06	0.15	0.23	0.32	0.49	0.59	0.54	0.53	0.19	0.08	0.04	0.03	0.06	0.07	0.06	0.06	0.05	0.04	0.24	8	9
0.02	0.04	0.10	0.20	0.30	0.49	0.52	0.43	0.31	0.28	0.56	0.58	0.22	0.18	0.13	0.06	0.06	0.41	0.02	0.02	0.07	0.04	0.04	0.04	0.21	8	10
0.06	0.06	0.08	0.10	0.10	0.10	0.10	0.08	0.08	0.12	0.20	0.20	0.14	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	8	11
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.19	0.30	0.35	0.46	0.46	0.31	0.35	0.35	0.35	0.28	0.22	0.22	0.24	0.30	0.36	0.40	0.22	8	12
0.42	0.44	0.50	0.48	0.56	0.60	0.60	0.48	0.32	0.54	0.65	0.68	0.89	0.98	0.85	0.28	0.15	0.24	0.31	0.40	0.46	0.52	0.58	0.59	0.52	8	13
0.60	0.62	0.64	0.58	0.54	0.58	0.43	0.50	0.43	0.47	0.65	0.70	0.72	0.32	0.41	0.51	0.46	0.45	0.37	0.03	0.03	0.04	0.04	0.06	0.42	8	14
0.12	0.16	0.18	0.18	0.20	0.18	0.13	0.21	0.22	0.08	0.03	0.02	0.03	0.00	0.00	0.00	0.03	0.05	0.05	0.05	0.14	0.14	0.14	0.14	0.10	8	15
0.18	0.20	0.18	0.16	0.12	0.10	0.08	0.06	0.06	0.07	0.11	0.11	0.15	0.29	0.30	0.30	0.37	0.43	0.45	0.45	0.50	0.44	0.40	0.36	0.24	8	16
0.36	0.34	0.34	0.34	0.40	0.37	0.37	0.40	0.29	0.10	0.15	0.10	0.19	0.30	0.27	0.33	0.33	0.25	0.09	0.09	0.12	0.15	0.12	0.10	0.25	8	17
0.12	0.14	0.12	0.30	0.50	0.62	0.62	0.62	0.50	0.41	0.46	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	8	18
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8	19
0.00	0.00	0.02	0.08	0.18	0.32	0.33	0.25	0.05	0.00	0.05	0.05	0.28	0.43	0.43	0.40	0.15	0.15	0.07	0.20	0.24	0.24	0.08	0.12	0.17	8	28
0.18	0.18	0.19	0.12	0.06	0.26	0.25	0.18	0.06	0.09	0.11	0.28	0.36	0.34	0.29	0.08	0.07	0.13	0.20	0.26	0.26	0.34	0.40	0.43	0.21	8	29
0.48	0.50	0.52	0.50	0.48	0.48	0.47	0.39	0.34	0.28	0.39	0.52	0.52	0.54	0.50	0.37	0.08	0.02	0.04	0.02	0.02	0.02	0.01	0.02	0.31	8	30
0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.12	0.20	0.26	0.28	0.30	0.34	0.36	0.08	8	31
0.36	0.36	0.38	0.44	0.44	0.42	0.50	0.40	0.04	0.07	0.09	0.02	0.01	0.02	0.10	0.20	0.05	0.13	0.19	0.32	0.36	0.34	0.26	0.24	0.24	9	1
0.24	0.22	0.22	0.20	0.18	0.17	0.36	0.10	0.08	0.05	0.03	0.11	0.02	0.03	0.07	0.20	0.33	0.41	0.45	0.37	0.28	0.22	0.17	0.13	0.19	9	2
0.11	0.09	0.08	0.09	0.09	0.10	0.17	0.39	0.74	0.64	0.61	0.65	0.55	0.30	0.24	0.24	0.24	0.36	0.34	0.30	0.24	0.28	0.14	0.00	0.29	9	3
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.22	0.23	0.24	0.25	0.27	0.28	0.07	9	4
0.28	0.29	0.29	0.28	0.28	0.28	0.28	0.29	0.25	0.89	0.87	0.79	0.70	0.66	0.63	0.58	1.00	0.61	0.57	0.53	0.52	0.52	0.46	0.44	0.51	9	5
0.40	0.40	0.38	0.40	0.36	0.36	0.40	0.35	0.28	0.21	0.10	0.10	0.09	0.08	0.08	0.00	0.00	0.00	0.03	0.10	0.14	0.16	0.10	0.08	0.19	9	6
0.08	0.08	0.08	0.06	0.08	0.09	0.21	0.10	0.11	0.09	0.08	0.08	0.10	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.06	9	7
0.20	0.22	0.20	0.20	0.20	0.22	0.23	0.24	0.29	0.26	0.33	0.35	0.41	0.38	0.33	0.30	0.25	0.19	0.22	0.22	0.22	0.24	0.26	0.25	0.26	9	8
0.26	0.24	0.30	0.36	0.34	0.28	0.26	0.28	0.29	0.28	0.35	0.90	0.80	0.62	0.66	0.55	0.38	0.36	0.36	0.34	0.38	0.36	0.36	0.38	0.40	9	9
0.40	0.42	0.46	0.54	0.60	0.71	0.65	0.62	0.59	0.81	0.80	0.85	0.88	0.51	0.58	0.49	0.41	0.28	0.15	0.12	0.14	0.16	0.16	0.20	0.48	9	10
0.40	0.48	0.60	0.68	0.78	0.86	1.00	1.00	1.00	1.00	1.00	0.84	0.85	0.70	0.63	0.64	0.64	0.62	0.62	0.60	0.66	0.70	0.70	0.70	0.74	9	11
0.64	0.64	0.62	0.64	0.68	0.68	0.68	0.68	0.68	0.73	0.64	0.68	0.63	0.61	0.62	0.39	0.32	0.26	0.24	0.24	0.16	0.10	0.02	0.02	0.48	9	12
0.04	0.12	0.24	0.18	0.22	0.23	0.00	0.02	0.04	0.03	0.04	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	9	13
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.18	0.30	0.42	0.35	0.38	0.48	0.59	0.70	0.72	0.74	0.70	0.70	0.50	0.20	0.30	9	25
0.05	0.10	0.25	0.30	0.70	0.50	0.20	0.05	0.99	1.00	0.85	0.69	0.29	0.47	0.65	0.62	0.59	0.40	0.20	0.00	0.00	0.00	0.00	0.00	0.37	9	26
0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.18	0.26	0.97	0.75	0.56	0.45	0.32	0.42	0.24	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	9	29

APPENDIX C

TABLE C-I

CHEMICAL APPLICATION RATE IN LBS/HR AT LAKE HEFNER, 1966

0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	Avg	Mo	Da
0.	0.	0.	0.	0.	0.	0.	0.	0.	100.	95.	95.	95.	85.	62.	80.	63.	65.	90.	65.	35.	35.	20.	20.	42.	7	6
0.	60.	12.	32.	35.	60.	10.	39.	65.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	13.	7	7
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7	8
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	100.	125.	117.	105.	110.	125.	115.	70.	50.	0.	120.	60.	77.	72.	52.	7	9
123.	75.	88.	83.	75.	95.	70.	75.	30.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	30.	7	10
0.	0.	0.	0.	0.	0.	0.	0.	0.	160.	135.	156.	180.	120.	112.	121.	0.	0.	0.	0.	0.	0.	0.	0.	41.	7	11
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	125.	165.	50.	0.	0.	0.	90.	80.	19.	38.	12.	40.	40.	27.	7	14
41.	59.	60.	43.	63.	50.	20.	40.	32.	0.	0.	0.	32.	50.	55.	25.	0.	0.	0.	0.	0.	0.	0.	0.	24.	7	15
0.	0.	0.	0.	0.	0.	0.	20.	12.	12.	42.	45.	8.	62.	45.	87.	0.	91.	90.	75.	85.	60.	55.	56.	35.	7	25
50.	58.	50.	50.	50.	15.	45.	45.	0.	65.	80.	97.	90.	83.	60.	57.	57.	50.	45.	42.	39.	35.	33.	32.	51.	7	26
32.	34.	37.	45.	52.	50.	47.	43.	40.	37.	42.	47.	52.	56.	60.	65.	69.	74.	43.	43.	43.	43.	42.	55.	48.	7	27
50.	0.	0.	0.	0.	0.	0.	0.	58.	65.	75.	107.	87.	100.	120.	105.	90.	58.	52.	48.	45.	37.	59.	42.	50.	7	28
42.	42.	41.	40.	50.	46.	42.	42.	41.	41.	40.	38.	37.	35.	33.	32.	25.	23.	19.	38.	36.	33.	31.	45.	37.	7	29
59.	44.	28.	37.	46.	40.	75.	68.	70.	75.	83.	60.	50.	44.	38.	50.	61.	37.	50.	0.	0.	0.	73.	65.	48.	7	30
57.	50.	47.	43.	39.	48.	57.	50.	46.	42.	50.	80.	108.	136.	134.	110.	85.	62.	47.	57.	75.	60.	43.	55.	66.	7	31
59.	55.	58.	48.	40.	50.	58.	53.	41.	41.	42.	44.	47.	50.	50.	50.	50.	49.	48.	58.	43.	45.	44.	43.	49.	8	1
40.	41.	38.	42.	38.	25.	-0.	-0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	9.	8	2
0.	0.	0.	0.	0.	0.	0.	0.	38.	37.	40.	43.	38.	33.	33.	33.	34.	36.	37.	39.	30.	20.	37.	50.	24.	8	3
19.	25.	32.	25.	25.	26.	27.	31.	33.	30.	26.	25.	22.	25.	50.	75.	19.	30.	0.	0.	0.	0.	0.	0.	23.	8	4
0.	0.	0.	0.	0.	0.	0.	0.	48.	32.	20.	14.	25.	35.	48.	13.	37.	15.	0.	0.	0.	0.	0.	0.	12.	8	5
0.	0.	0.	0.	0.	0.	0.	0.	46.	61.	16.	14.	17.	21.	30.	27.	27.	27.	30.	30.	32.	25.	31.	25.	19.	8	6
25.	27.	29.	23.	20.	23.	27.	22.	19.	25.	28.	32.	23.	23.	25.	25.	20.	20.	21.	33.	34.	39.	24.	37.	26.	8	7
46.	22.	28.	25.	25.	25.	22.	31.	37.	30.	30.	27.	28.	21.	32.	22.	22.	23.	19.	19.	25.	30.	33.	25.	27.	8	8
34.	34.	32.	30.	34.	42.	51.	64.	62.	62.	56.	52.	43.	43.	75.	50.	56.	62.	78.	75.	75.	75.	75.	75.	56.	8	9
75.	67.	80.	78.	77.	77.	72.	100.	50.	45.	50.	50.	49.	48.	47.	43.	43.	35.	25.	56.	42.	25.	56.	45.	56.	8	10
37.	37.	38.	42.	46.	50.	43.	45.	46.	47.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	18.	8	11
0.	0.	0.	0.	0.	93.	112.	100.	50.	45.	46.	50.	50.	42.	57.	51.	55.	57.	60.	50.	58.	170.	128.	113.	58.	8	12
96.	109.	105.	46.	39.	50.	50.	45.	41.	51.	50.	45.	42.	40.	40.	40.	39.	38.	31.	37.	30.	50.	39.	40.	50.	8	13
41.	12.	32.	50.	30.	38.	44.	50.	62.	67.	75.	42.	60.	60.	180.	92.	75.	84.	92.	125.	205.	120.	122.	118.	78.	8	14
115.	118.	101.	86.	71.	95.	115.	138.	86.	92.	105.	125.	117.	0.	0.	225.	200.	212.	225.	180.	136.	187.	141.	171.	127.	8	15
149.	120.	115.	96.	90.	123.	130.	120.	155.	170.	170.	145.	216.	155.	145.	193.	187.	172.	172.	172.	160.	171.	165.	154.	152.	8	16
141.	150.	150.	150.	150.	150.	150.	0.	0.	175.	150.	0.	212.	162.	174.	108.	-0.	0.	202.	190.	177.	175.	167.	158.	129.	8	17
150.	150.	125.	150.	175.	100.	150.	138.	130.	143.	140.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	63.	8	18
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8	19
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8	21
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8	22
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8	23
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8	27
0.	150.	125.	125.	132.	130.	0.	0.	0.	0.	185.	110.	150.	141.	0.	0.	155.	195.	180.	163.	0.	0.	150.	150.	93.	8	28
150.	150.	0.	0.	150.	162.	0.	0.	132.	148.	167.	200.	141.	0.	0.	0.	170.	150.	115.	180.	178.	176.	175.	175.	113.	8	29
150.	150.	145.	150.	150.	150.	150.	125.	158.	154.	157.	154.	150.	165.	155.	145.	110.	75.	150.	150.	157.	164.	186.	150.	148.	8	30
120.	150.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	187.	145.	137.	218.	219.	188.	165.	172.	182.	225.	88.	8	31
152.	125.	150.	150.	140.	150.	155.	150.	130.	215.	215.	215.	220.	195.	0.	0.	0.	225.	220.	215.	210.	173.	173.	175.	158.	9	1
168.	160.	155.	162.	167.	150.	114.	179.	195.	185.	175.	220.	208.	195.	176.	162.	165.	166.	150.	145.	140.	138.	150.	150.	166.	9	2
150.	150.	150.	148.	145.	0.	136.	132.	152.	160.	170.	138.	153.	150.	205.	155.	200.	163.	183.	140.	145.	150.	0.	0.	136.	9	3
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	138.	100.	62.	57.	50.	50.	50.	21.	9	4
50.	50.	50.	50.	44.	50.	50.	55.	62.	57.	54.	50.	54.	58.	43.	41.	40.	38.	37.	50.	38.	75.	80.	75.	52.	9	5
75.	77.	100.	107.	100.	105.	95.	95.	145.	200.	140.	120.	125.	132.	170.	0.	0.	0.	125.	100.	75.	75.	93.	85.	97.	9	6
80.	75.	75.	75.	75.	75.	62.	50.	66.	58.	51.	51.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	49.	35.	9	7
36.	33.	30.	35.	40.	60.	80.	98.	168.	170.	135.	95.	75.	62.	40.	40.	44.	38.	35.	35.	38.	44.	49.	30.	63.	9	8
30.	40.	38.	38.	50.	60.	57.	58.	65.	75.	50.	42.	33.	42.	47.	51.	55.	77.	100.	50.	50.	75.	65.	55.	54.	9	9
52.	50.	55.	50.	45.	56.	50.	44.	43.	43.	0.	0.	0.	0.	0.	0.	0.	0.	0.	53.	61.	61.	60.	60.	33.	9	10
55.	52.	50.	52.	55.	50.	45.	0.	0.	0.	0.	0.	0.	0.	0.	62.	67.	61.	55.	57.	60.	62.	57.	50.	37.	9	11
50.	38.	38.	38.	38.	75.	57.	40.	40.	75.	60.	46.	42.	44.	45.	40.	70.	100.	85.	65.	50.	58.	50.	50.	54.	9	12
62.	55.	47.	40.	75.	50.	50.	52.	55.	77.	100.	125.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	33.	9	13
0.	0.	0.	0.	0.	0.	0.	150.	162.	150.	170.	190.	210.	215.	223.	230.	0.	0.	0.	0.	0.	0.	0.	0.	71.	9	24
0.	0.	0.	0.	0.	0.	0.	0.	137.	137.	137.	120.	119.	117.	116.	115.	112.	110.	100.	94.	90.	87.	85.	81.	73.	9	25
78.	75.	73.	70.	67.	65.	62.	67.	74.	80.	87.	93.	99.	92.	85.	80.	73.	67.	60.	55.	0.	0.	0.	0.	63.	9	26
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	65.	62.	60.	56.	55.	54.	15.	9	28
52.	51.	50.	50.	48.	46.	57.	69.	79.	89.	83.	80.	76.	56.	85.	118.	0.	0.	0.	0.	0.	0.	0.	0.	45.	9	29

VITA

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Candidate for the Degree of

Master of Science

Thesis: A STUDY OF WIND AND OF THE EFFECTS OF WIND AND CHEMICAL APPLICATION ON FILM COVER AT LAKE HEFNER FOR 1966.

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