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DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

**BEACH EROSION BOARD
OFFICE OF THE CHIEF OF ENGINEERS**

**WAVE AND
LAKE LEVEL STATISTICS
FOR LAKE ERIE**

TECHNICAL MEMORANDUM NO. 37

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BEACH EROSION BOARD
CORPS OF ENGINEERS

MARCH 1953

FOREWORD

This is the second of a series of reports to be issued by the Beach Erosion Board under its General Investigations program to provide wave statistics for selected regions. The need for such data is evident, and it is planned ultimately to supply it by actual wave measurement for sufficiently long periods to establish the wave climate at many locations. Suitable instruments for that purpose have not yet been developed and even after they become available much time must pass before the records can attain statistical value. The production of wave statistics by "hindcast" technique, admittedly of presently indeterminate quantitative accuracy, will nevertheless provide the engineer with better wave data than have heretofore been available.

Thorndike Saville, Jr., author of the report, is a Hydraulic Engineer in the Research Division of the Beach Erosion Board under the supervision of Joseph M. Caldwell, Chief of the Division. At the time this report was prepared, the technical staff of the Board was under general supervision of Colonel E. E. Gesler, President of the Board and R. O. Eaton, Chief Technical Assistant.

The author was aided in the study by Robert F. Dearduff, Hydraulic Engineer; by Morrison G. Essick, John C. Fairchild, Francis W. Kellum and Herman P. VanEckhardt in computations and compilations; in map reduction by Carleton L. Bell, George P. Cummings, Lowell E. Finch, Richard E. Nearman and John J. Sharer; and in drafting by Wendell E. Reece. The report was edited for publication by Albert C. Rayner. Views and conclusions stated in the report are not necessarily those of the Beach Erosion Board.

TABLE OF CONTENTS

	Page
Introduction	1
Wave Statistics	1
Lake Levels	8

APPENDICES

- A - Wave Statistics for Monroe, Michigan
- B - Wave Statistics for Cleveland, Ohio
- C - Wave Statistics for Erie, Pennsylvania
- D - Wave Statistics for Buffalo, New York

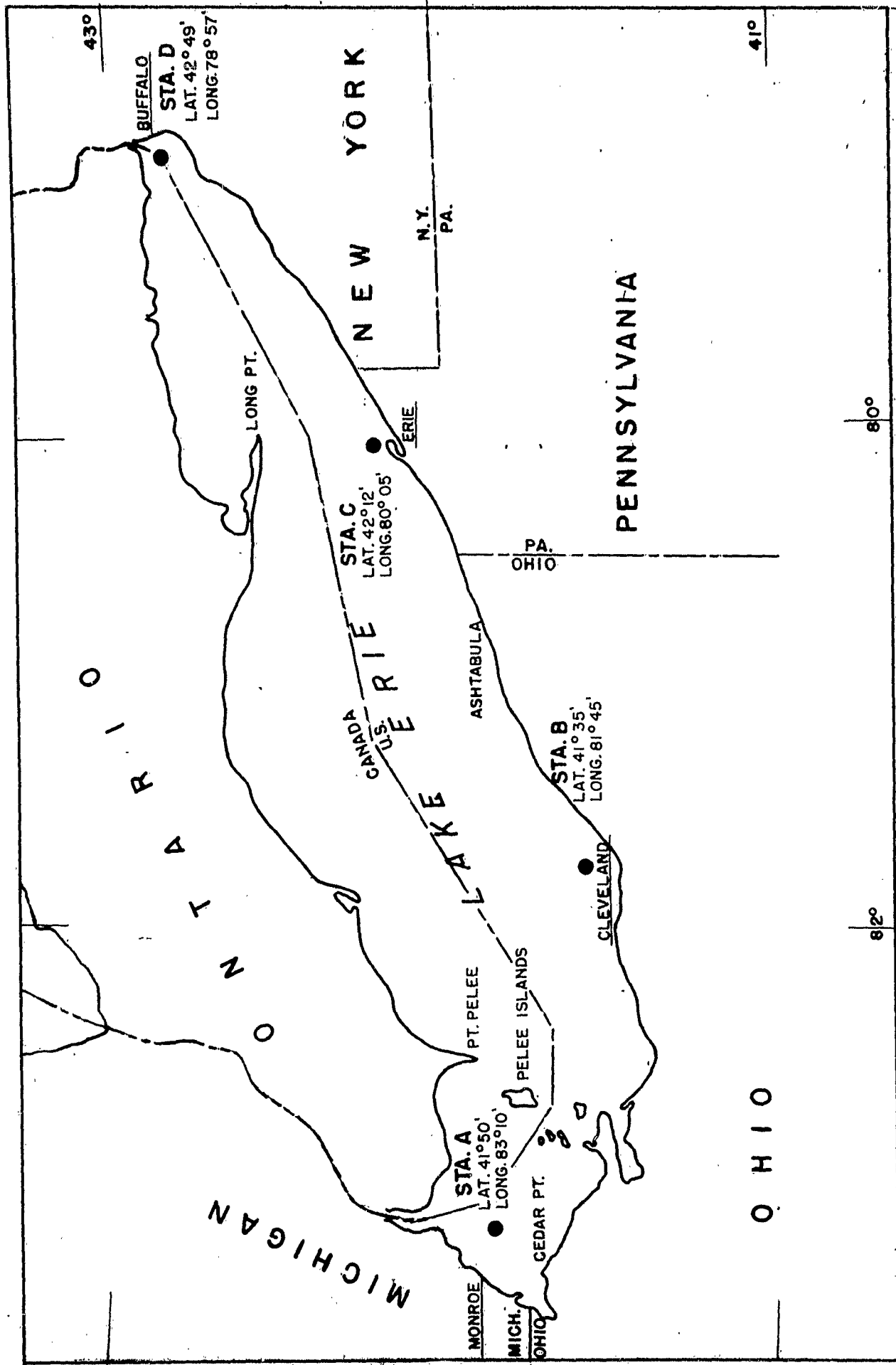


FIG.1 LOCATION OF WAVE HINDCASTING STATIONS FOR LAKE ERIE

WAVE AND LAKE LEVEL STATISTICS FOR LAKE ERIE

by

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INTRODUCTION

The General Investigations program of the Beach Erosion Board comprises investigations, regional rather than local in scope, designed to improve, simplify, and expedite the solution of local problems, by giving a compilation of all existing data pertinent to shore processes in the particular region. As a first step in the compilation of these data a study of wave and lake level conditions on the Great Lakes is being made. The results of such a study for Lake Erie are presented herein.

WAVE STATISTICS

Four stations on Lake Erie were selected for a comprehensive wave analysis, the locations (see Figure 1) being as follows:

<u>Station</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Vicinity</u>
A	41°50' N	83°10' W	Monroe, Michigan
B	41°35' N	81°45' W	Cleveland, Ohio
C	42°12' N	80°05' W	Erie, Pennsylvania
D	42°49' N	78°57' W	Buffalo, New York

These particular stations were selected since it was thought that they would give adequate coverage to the entire lake shore in the United States, and permit interpolation of values between stations, thus giving an accurate representation of wave action at any point along the United States shore line.

Wave characteristics were determined from synoptic weather charts for each station for the three-year period 1948-1950. The weather maps used were the United States Surface Synoptic Charts compiled at six-hour intervals by the U. S. Weather Bureau. Fetch areas, and the wind speeds and durations in these areas, were determined directly from the weather maps; these values were used with curves derived by Sverdrup and Munk (1)* and revised by Arthur (2) to obtain the hindcast wave

characteristics. The revisions in the curves recently suggested by Bretschneider (3) were not employed, hence the wave periods determined may be expected to be slightly low. The only major variation from the usual methods of wave forecasting or hindcasting (4) was that the surface wind was determined directly from reported observations rather than from a gradient wind determined from the isobar spacing. It was thought that with the lake area so small in comparison to the area of the pressure cell, the isobaric pattern on the surface would be influenced to a large extent by the surface topography, and gradient winds determined from the isobar spacing would not necessarily give true values of wind velocity over the lake surface. Hence reported values of the surface wind could be expected to give a more realistic figure of the wind velocity. Observations have shown (5) that the greater surface friction serves to reduce the wind over land from what it may be over water. Since the reported values were almost always obtained at land stations, the wind speeds used in the analysis may have been lower than those actually occurring over the lake in the generating area. Some compensation was made for this by selecting the top speed of the Beaufort range reported rather than the middle value.

The wave characteristics thus determined are for the significant wave -- that is, the period is that of the predominating waves, and the height is the average of the higher one-third of these predominant waves. These values are summarized for each station in Tables A-1 through D-1 (Appendices A through D). It should also be noted that the wave conditions given in these tables are deep water conditions. They must be used in conjunction with refraction diagrams to obtain inshore values. The tables show, for each station, the number of hours duration that deep water waves of any given height, period, and direction occurred during any month of the three-year period; and also for each month (as summations) the number of hours' occurrence of waves of any particular height and period exclusive of direction; the number of hours' occurrence of waves of any particular height and direction exclusive of period; and the total number of hours' occurrence of waves of any particular height.

As an example of the data presented, from Table B-1 (Table 1 for Station B) for the month of July, waves of 1 to 2-foot height and 2 to 3-second period from the north occurred for 6 hours during 1948, 18 hours during 1949, and 12 hours during 1950. Thus, waves of this category occurred for a duration of 36 hours during the three-year period and hence can be expected to occur for about 12 hours (on the average) during July of any year in the future. Waves of 1 to 2-foot height and 2 to 3-second period (from all directions) occurred for 120 hours over the three-year period, or an average of 40 hours per year. Waves of 1 to 2 foot height from the north (all periods) occurred for 66 hours over the three-year period, or an average of 22 hours per year. Waves 1 to 2-foot height (all periods and all directions) occurred for 198 hours over the three-year period, or an average of 66 hours per year.

Tables A-2 through D-2 show the summations of the values in Tables A-1 through D-1 for the entire year, and are read similarly to those tables.

During much of the winter season portions of the lake are covered with ice, and fetch areas are limited considerably. In addition, for a somewhat greater portion of the winter season, the coast area of the lake is covered with ice, and, even though waves are generated in offshore areas, they never reach the shore, being interrupted by the ice around the rim of the lake. No account of this effect of the ice was taken in the actual hindcasting of the waves, and the durations given for the various winter months are computed as though there were no ice on the lake, a fact that should be remembered in using these data.

From yearly records of lake and air temperatures, and the dates of opening and closing of the lake for navigation, an average ice-free period was determined. For Lake Erie this appeared to run, on the average, from April through November, and the average ice-free period was determined as 1 April - 1 December for all four stations. A summation of the wave data for this ice-free period is shown in Tables A-3 through D-3. These tables are similar to Tables 1 and 2, and represent a summation of the values in Tables 1 for all months from April through November. The durations of waves of particular height and direction have also been tabulated as percentages of time for the three-year period and are shown graphically in the wave roses for the full year and also for the ice-free period in Figures A-1 through D-1. In these roses, as in all other curves contained herein, the durations are percentages of 365 days, for the ice-free period as well as the full year data.

Figures A-2 through D-2 show the total percentages of time that the wave height may be expected to be greater than any particular height throughout the year. They thus show the (average) total duration time of specific waves over the year. Two curves are shown, one based on the data gathered for the entire year's period, and the other on just the average ice-free period (April through November). For example, at station B, the total duration of waves in excess of 10 feet in height during the ice-free period is expected to be 0.09 percent of the time; and 0.13 percent of the time during the full year. Hence waves 10 feet or higher can be expected to occur for a total duration of 11.5 hours ($0.0013 \times 365 \times 24$) over the course of each year, and, of this, 8 hours ($0.0009 \times 365 \times 24$) will be during the ice-free portion of the year when the waves will be certain to reach the shore.

Figures A-3 through D-3 show the frequency with which storms resulting in waves higher than a given height can be expected to occur. For example, at station B, on 0.56 percent of the days each year the waves may be expected to be ten feet or greater in height, and on 0.29 percent of the days they may be expected to reach this height during the ice-free portion of the year. Thus waves ten feet or higher may be expected to occur (on the average) twice each year (0.0056×365); of these occurrences, only one (0.0029×365) will be expected to occur during the ice-free portion of each year.

Combining the data obtained from graphs on Figures B-2 and B-3, waves ten feet and higher may be expected to occur at Station B about twice each year, and the average duration of each storm will be about 6 hours. During the ice-free portion of the year, waves of ten feet and higher may be expected to occur only once, and the duration of this storm is expected to be about 8 hours.

There are, in general, two methods of plotting points to obtain frequency curves such as those shown in Figures A-3 through D-3. One, based on the so-called theory of sampling, involves the assumption that the known period of record (three years) is a fair average sample of all similar three-year periods over an infinite number of years, and that therefore the largest storm of this three-year period is the median of all storms of the same class in all other three-year periods. This results in a frequency given by the following equation.

$$F = \frac{2N - 1}{2T} \times 100$$

where F = frequency (in percent) of the occurrence of storms equalling or exceeding the given storm

T = number of days of record

N = number of occurrences of a storm equal to or greater than the given storm

The second method essentially considers only the period of record, in which case the frequency becomes

$$F = \frac{N}{T} \times 100$$

Values of F are the abscissas of points on the frequency curve. Using the second equation above, the largest storm which occurred in the known three-year period would have an abscissa of .0914 percent and would represent the storm which would most probably occur once in three years, i.e., would be the "three-year storm", etc. But this would be contrary to the theory of sampling, where (above) the assumption is made that the largest storm in the known three-year period was the median of the largest storms in a long succession of three-year periods. Therefore, over a long period such as 300 years, it will be exceeded not 100 times, but 50 times; i.e. it is by definition not a "3-year storm", but a "6-year storm".

Either of the above equations could be, and have been used to prepare frequency curves. Although the former is the one most generally used for hydrologic data, the latter method has been used in this case. The use of this formula ($F = 100 N/T$) will result in somewhat more conservative interpretation of the data, and was thought justified in view of the extremely short period of record (3 years).

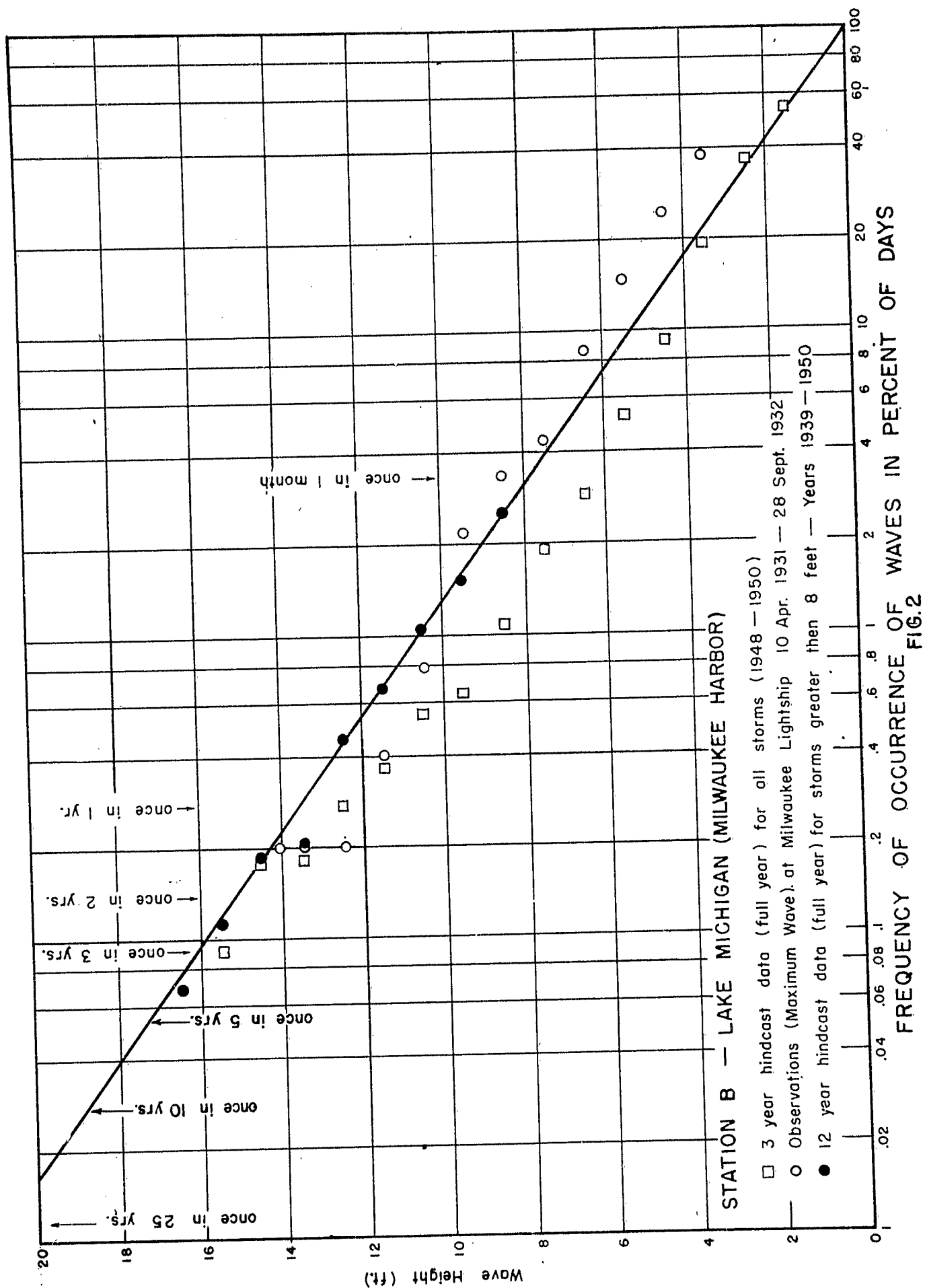
The points plotted may be represented fairly closely by a continuous curve which frequently approximates a straight line, as may be seen from the figures. The curves shown have, in general, been drawn as lines of visual best fit; occasionally, however, more weight has been placed on the higher values. This tends to give a somewhat more conservative interpretation, which is thought warranted in some cases. The user is free to make his own interpretation of the plotted points.

In view of the shortness of the period of record, some doubt may arise as to the validity of extrapolation from these curves, and as to whether the three years chosen were representative (i.e., that they represent average conditions, and not three years of abnormally high or low waves). In a similar report, on Lake Michigan, (6) hindcasts were made for one station for a period of 12 years (1939-1950) for all storms which were expected to give waves greater than 8 feet. The points determined were compared to those determined from the three-year data. These points fitted a straight line curve very closely and, though the points mostly lay slightly above those determined from the three-year data, the curve was not greatly different from that which had been drawn from the three-year data. Observations of the "average maximum" wave were obtained at this same station by the Milwaukee lightship over the period 10 April 1931 to 28 September 1932 (7) and these points were also compared to those hindcast. Although the exact correspondence between the significant waves hindcast and the "average maximum" waves observed is not known, values should be closely comparable -- and although the observed points lay somewhat higher for the lower waves, agreement was good for the higher waves. The comparison of these various points is shown in Figure 2.

Although these comparisons were made for a station on Lake Michigan, rather than one on Lake Erie, it is thought that the same degree of accuracy should be observed on Lake Erie, and therefore reasonable confidence can be put in the curves shown, at least for values of the waves occurring with frequencies less than about once in 10 years (with the possible exception of Station A).

Although for structural design purposes the important factor is the size of the maximum probable wave (within a certain time period), for computations involving sand movement and littoral drift, a more desirable parameter would be some averaged factor including within it the effect of both height and period, the variation of these parameters, and the duration that waves of each particular category exist. Present day knowledge indicates that sand movement by wave action is best correlated with the amount of energy transmitted forward (and eventually on to the beach) by the waves. The total energy per unit width in each wave is, in deep water

$$E_o = \frac{wLH^2}{8} \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right] = \frac{wg}{16\pi} H^2 T^2 \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right]$$



where w = unit weight of water = 62.4 lbs./cu.ft.

g = acceleration due to gravity = 32.2 ft./sec/sec.

H = wave height (ft.)

T = wave period (sec.)

L = wave length (ft.)

One-half of this energy is transmitted forward from deep water toward the shore, and it is this amount of energy that eventually reaches the shore line. The total energy transmitted forward in any given period of time (E_T) is then $E_0/2$ times the number of waves occurring in that period of time, and

$$E_T = \frac{E_0}{2} \times \frac{(3600t)}{T} = 7.195 \times 10^4 H^2 T t \left[1 - 4.93 \left(\frac{H}{L} \right)^2 \right]$$

where t is the duration of the waves in hours. If some particular time interval (say, one month) is considered during which waves of varying height and period pass a given point toward shore, then the heights and associated periods may be tabulated (as in Tables A-1 through D-1), and there will be n groups. If the height of the i th group is represented by its class mark H_i , and the wave period in that group denoted by T_i , and the duration of the group by t_i , then the total amount of energy transmitted forward during the entire time interval is

$$E_T = E_{T1} + E_{T2} + E_{T3} + \dots + E_{Ti} + \dots + E_{Tn}$$

and

$$E_T = 7.195 \times 10^4 \sum_{i=1}^{i=n} H_i^2 T_i t_i \left[1 - 4.93 \left(\frac{H_i}{L_i} \right)^2 \right]$$

Tables A-4 through D-4 show a tabulation of the average energy transmitted forward from deep water toward the shore during the average ice-free period in each category of height, period, and direction. Thus, for Station B, waves of 1 to 2-foot height and 2 to 3-second period from the north may be expected to transmit forward toward the shore 4724×10^4 foot-pounds per foot of wave crest each ice-free period. Waves of 1 to 2-foot height and 2 to 3-second period (all directions) would be expected to send forward $21,619 \times 10^4$ foot-pounds per foot of wave crest each ice-free period; waves of 1 to 2-foot height from the north (all periods) would be expected to send forward 6165×10^4 foot-pounds of energy per foot of wave crest; and waves of 1 to 2-foot height (all periods and directions) would be expected to transmit toward the shore $29,921 \times 10^4$ foot-pounds of energy per foot of wave crest each ice-free period. Tables A-5 through D-5 show a similar tabulation for the average full year. Since the values in Tables A-1 through D-1 represent significant wave height and period, these energy values are those obtained if the

wave system is uniform and consists only of waves of significant height and period. Wave trains in nature are, however, exceedingly irregular, and have less energy than that determined by the significant wave concept. The relationship between the actual energy contained in any given wave train and that computed from the significant wave has been examined somewhat by personnel at Scripps Institution of Oceanography (8) and more recently by Barber (9) and Darbyshire (10), and has been found to be very nearly a constant ratio (on the order of 0.58). The energies given, therefore, may be considered to be the true value of the energy multiplied by some nearly constant value, and hence can be used to determine quite accurately ratios of energies from different directions. These latter represent very closely the ratios of the drift-producing forces. Summations of these energies for each direction and period grouping are shown in Figures A-4 through D-4.

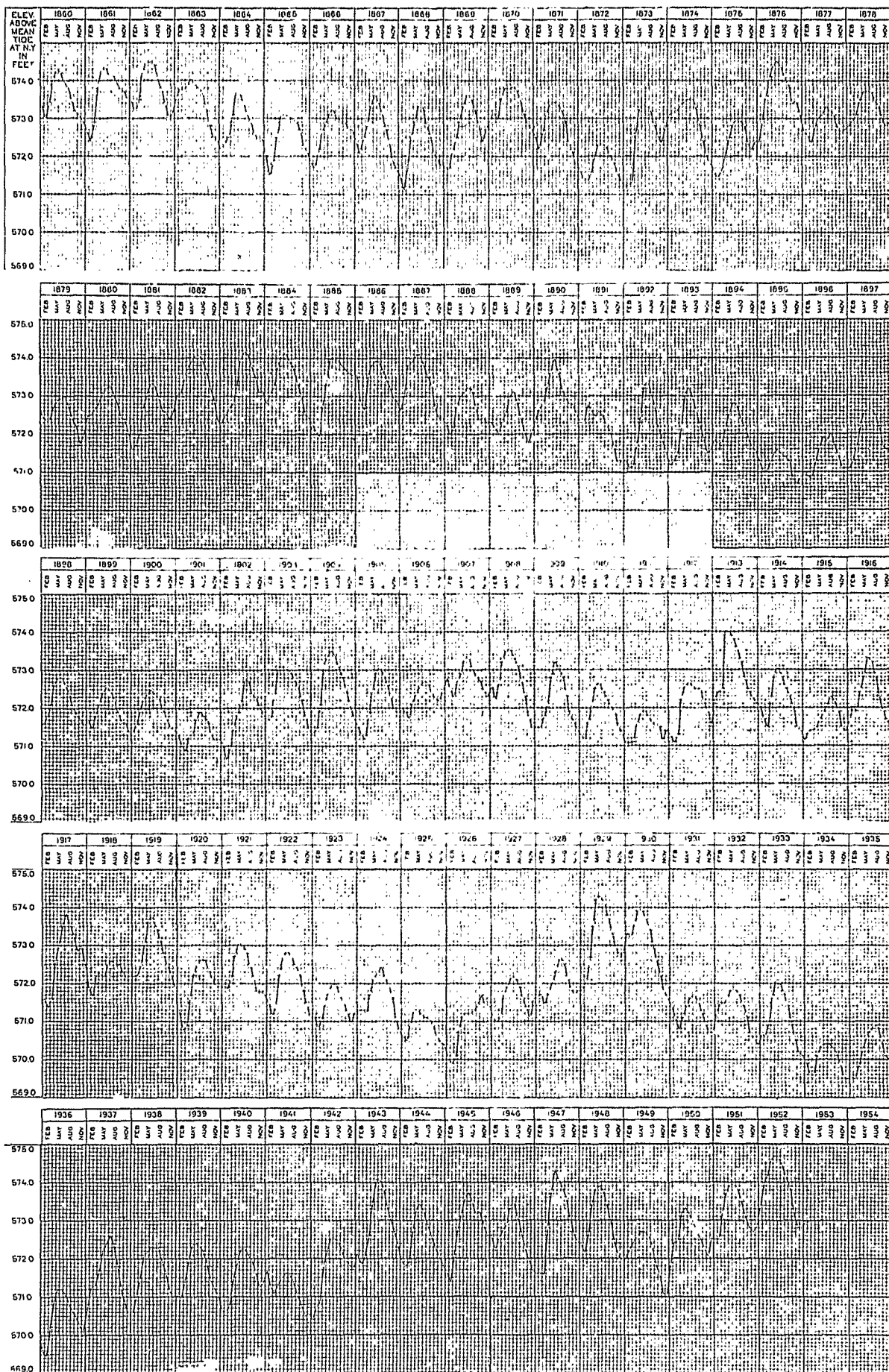
All the wave data given in the tables refer to deep water conditions -- that is, depths greater than one-half the wave length. As such, interpolation between stations to obtain values for other points along the shore is quite valid, and it is felt that adequate deep water hindcast values may be thus obtained for all points on the shores of Lake Erie in the United States.

Although the deep water data are useful for many types of design work, particularly for preliminary considerations, it is usually the in-shore, shallow water data which are of most interest. These data may be readily obtained from the deep water data through the use of refraction diagrams. A partial example for Ludington Harbor on Lake Michigan has been worked out and presented in the publication dealing with wave statistics on that lake (6), to which the reader may refer if unacquainted with the techniques involved.

LAKE LEVELS*

The levels of the Great Lakes fluctuate from year to year and from month to month during each year, depending upon the volume of water in the lakes. Continuous records of lake levels have been kept by the Corps of Engineers since 1860. A summary of these records for Lake Erie is shown in Figure 3, which is a hydrograph of the monthly average levels from 1860 to date. The monthly average was chosen to eliminate the effects of short period barometric or wind induced changes in stage. For Lake Erie, the average level during the period of record (1860-1952) was 572.31 feet (above mean tide at New York, 1935 Datum), the highest one-month average of 574.60 occurring in April 1952 and the lowest of 569.43 occurring in February 1936. The difference between the highest and lowest monthly average levels is thus 5.17 feet, although the seasonal variation usually ranges

*Much of the following data on lake levels is taken almost verbatim from an unpublished report by the Great Lakes Division, Corps of Engineers, entitled "Preliminary Examination Report on Property Damage on the Great Lakes" issued in June 1952(11).



MONTHLY MEAN WATER LEVELS OF LAKE ERIE
DATA COMPILED BY U.S. LAKE SURVEY, CORPS OF ENGINEERS

FIG. 3

between one and two feet (having an average range of 1.6 feet). The greatest range in level in a single season between the high and low month was 2.8 feet, and the lowest was 0.5 feet. The usual pattern of seasonal variation shows high levels in the summer and low levels in late winter (Figure 4). The highest monthly average level is usually reached in June and the lowest in February, though occasionally seasonal fluctuations have departed greatly from this pattern.

Figure 5 shows the percentage of time that the seasonal high average monthly level reached various elevations on Lake Erie for single, two, three, four, and five consecutive years. For example, it shows that the high monthly average each year reached elevation 571 feet or higher 98 percent of the time, reached elevation 572 feet or higher 89 percent of the time, reached elevation 574 feet or higher 14 percent of the time, and so on. It also shows that while the high monthly average level reached 572 feet or higher 89 percent of the time in single years, it reached this elevation only 82 percent of the time in two consecutive years, only 75 percent of the time in three consecutive years, only 70 percent of the time in four consecutive years, and only 63 percent of the time in five consecutive years.

Superimposed on the long range and seasonal fluctuations resulting from the actual quantities of water present in the lake, are daily and even hourly fluctuations resulting from an unbalance or tilting of the lake surface. These are induced primarily by winds, though some have attempted to ascribe them to differential barometric pressures. Figure 6 is derived from data given in a report by the Great Lakes Division Engineer (11) and shows the frequency of occurrence of short period fluctuations at various gage sites on Lake Erie during the period of record. Short-period rises at intermediate points between gage sites depend upon local conditions, but reference to the figures for points in the vicinity will provide an indication of the rises to be expected.

It has been found (12,13) that, at least for shallow water areas, the rise in level due to wind stress may be predicted quite accurately by the formula

$$S = 1.165 \times 10^{-3} \frac{V^2 F}{D} N \cos \alpha$$

where S is the total set-up (difference in water surface elevations at the windward and leeward sides of the lake) in feet, F is the fetch length in statute miles, V is the average wind velocity over the fetch in miles per hour, D is the average depth in feet of that portion of the lake that is more or less contiguous to the fetch, α is the angle between the wind and the fetch, and N is a shape coefficient dependent on the planform and nearshore hydrography of the particular area. Though methods of computing N are available, unless the area is a very marked convergent bay, it is usually sufficient to assume values of $N = 1$. The actual rise in water surface elevation above still water level will be slightly greater than $S/2$ depending on the nearshore hydrography; an average value of 0.57 has been in general use, and is quite adequate. Although this formula has been checked quite adequately for shallow areas (experimental tanks, the Zuider-Zee, and Lake Okeechobee) extension to deeper waters, as Lake Erie, may be unwarranted, and it should be used with some caution.

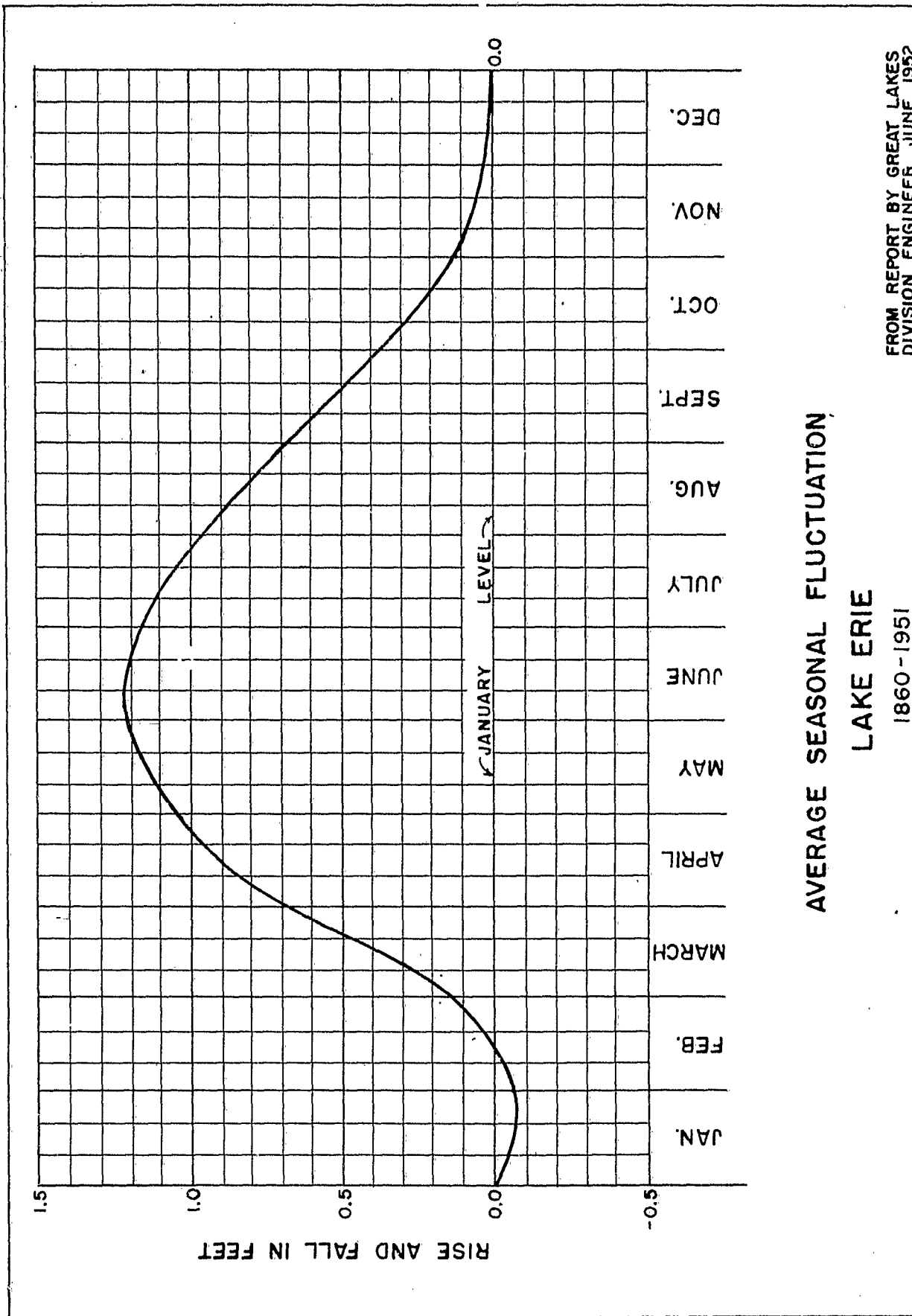
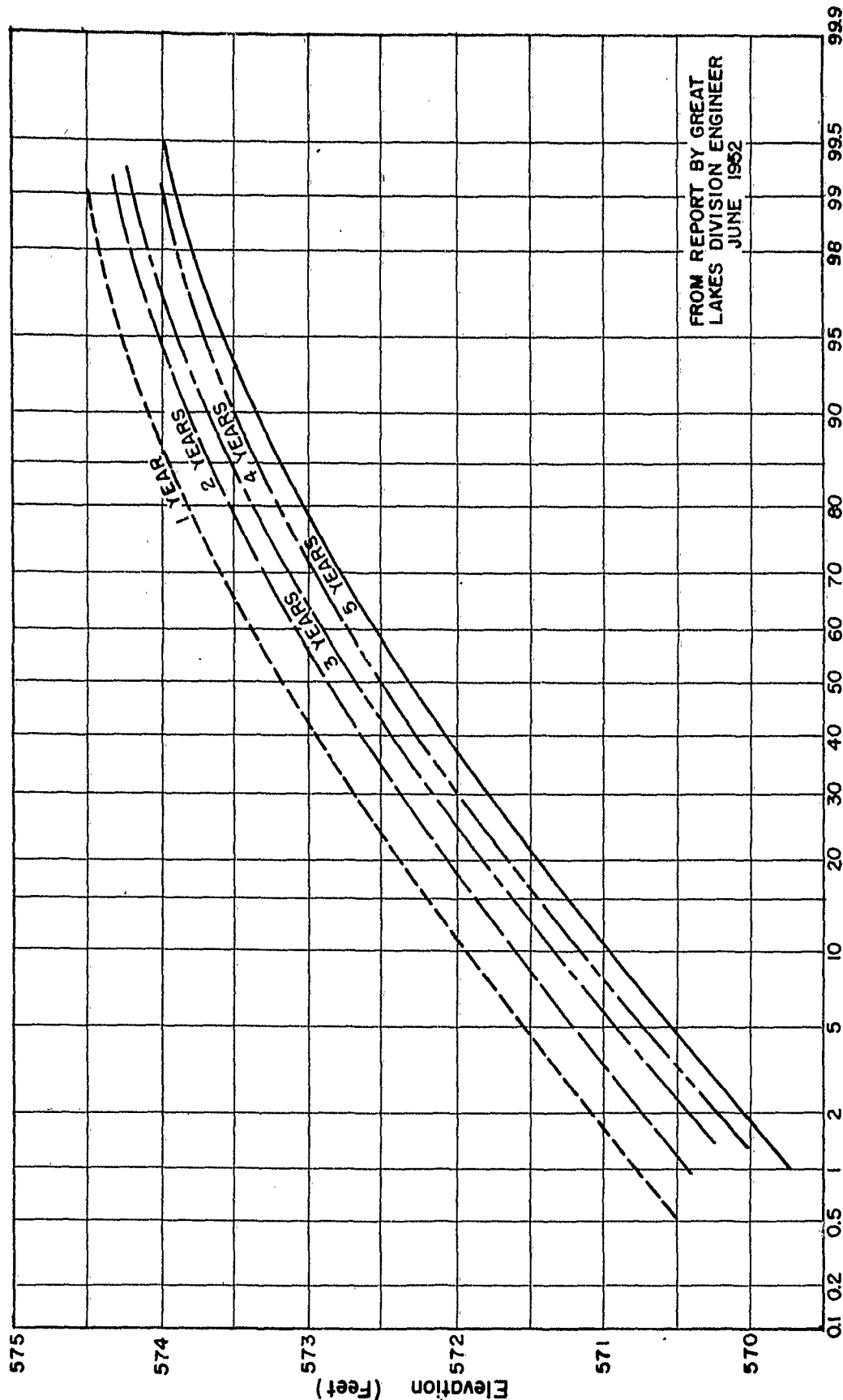


FIG. 4



Probability Equal To Or Less Than - %

OCCURRENCE OF ANNUAL MAXIMUM MONTHLY MEAN LAKE LEVEL
FOR 1, 2, 3, 4, & 5 CONSECUTIVE YEARS
LAKE ERIE 1860-1951

FIG. 5

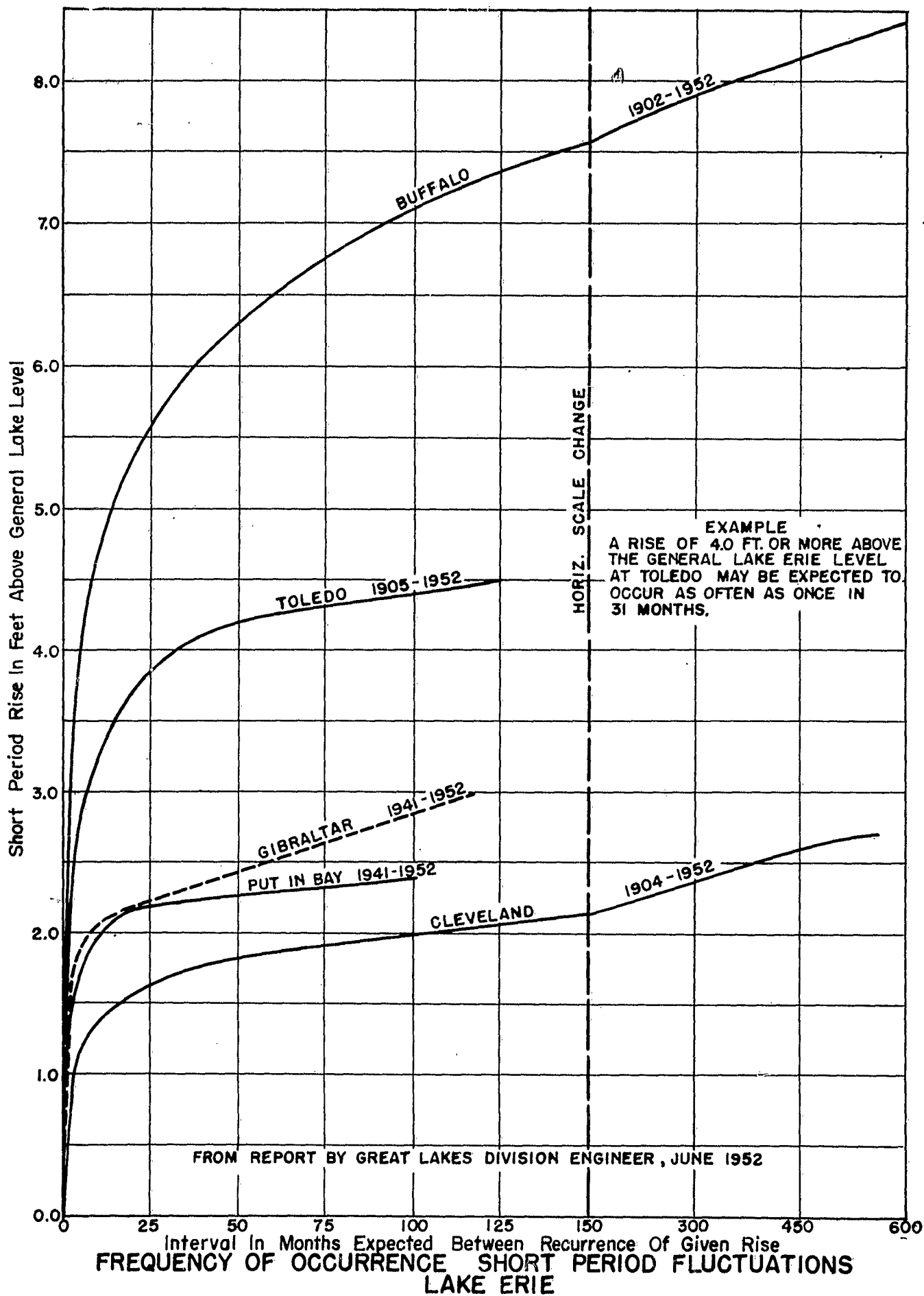


FIG. 6

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WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ERIE

APPENDIX A

WAVE STATISTICS

FOR

STATION A

MONROE, MICHIGAN

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
Duration given in hours. Height and period amininas Include lower value but not the upper.

JANUARY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				1-6 Seconds					
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
.5-1.0	NE	12	6	6	24														12	6	6	24					
	E		24	6	30															24	6	6	30				
	ESE		12	18	30		6	6	12											18	24	12	42				
	SE	6			6															6			6				
	SSE	6			6															6			6				
	Total	24	42	30	96		6	6	12										24	48	36	108					
1-2	NE	18			18	48	6	6	60										66	6	6	78					
	ENE					36			36											36			36				
	E					36			36	6	6	12								42	6	48					
	ESE					6	12	18												6	12	18					
	Total	18			18	48	30	162		6	6	12							66	90	36	192					
2-3	NE					12	6		18										12	6		18					
	E						6	6		18		18								18	6	24					
	ESE									6		6								6		6					
	SE									6		6									6		6				
	SSE							12	12													12	12				
	Total					12	6	18	36	30		30						12	36	18	66						
3-4	NE					6			6	6		6							6	6		12					
	ENE									6		6								6		6					
	E									12	6	18		6	6	12				18	12	30					
	ESE									6	6	12								6	6	12					
	Total					6		6		30	12	42		6	6	12				6	36	18	60				
4-5	NE																	6	6		6						
	ENE									6		6								6		6					
	Total									6		6						6	12		12						
	E									6		6								6		6					
	Total	42	42	30	114	66	96	54	216	12	66	18	96		6	6	12	6		6	126	210	108	444			
5-6	NE																										
	ENE									6		6								6		6					
	TOTAL	42	42	30	114	66	96	54	216	12	66	18	96		6	6	12	6		6	126	210	108	444			
	CALM																										
	TOTAL HOURS																										

FEBRUARY.																																														
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				Seconds				1-5 Seconds																								
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total																					
.5-1	NE	24	6	6	36																	24	6	6	36																					
	ENE	6	12	6	24																	6	12	6	24																					
	E		6		6	6			6													6	6		12																					
	ESE	12			12	6			6													18			18																					
	SE	6		12	18																	6			12																					
1-2	Total	48	24	24	96	12			12													60	24	24	108																					
	NE	36			36	12	6	12	30													48	6	12	66																					
	ENE	6			6	6	12	30	48													12	12	30	54																					
	E					24	18	12	54			6	6									24	18	18	60																					
	ESE					18	6	24														18	6	6	24																					
2-3	SE		6		6	6		6	12													6	6	6	18																					
	Total	42	6		48	48	54	66	168			6	6									90	60	72	222																					
	NE					6		6														6			6																					
	E						6	6	18		6	24										18		12	30																					
	ESE								6		6	12										6		6	12																					
3-4	SE					12		6	18			6	6									12		12	24																					
	Total					18		12	30	24		18	42									42		30	72																					
	NE					12			12													12			12																					
	ENE								12		6	18			6	6						12		12	24																					
	E										6	6												6	6																					
4-5	ESE										6	6										6		6	6																					
	SE											6	6									6		6	6																					
	Total					12			12	18		18	36			6	6					30		24	54																					
	NE											6	6											6	6																					
	ENE											6	6									6		6	6																					
5-6	E											12	12	6			6					6		12	18																					
	Total											12	12	6			6					6		12	18																					
	E																6							6	6																					
	Total	90	30	24	144	90	54	78	222	42		54	96	6		12	18					228	84	168	480																					
	CALM																																													
TOTAL HOURS																																														
																																											</			

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
Duration given in hours. Height and period groupings include lower value but not the upper.
MARCH

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	NE	6			6																	6			6
	ENE			6	6			6	6															12	12
	ESE	12		6	18																	12		6	18
	SE	6			6																	6			6
	TOTAL	24		12	36			6	6													24		18	42
1-2	NE	12	6		18	42	6	12	60													54	12	12	78
	ENE					6	6	36	48													6	6	36	48
	E									6			6									6			6
	ESE	6			6	6	12	12	30	12			12									24	12	12	48
	TOTAL	18	6		24	66	24	66	156	18			18									102	30	66	198
2-3	NE	6			6	30		6	36													36		6	42
	ENE					18			18				6	6								18		6	24
	E					6	6		12	12	18		30									18	24		42
	ESE												6	6										6	6
	TOTAL	6			6	54	6	6	66	18	18	18	54									78	24	24	126
3-4	NE					36			36	6			6									42			42
	ENE							6	6				12	12										18	18
	E									6			6										6		6
	ESE							12	12				6										6	12	18
	TOTAL					36		18	54	6	18	24	48									42	18	42	102
4-5	NE									6			6	12								6			12
	ENE									6	6	12											6	6	12
	E									6			6			6	6						6	6	12
	ESE												6	6										6	6
	TOTAL									6	12	18	36			6	6					6	12	24	42
5-6	NE									18			18									18			18
	ENE									6			6									6			6
	E									6			6										6		6
	ESE																								
	TOTAL									30			30									30			30
TOTAL		48	6	12	66	156	30	96	282	48	78	60	186		6	6						252	114	174	540
CALM																						432	648	576	1656
TOTAL HOURS																						744	744	744	2232

APRIL

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	ENE	18			18	12			12													30			30
	E	6			6	6			6													12			12
	ESE		12		12	6			6													6	12		18
	SE			6	6																		6		6
	TOTAL	24	12	6	42	24			24													48	12	6	66
1-2	NE					6			6														6		6
	ENE					30			30	6			6									36		12	48
	E						12		12		6		6										18		18
	ESE					6	24		30	18			18									24	24		48
	TOTAL					36	36	18	90	24	6		30									60	42	18	120
2-3	NE												6	6									6		6
	ENE						6	6	12				6	6									6	12	18
	E												18	18										18	18
	ESE					6			6	6			6	12								12		6	18
	TOTAL					6	6	6	18	6			36	42								12	6	42	60
3-4	ENE									18			6	24	6		6					24		6	30
	E										12		6	18									12		18
	ESE											12	12										12		12
	TOTAL									18	12	24	54	6		6						24	12	24	60
4-5	E											18	18											18	18
	ESE												6	6										6	6
	E															6	6								
	TOTAL															6	6								
5-6	NE																								
	ENE																								
	E																								
	ESE																								
	TOTAL																								
6-7	NE																								
	ENE																								
	E																								
	ESE																								
	TOTAL																								
TOTAL		24	12	6	42	66	42	24	132	48	18	84	150	6		6	12					144	72	120	336
CALM																						576	648	620	1844
TOTAL HOURS																						720	720	720	2160

TABLE A-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN

Duration given in hours. Height and period groupings include lower value but not the upper.

MAY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NE	12			12													12			12
	ENE		12		12														12		12
	ESE	12		6	18													12		6	18
	SE	12			12													12			12
	Total	36	12	6	54													36	12	6	54
1-2	ENE	24			24	24			24									48			48
	E					24	6	6	36									24	6	6	36
	ESE						18		18			6	6						18	6	24
	SE					6	6	30	42									6	6	30	42
	SSE	6			6	18			18									24			24
2-3	Total	30			30	72	30	36	138			6	6					102	30	42	174
	ENE					12	6	12	30			6	6					12	6	18	36
	E							12	12			12	12			6	6			30	30
	ESE							18	18	6	12		18					6	12	18	36
	Total					12	6	42	60	6	12	18	36			6	6	18	18	66	102
3-4	NE									12			12					12			12
	ENE							6	6											6	6
	E							6	6											6	6
	Total							12	12	12			12					12		12	24
	E											6	6			12	12			18	18
4-5	ESE									6			6					6			6
	Total									6		6	12			12	12			18	24
	Total	66	12	6	84	84	36	90	210	24	12	30	66			18	18	174	60	144	378
	CALM																	570	684	600	1854
	TOTAL HOURS																	744	744	744	2232

JUNE

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	ENE	6	12	6	24		6		6					6	18	6	30
	E			6	6			12	12								18
	ESE		6	6	12	6			6					6	6	6	18
	SE			6	6			12	12							18	18
	SSE		6	6	12			6	6						6	12	18
1-2	Total	6	24	30	60	6	6	30	42					12	30	60	102
	NE	12			12	24	42		66		12		12	36	54		90
	ENE	6			6	36	18		54					42	18		60
	E					6	12	12	30			12	12	6	12	24	42
	ESE		12		12	12		24	36					12	12	24	48
2-3	SE					6	6	30	42					6	6	30	42
	Total	18	12		30	84	78	66	228		12	12	24	102	102	78	282
	NE					6			6					6			6
	ENE									6				6	6		6
	E									18	6		24	18	6		24
3-4	ESE						6		6	6	12		18	6	18		24
	Total					6	6	12	30	30	18		48	36	24		60
	ESE									6			6	6			6
	Total	24	36	30	90	96	90	96	282	36	30	12	78	156	156	138	450
	CALM													564	564	582	1710
	TOTAL HOURS													720	720	720	2160

TABLE A-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN

Duration given in hours. Height and period groupings include lower value but not the upper.

JULY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NE		6		6		6		6						12		12
	E	6	6		12									6	6		12
	ESE	6		6	12	6			6					12		6	18
	SE	12	12		24	6	6		12					18	18		36
	SSE	12			12									12			12
1-2	Total	36	24	6	66	12	12		24					48	36	6	90
	NE		6		6	24			24					24	6		30
	ENE	6	12		18	6	18		24					12	30		42
	E		6		6	6	6	12	24	6			6	12	12	12	36
	ESE		6		6	24	18	12	54					24	24	12	60
2-3	SE	6	6	12	24	24			24					30	6	12	48
	SSE	6			6	6			6					12			12
	Total	18	36	12	66	90	42	24	156	6			6	114	78	36	228
	NE					6			6					6			6
	ENE					6	6		12		12		12	6	18		24
3-4	E						12		12	6			6	6	12		18
	ESE									6			6		6		6
	Total					12	18		30	6	18		24	18	36		54
	ENE					6			6					6			6
	E										6		6		6		6
4-5	Total					6			6		6		6	6	6		12
	NE										6		6		6		6
	ENE																
	E																
	Total																
5-6	NE											12	12			12	12
	Total	54	60	18	132	120	72	24	216	12	30	12	54	186	162	54	402
	NE																
	ENE																
	Total																
CALM	NE																
	ENE																
	E																
	ESE																
	Total																
TOTAL HOURS	NE																
	ENE																
	E																
	ESE																
	Total																

AUGUST

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NE	36			36	6			6					42			42
	ENE	12	6		18	6			6					18	6		24
	E	18			18	6		18	24					24		18	42
	ESE		6	24	30			24	24						6	48	54
	SE			6	6			12	12							18	18
1-2	SSE	12			12									12			12
	Total	78	12	30	120	18		54	72					96	12	84	192
	NE	12	18		30	24	12	6	42					36	30	6	72
	ENE					12	24	18	54					12	24	18	54
	E						12	12	24						12	12	24
2-3	ESE					6	6	6	18					6	6	6	18
	SE					6	6	12	24					6	6	12	24
	Total	12	18		30	48	60	54	162					60	78	54	192
	NE					12	6		18					12	6		18
	E						12		12						12		12
3-4	ESE									6			6	6			6
	Total					12	18		30	6			6	18	18		36
	NE									6			6	6			6
	Total	90	30	30	150	78	78	108	264	12			12	180	108	138	426
	NE																
CALM	NE																
	ENE																
	E																
	ESE																
	Total																
TOTAL HOURS	NE																
	ENE																
	E																
	ESE																
	Total																

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
Duration given in hours. Height and period groupings include lower value but not the upper.
SEPTEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				1-6 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	ENE							18	18															18	18
	E	18	12	6	36	6			6	18			18									42	12	6	60
	ESE		6	6	12	24	6		30													24	12	6	42
	SE		12		12	6	6		12													6	18		24
	SSE			12	12																			12	12
1-2	Total	18	30	24	72	36	12	18	66	18			18									72	42	42	156
	NE			6	6	18			18													18		6	24
	ENE					48		24	72													48		24	72
	E					66	18		84	12			12									78	18		96
	ESE					6	30		36	6			6									12	30		42
2-3	SE					6	12	6	24													6	12	6	24
	Total			6	6	144	60	30	234	18			18									162	60	36	258
	NE							12	12															12	12
	ENE					18		6	24													18		6	24
	E						6	6	6				6									6		6	12
3-4	ESE					6			6				6									12			12
	Total					24		24	48	12			12									36		24	60
	NE												6	6										6	6
	E															6	6							6	6
	Total												6	6			6	6						12	12
4-5	NE												12	12										12	12
	E												12	12										12	12
	Total												24	24										24	24
	NE												12	12										12	12
	E																18	18						18	18
5-6	Total												12	12			18	18						30	30
	E																6	6						12	12
	6-7												6	6										12	12
	7-8																	6	6					12	12
	8-9																							6	6
9-10	ENE																6	6						6	6
	E																6	6						6	6
	Total																12	12						12	12
	9-10																							12	12
	Total	18	30	30	78	204	72	72	348	48			48	96			54	54			6	6	270	102	210
CALM HOURS																						450			
TOTAL HOURS																						720			

OCTOBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				Seconds				1-4 Seconds			
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
.5-1	NE		12	6	18														12	6	18
	ENE		6		6		6	6	12										12	6	18
	ESE		12	6	18	6		6	12									6	12	12	30
	SE	12		12	24	6		18	24									18		30	48
	SSE	6			6													6			6
1-2	Total	18	30	24	72	12	6	30	48									30	36	54	120
	NE		30		30	6	18	30	54									6	48	30	84
	ENE		6		6	24	12	12	48									24	18	12	54
	E		6		6	6	6	18	30		6	6	12					6	18	24	48
	ESE	6			6	30	12	6	48	6	6		12					42	18	6	66
2-3	SE					36	12	12	60									36	12	12	60
	SSE					12		6	18									12		6	18
	Total	6	42		48	114	60	84	258	6	12	6	24					126	114	90	330
	NE					6		6	12									6		6	12
	ESE							6	6		6		6						6	6	12
3-4	SE					6		12	18	6			6					12		12	24
	Total					12		24	36	6	6		12					18	6	24	48
	NE							12	12											12	12
	ESE											6	6						6		6
	4-5	TOTAL	24	72	24	120	138	66	150	354	12	24	6	42					174	162	180
	CALM																	570	502	567	1711
	TOTAL HOURS																	720	720	720	2160

TABLE A-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
Duration given in hours. Height and period groupings include lower value but not the upper.
NOVEMBER

NOVEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				7-5 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
5-1	NE	6			6													6			6	
	E		6		6														6		6	
	ESE	6			6	12			12									18			18	
	SE			12	12															12	12	
	TOTAL	12	6	12	30	12			12									24	6	12	42	
1-2	ENE							6	6											6	6	
	E					12	12		24									12	12		24	
	ESE					18	6	18	42	6			6					24	6	18	48	
	SE					18			18									18			18	
	TOTAL					48	18	36	102	6			6					54	18	36	108	
2-3	ENE									6			6					6			6	
	E						6		6										6		6	
	ESE					12			12	12			12					24			24	
	SE							12	12			12	12							24	24	
	TOTAL					12	6	12	30	18		12	30					30	6	24	60	
3-4	E									6			6						6		6	
	ESE									12			12						12		12	
	SE					6			6	6			6					12			12	
	TOTAL					6			6	6	18		24					12	18		30	
	NE									6			6						6		6	
4-5	E									6			6						6		6	
	ESE										6	6								6	6	
	SE										6	6								6	6	
	TOTAL										12	6	18							12	18	
	5-6																6	6			6	
5-6	TOTAL	12	6	12	30	78	24	48	150	30	30	18	78				6	6	120	60	84	264
	CALM																		648	648	648	1944
	TOTAL HOURS																		720	720	720	2160

DECEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-6 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	E		6		6		6		6													12			12
	ESE	6	6	12	24																	6	6	12	24
	SE		6	6	12			6	6														6	12	18
	TOTAL	6	18	18	42		6	6	12													6	24	24	54
	NE							6	6														6		6
1-2	ENE			6	6	6	6		12	6			6									12	6	6	24
	E					18	48	6	72		12		12									18	60	6	84
	ESE						48		48														48		48
	SE						6		6														6		6
	TOTAL			6	6	24	120	6	150	6	12		18									30	132	12	174
2-3	ENE					6		6	12													6		6	12
	E									12			12										12		12
	SE						6		6		6		6										12		12
	TOTAL					6	6	6	18		18		18									6	24	6	36
	ESE							6	6			12	12			6	6							24	24
3-4	SE										12		12										12		12
	TOTAL						6	6		12	12	24											12	24	36
	E													6	6									12	12
	ESE													6	6									6	6
	TOTAL													12	12									18	18
7-8	ESE													6	6									6	6
	SE													6	6									6	6
	TOTAL													12	12									12	12
	E																					6	6		6
	TOTAL	6	18	24	48	30	132	24	186	6	42	12	60			30	30					12	12	42	192
8-9	E																							6	6
	TOTAL	6	18	24	48	30	132	24	186	6	42	12	60			30	30					12	12	42	192
	CALM																					702	552	672	1926
	TOTAL HOURS																					720	720	720	2160

TABLE A-2
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
FULL YEAR

Duration given in hours. Height and period groupings include lower value but not the upper.

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NE	96	30	18	144	6	6		12													102	36	18	156
	ENE	42	48	18	108	18	12	30	60													60	60	48	168
	E	48	60	18	126	24	6	30	60	18			18									90	66	48	204
	ESE	54	60	90	204	66	12	36	114													120	72	126	318
	SE	54	30	60	144	18	12	48	78													72	42	108	222
	SSE	36	6	18	60			6	6													36	6	24	66
1-2	Total	330	234	222	786	132	48	150	330	18			18									480	282	372	1134
	NE	90	60	6	156	198	96	72	366		12		12									288	168	78	534
	ENE	42	18	6	66	198	132	138	468	12			12									252	150	144	546
	E		12		12	162	186	78	426	24	30	30	84									186	228	108	522
	ESE	12	18		30	108	198	96	402	48	6	6	60									168	222	102	492
	SE	6	12	12	30	120	48	108	276													126	60	120	306
2-3	SSE	12			12	36	6	24	66													48	6	24	78
	Total	162	120	24	306	822	666	516	2004	84	48	36	168									1068	834	576	2478
	NE	6			6	78	12	24	114				6	6								84	12	30	126
	ENE					60	18	30	108	12	12	18	42									72	30	48	150
	E					6	36	30	72	60	54	72	150				6	6				66	90	72	228
	ESE					24	6	24	54	48	42	18	108									72	48	42	162
3-4	SE					18	6	30	54	12	12	24	48									30	18	54	102
	SSE							12	12															12	12
	Total	6			6	186	78	150	414	132	120	102	354				6	6				324	198	252	780
	NE					54		12	66	24	6	6	36									78	6	18	102
	ENE					6		12	18	30	6	24	60	6		6	12					42	6	42	90
	E							6	6		42	18	60		6	12	18						48	36	84
4-5	ESE							18	18	12	24	30	66			6	6					12	24	54	90
	SE					6		6	6	6	18	18	42									12	18	18	48
	SSE																								
	Total					66		48	114	72	96	96	264	6	6	24	36					144	102	168	414
	NE									6	12	24	42					6				6	12	12	24
	ENE									6	6	12	24									6	6	12	24
5-6	E										12	36	48	6		18	24					6	12	54	72
	ESE									6	6	12	24									6	6	12	24
	Total									18	36	84	138	6		18	24	6				6	30	36	102
	NE										18	24	42										18	24	42
	ENE									6	6		12									6	6		12
	E										6	6	12										6	30	36
6-7	ESE										6	6				24	24						6	6	
	Total									6	30	30	66			30	30					6	30	60	96
	E											6	6			18	18			6	6			30	30
	ESE															6	6							6	6
	SE															6	6							6	6
	Total															18	18					6	6	24	24
7-8	E																					12	12		
	ENE															6	6							6	6
	E															6	6							6	6
	ESE															6	6							6	6
	SE															6	6							6	6
	Total															18	18					6	6	24	24
8-9	E																					12	12		
	ENE															6	6							6	6
	E															6	6							6	6
	ESE															6	6							6	6
	SE															6	6							6	6
	Total															12	12					6	6	24	24
9-10	E																					12	12		
	ENE															6	6							6	6
	E															6	6							6	6
	ESE															6	6							6	6
	SE															6	6							6	6
	Total															12	12					6	6	24	24
TOTAL		498	354	246	1098	1206	792	864	2862	330	330	354	1014	12	6	132	150	6		24	30	2052	1482	1620	5154
CALM TOTAL HOURS																						6732	7278	7140	21150
																						8784	8740	8760	26304

TABLE A-3
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Duration given in hours. Height and period groupings include lower value but not the upper.

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				1-6 Seconds					
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
5-1	NE	54	18	6	78	6	6		12												160	24	6	90			
	ENE	36	36	6	78	18	12	24	54												54	48	30	132			
	E	48	24	12	84	18		30	48	18			18								84	24	42	150			
	ESE	24	42	54	120	60	6	30	96												84	48	84	216			
	SE	36	24	42	102	18	12	42	72												54	36	84	174			
	SSE	30	6	18	54			6	6												30	6	24	60			
	Total	228	150	138	516	120	36	132	288	18			18								366	186	270	822			
1-2	NE	24	54	6	84	96	72	42	210		12		12								120	138	48	306			
	ENE	36	18		54	180	72	72	324	6			6								222	90	72	384			
	E		12		12	120	84	60	264	18	12	18	48								138	108	78	324			
	ESE	6	18		24	102	114	66	282	36	6	6	48								144	138	72	354			
	SE	6	6	12	24	102	42	90	234												108	48	102	258			
	SSE	12			12	36		18	54												48		18	66			
	Total	84	108	18	210	636	384	348	1368	60	30	24	114								780	522	390	1692			
2-3	NE					30	6	18	54				6	6							30	6	24	60			
	ENE					36	18	24	78	12	12	12	36								48	30	36	114			
	E					30	18	48	96	30	6	30	66			6	6				30	36	54	120			
	ESE					24	6	24	54	42	36	6	84								66	42	30	138			
	SE					6		24	30	6		12	18								12		36	48			
	Total					96	60	108	264	90	54	66	210			6	6				186	114	180	480			
3-4	NE							12	12	18		6	24								18		18	36			
	ENE					6		6	12	18		6	24	6			6				30		12	42			
	E						6	6			24	6	30				6	6				24	18	42			
	ESE									6	12	12	30								6	12	12	30			
	SE					6		6	6	6			6								12			12			
	Total					12		24	36	48	36	30	114	6		6	12				66	36	60	162			
4-5	NE										12	12	24									12	12	24			
	E										6	36	42			12	12				6	48	54				
	ESE									6	6	6	18							6	6	6	18				
	Total									6	24	54	84			12	12				6	24	66	96			
5-6	NE											24	24										24	24			
	E										6	6				18	18						24	24			
	ESE															6	6						6	6			
	Total											30	30			24	24						54	54			
6-7	E										6	6				12	12						18	18			
7-8	E														6	6			6	6			12	12			
8-9	E														6	6							6	6			
9-10	ENE														6	6							6	6			
	E														6	6							6	6			
	Total														12	12							12	12			
TOTAL		312	258	156	726	864	480	612	1956	222	144	210	576	6		84	90			6	6	1404	882	1068	3354		
CALM																								1152	4974	4788	14244
TOTAL HOURS																								5856	5806	5806	17568

TABLE A-4

STATISTICAL ENERGY DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$,
Height and period groupings include lower value but not the upper

Height (feet)	Period					
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds
5-1	NE	155	40			195
	ENE	155	182			337
	E	166	161	85		412
	ESE	238	324			562
	SE	202	242			444
	SSE	107	20			127
	Total	1023	969	85		2077
1-2	NE	623	2802	226		3651
	ENE	400	4324	113		4837
	E	89	3523	904		4516
	ESE	178	3763	904		4845
	SE	178	3123			3301
	SSE	89	721			810
	Total	1557	18256	2147		21960
2-3	NE		1963	312		2275
	ENE		2835	1874		4709
	E		1745	3436	404	5585
	ESE		1963	4373		6336
	SE		1091	937		2028
	Total		9597	10932	404	20933
3-4	NE		829	2430		3259
	ENE		829	2430	789	4048
	E		415	3038	789	4242
	ESE			3038		3038
	SE		415	608		1023
	Total		2488	11544	1578	15610
4-5	NE			3977		3977
	E			6959	2598	9557
	ESE			2983		2983
	Total			13919	2598	16517
5-6	NE			5864		5864
	E			1466	5795	7261
	ESE				1932	1932
	Total			7330	7727	15057
6-7	E			2016	5366	7382
7-8	E				3549	7950
8-9	E				4524	4524
9-10	E				5602	5602
	E				5602	5602
	Total				11204	11204
TOTAL		2580	31310	47973	36950	4401
						123214

TABLE A-5
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION A, MONROE, MICHIGAN
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$.
Height and period groupings include lower value but not the upper

Height (feet)	Period					
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds
5-1	NE	285	40			325
	ENE	214	202			416
	E	250	202	85		537
	ESE	404	383			787
	SE	285	262			547
	SSE	119	20			139
	Total	1557	1109	85		2751
1-2	NE	1157	4884	226		6267
	ENE	489	6245	226		6960
	E	89	5685	1582		7356
	ESE	222	5365	1130		6717
	SE	222	3683			3905
	SSE	89	881			970
	Total	2268	26743	3164		32175
2-3	NE		4144	312		4456
	ENE		3926	2186		6112
	E		2617	7808	404	10829
	ESE		1963	5622		7585
	SE		1963	2499		4462
	SSE		436			436
	Total		15049	18427	404	33880
3-4	NE		4562	3645		8207
	ENE		1244	6075	1578	8897
	E		415	6075	2366	8856
	ESE		1244	6683	789	8716
	SE		415	4253		4668
	Total		7880	26731	4733	39344
4-5	NE			6959		8551
	ENE			3977		3977
	E			7954	5196	13150
	ESE			3977		3977
	Total			22867	5196	29655
	NE			10262		10262
	ENE			2932		2932
5-6	E			2932	7727	10659
	ESE				1932	1932
	Total			16126	9659	25785
	E			2016	8049	13380
	ESE				2683	2683
	Total			2016	10732	16063
	E				3549	7950
6-7	ESE				3549	3549
	SE				3549	3549
	Total				10647	15048
	E				4524	10158
	ENE				5602	5602
	E				5602	5602
	Total				11204	11204
7-8	E					
	ENE					
	E					
	ESE					
	SE					
	Total					
	E					
8-9	E					
	ENE					
	E					
	ESE					
	SE					
	Total					
	E					
9-10	E					
	ENE					
	E					
	ESE					
	SE					
	Total					
	E					
TOTAL		3825	50781	89416	57099	14942
						216063

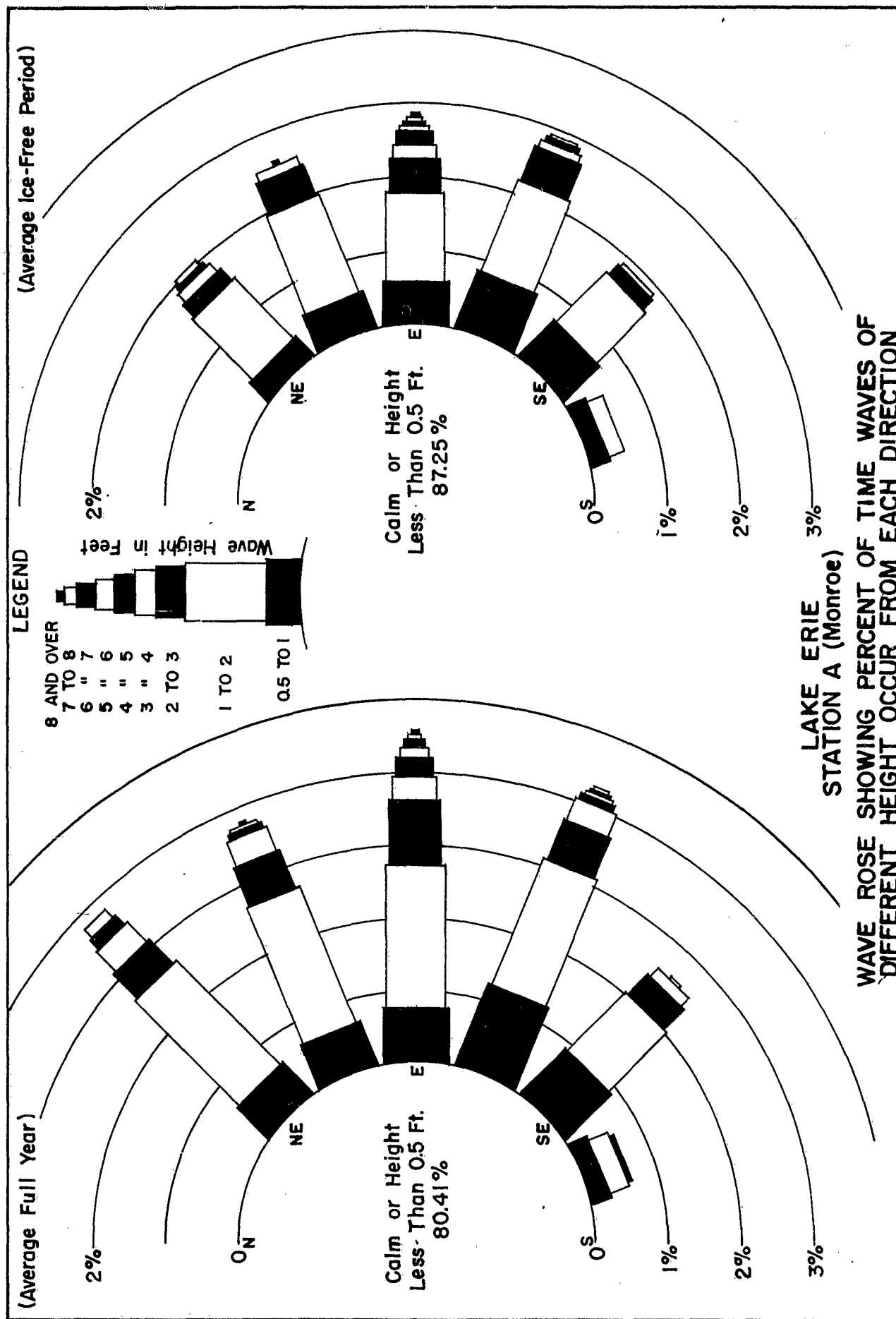


FIG. A-1

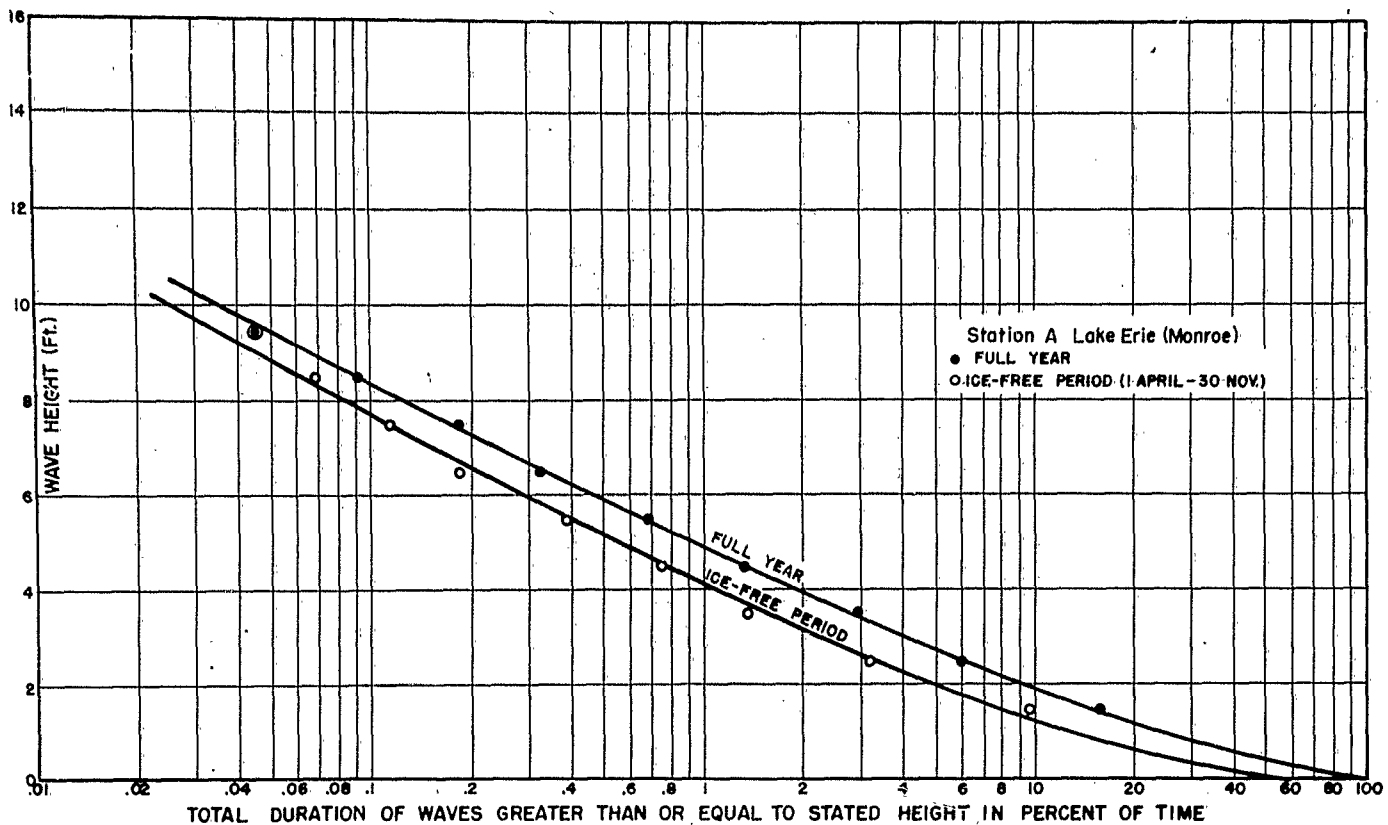


FIG. A-2

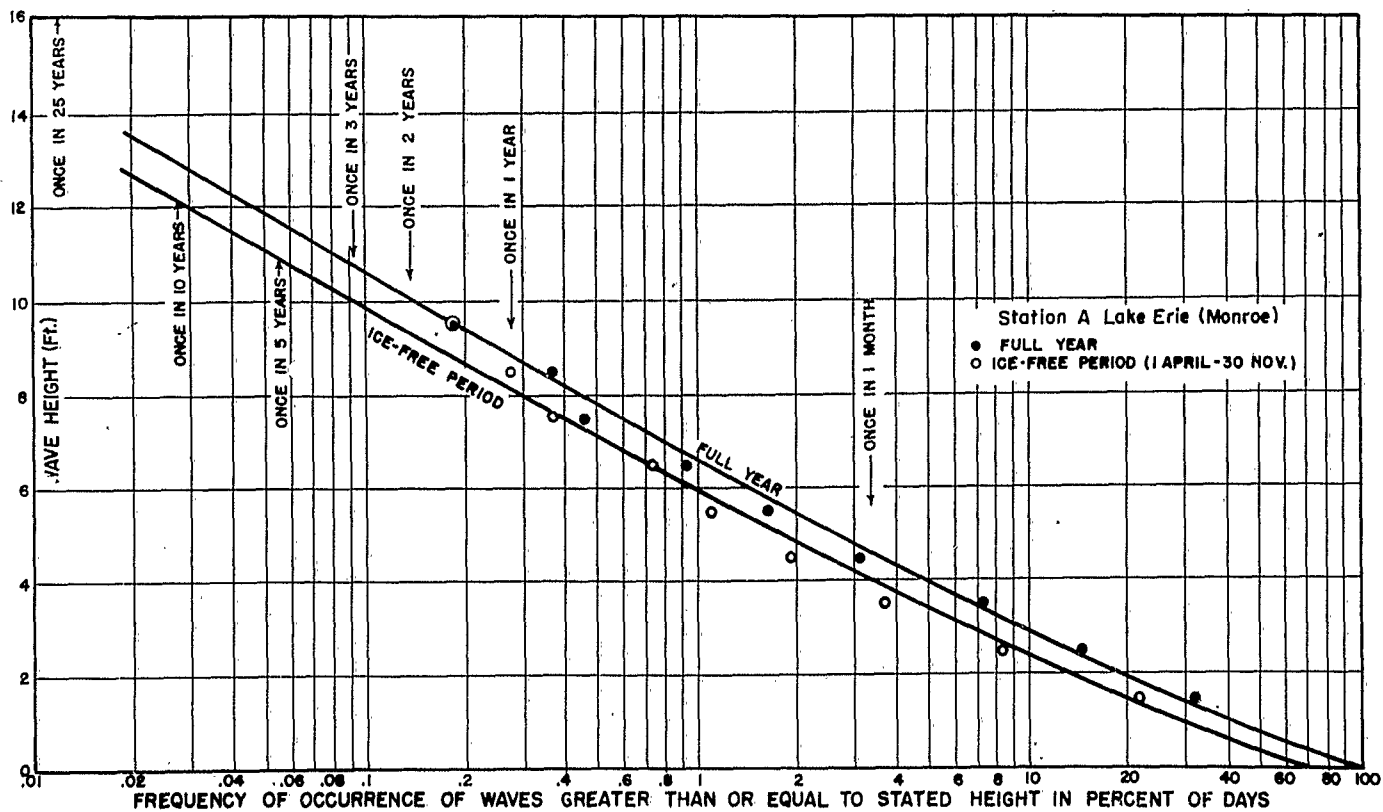
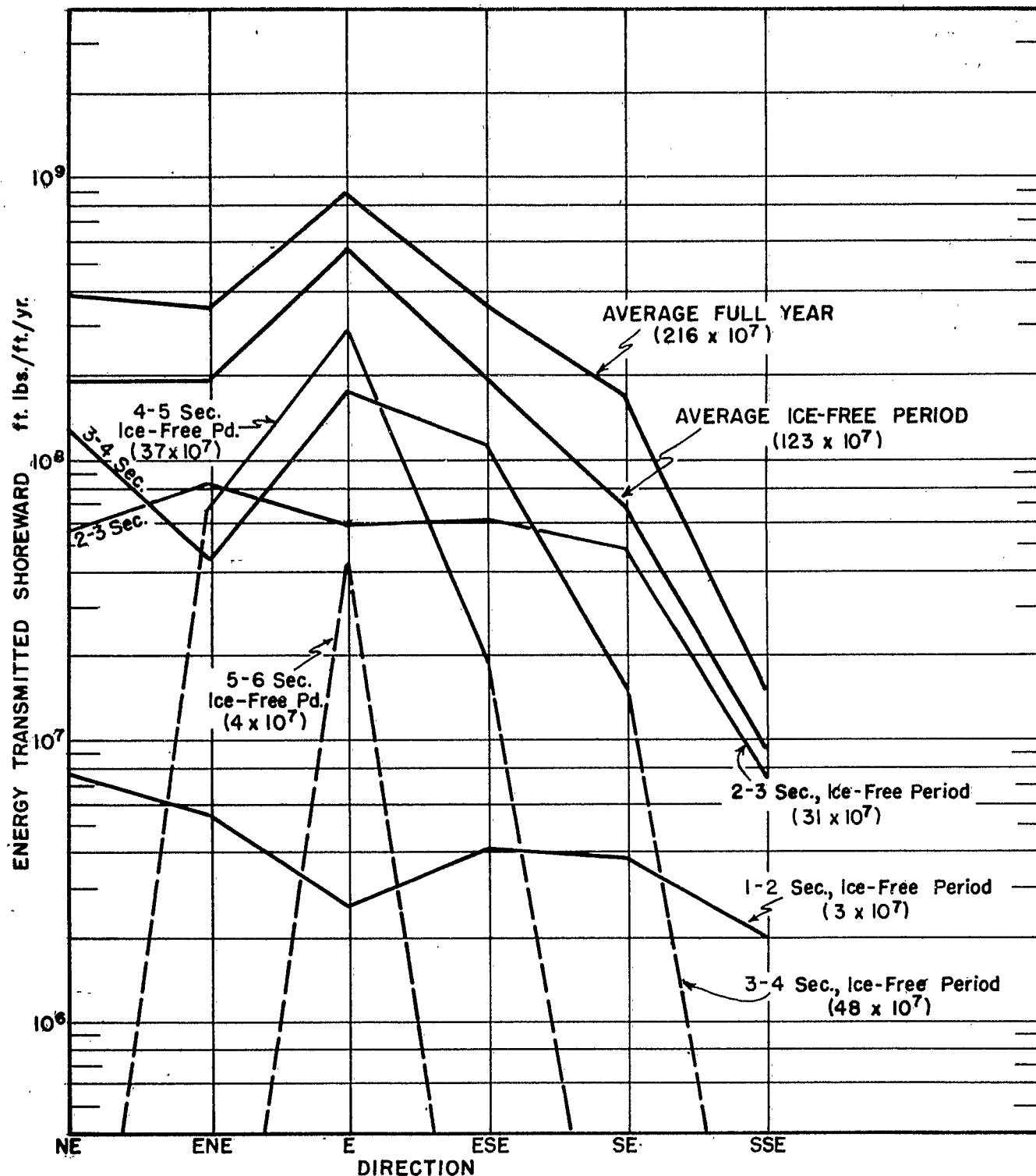


FIG. A-3



AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY.

LAKE ERIE - STATION A (Monroe)

FIG. A-4

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ERIE

APPENDIX B

WAVE STATISTICS

FOR

STATION B

CLEVELAND, OHIO

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value but not the upper.

JANUARY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
5-1	NW					6	6	12										6	6	12		
	N		6	6	12		12		12									18	6	24		
	NNE	6			6		12	6	18									6	12	6	24	
	Total	6	6	6	18		30	12	42									6	36	18	60	
	W	24			24	42		12	54	6	6	12	24					72	6	24	102	
1-2	WNW					12	12		24	6	6	12	24					18	18	12	48	
	NNW					6	6	30	42									6	6	30	42	
	N	12			12	12	18		30									24	18		42	
	NNE	6			6	12		6	18	6	12	18	36					24	12	24	60	
	NE	6			6	6	12		18	6			6					18	12		30	
2-3	Total	48			48	76	54	48	198	24	24	42	90					168	78	90	336	
	W					12	12	6	30	24	24	6	54					36	36	12	84	
	WNW					12	12	12	36	12	12	18	42					24	24	30	78	
	NNW							6	6			6	6						6	6	12	
	N										6	12	18						6	12	18	
3-4	NNE						6	6	12			6	6						6	12	18	
	NE					12			12		6		6			6	6	12	12		24	
	Total					36	30	30	96	36	54	48	138			6	6	72	90	78	240	
	W						12		12	12	24		36					12	36		48	
	WNW									6		12	18					6		12	18	
4-5	NNW									6			6					6			6	
	N										6		6					6			6	
	NNE									6	6	6	18					6	12	6	24	
	NE										6		6						6		6	
	ENE									6			6			6	6	6			6	
5-6	Total					12			12	42	36	18	96			6	6	42	54	18	114	
	W									6	6	6	18			6	12	18	6	12	36	
	WNW									6		6	12			12	6	18	6	12	30	
	NNW										6		6						6		6	
	Total									12	12	18	42			18	18	36	12	30	78	
6-7	W												6					6			6	
	NNW									6			6			12	12	6	12		18	
	NE									6			6					6			6	
	Total									12		6	18			12	12	12	12	6	30	
	W									6			6					6			6	
7-8	NNW															6	6		6		6	
	Total									6			6			6	6	6	6		12	
	W															6	6		6		6	
	NNW																					
	Total																					
TOTAL		54	6	6	66	132	126	90	348	132	126	132	390			54	18	72	318	312	246	876
CALM																		126	182	198	406	
TOTAL HOURS																		744	744	744	2232	

TABLE B-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO

Duration given in hours. Height and period groupings include lower value but not the upper.

FEBRUARY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	W			6	6															6	6
	NNW	12			12			6	6									12		6	18
	N	6		6	12	6		6	12									12		12	24
	NNE	6	6	12	24	12		6	18			6	6					18	6	24	48
	NE		6		6	6			6									6	6		12
	Total	24	12	24	60	24		18	42			6	6					48	12	48	108
1-2	W					6	12	24	42			12	12					6	12	36	54
	WNW	6			6	6	6	18	30	6	6		12					18	12	18	48
	NW						12	24	36										12	24	36
	NNW					6		12	18									6		12	18
	N		6		6	6	18	6	30			6	6					6	24	12	42
	NNE					30		12	42	12	6	6	24					42	6	18	66
	NE					12		18	30	6		18	24					18		36	54
	ENE					6	6		12									6	6		12
	Total	6	6		12	72	54	114	240	24	12	42	78					102	72	156	330
2-3	W					6	6	12	24	6		12	18					12	6	24	42
	WNW					6			6		6		6					6		6	12
	NW						6		6		6		6						12		12
	NNW								6			18	24					6		18	24
	N								6		6		6						6		6
	NNE					6		6	12	12			12					18		6	24
	NE								12			12	12							12	12
	Total					18	12	18	48	24	18	42	84					42	30	60	132
3-4	W									6		6	6			6	6			12	12
	WNW									12	12	12	36					12	12	12	36
	NW									6		6	12					6		6	12
	NNW										6	6	12						6		12
	NNE									6		12	18	6			6	12		12	24
	NE									12		12	12					12			12
	Total									36	18	42	96	6		6	12	42	18	48	108
4-5	W									6		6	6					6			6
	WNW									18	12		30					18	12		30
	NW											6	6							6	6
	NNW									6			6					6			6
	NNE											6	6							6	6
	Total									30	12	12	54					30	12	12	54
5-6	W										6		6	6			6	6	6		12
	WNW										6		6	12	12		24	12	18		30
	NW									6			6					6			6
	Total									6	12		18	18	12		30	24	24		48
6-7	W									6			6	6			6	12			12
7-8	WNW													6			6		6		6
	NW														6		6		6		6
	Total													12			12		12		12
	TOTAL	30	18	24	72	114	66	150	330	126	72	144	342	30	24	6	60	300	180	324	804
	CALM																	376	772	548	1236
	TOTAL HOURS																	696	672	672	2040

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value (but not the upper).

		MARCH																												
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-8 Seconds				1-9 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
5-1	N		6		6																					6		6		
	ENE		6		6																					6		6		
	TOTAL		12		12																						12		12	
1-2	W							6	6			6		6													6	6	12	
	WNW					12	12		24			6		6												12	18	30		
	NW					6			6																	6		6		
	NNW					12	12	6	30																	12	12	6		
	N					18	6	12	36	6			6													24	6	12		
	NNE					6			6	6			6	12												12		6		
	NE					6	6	6	18				6	6												6	6	12		
	ENE					6			6	12	6															12		6		
	TOTAL					66	36	36	138	18	12	12	42														84	48	48	
	2-3	W					12	6		18			12	6	18													12	18	6
WNW						6	6	6	18			30	24	54												6	36	30		
NW							24	12	36			18	18	36												42	30	72		
NNW										6	6			12												6	6	12		
N												12	6	18												12	6	18		
NNE								6	6	12			12													12		6		
NE						6		6	12	24			24	48	6		6									36		30		
TOTAL						24	36	30	90	42	78	78	156	6		6										72	114	180		
3-4		W					6			6	12	6	6	24													18	6	30	
		WNW											12	6	18												6	12	6	
	NW									6	24	12	42													6	24	12		
	NNW									6			6													6		6		
	N							6	6	6			6													6		12		
	NNE							6	6	24	6		30													24	6	36		
	NE									12	6	12	30													12	6	30		
	TOTAL					6		12	18	66	54	36	156													74	54	78		
	4-5	W									6	6	12														6	6	12	
		WNW											12	12	24		12	12	24								24	24	48	
NW												6	6	12												6	6	12		
NNW										6		6	12													6		6		
ENE												12		12												12		12		
TOTAL										24	24	24	72			12	12	24								24	36	36		
5-6		W													6	6	12										6	6	12	
		WNW											6		6		6	6									12		12	
		NW													6		6	6									6	6	6	
		NNE											6		6	6	12	18								6	18	24		
	TOTAL											12	12	30	42											12	42	54		
	6-7	W														6	6	6									6	6	6	
		WNW														6	12	18								6	18	24		
		NW															6	6									6	6	6	
		TOTAL															12	18	30							6	6	12	24	
		7-8	W																											
WNW																		12	12									12	12	
NW																		6	6									6	6	
NNW																												6	6	
ENE																												6	6	
TOTAL																												6	6	
8-9	W																													
	WNW																													
	NW																													
	NNW																													
	ENE																													
	TOTAL																													
	9-10	W																												
		WNW																												
		NW																												
		NNW																												
ENE																														
TOTAL																														
10-11		W																												
		WNW																												
		NW																												
		NNW																												
	ENE																													
	TOTAL																													
	TOTAL		12		12	96	72	78	246	150	180	150	480	18	54	48	120			12	12			6	6	6	6	264	318	274
		CALM																												
	TOTAL HOURS																													

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value but not the upper.

APRIL

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	WNW	6			6	6			6									12			12
	NE	12			12													12			12
	Total	18			18	6			6									24			24
1-2	W					6			6				6					6			6
	WNW					12	12		24	6	6		12					18	18		36
	NW						6	18	24										6	18	24
	NNW					30	30	12	72									30	30	12	72
	N						18	6	24				6	6					18	12	30
	NNE					36			36	6	12		18					42	12		54
	NE					18	6	12	36	6			6					24	6	12	42
2-3	Total					102	72	48	222	18	18	12	48					120	90	60	270
	W					18			18									18			18
	WNW					12	6		18	30	18	12	60					42	24	12	78
	NW							6	6	6	6	12	24					6	6	18	30
	NNW						6	6	12		18		18						24	6	30
	N									6	18		24					6	18		24
	NNE							6	6				6					6		6	12
3-4	NE					6	6		12		12	12	24					6	18	12	36
	Total					36	18	18	72	48	72	36	156					84	90	54	228
	W									6			6					6			6
	WNW									6			12		6		6	6	6		18
	NW									12	18	12	42					12	18	12	42
	NNW									6	6	30	42					6	6	30	42
	N									12			12					12			12
4-5	NNE									12			12	6			6	18			18
	NE									6	6		12	6	6		12	12	12		24
	Total									60	30	48	138	12	12		24	72	42	48	162
	W									6			12					6			12
	WNW										12		12			6	6		12	6	18
	NW										6	18	24					6	18		24
	NNW											6	6							6	6
5-6	N											6	6							6	6
	NNE											6	6	6			6	6		6	12
	NE										6	6	12	6	6		12	6	12	6	24
	Total									6	24	48	78	12	6	6	24	18	30	54	102
	W													6			6	6			6
	WNW													12			12	12			12
	NW										12	6	18						12	6	18
6-7	NNE											6	6			6	6			12	12
	NE											6	12	6	6		12	6	12	6	24
	Total											12	24	18		6	24	18	12	18	48
7-8	W													6			6	6			6
	WNW														6		6				6
	NW															6	6		6		6
8-9	NNE															6	6		6		6
	NE															6	6	12	6	6	12
	Total															6	6		6		6
TOTAL		18			18	144	90	66	300	132	156	156	444	48	36	18	102	342	282	240	864
CALM																					
TOTAL HOURS																		378	438	480	1296
																		720	720	720	2160

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value, but not the upper.

MAY																					
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NNE	6		6	12													6		6	12
	NNE							6	6											6	6
	TOTAL	6		6	12			6	6									6		12	12
	WNW							12	12	6		6	12					6		18	24
1-2	WNW						6	6	12		6	6	6						12	6	18
	NNW	6				24	24	60	108			6	6					30	24	66	120
	N					30	12	30	72			12	12					30	12	72	84
	NNE					30	18	12	60	18	12	6	36					48	30	18	96
2-3	NE					6			6			18	24					12		18	30
	TOTAL	6				90	60	120	270	30	18	48	96					126	78	168	372
	W					6			6	6		6	6					12		6	12
	WNW					6			6	12		6	18					18		6	24
3-4	NNW								12	18		20						12	18	30	42
	NNW					12	12	6	30			12	12					12	12	18	42
	N	6			6	6	18	12	36	30		6	36					42	18	18	78
	NNE						6		6	18	12	18	48					18	18	18	54
4-5	NE					6			6			12	18				6	6	12	18	30
	TOTAL	6			6	36	36	18	90	84	30	54	168			6	6	126	66	78	270
	WNW								6			6						6			6
	NNW								12	12		24						12	12		24
5-6	NNW								36		6	42						36		6	42
	N								18		18							18			18
	NNE								6	18	6	30					6	18	6	30	
	TOTAL								78	48	24	150						78	48	24	150
6-7	NNW								6			6		6			6	12			12
	N																				
	NNE									6		6	24		24		30			30	
	TOTAL									6	6	12	6	24	30	12	30				42
7-8	WNW								6		6	6					6	12		6	12
	N										6			6			6		6	6	12
	NNE											6		6			6	6		6	6
	TOTAL										6	12	6		12	6	18	18	6	6	30
9-10	W																6	6			6
	NE																6	6		6	6
	TOTAL																6	6		6	6
	WNW																6	6		6	6
TOTAL	18		6	24	126	96	144	366	204	102	132	438	36	36	6	78	384	234	288	946	
	CALM																		360	510	
TOTAL HOURS																		744	744		

		JUNE																			
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				1-4 Seconds							
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total				
5-1	W	6			6																
	W																				
	W																				
	W																				
	W																				
1-2	W																				
	W																				
	W																				
	W																				
	W																				
2-3	W																				
	W																				
	W																				
	W																				
	W																				
3-4	W																				
	W																				
	W																				
	W																				
	W																				
TOTAL		18	54	30	102	114	60	108	282	84	48	42	174	216	162	180	558				
CALM																				504	558
TOTAL HOURS																				720	720

TABLE B-1

Duration given in hours, Height and period groupings include lower value but not the upper.

JULY

CALM
TOTAL HOURS

550	500	502	1720
744	744	744	2232

AUGUST 1964

CALM
TOTAL HOURS

510	576	432	1518
744	744	744	2232

TABLE B-1
 STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
 Duration given in hours. Height and period groupings include lower value but not the upper.
 SEPTEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	W		6		6		6		6									12		12	
	WNW	12	6	6	24			12	12									12	6	18	36
	NNW						12		12									12			12
	N						6		6									6			6
	NNE	24			24	6		6	12									30		6	36
	NE	6		12	18													6		12	18
	Total	42	12	18	72	6	30	18	54									48	42	36	126
1-2	W					12	6		18		6		6					12	12		24
	WNW					6	12		18		6		6					6	18		24
	NNW					12	24	6	42		6		6					12	30	6	48
	N			6	6	18	24	6	48									18	24	6	48
	NNE					78		12	90	12		12	24					90		24	114
	NE					6	6	6	18	30		6	36					36	6	12	54
	Total			6	6	138	96	42	276	42	18	18	78					180	114	66	360
2-3	W					6			6		12		12					6	12		18
	WNW										12		18					12		6	18
	NNW									6	24	6	36					6	24	6	36
	N							6	6		6	6	12						6	12	18
	NNE					6		6	12	12			12					18		6	24
	NE					12		18	30				24	24				12		42	54
	Total					24		30	54	18	54	42	114					42	54	72	168
3-4	W					6		6	12		24		24					6	24	6	36
	WNW										6		6						6		6
	NNW											6	6							6	6
	N										12		18					12		6	18
	NNE												6	6						6	6
	NE												6	6						6	6
	Total					6		6	12		42	24	66			6	6	6	42	36	84
4-5	W										6	6	12						6	6	12
	WNW														6		6		6		6
	NNW										6		6						6		6
	NNE											18	18						18	18	
	NE											6	6						6	6	
	Total										12	36	48			6	6		18	36	54
5-6	W													6		6			6		6
	NNE											6	6			18	18			24	24
	Total											6	6			6	18	24		6	30
6-7	NNW															6	6			6	6
	NNE															6	6			6	6
	Total																12	12			12
TOTAL		42	12	24	78	174	126	96	396	60	126	126	312		12	36	48	276	276	282	834
CALM																					
TOTAL HOURS																					
																		720	720	720	2160

TABLE B-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value but not the upper.

OCTOBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	NW	6			6													6			6
	N	12			12													12			12
	NNE							6	6											6	6
	NE			6	6															6	6
	ENE			6	6															6	6
1-2	Total	18		12	30			6	6									18		12	36
	W							6	6											6	6
	WNW					6		12	18	18			18					24		12	36
	NW	6			6	12		18	30									18		18	36
	NNW					12	6	6	24									12	6	6	24
2-3	N					30	18		48									30	18		48
	NNE					6	12	18	36	6	6	12	24					6	12	24	42
	NE					6	12	18	36	6	6	12	24					6	12	18	30
	Total	6			6	60	36	66	162	24	12	18	54					90	48	84	222
	W							6	6			6	6						12		12
3-4	WNW							12	18			6	24					18	12	6	36
	NW					6		6	12			6	6					6		12	18
	NNW						6	6	12		12		12						18		18
	N					12	6	18	36	6	6		12					6	18	6	30
	NNE										6	18	24					6	6	18	24
4-5	NE										6	12	18					6	12		18
	Total					6	36	12	54	30	42	30	102					36	78	42	156
	WNW									18	6	12	36					18	6	12	36
	NNW										6		6						6		6
	N									6	6	6	12					6	6	6	12
5-6	NNE									6	6	6	18					6	6	6	18
	NE									6		6	6					6		6	6
	Total									36	18	24	78					36	18	24	78
	W										6		6						6		6
	WNW											6	6	6			6	6		6	12
6-7	NW										6	6	6						6	6	6
	Total										6	12	18	6				6	6	6	12
	WNW										6		6						6		6
	W																	6	6		6
	NNW																	6	6		6
7-8	NW																	6	6		6
	Total																	12	12		12
	W																				
	WNW																				
	NNW																				
TOTAL		24		12	36	66	72	84	222	90	84	84	258	6		18	24	186	156	178	540
CALM																		558	588	546	1692
TOTAL HOURS																		744	744	744	2232

NOVEMBER

CALM
TOTAL HOURS

TABLE B-I
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
Duration given in hours. Height and period groupings include lower value but not the upper.

DECEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	W		6		6		12		12										18		18
	WNW	6	6		12													6	6		12
	NNW							6	6											6	6
	NE										6	6								6	6
	Total	6	12		18		12	6	18			6	6					6	24	12	42
1-2	W					6	36	42		12			12					18	36	54	
	WNW					18	12	24	54		18	6	24					18	30	30	78
	NW					12	18	36	66		6	6	12					12	24	42	78
	NNW						6	18	24										6	18	24
	N					6		6	12									6		6	12
	NNE					6	6	6	18									6	6	6	18
	NE					6		6	12		6		6					6	6	6	18
	Total					78	78	182	238		42	12	54					78	90	144	282
2-3	W					6		6		36	6	42							42	6	48
	WNW					12	6	6	24	6	12	12	30					18	18	18	54
	NW					12		18	30	6	18		24					18	18	18	54
	NNW						6		6	6		6	12					6	6	6	18
	N									6	6		12					6	6		12
	NNE					6			6	6		6	12					12		6	18
	Total					30	18	24	72	30	72	30	132					60	90	54	204
3-4	W						6		6	12	6	12	30					12	12	12	36
	WNW									6	6	12	24					12	6	12	30
	NW					6			6		6	12	24					12	6	12	30
	NNW											6	12						6	6	12
	N									12			12					12			12
	NNE					6			6									6			6
	Total					12	6		18	30	30	30	90					42	36	30	108
4-5	W										12		12			18		18		30	30
	N									6		6	6	6			6	12			12
	Total									6	12	18	18	6	18		24	12	30		42
5-6	W										6		6			6	6			6	6
	WNW									12			12				6	12			12
	Total									12	6		18			6	6	12	6	6	24
6-7	W										6		6		18	6	24		24	6	30
	WNW									6			6				6	6			6
	NW													6		6	12	6		6	12
	NNW													6		6	6	6			6
7-8	Total									6	6		12	12	18	12	42	18	24	12	54
	NW													6		6	6	6			6
	TOTAL	6	12		18	90	84	162	336	84	168	78	330	24	36	18	78	204	300	258	762
	CALM																	540	444	486	1470
	TOTAL HOURS																	744	744	744	2232

TABLE B-2
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
FULL YEAR

Duration given in hours; Height and period groupings include lower value but not the upper.

Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				1-9 Seconds					
	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
W.	6	12	12	30		18		18																					6	30	12	48		
WNW	24	18	18	60	6		18	24																					30	18	36	84		
NW	18		24	42	6	18		24																					24	18	36	78		
NNW	12	18	6	36	18	6		24	18																				30	24	30	84		
N	30	18	18	66	12	24		36																					42	32	30	104		
NNE	32	30	30	92	36	12		48					6	6															70	32	100	202		
N	18	6	24	48	6			18					6	6															24	6	48	78		
NNE	6	6	12	24																									6	6	12			
Total	150	108	156	414	84	78		162				12	12																234	136	306	726		
W.	24			24	78	36	120	234	6	30	42	78																	108	66	162	336		
WNW	24	6		30	114	24	108	246	54	48	24	126																	174	150	132	456		
NW	6		6	12	108	78	180	366					18	12	30														114	76	170	360		
NNW	12	6	6	24	138	126	192	456					6	6	12														150	138	246	534		
N	18	30	12	60	150	174	138	462	18	18	36	72																	106	222	106	534		
NNE	6		6	12	222	60	102	384	66	72	72	210																	234	132	174	600		
N	6	6		12	66	42	60	168	54	18	54	126																	126	66	114	306		
NNE	6			6	18	12	6	36	6																				24	18	6	48		
Total	76	54	24	154	876	624	906	2406	204	210	246	660																	1174	888	1176	3258		
W.					90	42	54	186	54	90	42	186																	186	132	96	414		
WNW					30	36	24	90	84	90	270																		114	144	114	372		
NW					30	36	24	90	72	120	210																		72	156	120	348		
NNW					12	12	24	48	24	84	120																			66	126	90	282	
N	6			6	12	12	24	48	96	90	180																		114	132	66	312		
NNE					30	30	30	90	108	36	144																		138	66	96	300		
N					42	12	36	90	42	42	70	174	6	6	6	18													90	60	132	282		
Total	6			6	242	764	252	858	462	524	654	1640	6	6	6	18													816	816	714	2346		
W.					12	12	6	30	42	66	114																		54	78	92	174		
WNW					6			6	72	78	150																		72	90	72	234		
NW					6			6	48	72	120																		54	72	54	180		
NNW									72	36	60	168																	72	36	60	168		
N					6	6	12	24	66	12	12	90																	66	18	18	102		
NNE						12	12	24	36	54	168																		90	72	66	198		
N					6			6	48	42	24	114	6	12	6	24													60	54	30	144		
NNE									6																				6				6	
Total					24	24	24	72	432	324	324	1080	18	24	12	54													474	390	342	1206		
W.					24	36	24	84	24	84	24	132	24	12	36														24	60	36	120		
WNW					48	42	24	114	12	48	30	90																	60	90	54	204		
NW					6	24		30	72	36	108																		6	24	48	78		
NNW					24			24	36	60																			30	36	24	90		
N					6			6	12	18																			12		12	24		
NNE					12	6	36	54	6	24	30																		18	30	36	84		
N					6			6	12	24																			12	12	18	42		
NNE					6			6	12	24																			6	54	30	144		
Total					138	114	186	438	36	102	54	192	36	102	54	192													162	216	240	618		
W.					12	6	18	36	18	12	30																		18	36	6	60		
WNW					6	18	6	30	36	18	54																		36	36	12	84		
NW					18	12	6	36	24	18	60																		18	36	6	60		
NNW					6			6																					6				6	
N									6	6																				6	12	18		
NNE									6	12	18																		12	18	36	66		
N									6																				6				6	
Total					36	24	36	96	60	72	36	168																	72	180	72	324		
W.					12	6		18	12	24	6	42																	24	30	6	60		
WNW					6			6																					6	24	24	54		
NW									6	6	24	36																	6	6	24	36		
NNW									6		6	12																	6		6	12		
N									6	6	12																		6	6	6	12		
NNE									6	6	12																			6		6	12	
Total					18	6		24	24	60	60	144																6	6	42	66	66	174	
W.									6	12	24	42																	6	12	24	42		
WNW									6	12	6	24																	6	12	6	24		
Total																																		

Duration given in hours. Height and period groupings include lower value but not the upper.

CALM	TOTAL HOURS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

TABLE B-4
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$.

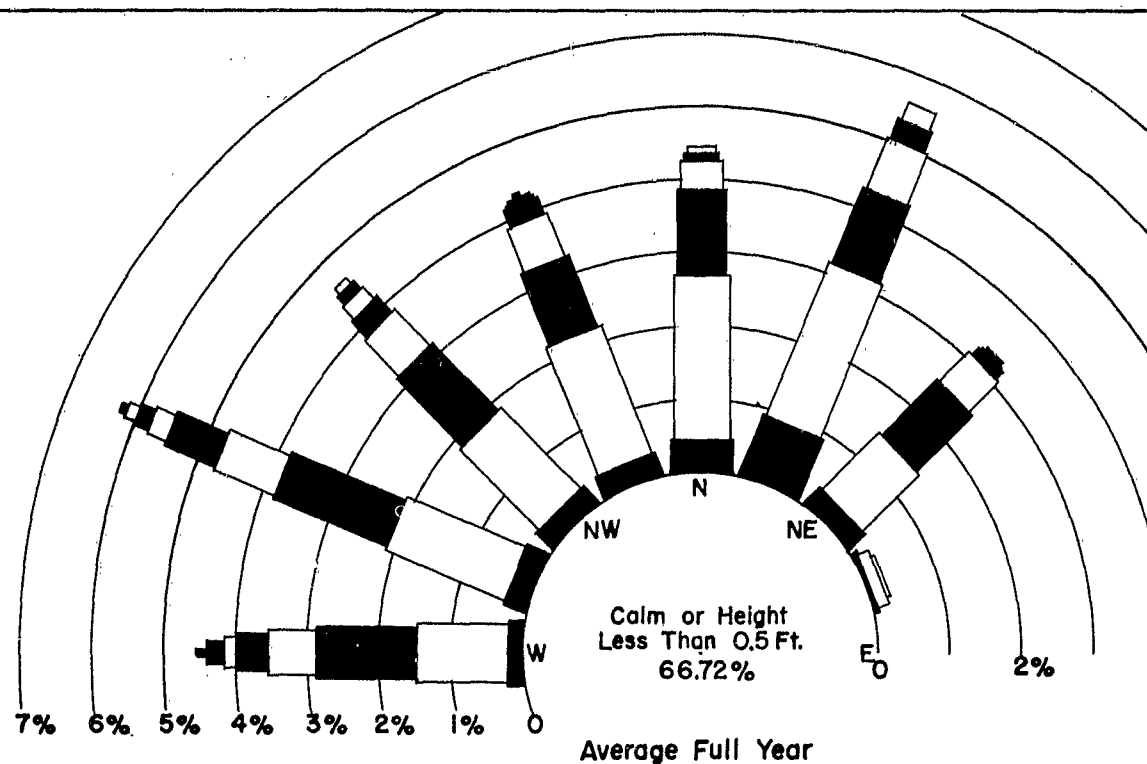
Height and period groupings include lower value but not the upper.

Height (feet)	Period Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	1-6 Seconds
.5-1	W	36	20				56
	WNW	83	81				164
	NNW	83	81				164
	NNW	88	121				169
	N	83	81				164
	NNE	178	222				400
	NE	83	61				144
	ENE	12					12
	Total	606	667				1273
	W		1201	452			1653
1-2	WNW	178	2482	1130			3720
	NW	89	2883	339			3311
	NNW	178	4964	226			5368
	N	311	4724	1130			6165
	NNE		4004	2522			6603
	NE	44	1201	1582			2827
	ENE	44	160				204
	Total	844	21619	7458			29721
	W		3926	2811			6737
	WNW		3990	7183			10673
2-3	NW		1745	7808			9553
	NNW		3708	6246			9954
	N	104	2825	9027			11996
	NNE		1962	8725			10708
	NE		2399	5622	404		8425
	Total	104	20866	47822	404		68046
	W		829	6075			6904
	WNW			12150	789		12939
	NW			9113			9113
	NNW			13272			13272
3-4	N		415	6683			7098
	NNE		415	10382	789		11522
	NE			6682	3755		9838
	Total		1657	65005	4733		71397
	W			5965			5965
	WNW			7254	10393		10393
	NW			7254	1229		8253
	NNW			5965	1229		7264
	N			1988			1988
	NNE			5965	6995		12460
4-5	NE			3977	3877		7874
	Total			27768	29383		63151
	W				3864		3864
	WNW			4392	5725		10193
	NW			4392	1932		6330
	N			1466	3864		5330
	NNE			2932	9659		12591
	Total			13194	25114		38308
	W				2683		2683
	WNW				8029		8029
5-6	NW				8029		8029
	NNW				2683		2683
	N				5366		5366
	Total				26830		26830
	WNW				10647		10647
	NW				7098		7098
	Total				17745		17745
	W				9048		9048
	WNW					5634	14682
	Total				9048	11268	20316
6-7	W				5602		5602
	WNW					7011	7011
	Total				5602	7011	12613
	10-11 W					8529	8529
	11-12 NNW					10182	10182
	16-17 NNW					20343	20343
	TOTAL	1554	44011	172897	112859	57333	388654

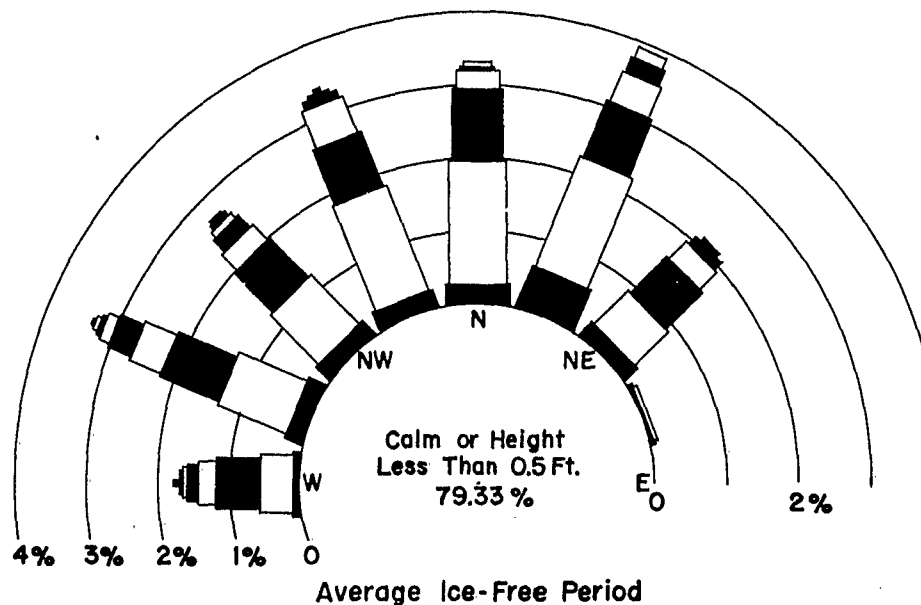
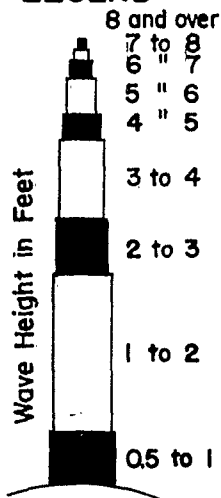
TABLE B-5
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION B, CLEVELAND, OHIO
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Height (feet)	Period Dir.	Period						
		1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	7-8 Seconds	1-8 Seconds
5-1	W	59	61					120
	WNW	119	81					200
	NW	83	121					204
	NNW	71	161					232
	N	131	161					292
	NNE	238	243	28				609
	NE	95	81	28				204
	ENE	24						24
	Total	820	1009	56				1885
	W	178	3123					3669
1-2	WNW	222	4244					5261
	NW	89	4884					5115
	NNW	178	6085					6320
	N	445	6165					6950
	NNE	44	5124					6159
	NE	89	2242					2926
	ENE	44	480					552
	Total	1289	32347					36752
	W		6761	9682				16443
	WNW		6523	14055				20578
2-3	NW		4580	11556				16136
	NNW		3926	9057				12983
	N	104	2835	11868				14807
	NNE		3272	10931				14203
	NE		3272	9057	1211			13540
	Total	104	31189	76706	1211			104710
	W		2073	13973	789			16835
	WNW		415	22477	789			23683
	NW		415	17618				18033
	NNW			17010				17010
3-4	N		829	9113				9942
	NNE		829	17010	2366			20205
	NE		415	11543	3155			15113
	ENE			608				608
	Total		4976	109354	7099			121429
	W			13919	2775			21714
	WNW			18870	19486			38376
	NW			11930	1299			13229
	NNW			9942	1299			11241
	N			2983	1299			4282
4-5	NNE			8948	6475			15443
	NE			3977	3977			7874
	Total			20589	41570			112159
	W			4398	9659			14057
	WNW			7330	17386			24716
	NW			8796	7727			16523
	NNW			1466				1466
	N			1466	3864			5330
	NNE			4398	15455			19853
	NE			1466				1466
5-6	Total			22320	54091			83411
	W			6047	18782			24829
	WNW			2016	18782	4557		25355
	NW				16099			16099
	NNW				5366			5366
	N				5366			5366
	Total			8063	64395	4557		77015
	W				24842			24842
	WNW				14175			14175
	Total				32037			32037
6-7	W				9048	5634		14682
	WNW				4524	5634		10158
	Total				13572	11268		24840
	W				5602			5602
	WNW					7011		7011
	NNW					7011		7011
	Total				5602	14022		19624
	W					8529		8529
	WNW					8529		8529
	Total					17058		17058
8-9	W							10182
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
10-11	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
12-13	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
14-15	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
16-17	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
18-19	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
20-21	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
22-23	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
24-25	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
26-27	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
28-29	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
30-31	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
32-33	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
34-35	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
36-37	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
38-39	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
40-41	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
42-43	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
	W							20343
	WNW							20343
	Total							20343
44-45	W							20343
	WNW							20343
	Total							20343
	W							



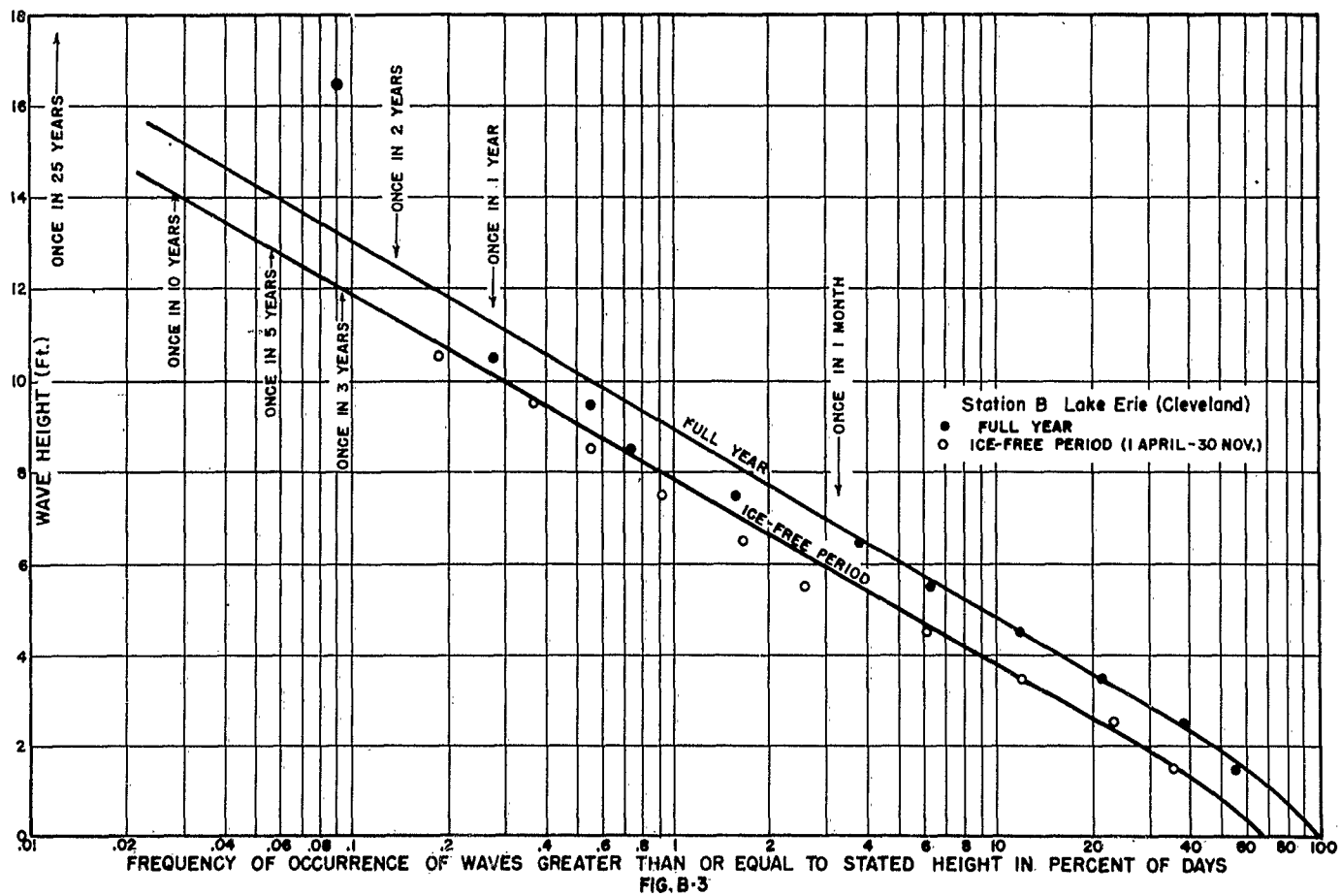
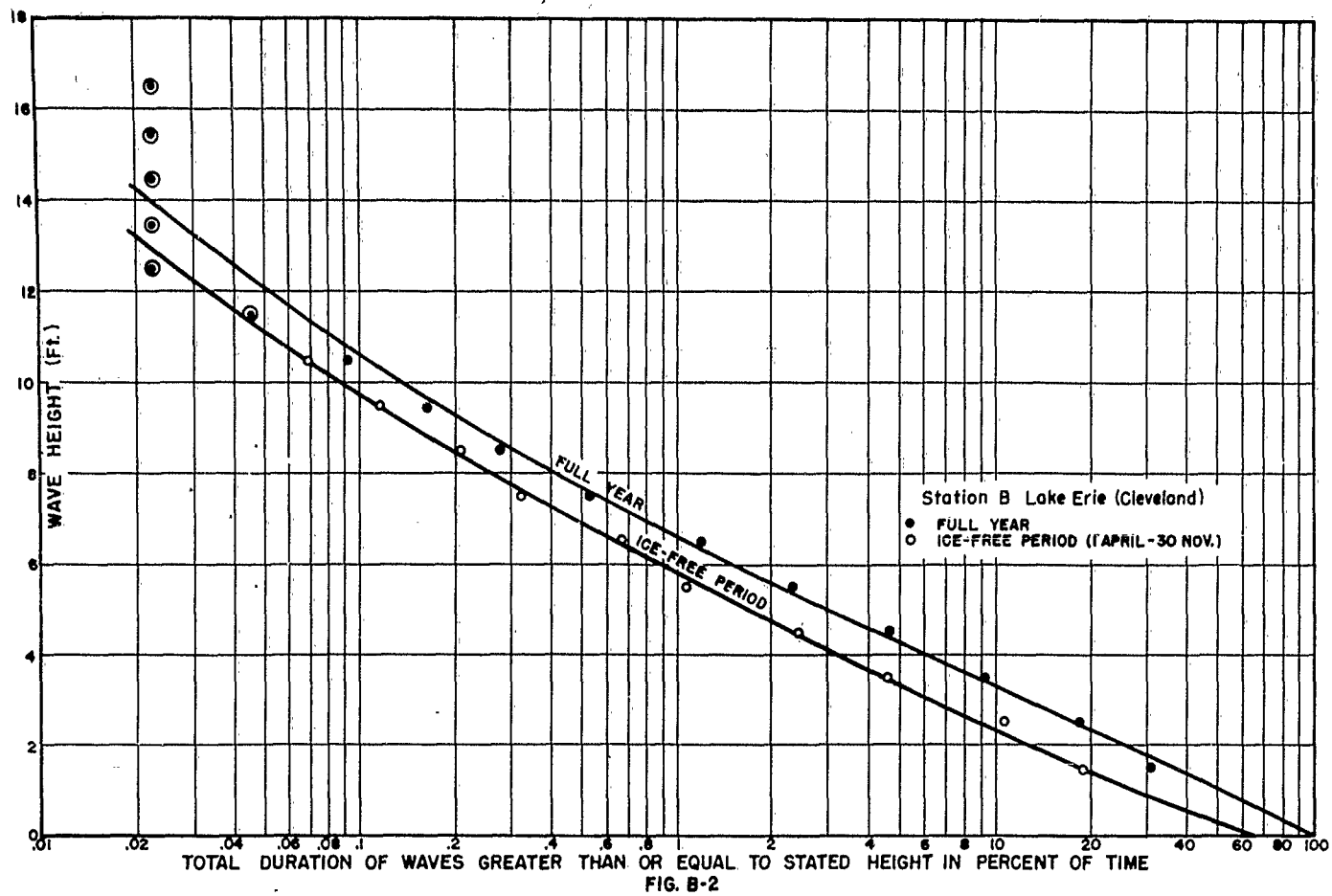
LEGEND

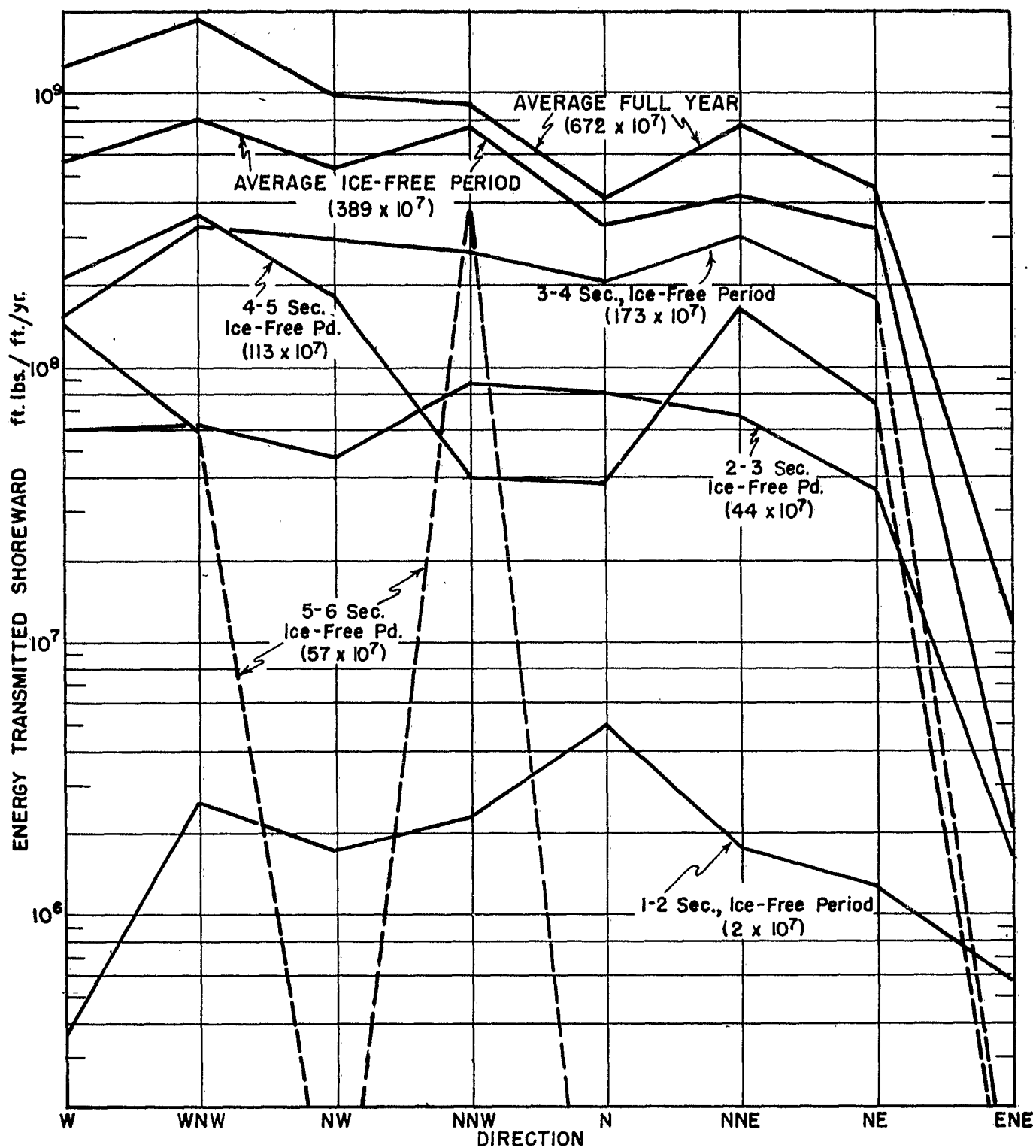


LAKE ERIE
STATION B (Cleveland)

WAVE ROSE SHOWING PERCENT OF TIME WAVES OF
DIFFERENT HEIGHT OCCUR FROM EACH DIRECTION

FIG. B-1





AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY.

LAKE ERIE - STATION B (Cleveland)

FIG. B-4

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ERIE

APPENDIX C

WAVE STATISTICS

FOR

STATION C

ERIE, PENNSYLVANIA

TABLE C-1
 STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
 Duration given in hours. Height and period groupings include lower value but not the upper.
 JANUARY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-6 Seconds					
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
5-1	WSW		6		6																	6			6		
	W		6		6																	6			6		
	N						6		6													6			6		
	NNE			6	6			6	6														12		12		
	TOTAL		12	6	18			6	12														18	12		30	
1-2	WSW								6	6			6										6	6		12	
	W			6	6	18	24	12	54	6	18	12	36									24	42	30	96		
	WNW	6			6	12		12	12		12	6	18									18	12	6	36		
	NW							12	12			6	6										18		18		
	NNW					6	12	6	24													6	12	6	24		
	N					18	36		54													18	36		54		
	NNE	12			12	12	12	6	30		6	6	12									24	18	12	54		
	NE							12	6	18													12	6	18		
	TOTAL	18		6	24	66	96	48	210	6	42	30	78									90	138	84	312		
2-3	WSW					6	6		12					6			6					6	12		18		
	W					6	36	12	54	18	12	30	60									24	48	42	114		
	WNW					12			12	30		12	42									42		12	54		
	NW					6			6	18		6	24									24		6	30		
	NNW					6			6													6			6		
	NNE						6		6		12	6	18										18	6	24		
	NE							6	6	6	12	6	24									6	12	12	30		
	TOTAL					36	48	18	102	72	36	60	168		6		6					108	90	78	276		
3-4	WSW							6	6		12	6	18		6	12	18						18	24	42		
	W					6			6	30	18	54		30			30					12	60	18	90		
	WNW									12		12	24									12		12	24		
	NW											18	18										18		18		
	NNW									6			6									6			6		
	NNE										6		6										6		6		
	NE										6		6										6		6		
	TOTAL					6		6	12	24	54	54	132		36	12	48					30	90	72	192		
4-5	WSW									18			6	6	18	6	30						6		6		
	WNW										6		6									24	18	6	48		
	NW											6	12										6		6		
	NNW									6		6	12									6		6	12		
	NNE											6	6										6		6		
	NE									12			12										12			12	
5-6	TOTAL									36	12	12	60		6	18	6	30					42	30	18	90	
	WSW											6	6		6		6						6	6	12		
	W										6	6	12		12	12	24						18	18	36		
	NW												6				6					6			6		
	TOTAL									6	6	12	24		6	18	12	36					12	24	24	60	
6-7	WSW														6		6						6		6		
	W									6		6	12		6		6					6	6	6	18		
	WNW												6										6		6		
7-8	TOTAL									6		6	12		18		18					6	18	6	30		
	W														6		6							6	6		
8-9	NW														6		6						6		6		
	NNW														6		6						6		6		
	TOTAL														12		12						12		12		
10-11	NNW																				6	6		6	6		
TOTAL	18	12	12	42	108	150	78	336	150	150	174	474	12	108	36	156					6	6	288	420	306	1014	
	CALM																							456	324	438	1218
	TOTAL HOURS																							744	744	744	2232

TABLE C-1
 STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
 Duration given in hours Height and period groupings include lower value but not the upper
 FEBRUARY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				1-6 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
.5-1	W			6	6																			6	6	
	WNW	12			12																	12			12	
	NW	6			6																	6			6	
	NNW			6	6	6			6													6			6	
	N		12		12			6	6													12	6		18	
	NNE			12	12			6	6														18		18	
	NE					6			6													6			6	
	Total	18	12	24	54	12		12	24													30	12	36	78	
1-2	WSW					6	6	6	18													6	6	6	18	
	W					12	18	18	48	6		12	18									18	18	30	66	
	WNW	6			6			6	6		6	6	12									6	6	12	24	
	NW					12		18	30			6	6									12		24	36	
	NNW					6	12	18	36													6	12	18	36	
	N		6		6	12	24	6	42													12	30	6	48	
	NNE					30		12	42	6			6									36		12	48	
	NE		6		6	24		30	54			12	12									24	6	42	72	
	Total	6	12		18	102	60	114	276	12	6	36	54									120	78	150	348	
2-3	WSW					6		6	12				6	6								6		12	18	
	W					6		12	12	6	12	6	24	6			6					18	18	6	42	
	WNW						12	6	18	18	12		30									18	24	6	48	
	NW						6	6	12														6	6	12	
	NNW						6	6	12		6	6	12										12	12	24	
	NNE					6		6	12			12	24									18		12	30	
	NE					6		6	18			18	36									24		18	42	
	Total					24	30	24	78	54	30	48	132	6			6					84	60	72	216	
3-4	WSW					6			6													6			6	
	W									6	6	18	30			6	18	24				6	12	36	54	
	WNW									6		6	12									6		6	12	
	NW											12	12											12	12	
	NNW									6	6	12											6	6	12	
	NNE									12		6	18									12		6	18	
	NE						6	6	6	6		6	12									6		12	18	
	Total					6		6	12	30	12	54	96			6	18	24				36	18	78	132	
4-5	WSW										6	6	12										6	6	12	
	W									12			12				18	18				12		18	30	
	WNW									6	6	6	18									6	6	6	18	
	NW									6	6		12									6	6		12	
	NNW									6			6									6			6	
	NNE									6			6									6			6	
	NE									6			6									6			6	
	Total									36	18	12	66				18	18				36	18	30	84	
5-6	W										12		12		6	6		12				6	18		24	
	WNW									6			6			6						6	6		12	
	NW														6							6			6	
	NNW														6							6			6	
	NNE														6							6			6	
	NE														6							6			6	
	Total									6	12		18	18	12		30					24	24		48	
	6-7	WSW														6							6		6	
7-8	W														6	6		6	6			6	12		12	
	WNW															6		6				6			6	
	Total														6	6		12	6			6	12	6	18	
	10-11	WNW															6					6	6		6	
	TOTAL	24	24	24	72	144	90	156	390	138	78	150	366	30	30	36	96	12				12	348	222	366	936
	CALM																									
	TOTAL HOURS																									

TABLE C-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.
MARCH

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				1-7 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-1	WSW			6	6																						6	6	
	W		6	6	12																					6	6	12	
	NW																									6	6	12	
	TOTAL		6	12	18																					6	12	18	
1-2	WSW					6	12	18	18	6	6	6	18												6	6	24	36	
	W					12	6	6	24			12	12											6	12	18	36		
	NW		6		6	12	6	6	24		6		6											12	18	6	36		
	TOTAL		6		6	12	18	12	42															12	24	12	48		
2-3	WSW																												
	W																												
	NW																												
	TOTAL																												
3-4	WSW																												
	W																												
	NW																												
	TOTAL																												
4-5	WSW																												
	W																												
	NW																												
	TOTAL																												
5-6	WSW																												
	W																												
	NW																												
	TOTAL																												
6-7	WSW																												
	W																												
	NW																												
	TOTAL																												
7-8	WSW																												
	W																												
	NW																												
	TOTAL																												
8-9	WSW																												
	W																												
	NW																												
	TOTAL																												
9-10	WSW																												
	W																												
	NW																												
	TOTAL																												
10-11	WSW																												
	W																												
	NW																												
	TOTAL																												
12-13	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
Calm	WSW																												
	W																												
	NW																												
	TOTAL																												
Total Hours	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												
	TOTAL																												
TOTAL	WSW																												
	W																												
	NW																												

TABLE C-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.

APRIL

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-2	WSW			6	6															6	6
	W	6			6													6			6
	NR	6			6													6			6
	Total	12		6	18													12		6	18
2-2	WSW					6			6									6			6
	W					18	18	6	42	6	12	6	24	6			6	30	30	12	72
	WNW					6	6		12	6			6				12	6		18	
	NW						42	30	72		6		6					48	30	78	
	NNW					12		12	24		6		6				12	6	12	30	
	N						6	12	18									6	12	18	
	NNE					24	12		36	6			6				30	12		42	
	NE					24		6	30		6		6				24	6	6	36	
	Total					90	84	66	240	18	30	6	54	6			6	114	114	72	300
2-3	WSW													6			6	6			6
	W					24	12		36	6	18	6	30		12		12	30	42	6	78
	WNW							12	12	12		6	18				12		18	30	
	NW									6	12	12	30				6	12	12	30	
	NNW											18	6	24				18	6	24	
	N						6		6									6		6	
	NNE					24	6	6	36	18		6	24				42	6	12	60	
	NE								6	6	12	24					6	6	12	24	
	Total					48	24	18	90	48	54	48	150	6	12		18	102	90	66	258
3-4	W					6			6	18	12	24	54		6		6	24	18	24	66
	WNW						6		6	6	12	12	30				6	18	12	36	
	NW										12	12	24					12	12	24	
	NNW									6		12	18				6		12	18	
	N											6	6						6	6	
	NNE									18	6	6	30				18	6	6	30	
	NE								6	12	6	18					12	6		18	
	Total					6	6		12	48	48	72	180		6		6	66	60	72	198
4-5	WSW									6			6				6	6			6
	W									6			6		6		6	6	6		12
	WNW									6			6				6				6
	NW										12	18	30					12	18	30	
	NNW											6	6						6	6	
	NE									6		6	6	6			6	6	6		12
5-6	Total									18	18	24	60	6	6		12	24	24	24	72
	W													6			6	6			6
	WNW														6		6		6		6
	NW									6		6	6	6		6	12	6	6	6	18
	NE													6	18		24	6	18		24
6-7	Total									6		6	18	24	6	48	18	30	6	54	
	W									6	6	12				6	6		6	12	18
	NW															6	6		6	6	
TOTAL		12		6	18	144	114	84	342	144	162	156	462	36	48	18	102	336	324	264	924
CALM																		384	376	456	1216
TOTAL HOURS																		720	720	720	2160

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.
MAY

C-5

TABLE C-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.
JUNE

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-8	WSW							12	12							12	12
	W	6			6									6			6
	WNW		6	6	12										6	6	12
	NW		6	6	12			6	6						6	12	18
	NNW			6	6											6	6
	N							6	6							6	6
	NNE		18		18										18		18
	Total	6	30	12	54			24	24					6	30	42	78
1-2	WSW							6	18	24			18	18		6	36
	W							12	6	18			6	6		12	24
	WNW					18		6	6	30	6	6		12	24	12	42
	NW					12		30	42					12		30	42
	NNW		6		6	24	6	18	48					24	12	18	54
	N		6		6	6	24	6	36					6	30	6	42
	NNE					12	18	12	42					12	18	12	42
	NE		6		6	12			12		6		6	12	12		24
2-3	Total		18		18	84	72	96	252	6	12	24	42	90	102	120	312
	WSW					6		24	30					6		24	30
	W					6	18	18	42			12	12	6	18	30	54
	WNW									12	6		18	12	6		18
	NW					6		6	12	12	6	6	24	18	6	12	36
	NNW					18		6	24	12		6	18	30		12	42
	N					6	6		12	12	6		18	18	12		30
	NNE					6			6				6				6
3-4	Total					48	24	54	126	48	18	24	90	96	42	78	216
	WSW									6		6	12	6		6	12
	W											6	6			6	6
	WNW									6			6	6			6
	NW										6	6	12		6	6	12
	NNW												6				6
	N									12			12	12			12
	Total									30	6	18	54	30	6	18	54
TOTAL		6	48	18	72	132	96	174	402	84	36	66	186	222	180	258	660
CALM														498	540	462	1500
TOTAL HOURS														780	720	780	2160

TABLE C-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.
JULY

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				1-4 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
0.5-1	NW			6	6											6	6
	NNW		6		6		6		6					12			12
	Total		6	6	12		6		6					12		6	18
1-2	WSW	6			6	6	6		12				6	12	6		18
	W					6	6	12	24		6		6	6	12	12	30
	WNW					6		6	12					6		6	12
	NW		6	6	12	12		12	24					12	6	18	36
	NNW						18	18	36						18	18	36
	N		6	6	12		24	6	30						30	12	42
	NNE					12	12		24					12	12		24
	NE						6		6						6		6
	Total	6	12	12	30	42	72	54	168		6		6	48	90	66	204
2-3	WSW					6			6	6			6	12			12
	W					24	6	6	36	12		6	18	36	6	12	54
	WNW						6	6	12	6			6	6	6	6	18
	NW					6		12	18	6	12	6	24	12	12	18	42
	NNW						12		12	6	6		12	6	18		24
	NNE								18				18	18			18
	NE						6		6	12	6		18	12	12		24
	Total					36	30	24	90	66	24	12	102	102	54	36	192
3-4	W									6	6	6	18	6	6	6	18
	WNW					6			6	6			6	12			12
	NW									6		6	12	6		6	12
	NNW									6			6	6			6
	NNE									6			6	6			6
	Total					6			6	30	6	12	48	36	6	12	54
4-5	W										6		6		6		6
	WNW									6			6	6		6	6
	NW											6	6			6	6
	NE									6			6	6			6
	Total									12	6	6	24	12	6	6	24
TOTAL		6	18	18	42	84	108	78	270	108	42	30	180	198	168	126	492
CALM														546	576	618	1740
TOTAL HOURS														744	744	744	2232

TABLE C-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
Duration given in hours. Height and period groupings include lower value but not the upper.

AUGUST

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	WSW			6	6											6	6
	W			6	6							6	6		1	12	12
	WNW	12			12									12			12
	NW	6			6									6			6
	NNW		6	12	18	6		6	12					6	6	18	30
	N	6	6		12		6		6					6	12		18
	NNE			12	12	12		12	24					12		24	36
	NE					6			6					6			6
	TOTAL	24	12	36	72	24	6	18	48			6	6	48	18	60	126
	W					12		42	54			6	6	12		48	60
1-2	WSW					24		18	42					24		18	42
	W											6	6			12	12
	WNW	6	6		12	36		6	42			6	6	42	6	12	60
	NW		6		6	42	24	18	84					42	30	18	90
	NNW	6	6		12	30	24	30	84					36	30	30	96
	N	6	6		12	6	36	42	84					12	42	42	96
	NNE					12		54	66					12		54	66
	NE					18		30	48					18		30	48
	TOTAL	18	24		42	180	84	240	504			12	12	198	108	252	558
	W					12	6	12	30			6	6	12	6	18	36
2-3	WSW					6			6							6	6
	W									6	6	6	18	6	12	6	24
	WNW											6	6	6	6		12
	NW											6	6		12		12
	NNW													12	12		24
	N									12	12	12	36	12	12		36
	NNE																
	NE																
	TOTAL					12	30	12	54	24	12	12	48	36	42	24	102
	W											6	6			6	12
3-4	WSW																
	W									6				6	6		12
	WNW																
	NW																
	NNW																
	N																
	NNE									24				24	24		72
	NE									6				6	6		12
	TOTAL									36		6	42	36		6	78
	W											6	6				12
TOTAL		42	36	36	114	216	120	270	606	60	12	36	108	318	168	342	828
CALM														426	576	402	1404
TOTAL HOURS														744	744	744	2232

TABLE C-1
 STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
 Duration given in hours. Height and period groupings include lower value but not the upper.
 SEPTEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
0.5-1	WSW			12	12															12	12
	W	6	6		12		6		6									6	12		18
	NW			6	6		6		6										6	6	12
	NNW			6	6															6	6
	N	6			6													6			6
	NNE	18		12	30	6			6									24		12	36
	NE	18		6	24	6			6									24		6	30
	TOTAL	48	6	42	96	12	12		24									60	18	42	120
1-2	WSW						24	6	30		18	6	24						42	12	54
	W					6	12	6	24									6	12	6	24
	NNW					18	12	6	36									18	12	6	36
	NW					18	12		30									18	12		30
	NNW						60	24	84										60	24	84
	N					12	24		36									12	24		36
	NNE					66	6	6	78	6			6					72	6	6	84
	NE					30	6	6	42	6		12	18					36	6	18	60
	TOTAL					150	156	54	360	12	18	18	48					162	174	72	408
2-3	WSW						12	6	18										12	6	18
	W					12		6	18		12	18	30					12	12	24	48
	NNW											6	6							6	6
	NW						6		6		18	12	30						24	12	36
	NNW						6		6		6	12	18						12	12	24
	N							24	24	6			6					6		24	30
	NNE					6		6	12									6		6	12
	NE					12		6	18	6			6					18		6	24
	TOTAL					30	24	48	102	12	36	48	96					42	60	96	198
3-4	WSW						6		6										6		6
	W									6	18		24		6		6	6	24		30
	NW										6	6	12						6	6	12
	NNW										6		6						6		6
	TOTAL						6		6	6	30	18	54		6		6	6	42	18	66
4-5	W										18		18		6		6		24		24
	NNW										6		6						6		6
	NNW											18	18							18	18
	NNE											6	6							6	6
	TOTAL										24	24	48		6		6		30	24	54
5-6	NNW											6	6							6	6
	NE															6	6			6	6
	TOTAL															6	6			12	12
6-7	W														12		12		12		12
	NNW											6	6							6	6
	TOTAL																			12	12
	TOTAL	48	6	42	96	192	198	102	492	30	108	120	258		24	6	30	270	336	270	876
	CALM																				
	TOTAL HOURS																	450	384	450	1284
																		720	720	720	2160

OCTOBER

C-10

TABLE C-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.

Duration given in hours. Height and period groupings include lower value but not the upper.

NOVEMBER

Calm	
Total Hours	

TABLE C-1
 STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
 Duration given in hours. Height and period groupings include lower value but not the upper.
 DECEMBER

DECEMBER																									
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
5-8	WSW							12	12			6	6										6	12	18
	NW			6	6																		6	6	6
	Total			6	6			12	12			6	6										6	18	24
	WSW							12	12			12	12	24									12	24	36
	W					12		18	30	18		6	18	42								30	6	36	72
1-2	WNW							18	18	6		6	6	18								6	6	24	36
	NW			6	6		6	24	36				6	6							6	6	30	42	
	WNW					12		24	36												12		24	36	
	N							6	6														6	6	6
	NNE							6	6	12												6	6	12	
2-3	NE							6	6			6	6									6	6	12	
	Total					30	12	114	156	24	30	42	96								54	42	156	252	
	WSW							6	12	18			6	6		6							12	18	30
	W					12	12	6	30	6	18	18	42									18	30	24	72
	WNW					6			6		24	6	30									6	24	6	36
3-4	NW					6			6	6	12	6	24									12	12	6	30
	WNW						12	6	18		12	18	30									24	24	48	
	NNE					6			6	36	6	6	36								30	6	6	42	
	Total					30	30	24	84	36	72	60	168			6	6					66	108	84	258
	WSW									6	6		12			6						6	12		18
4-5	W					6			6		18		18	6	24		30					12	42		54
	WNW					6			6	6		6	12									12		6	18
	Total									12	36	48	18	24	12	54						30	60	12	102
	WSW													6		6		6		6			12		12
	W									6	6		12		6		6	12	6		18	18	18		36
5-6	WNW									6		6	6		6	12						12		6	18
	NNE									6		6	6		6							12			12
	Total									18	6	24	12	12	6	30	12	12		24	42	30	6	78	
	W									6	6		12	6	6		12					12	12		24
	WNW													6		6		6				6			6
6-7	NNE													6		6		6				6			6
	Total									6	6		12	18	6	24					24	12		36	
	NW													6		6					6			6	
	WSW																	6		6		6		6	
	W																								6
7-8	WSW																		6		6		6		6
	NW													6		6					6			6	
	WSW																		6		6		6		6
	NW													6		6					6			6	
	WNW													6		6					6			6	
8-9	Total													12		12		6		6	12	6		18	
	W																	6			6	6		6	
	TOTAL			6	6	72	42	150	264	132	172	126	450	72	78	18	168	18	18		36	294	330	300	924
	CALM																					450	414	444	1308
	TOTAL HOURS																					744	744	744	2232

Duration given in hours. Height and period groupings include lower value but not the upper.

C-13

TABLE C-3
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION C, ERIE, PA.
ICE-FREE PERIOD (1 APRIL-30 NOV.)

Duration given in hours. Height and period groupings include lower value but not the upper.

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
5-1	WSW			36	36			12	12																					
	W	18	6	12	36			6	6				6	6												18	12	24	54	
	WNW	18	6	12	36	6			6																	24	6	12	42	
	WNW	18	12	18	48			6	6																	18	18	24	60	
	WNW		18	24	42	6		6	18																	6	24	30	60	
	N	24	6	30	60			6	12	18																24	12	12	48	
	ENE	24	18	36	78	24		12	36																	48	18	48	114	
5-2	W	24	6	36	66	12		12																		36	6	6	48	
	Total	126	72	174	372	48	24	54	126																	174	96	204	474	
	WSW	6			6	30	48	84	162																					
	W					78	66	114	258	6	42	18	66	6			6									90	108	132	330	
	WNW	12	6		18	72	36	30	162	12	12	6	30													120	54	36	210	
	WNW	6	12	6	24	120	102	132	354																	126	136	138	399	
	WNW	6	12		18	120	126	150	396			18	6	24												126	156	156	438	
5-3	N	12	18	6	36	76	120	72	268				6	6												108	138	84	330	
	ENE					138	96	120	354	24			24													162	96	120	378	
	NE		12		12	90	12	90	192	6	24	36	66													96	48	124	270	
	Total	42	60	12	114	768	606	792	2166	48	138	108	294	6			6									864	402	712	2578	
	WSW					12	30	36	78	6	6	18	6				6									24	36	42	102	
	W					90	66	60	216	24	66	54	144	6	36		42									120	168	114	402	
	WNW						24	24	48	36	18	18	72													36	42	42	120	
5-4	WNW					24	30	18	72	90	72	78	240														114	102	96	312
	WNW					36	54	12	102	30	66	24	120													66	120	36	222	
	N					24	24	24	72	30	12		42													54	36	24	114	
	ENE					48	18	18	84	72	12	24	108													120	30	42	192	
	NE					24	6	18	48	36	30	48	114													60	36	66	162	
	Total					258	282	210	750	324	282	252	858	12	36		42									574	570	462	1674	
	WSW						6	6	6	18	24	6	48				6	6								18	36	12	66	
5-5	W					6	18	6	6	42	84	60	186	6	12		18									54	112	66	232	
	WNW					12	6		18	48	18	24	90	6			6									66	24	24	114	
	WNW									42	24	24	90													42	24	24	90	
	WNW									12	24	24	60													12	24	30	66	
	N									18		6	24													18		6	24	
	ENE									78	18	36	132													78	18	36	132	
	NE									18	18	12	48													18	18	12	48	
5-6	Total					18	18	12	48	276	210	192	678	12	18	6	36									306	276	210	792	
	WSW									12			12				6	6								12			6	
	W									6	24	12	42	12	12		24									18	36	12	66	
	WNW									18	6		24													18	6		24	
	WNW									12	18	48	78				18	18								12	18	66	96	
	WNW											36	36															36	36	
	ENE										18	6	24														18	6	24	
5-7	NE									12	6	6	24	6	6	6	18									18	12	12	42	
	Total									60	72	108	240	18	18	30	66									78	90	138	306	
	WSW																6									6			6	
	W										6		6	12		12	34									12	6	18	36	
	WNW													6	6	6	18									6	6	6	18	
	WNW										6		6	6	6	6	18									6	12	6	24	
	WNW											6	6													6		6	12	
5-8	N																												6	
	ENE																6	18	6	30						6	12		18	
	NE																6	18	6	30						6	18	6	30	
	Total										6	30	6	42	36	30	30	96	6		6	12				48	60	42	150	
	W										6	6	12	24		12	18	30			12	12				6	18	42	66	
	WNW													6	6		6											6	6	
	NE																6										6		6	
5-9	Total										6	6	18	30		18	30	48			12	12				6	24	60	90	
	W																6										6		6	6
	WNW																6										6		6	6
	WNW																6										6		6	6
	WNW																6										6		6	6
	NE																6	18	6	30						6	18	6	30	
	Total																12	6								6	6		6	6
5-10	W																												6	6
	WSW																												6	6
	W																												6	6
	WNW																												6	6
	WNW																												6	6
	WNW																												6	6
	Total																												6	6
5-11	W																												6	6
	WSW													</																

TABLE C-4
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION C, ERIE, PA
ICE-FREE PERIOD (1 APRIL - 30 NOV.)

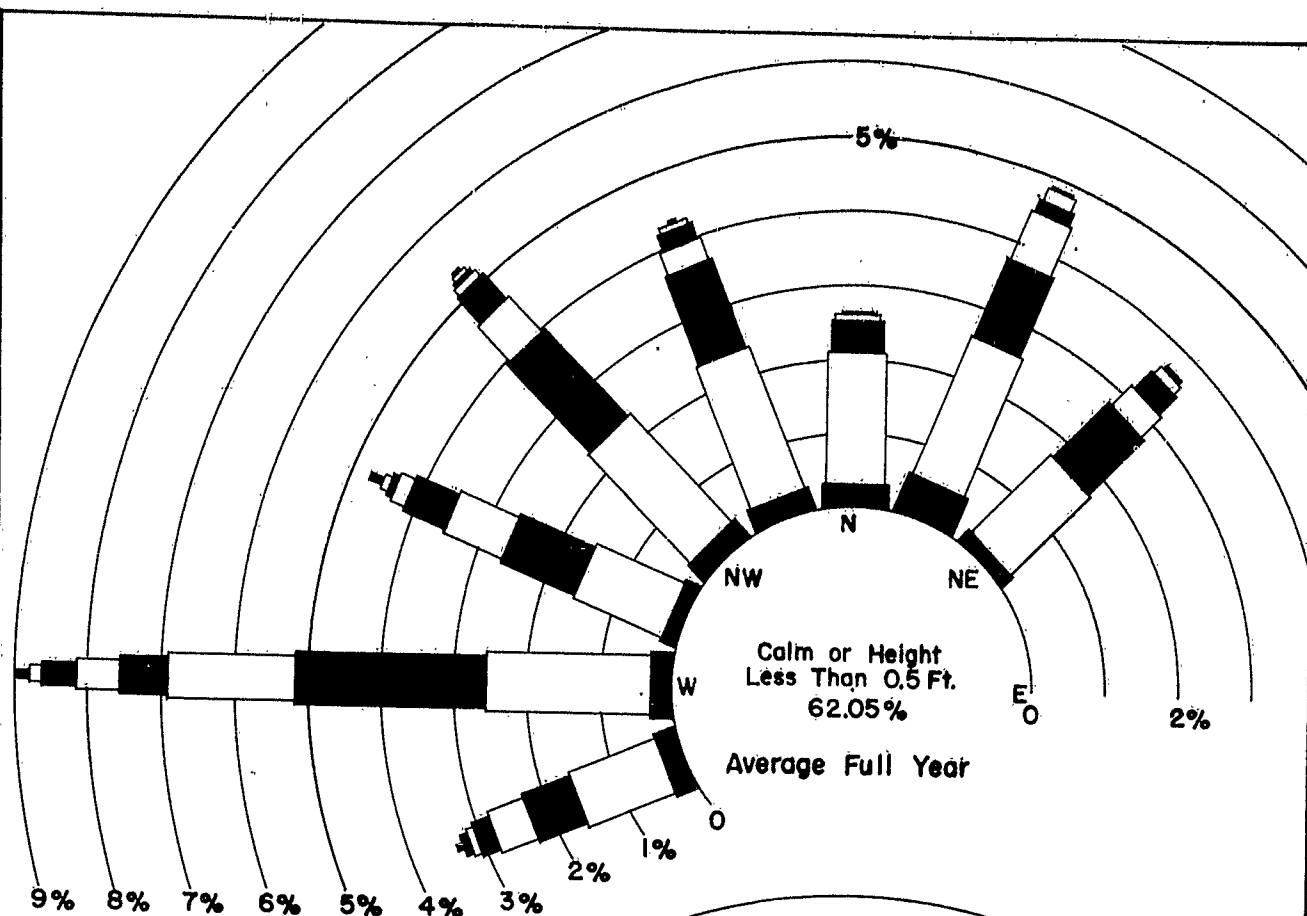
Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Height (feet)	Period						
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds
5-1	WSW	71	40				111
	W	71	40	28			139
	WNW	71	20				91
	NW	85	40				135
	NNW	83	61				144
	N	59	61				120
	NNE	155	121				276
	NE	71	40				111
	Total	676	423	28			1127
	WSW	44	2162	1243			3449
1-2	W		3443	1243	146		4832
	WNW	133	2162	565			2860
	NW	178	4724	226			5728
	NNW	133	5285	452			5870
	N	267	3843	113			4223
	NNE		4724	452			5176
	NE	89	2562	1243			3894
	Total	844	28905	5537	146		35432
	WSW		2835	937	104		4176
	W		7652	7496	2025		18173
2-3	NNW		1745	3748			5493
	NW		2617	12493			15110
	NNW		3708	6246			9954
	N		2617	2186			4803
	NNE		3053	5622			8675
	NE		1745	5234			7679
	Total		26172	46662	3229		74063
	WSW		415	4860	1578		6853
	W		1244	10833	2266		22443
	NNW		1244	9113	789		11146
3-4	NW			2113			2113
	NNW		415	6075			6490
	N			2430			2430
	NNE			13366			13366
	NE			4860			4860
	Total		3318	68650	4733		76701
	WSW			1788	1299		3287
	W			6959	5196		12155
	NNW			3977			3977
	NW			12924	3897		16821
4-5	NNW			5765			5765
	NNE			3977			3977
	NE			3977	3897		7874
	Total			3977	14289		54056
	WSW					2379	2379
	W			1466	7727	2379	11572
	NNW				5795		5795
	NW			1466	5795		7261
	NNW			2932			2932
	N			1466			1466
5-6	NNE			2932	1932		4864
	NE				9659		9659
	Total			10262	30908	4758	45928
	W			8063	13415	6630	28108
	NNW			2016	2683		4699
	NW				2683		2683
	NE				2683		2683
	Total			10079	21464	6630	38173
	W				3549		3549
	NNW				3549		3549
7-8	NW				3549		3549
	Total				10647		10647
	WSW					6707	6707
	W				9048	5634	14682
8-9	NNW				4524	5634	10158
	Total				13572	11268	31547
9-10	W					7011	7011
	WSW					17057	17057
10-11	TOTAL	1520	58818	178985	98988	46724	391742

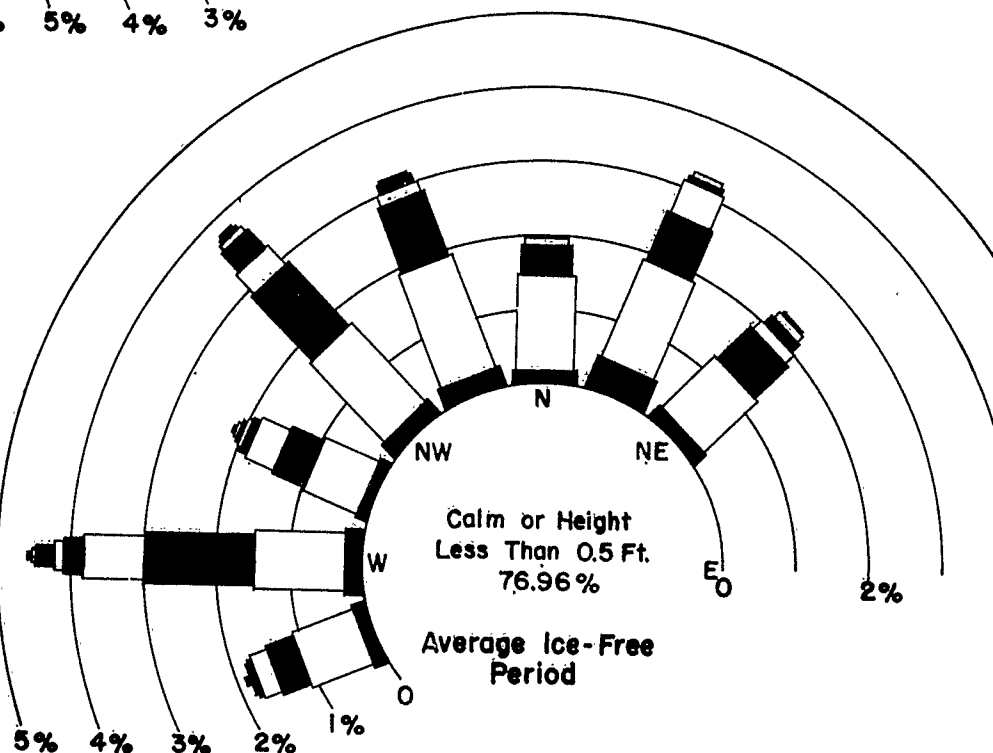
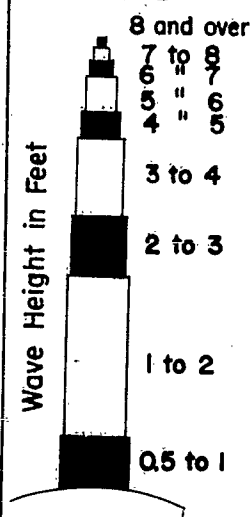
TABLE C-5
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION C, ERIE, PA.
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^4$. Height and period groupings include lower value but not the upper

Height (feet)	Period							
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	1-7 Seconds
5-1	WSW	83	81	28				192
	W	95	40	28				163
	NNW	95	20					115
	NW	119	40					159
	NNW	107	81					168
	N	107	101					208
	NNE	190	161					351
	NE	71	61					132
	Total	867	585	56				1508
	WSW	44	2883	2,147				5,074
1-2	W	44	5525	3,272	144			8992
	NNW	267	2963	1,582				4812
	NW	222	6326	565				7,113
	NNW	178	6646	452				7,276
	N	311	5525	113				5,749
	NNE	133	6245	904				7,282
	NE	133	3923	1582				5,638
	Total	1332	40,036	10,622	144			52,136
	WSW		4580	1,562	1,614			7,756
	W		12,432	14,679	4,439			31,550
2-3	NNW		3,272	10,619				13,891
	NW		4,144	16,553				20,697
	NNW		5234	9,682				14,916
	N		2,835	2,186				5,021
	NNE		3,708	10,619				14,327
	NE		3,053	10,619				13,672
	Total		39,258	76,519	6,053			121,830
	WSW		1,244	8,305	4,253			14,002
	W		2,903	30,377	12,151			45,431
	NNW		2,073	19,441	1,215			22,729
3-4	NW			17,618				17,618
	NNW		415	2,898				3,313
	N			2,430				2,430
	NNE			20,098				20,098
	NE		415	9,113				9,528
	Total		7050	115,430	17,619			140,099
	WSW			6,959	5,186			12,155
	W			15,907	16,888			32,795
	NNW			14,915	15,589			30,502
	NW			16,901	3,897			20,798
4-5	NNW			10,936				10,936
	NNE			7,954				7,954
	NE			8,942	5,116			14,058
	Total			83,512	46,766			130,278
	WSW			1,466	2,864	4,753		10,083
	W			11,728	23,182	14,258		49,168
	NNW			2,932	15,454			18,386
	NW			1,466	11,591			13,057
	NNW			5,864				5,864
	N			1,466				1,466
5-6	NNE			7,330	7,727			15,057
	NE			1,466	11,591			13,057
	Total			33,718	73,409	19,011		126,138
	WSW			2,016	8,049			10,065
	W			18,162	26,891	9,944		54,917
	NNW			2,016	8,049			10,065
	NW				5,366			5,366
	NNE				2,683			2,683
	NE				5,366			5,366
	Total			22,174	56,344	9,944		88,462
6-7	W				14,195	8,001		22,196
	NNW				10,647			10,647
	NW				7,098			7,098
	Total				31,940	8,001		40,241
	WSW					5,634	6,707	12,341
	W				9,048	5,634	13,413	28,095
	NNW				9,048	5,634		14,682
	NW				9,048			9,048
	NNW				9,048			9,048
	Total				36,192	16,902	29,120	73,214
7-8	W							
	WSW							
	W							
	NNW							
	NW							
	Total							
	W							
	WSW							
	W							
	NNW							
8-9	W							
	WSW							
	W							
	NNW							
	NW							
	Total							
	W							
	WSW							
	W							
	NNW							
9-10	W							
	WSW							
	W							
	NNW							
	NW							
	Total							
	W							
	WSW							
	W							
	NNW							
10-11	W							
	WSW							
	W							
	NNW							
	NW							
	Total							
	W							
	WSW							
	W							
	NNW							
12-13	W							
	WSW							
	W							
	NNW							
	NW							
	Total							
	W							
	WSW							
	W							
	NNW							
TOTAL	2,199	86,929	342,031	268,749	140,348	20,120	860,096	



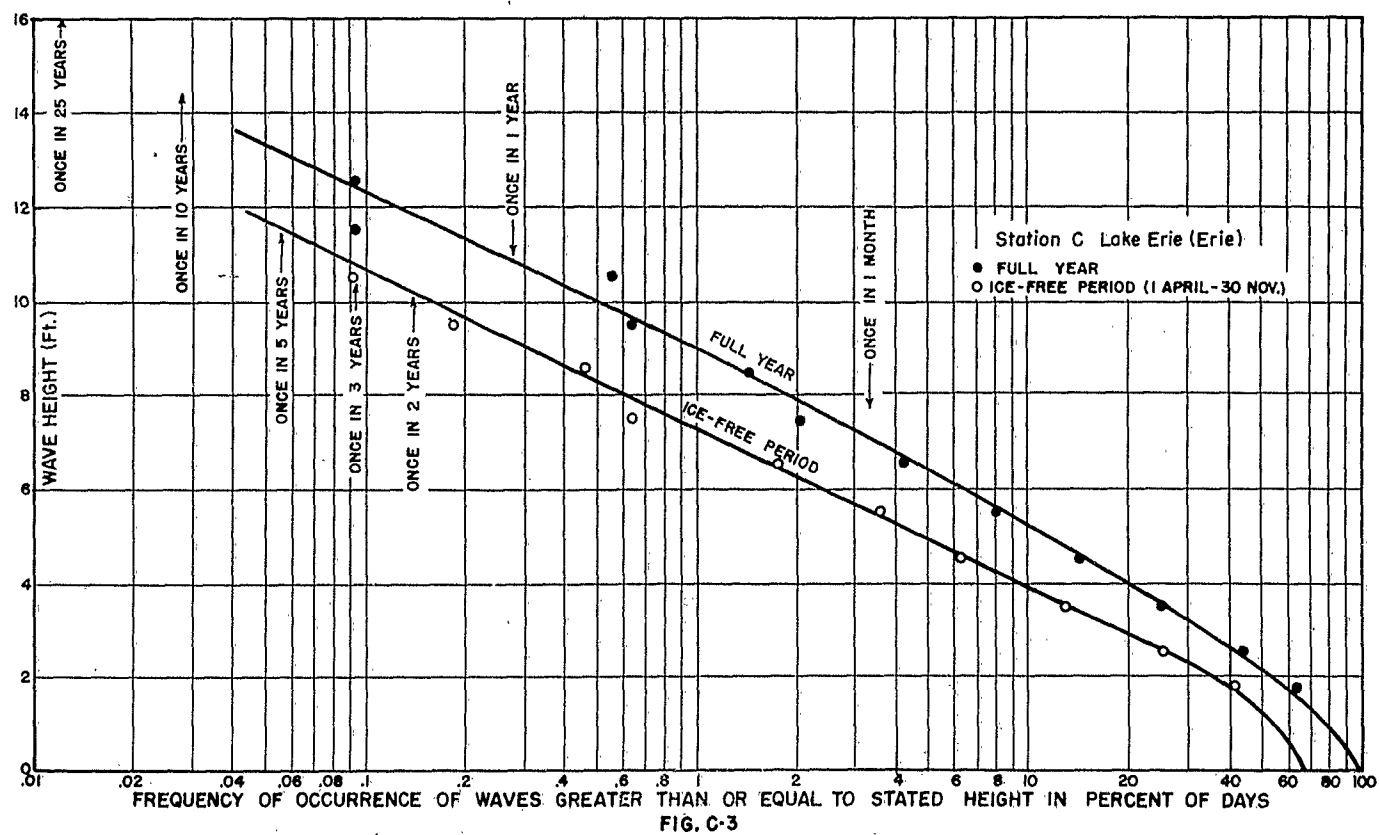
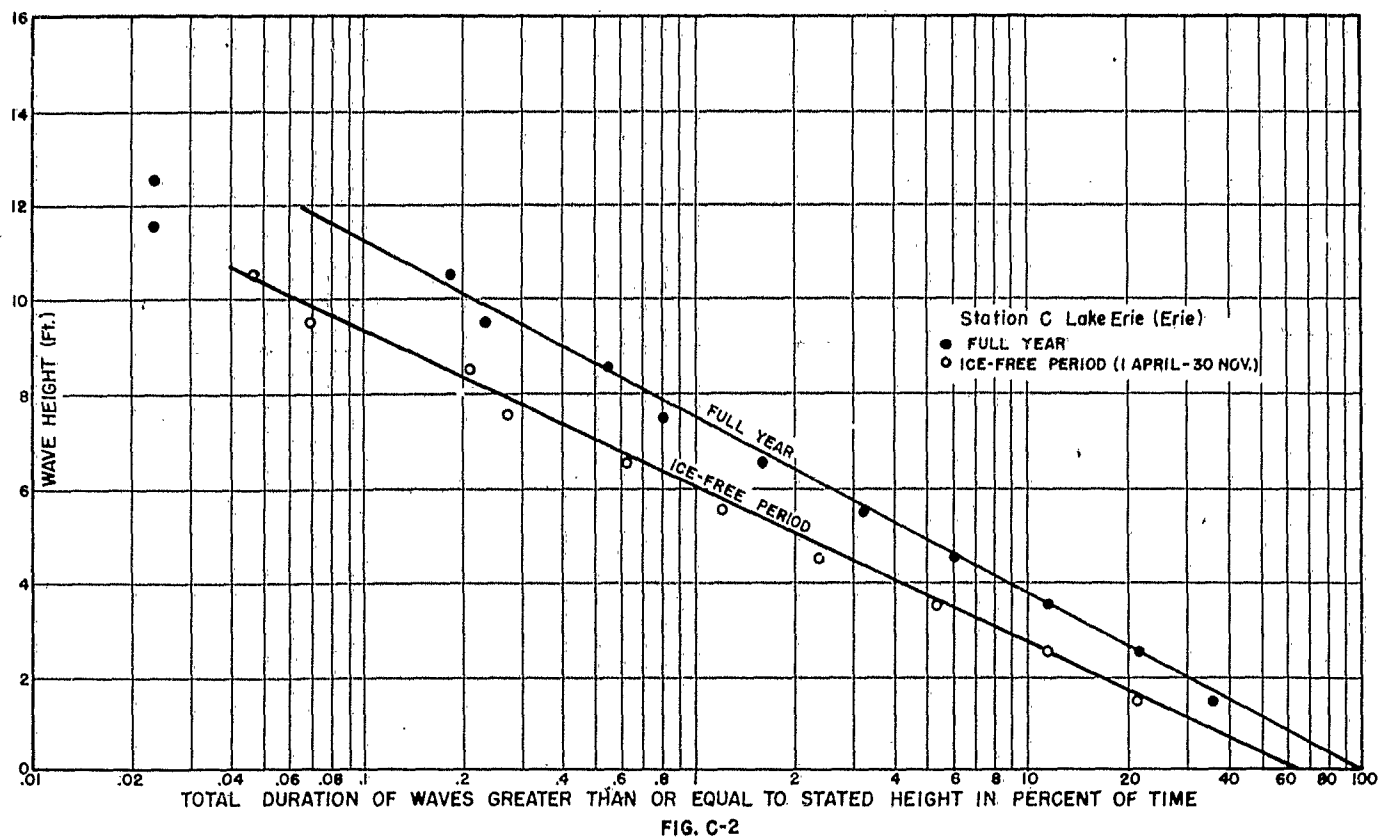
LEGEND

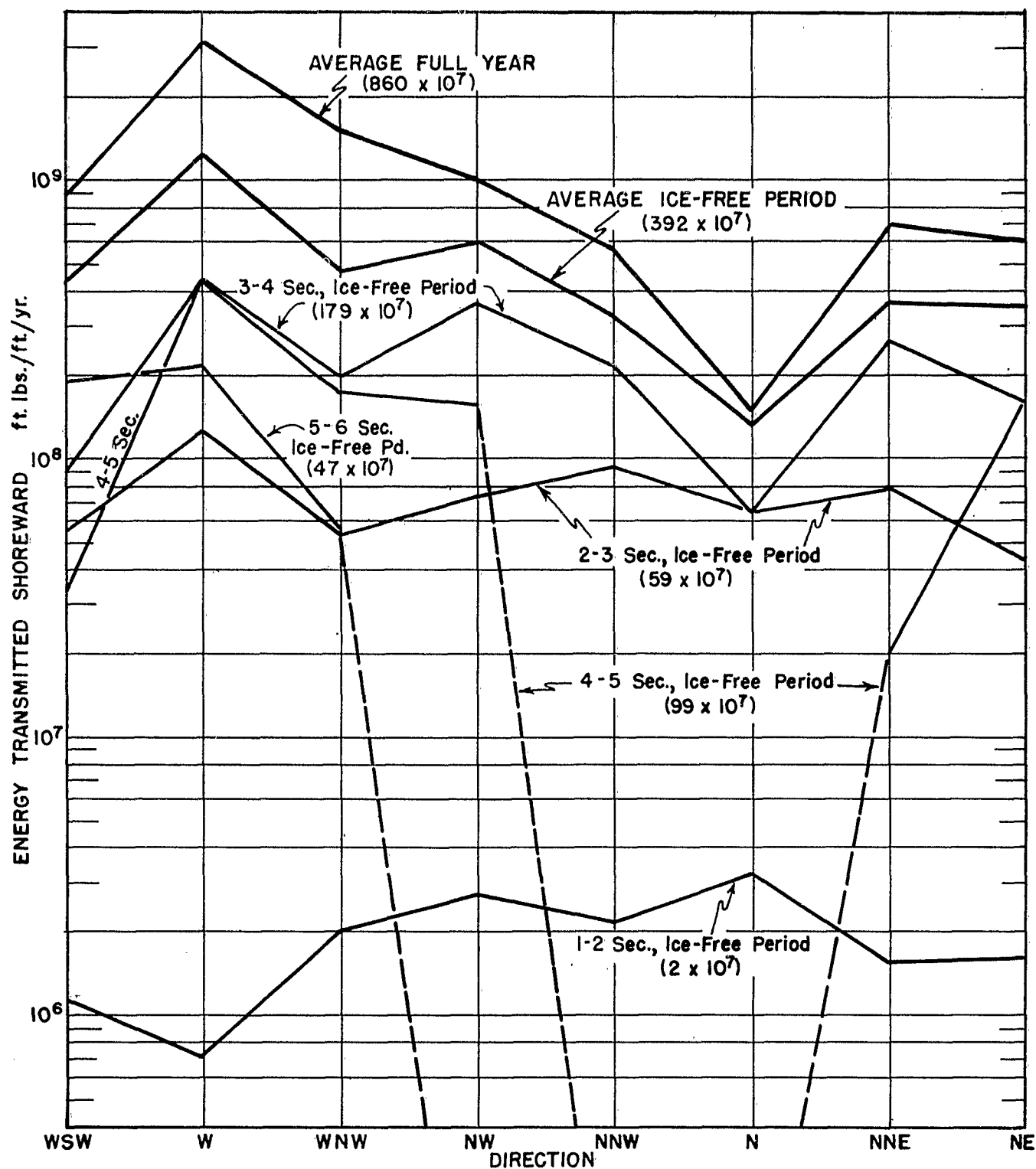


LAKE ERIE
STATION C (Erie)

WAVE ROSE SHOWING PERCENT OF TIME WAVES OF
DIFFERENT HEIGHT OCCUR FROM EACH DIRECTION

FIG. C-1





AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY.

LAKE ERIE - STATION C (Erie)

FIG. C-4

WAVE AND LAKE LEVEL STATISTICS

FOR

LAKE ERIE

APPENDIX D

WAVE STATISTICS

FOR

STATION D

BUFFALO, NEW YORK

TABLE D-1

JANUARY

[illegible]

FEBRUARY

FEBRUARY																															
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				P 1-7 Seconds					
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total		
AS-1	SW				6				6																						
	WSW	6			6																					6			6		
	W	12	6	6	24																					6			6		
	Total	18	6	6	30	6			6																	12	6	6	24		
1-2	WSW	6			6	12	6	18	6	6	6	18														24	6	6	36		
	W	12			12	18	12	18	48	6	6		12													12	18	12	42		
	Total	18			18	30	24	36	66	12	12	6	30													36	30	24	96		
	SW					12		12		18		18																			
2-3	WSW					24	6	30	6	6	12	24	6				6										30			30	
	W					6	18	6	30	12	12	24														12	30	18	60		
	Total					6	34	12	72	18	36	12	66	6			6									30	90	24	144		
	SW									12		12																			
3-4	WSW					6	6	12	6	6	24				6	6											12	6	18	36	
	W							12	6	42	60		6		6	12										12	6	18	36		
	Total					6	6	24	12	48	84		6		12	18										30	12	48	108		
	SW									12		12																			
4-5	WSW								6	12	18	36		6	12	18	6				6						12	18	30	60	
	W								12	12	24	48		12	6	18										12	24	30	66		
	Total								30	24	42	96		18	18	36	6				6					36	42	60	138		
	WSW								6	6		12	6			6											12	6		18	
5-6	W								6	12		18	12	6	6	24	6	6			12						24	24	6	54	
	Total								12	18		30	18	6	6	30	6	6			12					36	30	6	72		
	SW												6			6										6			6		
	WSW												12			12		6			6	6				6	18		24		
6-7	W								6	6	6	6	12		6	6		6			6	6				12	12		24		
	Total								6	6	6	12	18		12	18		12	6		12	6				24	30		54		
	SW													6			6									6			6		
	WSW													12			12				6	6				6	18		24		
7-8	W												6	6		6										6			6		
	Total												6	6		12										6	6		12		
	SW													6	12		18									6	12		18		
	Total	36	6	6	48	30	78	42	150	96	108	108	312	54	54	36	144	24	18		42	6				6	24	264	132	702	
CALM TOTAL HOURS																												450	408	480	1338
																												696	672	672	2040

TABLE D-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
Duration given in hours. Height and period groupings include lower value but not the upper.
MARCH

MARON

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	SW																												
	W		6	6	12																						6	6	
	TOTAL		6	6	12																						6	12	
1-2	SW					36			72																		42	6	
	WSW					6	6	6	18	6			6													12	6	36	
	TOTAL	6	6		12	42	12	12	66	12	6	6	12													24	12	78	
2-3	SW					18	12		30	12	6		18														30	18	
	WSW					12	18	6	36	6	12		18														18	36	
	TOTAL	6	6		12	30	30	12	72	18	18	18	54														48	54	
3-4	SW									12	12		24														12	12	
	WSW									18	18		36														30	24	
	TOTAL									30	30		60														42	36	
4-5	SW									12	12		24														12	12	
	WSW									18	18		36														30	24	
	TOTAL									30	30		60														42	36	
5-6	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
6-7	SW									12	12		24														12	12	
	WSW									18	18		36														30	24	
	TOTAL									30	30		60														42	36	
7-8	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
8-9	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
9-10	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
10-11	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
12-13	SW																												
	WSW									12	12		24														12	12	
	TOTAL									24	24		48														24	24	
TOTAL		6	12	6	24	54	72	72	198	108	168	102	378	54	30	78	162	6	24	18	48					18	18	228	330

CALM.
TOTAL HOURS

516 412 450 1380
774 276 774 2232

APRIL

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				7-8 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
0.5-1	SW	6			6																				
	WSW					24	6	6	36			6	6									24	12	6	42
	W			12	12	30	6	12	48	12	12	12	36									42	18	36	96
	TOTAL			12	12	54	12	18	84	12	18	12	42									66	30	42	138
1-2	SW							12	12															12	12
	WSW					24	12	6	42	18	12		30								42	24	6	72	
	W						18	36		6	6	12										24	24	48	
	TOTAL					24	30	36	90	18	18	6	42								42	48	42	132	
2-3	SW																								
	WSW																								
	W																								
	TOTAL																								
3-4	SW																								
	WSW																								
	W																								
	TOTAL																								
4-5	SW																								
	WSW																								
	W																								
	TOTAL																								
5-6	SW																								
	WSW																								
	W																								
	TOTAL																								
6-7	SW																								
	WSW																								
	W																								
	TOTAL																								
7-8	SW																								
	WSW																								
	W																								
	TOTAL																								
8-9	SW																								
	WSW																								
	W																								
	TOTAL																								
9-10	SW																								
	WSW																								
	W																								
	TOTAL																								
TOTAL		6		12	18	84	42	54	180	66	84	66	216	48	36	42	126	42	6	48	204	204	180	588	
CALM TOTAL HOURS																									

MAY

		MAY																												
Period		1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				1-7 Seconds				
HEIGHT (FEET)		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
5-5.5	WSW	6			6																					6			6	
	SW					18			18																					
	WSW					6	12	18	36		6		6													6	18	18	42	
1-2	W					12	6	6	24																	12	6	6	24	
	Total					36	18	24	78		6		6													36	24	24	84	
2-3	WSW					6	6	6	18					30			30									6	36	6	48	
	W					24		12	36		12	6	18													24	12	18	54	
	Total					30	6	18	54		12	6	18	30			30									30	48	24	102	
3-4	WSW									6	30	6	42	12	6		18									6	42	12	60	
	W									18	6		24													18	6		24	
	Total									24	36	6	66	12	6		18									24	48	12	84	
	SW									6			6													6			6	
4-5	WSW										30	6	36							24		24					54	6	60	
	W									18		6	24				6									18		12	30	
	Total									24	30	12	66				6	6		24		24				24	54	12	86	
5-6	WSW													6			6			6	6						6	6	12	
	W																									6			6	
	Total													6			6				6	6				6	6	6	18	
	WSW										12	6	18		6	6	12			6		6					24	12	36	
6-7	W									6			6	6		12	18									12		12	24	
	Total									6	12	6	24	6	6	12	30			6		6				12	24	24	60	
7-8	WSW													12	12	24														
8-9	W																			6		6				6			6	
9-10	W													6							6					6			6	
10-11	WSW																				6					6			12	
11-12	WSW																					6	6			6			6	
TOTAL		6			6	66	24	42	132	60	96	30	186	12	66	42	120	6	30	18	54				6	6	150	216	138	504
CALM																														
TOTAL HOURS																														

JUNE

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				1-6 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
05-1	SW	6			6																	6			6	
	NSW			6	6																			6	6	
	W	6		18	24																	6		18	24	
	TOTAL	12		24	36																	12		24	36	
1-2	SW					18	6		24													18	6		24	
	NSW		6		6	12	24	42	78	6	6	18	30									18	36	60	114	
	W	6	6		12	30	12	24	66			6	6									36	18	30	84	
	TOTAL	6	12		18	60	42	66	168	6	6	24	36									72	60	90	222	
2-3	SW					12	18		30	6	12		18									18	30		48	
	NSW					6	18	12	36	6	24	12	42	12	6	6	24					24	48	30	102	
	W					6		12	18		12	6	18									6	12	18	36	
	TOTAL					24	36	24	84	12	48	18	78	12	6	6	24					48	90	48	186	
3-4	SW					6		6	6	12		18										12	12		24	
	NSW					12		6	18	12	30	18	60					12				12	36	30	24	
	W							6	18		6	30	36										6	30	36	
	TOTAL					18		6	24	18	48	48	114					12				12	48	48	54	
4-5	SW									18	6		24									18	6		24	
	W									6		6										6			6	
	TOTAL									24	6		30									24	6		30	
	5-6	NSW									6	6		12	6		6						12	6		18
6-7	NSW									6			6									6			6	
	TOTAL	18	12	24	54	102	78	96	276	72	114	90	276	18	6	6	30	12				12	222	210	216	648
	CALM																									
	TOTAL HOURS																						498	510	504	1512
																							720	720	720	2160

TABLE D-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
Duration given in hours. Height and period groupings include lower value but not the upper.

		JULY																			
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	SW		6		6														6		6
	WSW			6	6															6	6
	W		6	6	12														6	6	12
	Total		6	6	12														6	6	12
1-2	SW		6	6	12	12	6	6	24									12	12	12	36
	WSW			18	18	12		6	18	6			6					18	12	24	54
	W	6		6	12	24	18	30	72		6		6					30	24	36	90
	Total	6	6	24	42	42	24	42	114	6	6		12					60	36	72	168
2-3	SW					12			12	6	12		18					18	12		30
	WSW					12	18	6	36	18	6	6	50					30	24	12	66
	W					18	12	18	48	12		12	24					30	12	36	72
	Total					42	30	24	96	36	18	18	72					78	48	60	168
3-4	SW									6	6	12						6	6	6	12
	WSW									24	18	32						24	18		42
	W									24	6		30					24	6		30
	Total									48	24	42						48	24	6	78
4-5	WSW									6	12	6	24		6		6	6	18	6	30
	W									6			6					6			6
	WSW									12	12	6	30		6		6	12	18	6	36
	Total									12	12	6	30		6		6	12	18	6	36
5-6	WSW											6	6							6	6
	W									6			6					6			6
	WSW									6		6	12					6		6	12
	Total									6		6	12					6		6	12
TOTAL		6	12	36	54	90	54	66	210	66	36	210		6			6	24	138	120	280
CALM																		540	600	600	1740
TOTAL HOURS																		744	744	744	2232

		AUGUST																			
HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
.5-1	WSW		6	6	12														6	6	12
	W	6			6	24			24									30			30
	Total	6	6	6	18	24			24									30	6	6	42
	SW	12	12		24	18			18									30	12		42
1-2	WSW	6	12		18	6	12	60	78	6		6	12					18	24	66	108
	W	30	6		36	54	6	12	72									84	12	12	108
	Total	48	30		78	78	18	72	168	6		6	12					132	48	78	258
	SW					12	6		18	18			18					30	6		36
2-3	WSW					6	6	18	30	6		6	12					12	6	24	42
	W					24		12	36	36		18	54					60		30	90
	Total					42	12	30	84	60		24	84					102	12	54	168
	SW									18			18	6			6	24			24
3-4	WSW									12			12	6			6	18			18
	W									18		12	30				18			12	30
	Total									48		12	60	12			12	60		12	72
	WSW									12	6		18				12	6			18
TOTAL		54	36	6	96	144	30	102	276	126	6	42	174	12			12	536	72	150	558
CALM																		408	672	594	1674
TOTAL HOURS																		744	744	744	2232

TABLE D-1
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
Duration given in hours. Height and period groupings include lower value but not the upper.
SEPTEMBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
1-1	SW			6	6															6	6
	WSW		12		12														12		12
	W		6		6				6									6	6		12
	Total		18	6	24				6									6	18	6	30
1-2	WSW					6	36	6	48	6	18		24					12	54	6	72
	W					24	18	18	60		6		6					24	24	18	66
	Total					30	54	24	108	6	24		30					36	78	24	138
	SW						6	6	6		6		6					6		6	12
2-3	WSW					12	12	6	30		6		6			12	12	12	18	18	48
	W					18	6	6	30		30	6	36					18	36	12	66
	Total					30	18	18	66	6	36	6	48			12	12	36	54	36	126
	WSW					6	6		12	12	12		24					18	18		36
3-4	W					6		6	12		12	18	30					6	12	24	42
	Total					12	6	6	24	12	24	18	54					24	30	24	78
	WSW									6	6	12	6				6	6	6	6	18
	W										6		6		6		6	6	12		12
4-5	Total									12	6	18	6	6		12	6	18	6	6	30
	WSW													6			6	6			6
	W														6		6	6			6
	Total													6	6		12	6	6		12
5-6	WSW																				6
	W																	6			6
	Total																	6	6		12
	WSW											6	6							6	6
6-7	W																			6	6
	Total											6	6							6	6
	WSW																			6	6
	W															6	6				12
7-8	WSW																			6	6
	W															6	6		6		6
	WSW																				6
	W																				6
10-11	WSW																				6
	W																				6
	WSW																				6
	W																				6
TOTAL		18	6	24	78	78	48	204	24	96	36	156	12	18	24	54	114	210	114	438	
	CALM																	606	510	606	1722
	TOTAL HOURS																	720	720	720	2160

OCTOBER

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				1-5 Seconds			
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total
1-2	SW						36	36	72										36	36	72
	WSW					6	30	12	48									6	30	12	48
	W					18	12	54	84		6	6	12					18	18	60	96
	Total					24	78	102	204		6	6	12					24	84	108	216
2-3	SW					12	24	36			6							12	30		42
	WSW					12		6	18			12	12					12		18	30
	W					6	6	42	54	12		24	36					18	6	66	90
	Total					18	18	72	108	12		42	54					30	18	114	162
3-4	SW					6			6			18	18					6		18	24
	WSW						6		6				6					6	6		12
	W									18	12	30							18	12	30
	Total					6	6		12	6	18	30	54					12	34	30	66
4-5	SW										6		6								6
	W										6	6	12						6	6	12
	Total										6	6	18						6	6	18
5-6	SW																	6			6
	W										6	6	12					6	6	6	18
	Total										6	6	18					6	6	6	18
6-7	SW																				
	W															12	12			12	12
	Total															12	12			12	12
7-8	SW													6	6		12	6	6		12
10-11	W													6	6		12	6	6		12
	TOTAL					48	102	174	324	24	96	90	162	12	12	12	36	84	162	276	522
	CALM																	660	582	660	1710
	TOTAL HOURS																	720	720	720	2160

TABLE D-1

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
Duration given in hours. Height and period groupings include lower value but not the upper.

NOVEMBER

CALM	TOTAL HOURS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

DECEMBER

CALM
TOTAL HOURS

TABLE D-2
STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
FULL YEAR
Duration given in hours. Height and period groupings include lower value but not the upper.

HEIGHT (FEET)	Period	1-2 Seconds				2-3 Seconds				3-4 Seconds				4-5 Seconds				5-6 Seconds				6-7 Seconds				7-8 Seconds				
		1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	1948	1949	1950	Total	
0.5-1	SW	12	6	6	24	6		6	12				6												18	6	12	36		
	WSW	12	18	30	60			6	6				6												18	18	36	72		
	W	36	24	36	96	30			30																66	24	36	126		
	Total	60	48	72	180	36		12	48	6			6												102	48	84	234		
1-2	SW	18	18	6	42	96	84	48	228				6												114	108	54	276		
	WSW	12	18	24	54	126	174	222	522	48	48	48	144	6	12		18								192	252	294	738		
	W	60	30	18	108	282	168	288	738	36	78	48	162												378	276	354	1008		
	Total	90	66	48	204	504	426	558	1488	84	132	96	312	6	12		18								684	636	702	2022		
2-3	SW					66	60	42	168	60	48	12	120												126	108	54	288		
	WSW					96	162	90	348	66	84	90	240	24	72	30	126								186	318	210	714		
	W					156	90	174	420	150	144	150	444												306	234	324	864		
	Total					318	312	306	936	276	276	252	804	24	72	30	126								418	642	588	1664		
3-4	SW					12			12	42	30	30	102	12			12								66	30	30	126		
	WSW					36	24	12	72	138	156	66	360	30	54	18	102	12	6		18				216	240	96	552		
	W					12	6	18	36	132	150	156	438	12		18	30								156	156	192	504		
	Total					60	30	30	120	312	336	252	900	54	54	36	144	12	6		18				438	426	318	1182		
4-5	SW									48		12	60												48		12	60		
	WSW									84	126	60	270	18	36	12	66	6	60	6	72				108	222	78	408		
	W									72	144	96	312	24	42	18	84								96	186	114	396		
	Total									204	270	168	642	42	78	30	150	6	60	6	72				252	408	204	864		
5-6	SW									6		6	12	6			6	12							12		12	24		
	WSW									18	12	24	54	48	36	12	96	12	24	12	48		6	12	18	78	78	60	216	
	W									42	24	18	84	30	84	54	168	6	6		12				78	114	72	264		
	Total									66	36	48	150	84	120	72	276	18	30	12	60		6	12	18	168	192	144	504	
6-7	SW									12	12		24	6			6	12							6	18	18	6	42	
	WSW									30	30	30	90	24	36	18	78		12		12	12			12	66	78	48	192	
	W									6	18	24	48	60	30	72	162	6			6				72	48	96	216		
	Total									48	60	54	162	90	66	96	258	6	18		24	12			12	156	144	150	450	
7-8	SW													6	6		12								6	6		12		
	WSW													12	18	12	42		18		6			6	12	18	36	18	72	
	W													24	18		42		6		6				24	24		48		
	Total													42	42	12	96		24		24	6		6	12	48	66	18	132	
8-9	WSW													18		18	36	6	6		12				12	12	24	6	30	60
	W													6	12	12	30	6	6	6	18				12	18	18	48		
	Total													24	12	30	66	12	12	6	30				12	36	24	48	108	
	WSW														6	12	18									6		12	18	
9-10	W													24	6		30		6	24	30				24	12	24	60		
	Total													24	12	12	48		6	24	30				24	18	36	78		
	WSW													6		6	12	6	12	12	30		6		6	12	18	18	78	
	W													12	6	6	24			6	6				12	6	12	30		
10-11	Total													18	6	12	36	6	12	18	36		6		6	24	24	30	78	
	WSW																	6		6	6				6	12	12		6	18
	W																		6	6									6	6
	Total																			6	6					6	12	12		6
11-12	WSW																													
	W																													
	Total																													
	WSW																													
12-13	W																													
	Total																													
	WSW																													
	W																													
13-14	Total																													
	WSW																													
	W																													
	Total																													
14-15	WSW																													
	W																													
	Total																													
	WSW																													
15-16	W																													
	Total																													
	WSW																													
	W																													
16-17	Total																													
	WSW																													
	W																													
	Total																													
TOTAL	SW	150	114	120	384	918	768	906	2592	776	1110	870	2756	448	474	330	1252	72	168	84	324	24	12	48	84	2568	2646	2358	7572	
	WSW																													
	W																													
	Total																													
CALM	SW																													
	WSW																													
	W																													

STATISTICAL HINDCAST DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
(ICE-FREE PERIOD (1 APRIL - 30 NOV.)

4362	4404	4440	13206
5856	5856	5856	17568

TABLE D-4

STATISTICAL ENERGY DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.

ICE-FREE PERIOD (1 APRIL - 30 NOV.)

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Height (feet)	Period						
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds
.5-1	SW	48					48
	WSW	83		28			111
	W	95	101				196
	Total	226	101	28			355
1-2	SW	267	2082				2349
	WSW	312	5285	1582	145		7324
	W	534	6245	1808			8587
	Total	1113	13612	3390	145		18260
2-3	SW		4144	3436			7580
	WSW		8942	8433	6456		23831
	W		10905	11868			22773
	Total		23991	23737	6456		54184
3-4	SW		829	6683	789		8301
	WSW		3318	24300	8677	2901	39196
	W		1,244	23,086	789		25,119
	Total		5,391	54,069	10255	2901	72,616
4-5	SW			1,988			1,988
	WSW			27,837	5,194	12,780	45,813
	W			15,907	7795		23,702
	Total			45,732	12991	12,780	71,503
5-6	SW			1,466	1,932		3,398
	WSW			5,864	15,454	11,896	33,214
	W			7330	5,795		13,125
	Total			14,660	23,181	11,896	49,737
6-7	SW			4,032	2,683	3,315	10,030
	WSW			16,126	16,099	3,315	35,540
	W			8,063	32,197		40,260
	Total			28,221	50,979	6,630	85,830
7-8	SW				7,098		7,098
	WSW				14,195	13,202	37,858
	W				7,098		7,098
	Total				28,391	13,202	52,054
8-9	SW					6,707	6,707
	WSW					16,901	16,901
	W					16,901	33,802
	Total					33,608	50,509
9-10	SW				11,203	21,032	32,235
	WSW				6,779	34,114	40,893
	W				13,559		13,559
	Total				20,338	55,146	86,687
10-11	SW						
	WSW						
	W						
	Total						
11-12	SW						
	WSW						
	W						
	Total						
TOTAL		1339	43,095	169,837	163,939	118,456	527,032

TABLE D-5
STATISTICAL ENERGY DATA FOR LAKE ERIE STATION D, BUFFALO, N. Y.
FULL YEAR

Energy given in foot-pounds per foot of crest per year $\times 10^{-4}$. Height and period groupings include lower value but not the upper

Height (feet)	Period							
	Dir.	1-2 Seconds	2-3 Seconds	3-4 Seconds	4-5 Seconds	5-6 Seconds	6-7 Seconds	1-7 Seconds
1-5	SW	48	40					88
	WSW	119	20	28				167
	W	180	101					291
	Total	357	161	28				546
1-2	SW	312	3,093	113				3,468
	WSW	401	6,966	2,712	437			10,516
	W	801	9,849	3,051				13,701
	Total	1514	19,858	5,876	437			27,685
2-3	SW		6,107	6,247				12,354
	WSW		12,650	12,493	8,474			33,617
	W		15,267	23,112				38,379
	Total		34,024	41,852	8,474			84,350
3-4	SW		827	10,328	1,578			12,735
	WSW		4,776	76,452	13,410	2,901		57,739
	W		2,488	44,350	3,944			50,782
	Total		8,293	91,130	18,932	2,901		121,256
4-5	SW			9,942				9,942
	WSW			44,737	14,290	19,171		78,200
	W			51,698	18,187			69,885
	Total			106,377	32,477	19,171		158,027
5-6	SW			2,932	3,864			6,796
	WSW			13,194	30,909	19,034	8,461	71,598
	W			20,523	52,021	4,759		77,373
	Total			36,649	84,864	23,793	8,461	157,767
6-7	SW			8,063	5,366	3,315		16,744
	WSW			30,237	34,880	6,630	7,867	79,616
	W			16,126	72,443	3,315		91,884
	Total			54,426	112,689	13,260	7,867	188,244
7-8	SW				7,098			7,098
	WSW				24,842	13,202	10,461	48,505
	W				24,842	4,401		29,243
	Total				56,782	17,603	10,461	82,846
8-9	WSW				27,193	11,267	13,413	51,823
	W				22,619	16,901		39,520
	Total				49,762	28,168	13,413	91,343
	WSW				16,805			16,805
9-10	W				28,008	35,054		63,062
	Total				44,813	35,054		79,867
	WSW				13,559	42,643	12,198	68,400
	W				27,118	8,527		35,647
10-11	Total				40,677	51,172	12,198	104,047
	WSW					10,182	24,396	34,578
	W					10,182		10,182
	Total					20,364	24,396	44,760
12-13	WSW					11,269		11,269
	WSW					13,885		13,885
	W					18,077		18,077
	WSW					47,517		47,517
TOTAL		1871	62,336	336,390	453,907	255,417	126,315	1,236,106

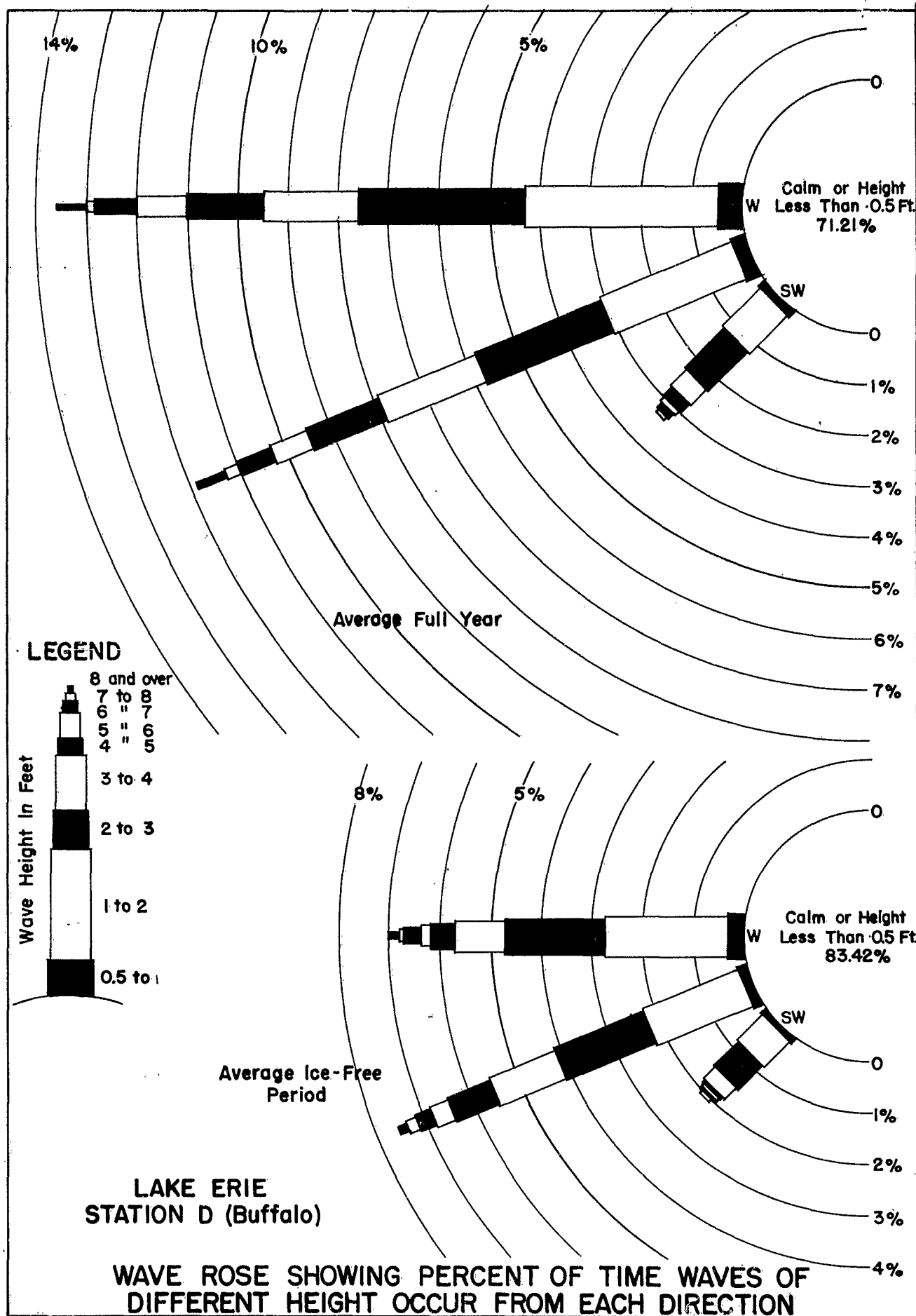


FIG. D-I

D-II

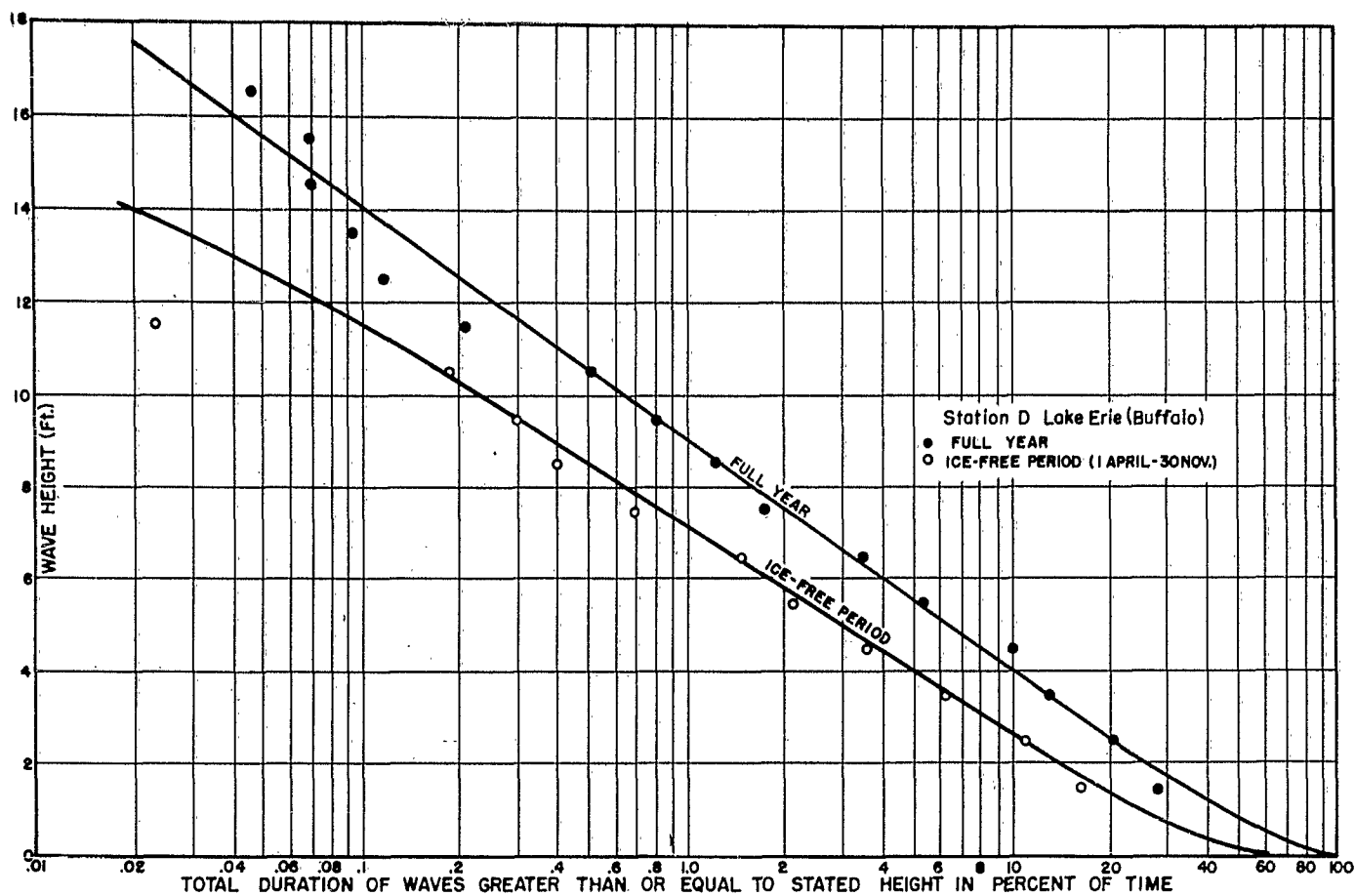


FIG. D-2

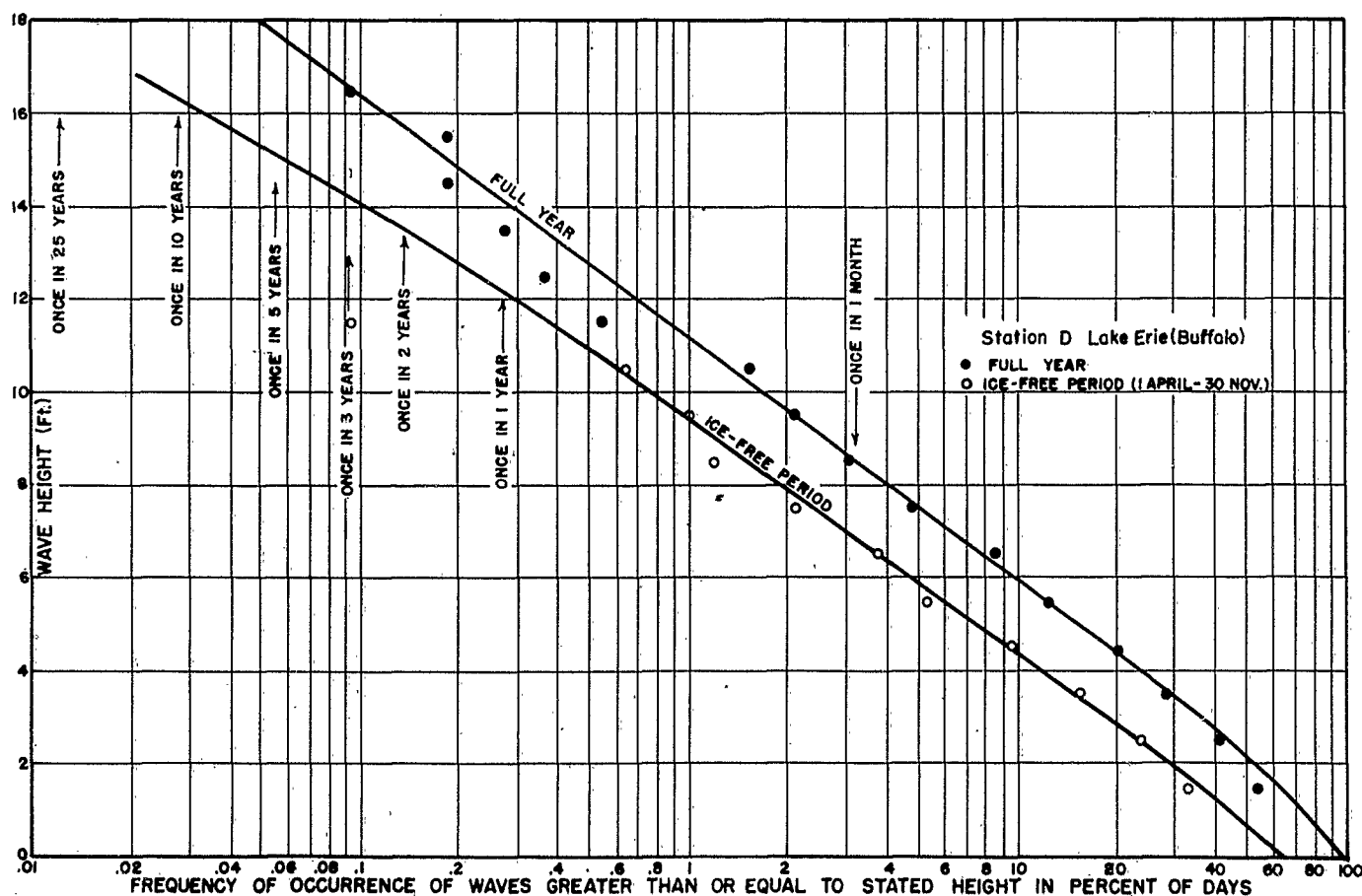
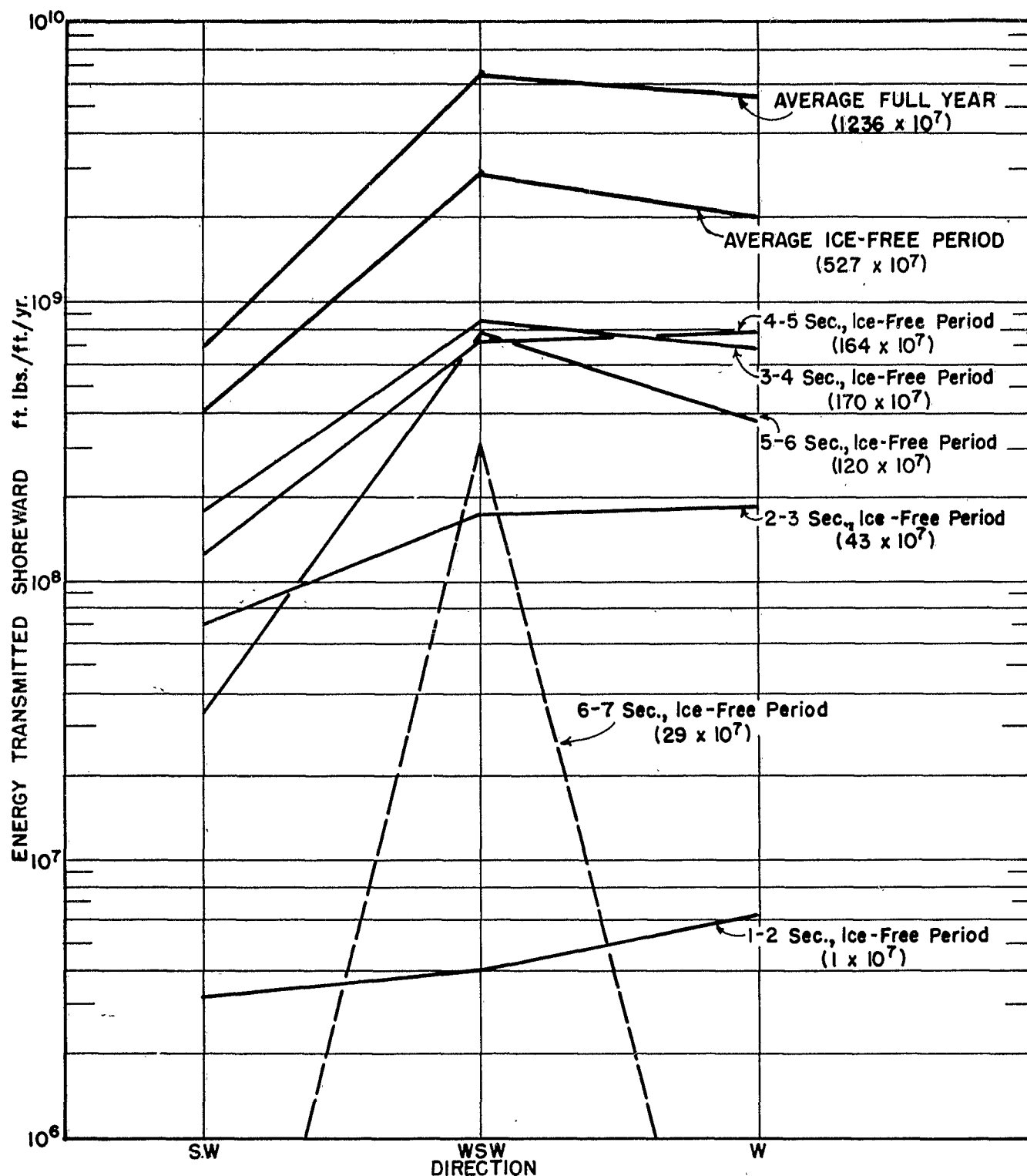


FIG. D-3



AVERAGE AMOUNT OF ENERGY TRANSMITTED SHOREWARD PER FOOT OF CREST LENGTH PER YEAR, IF WAVE SYSTEM IS CONSIDERED AS AN HYPOTHETICAL UNIFORM SYSTEM COMPOSED OF WAVES OF SIGNIFICANT HEIGHT AND PERIOD ONLY.

LAKE ERIE - STATION D (Buffalo)

FIG. D-4