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Environmental Research Laboratories

Lake Michigan Beginning-of-Month Water Levels and Monthly Rates of Change of Storage

FRANK H. QUINN

BOULDER, COLO.
MARCH 1975

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LAKE MICHIGAN BEGINNING-OF-MONTH WATER LEVELS AND MONTHLY RATES OF CHANGE OF STORAGE

Frank H. Quinn

This report describes the results of a study of Lake Michigan beginning-of-month water levels and monthly changes of storage. The study established that the number and distribution of water level gages in the presently existing gage network is adequate for the computation of beginnning-of-month water levels. Computed beginning-of-month water levels and changes of storage for the period 1900-1972 are listed for use in scientific and planning studies.

1. INTRODUCTION

A study of the Lake Michigan beginning-of-month water levels was undertaken to provide information necessary for lake studies concerning hydrology, beach and shore erosion, navigation, and hydro-electric power and lake regulation. The monthly changes of storage which are computed from the beginning-of-month levels from two consecutive months are utilized in water budget studies such as the determination of lake evaporation rates and net groundwater influx into the lakes.

Initial consideration was given to the 1950-1970 time base since it contains a sufficient number of water level gages to analyze the effect of the gage network size on the beginning-of-month level computations. This period is also significant as it includes the modern record high lake levels of 1952 as well as the record lows of 1964.

The Thiessen polygon procedure was used to compute the beginning-of-month lake levels. This is the technique commonly used by hydrologists to obtain a weighted average (a representative basin value) of point source measurements of precipitation within a basin. The Thiessen polygon procedure provides a better overall representative lake level than straight averaging and at the same time standardizes a procedure for computing these levels.

Results of the initial study revealed that the Thiessen polygon procedure was adequate and should be used in quantifying the data for the years prior to 1950, i.e., for the 1900-1949 period. Further, it showed that the presently existing gage network is adequate for updating the data in the future. Therefore, this report has quantified beginning-of-month levels and rates of change of lake storage data for the period of 1900-1972 as presented in section 3.

2. METHODOLOGY

The beginning-of-month water levels for Lake Michigan were computed using a water level gage network located on the periphery of the Lake. Ideally, these beginning-of-month levels should represent the instantaneous levels at the beginning of the months. Practically, however, representative instantaneous true water levels are difficult, if not impossible, to measure because of the effect of short-term fluctuations in wind speed and direction and changes in atmospheric pressure over very small time periods. These fluctuations could cause considerable error in computing a true instantaneous level for the Lake. This error is lessened by specifying that the beginning-of-month level for each gage shall be equal to the average of the daily mean water levels of the first day of the month and the last day of the previous month.

The computations procedure was set forth by Quinn (1971) and consists of applying weighting factors to each water level gage in the network. The weighting factors were computed from Thiessen polygon networks drawn from the various water level gage networks. This is expressed mathematically as

$$L_o = W_1L_1 + W_2L_2 + W_3L_3 + \ldots\ldots + W_nL_n$$

$$\text{for } W_1 + W_2 + W_3 + \ldots\ldots W_n = 1.0$$

where L_o is the weighted Lake Michigan beginning-of-month water level,
L_1-L_n are the beginning-of-month levels at the various gage locations,
W_1-W_n are the Thiessen polygon weighting factors for gage locations,
1 to n,
n is the number of water level gages in the network.

The basic data used consist of daily mean water levels for the first and last days of the months for each water level gage in operation. These levels were computed from the gages using sampling rates varying from hourly values in the current period to tri-daily readings in the early nineteen hundreds. The gage response time of less than 1 minute is sufficient to filter out wind waves and ship effects but maintain the longer period variations. The water level gages used in the study, along with their period of record, are given in table 1, and their location is shown in figure 1. Occasional missing gage data were interpolated from existing gages.

Table 1. Water Level Gages and Period of Record

Gage Location	Period of Record (daily means)
Mackinaw City	1899-Date
Milwaukee	1899-Date
Ludington	1950-Date
Holland	1960--Date
Calumet	1903-Date
Sturgeon Bay	1946-Date
Green Bay	1955-Date
Port Inland	1965-Date

In the initial analysis four different gage networks were developed for the 1950-1970 period to determine the optimum network size as well as to quantify a data set for this period. For obtaining a quantified data set for the period 1900-1949, an additional three different gage networks were established. The Thiessen polygons shown on figures 2-4 were drawn and weighting factors computed for their gages in the various networks. These networks with their corresponding gages and weighting factors are given in table 2.

Table 2. Gage Networks and Weighting Factors

	Weighting Factors and Period Used						
Gage	2 Gage Network 1900-1972	3 Gage Network 1903-1972	4 Gage Network 1946-1972	5 Gage Network 1950-1972	6 Gage Network 1955-1972	7 Gage Network 1960-1972	8 Gage Network 1965-1972
Milwaukee	.500	.468	.313	.219	.219	.152	.152
Mackinaw	.500	.381	.158	.158	.158	.158	.057
Calumet		.151	.151	.151	.151	.108	.108
Sturgeon Bay			.378	.278	.241	.241	.199
Ludington				.194	.194	.161	.161
Green Bay					.037	.037	.037
Holland						.143	.143
Port Inland							.143

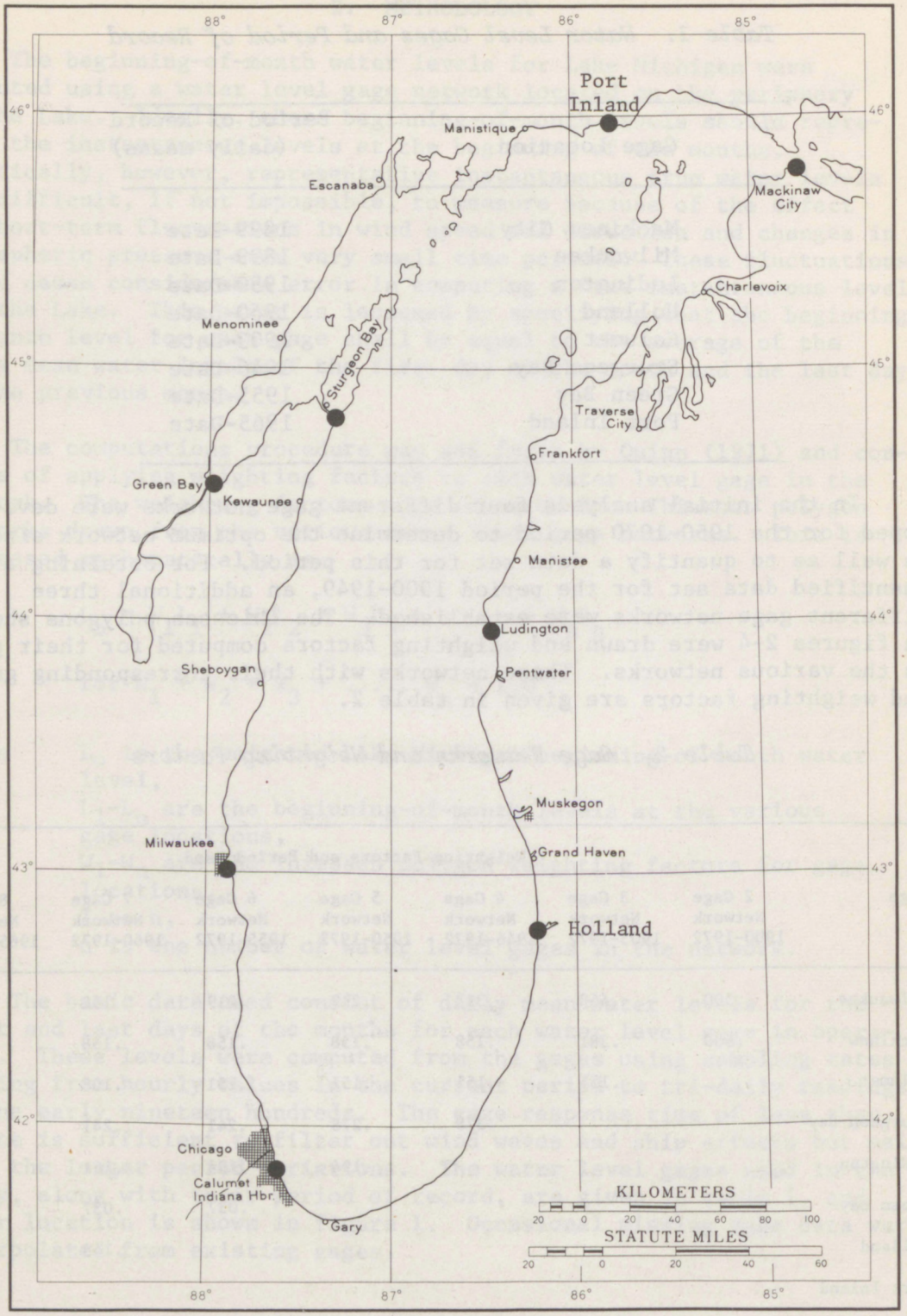


Figure 1. Water level gage locations.

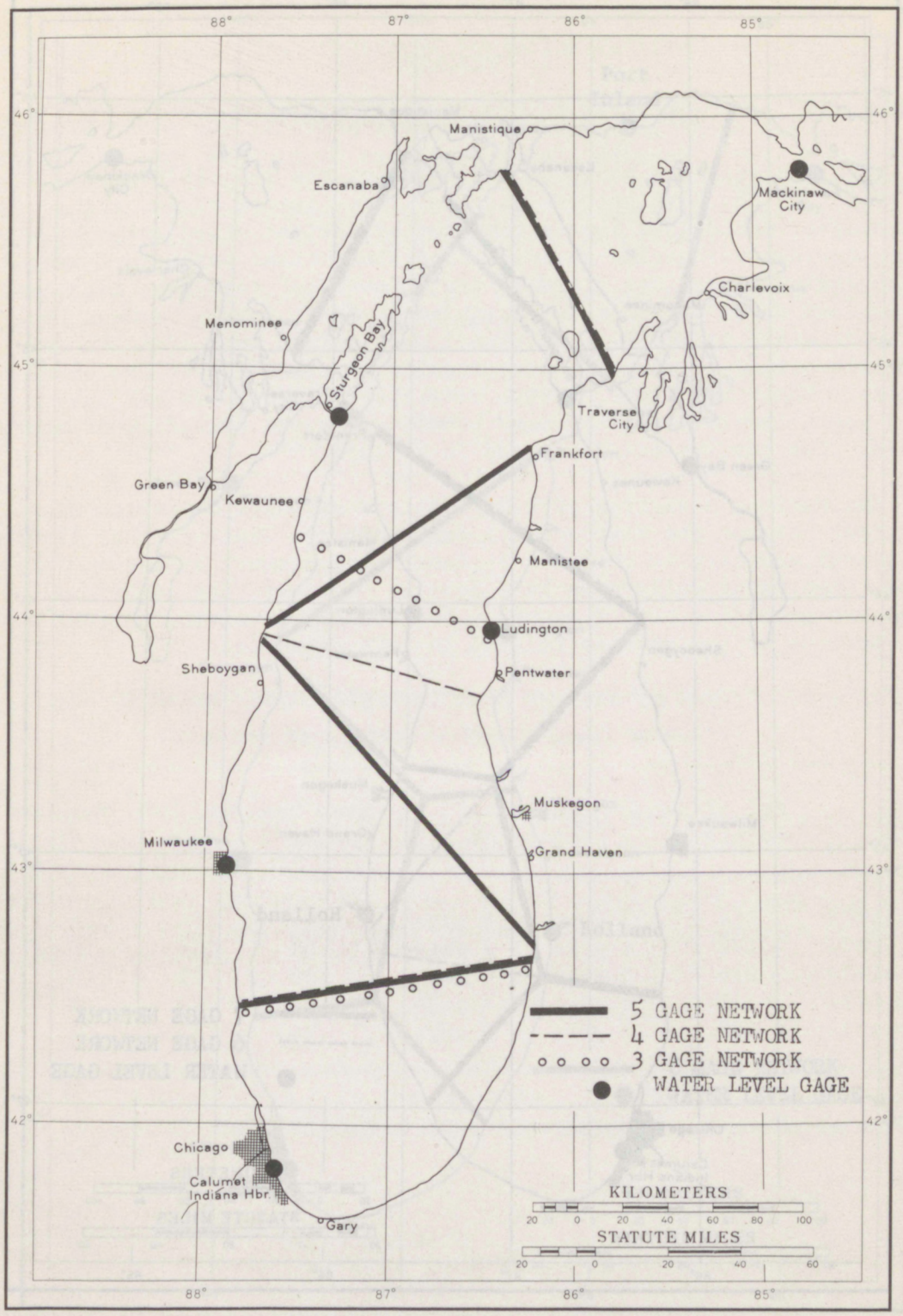


Figure 2. Thiessen polygon networks.

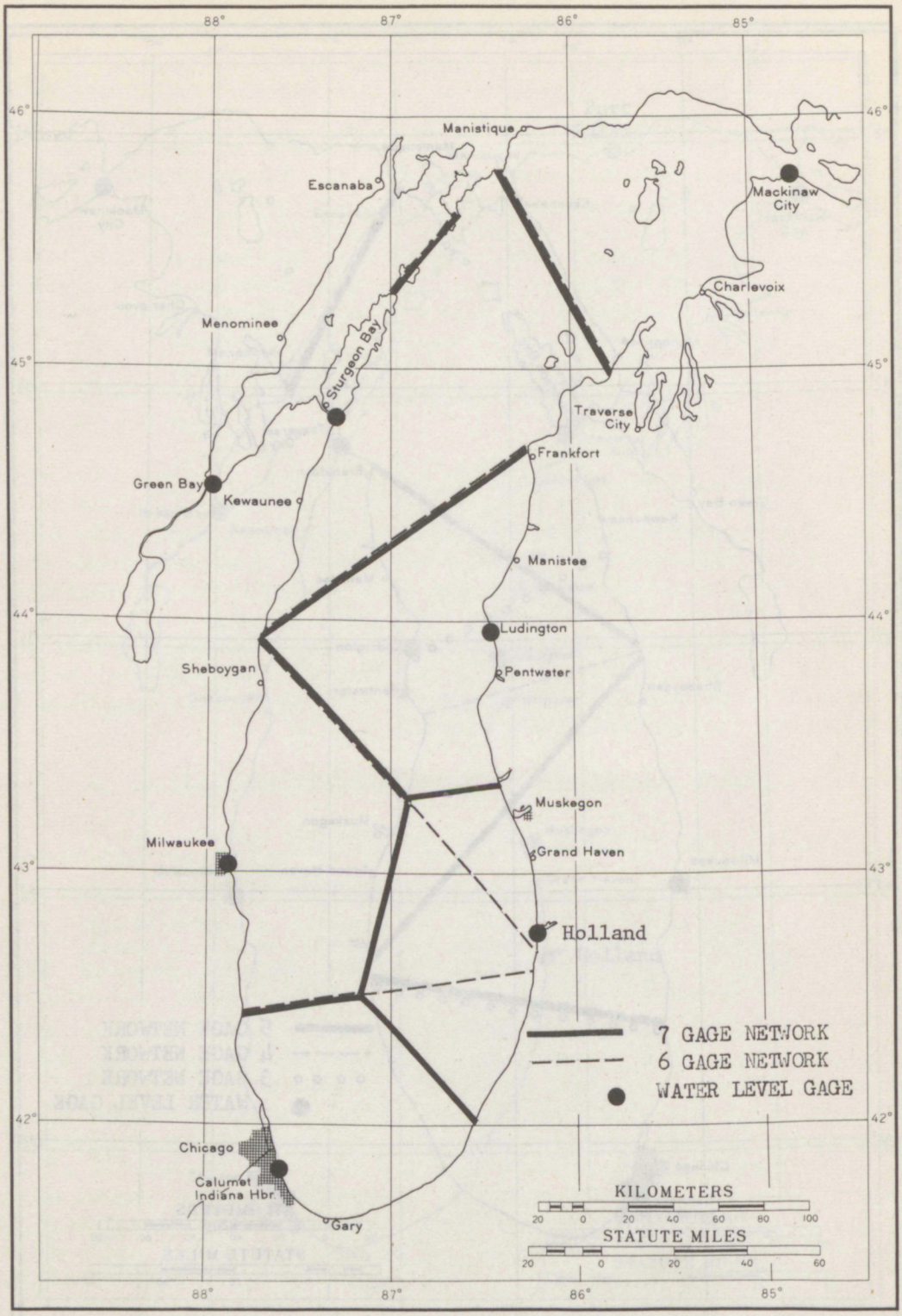


Figure 3. Thiessen polygon networks.

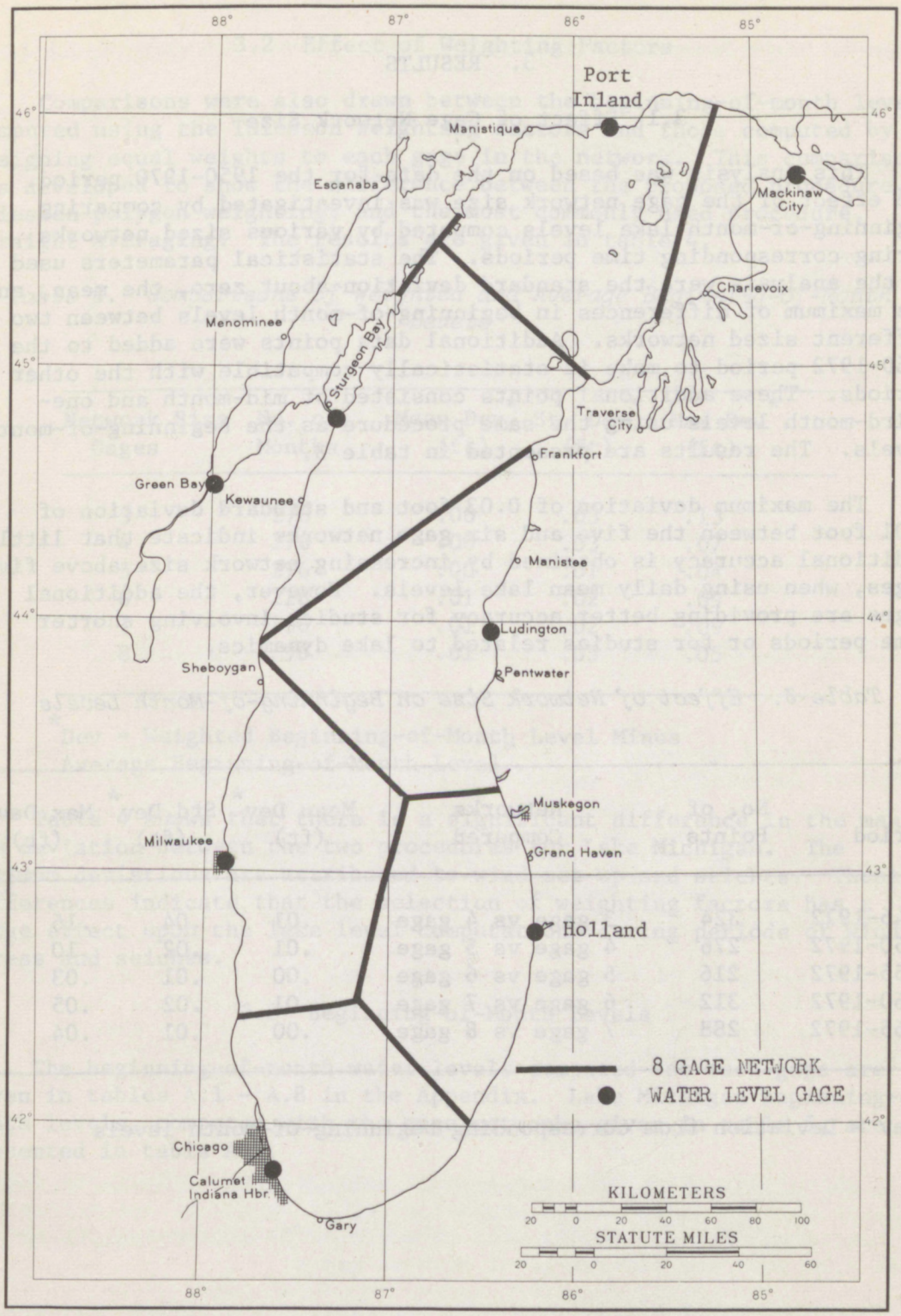


Figure 4. Thiessen polygon networks.

3. RESULTS

3.1 Effect of Gage Network Size

This analysis was based on the data for the 1950-1970 period. The effect of the gage network size was investigated by comparing beginning-of-month lake levels computed by various sized networks during corresponding time periods. The statistical parameters used in the analysis were the standard deviation about zero, the mean, and the maximum of differences in beginning-of-month levels between two different sized networks. Additional data points were added to the 1960-1972 period to make it statistically compatible with the other periods. These additional points consisted of mid-month and one-third-month levels using the same procedure as the beginning-of-month levels. The results are presented in table 3.

The maximum deviation of 0.03 foot and standard deviation of 0.01 foot between the five and six gage networks indicate that little additional accuracy is obtained by increasing network size above five gages, when using daily mean lake levels. However, the additional gages are providing better accuracy for studies involving shorter time periods or for studies related to lake dynamics.

Table 3. Effect of Network Size on Beginning-of-Month Levels

Period	No. of Points	Networks Compared	Mean Dev* (ft)	Std.Dev* (ft)	Max.Dev* (ft)
1946-1972	324	3 gage vs 4 gage	.01	.04	.16
1950-1972	276	4 gage vs 5 gage	.01	.02	.10
1955-1972	216	5 gage vs 6 gage	.00	.01	.03
1960-1972	312	6 gage vs 7 gage	.01	.02	.05
1965-1972	288	7 gage vs 8 gage	.00	.01	.04

*Dev = Deviation from corresponding beginning-of-month levels

3.2 Effect of Weighting Factors

Comparisons were also drawn between the beginning-of-month levels computed using the Thiesson weighting factors and those computed by assigning equal weights to each gage in the network. This comparison was developed to show the difference between the proposed procedure, Thiessen polygon weighting, and the most commonly used procedure, straight averaging. The results are given in table 4.

Table 4. Comparisons of Weighted and Average Beginning-of-Month Levels

Network Size Gages	No. of Months	Mean Dev* (ft)	St. Dev* (ft)	Max Dev* (ft)
3	276	.00	.03	.13
4	276	.00	.03	.07
5	276	.00	.01	.04
6	216	.01	.02	.09
7	156	.01	.02	.09
8	96	.01	.05	.05

*Dev = Weighted Beginning-of-Month Level Minus Average Beginning-of-Month Level

Table 4 shows that there is a significant difference in the maximum deviation between the two procedures for Lake Michigan. The maximum deviations are attributed to wind set-up and seiches. These differences indicate that the selection of weighting factors has a large effect upon the lake level computations during periods of wind stress and seiches.

3.3 Beginning-of-Month Levels

The beginning-of-month water levels computed for each gage are given in tables A.1 - A.8 in the Appendix. Lake Michigan beginning-of-month levels, computed with the gage networks given in table 5, are presented in table A.9.

Table 5. Gage Networks Used for Lake Michigan Beginning-of-Month Levels

Period	No. of Gages in Network	Period	No. of Gages in Network
1900-1902	2	1955-1959	6
1903-1945	3	1960-1964	7
1946-1949	4	1965-1972	8
1950-1954	5		

3.4 Change of Storage

The monthly changes in storage were computed by multiplying the difference between two consecutive beginning-of-month levels by the area of Lake Michigan, 22,300 square miles. The changes in storage were then converted into monthly rates by dividing the number of seconds in each month. These rates of change are given in table A.10 expressed as hundreds of cubic feet per second months (HCFS-months).

3.5 Crustal Movement Analysis

A crustal movement analysis was undertaken to determine relative rates of subsidence, if any, along the longitudinal and latitudinal lake axes. The data used in the analysis consisted of yearly mean-water-level data for the period of record. No relative movement was discovered on the latitudinal axis between the Milwaukee and Ludington gages. This, however, may be due to the limited time period for comparison, about 23 years.

The analysis of relative movement along the longitudinal axis showed well defined movement between the Mackinaw City and Calumet gages. As depicted in figure 5, the relative rate of movement between the two gages is 0.65 foot per 100 years.

4. CONCLUSIONS AND RECOMMENDATIONS

This study shows that the present gage network is adequate for both scientific and planning studies and that no additional accuracy in beginning-of-month levels will be achieved by increasing the network size over the present level of nine gages.

The method of computation, i.e., weighted or averaged, was found to have as large an effect on the beginning-of-month levels as the number of gages in the network. Therefore, the weighting factors should be carefully selected using the Thiessen polygon procedure.

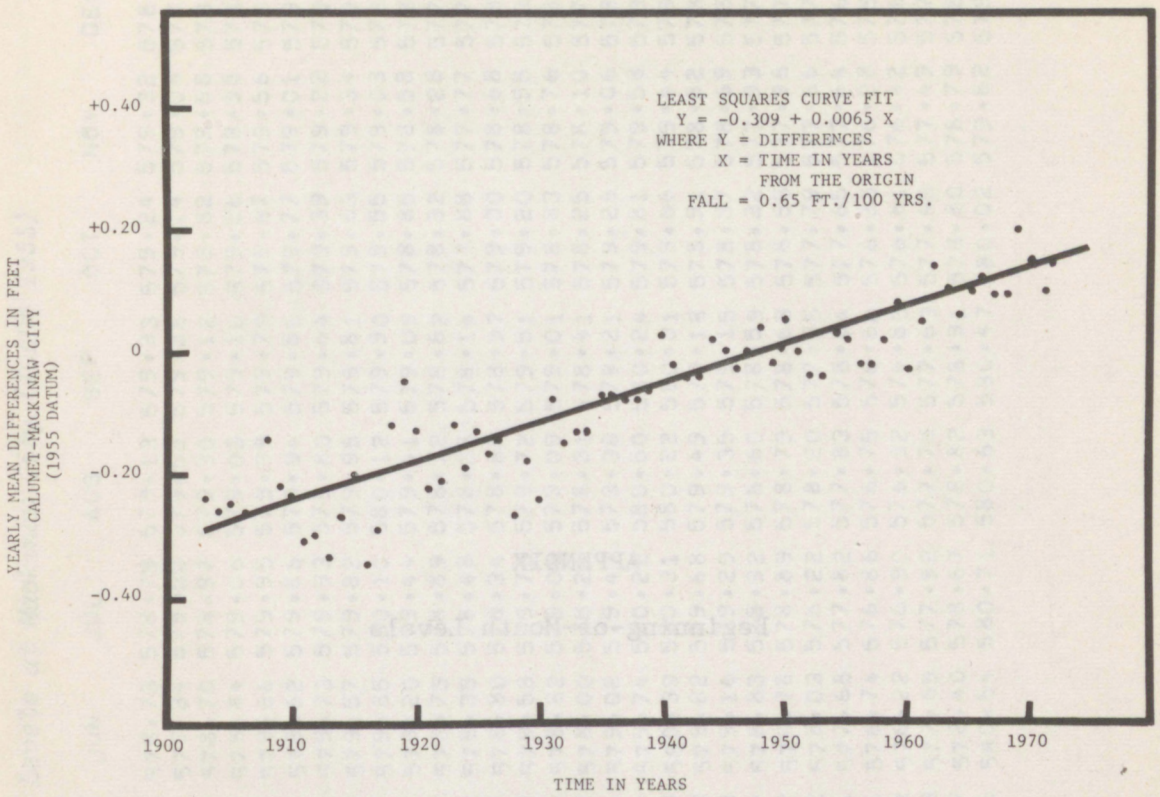


Figure 5. Plot demonstrating the relative crustal movement between Calumet and Mackinaw City gages.

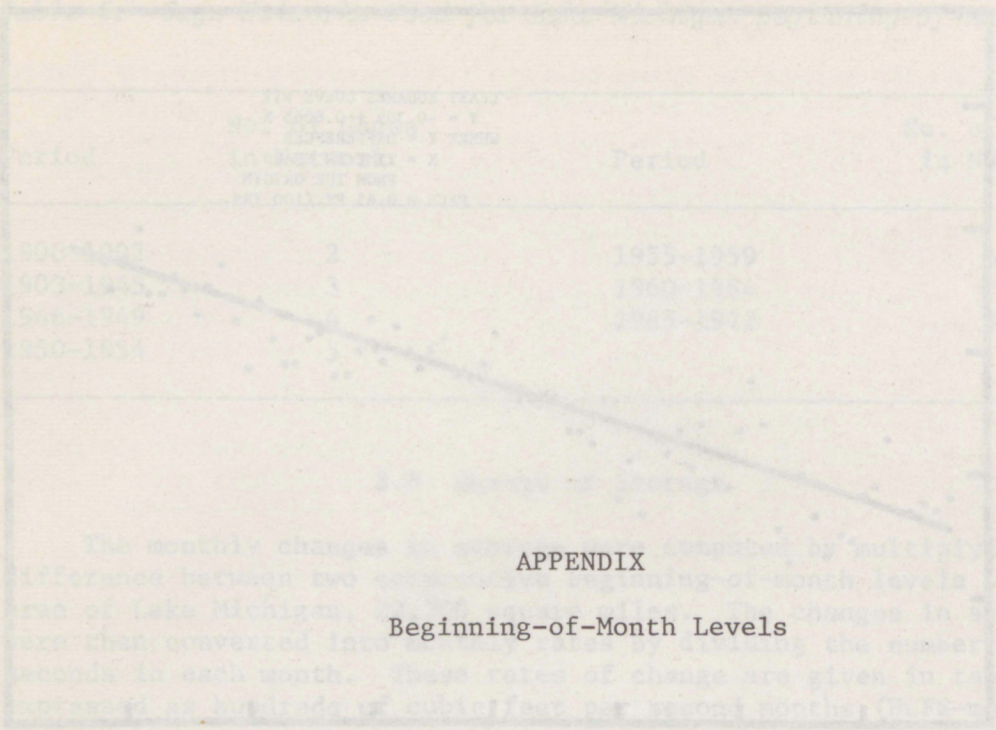
The beginning-of-month levels and storage changes listed in tables A.9 and A.10 are recommended for use in scientific and planning studies and should be updated on a yearly basis using the Thiessen polygon procedure.

5. ACKNOWLEDGMENTS

The assistance of Raymond N. Kelley in data reduction and report assemblage is gratefully acknowledged.

6. REFERENCES

Quinn, F. H. 1971. Quantitative Mathematical Models for Great Lakes Research. Ph.D. Dissertation, University of Michigan, Ann Arbor, Michigan.



APPENDIX

Beginning-of-Month Levels

Table A.1. Beginning-of-Month Levels at Mackinaw City (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1900	578.40	578.17	578.20	578.32	578.55	578.73	578.79	579.13	579.33	579.24	579.32	578.97
1901	578.66	578.51	578.46	578.65	579.13	579.34	579.50	579.59	579.36	579.14	579.08	578.64
1902	578.40	578.25	578.25	578.22	578.31	578.70	578.97	579.30	579.12	578.82	578.68	578.50
1903	578.38	578.14	578.23	578.56	578.73	578.84	579.06	579.03	579.16	579.26	578.98	578.54
1904	578.28	578.17	578.38	578.82	579.13	579.66	579.95	579.99	579.79	579.67	579.56	579.10
1905	578.87	578.69	578.67	578.85	579.09	579.62	579.86	579.94	579.85	579.77	579.01	579.22
1906	578.97	579.02	579.17	579.17	579.48	579.73	579.93	579.80	579.64	579.39	579.22	579.15
1907	579.01	579.14	579.07	579.05	579.32	579.57	579.82	579.95	579.81	579.63	579.34	579.05
1908	578.95	578.64	578.82	579.17	579.40	579.85	580.10	580.12	579.90	579.55	579.03	578.74
1909	578.43	578.27	578.39	578.36	579.01	579.20	579.44	579.41	579.09	578.85	578.58	578.46
1910	578.45	578.48	578.37	578.38	578.67	578.73	578.89	578.72	578.62	578.32	578.28	577.88
1911	577.82	577.83	577.78	577.58	577.79	578.35	578.48	578.38	578.14	577.88	577.77	577.84
1912	577.82	577.61	577.63	577.51	577.99	578.80	578.34	578.88	578.97	579.00	578.68	578.86
1913	578.66	578.49	578.52	578.82	579.13	579.58	579.75	579.72	579.51	579.20	578.95	578.82
1914	578.51	578.38	578.39	578.36	578.54	578.82	579.06	579.09	579.01	578.83	578.76	578.23
1915	577.88	577.81	577.82	577.69	577.82	578.00	578.24	578.31	578.41	578.25	578.10	577.89
1916	577.71	577.80	577.66	577.98	578.51	579.08	579.47	579.38	579.21	579.26	579.06	578.76
1917	578.76	578.52	578.80	578.86	579.34	579.74	580.22	580.50	580.24	579.81	579.58	579.31
1918	579.16	579.24	579.28	579.60	579.78	580.39	580.31	580.22	580.01	579.66	579.44	579.29
1919	579.16	579.00	578.90	578.88	579.43	579.82	579.68	579.49	579.18	578.91	578.82	578.68
1920	578.46	578.27	578.20	578.68	578.93	579.16	579.29	579.35	579.15	578.87	578.69	578.79
1921	578.48	578.30	578.30	578.01	578.74	578.83	578.92	578.60	578.59	578.32	577.93	577.74
1922	577.66	577.64	577.64	577.72	578.52	578.78	578.89	578.79	578.68	578.55	577.98	577.77
1923	577.66	577.24	577.23	577.31	577.62	578.03	578.22	578.20	577.95	577.79	577.66	577.32
1924	576.94	576.88	576.81	576.97	577.21	577.68	577.82	577.83	578.04	577.65	577.64	576.89
1925	576.68	576.59	576.49	576.46	576.51	576.74	576.86	576.75	576.60	576.33	576.28	575.89
1926	575.75	575.54	575.60	575.52	576.22	576.22	576.90	576.92	576.85	576.81	576.42	576.64
1927	576.51	576.73	576.63	576.75	577.23	577.69	577.92	577.78	577.63	577.49	577.49	577.21
1928	576.83	577.02	577.22	577.40	578.07	578.40	578.67	578.82	578.91	578.80	578.79	578.92
1929	578.76	578.87	578.71	578.77	579.66	580.54	580.71	580.63	580.47	580.02	579.82	579.16

* IGLD - International Great Lakes Datum

Table A.1. Beginning-of-Month Levels at Mackinaw City (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1930	578.95	578.91	579.04	578.99	579.25	579.38	579.36	579.36	579.36	578.78	578.41	577.95
1931	578.14	577.47	577.11	577.22	577.42	577.46	577.52	577.30	576.95	577.19	576.68	576.76
1932	576.38	576.57	576.36	576.41	576.65	576.87	576.94	576.86	576.76	576.45	576.26	576.22
1933	576.15	576.03	575.86	575.89	576.42	576.92	577.02	577.00	576.58	576.40	576.14	575.86
1934	575.69	575.84	575.59	575.70	576.21	576.24	576.32	576.19	576.08	576.26	575.83	576.15
1935	576.15	575.93	575.91	576.10	576.29	576.49	576.82	576.94	576.78	576.59	576.39	576.30
1936	576.27	576.14	576.13	576.26	576.51	576.95	576.93	576.85	576.75	576.74	576.67	576.21
1937	576.28	575.97	576.22	576.14	576.53	576.78	576.92	576.84	576.84	576.59	576.39	576.21
1938	575.98	576.00	576.32	576.93	577.15	577.53	577.79	577.86	577.83	577.74	577.61	577.20
1939	577.08	576.95	577.00	577.13	577.44	577.79	578.22	578.19	578.27	578.07	577.80	577.57
1940	577.14	576.96	576.85	576.67	576.94	577.26	577.56	577.56	577.65	577.42	577.21	577.00
1941	576.97	577.01	576.88	576.79	577.21	577.29	577.36	577.23	576.98	577.13	577.12	577.30
1942	577.08	576.96	577.09	577.55	577.81	578.19	578.47	578.46	578.33	578.09	577.97	577.77
1943	577.51	577.54	577.54	578.01	578.27	578.95	579.55	579.76	579.76	579.47	579.19	579.20
1944	578.74	578.48	578.34	578.59	578.73	578.86	579.11	579.06	579.05	578.72	578.58	578.13
1945	577.98	577.69	577.92	578.16	578.29	578.70	579.28	579.23	579.09	578.98	578.75	578.73
1946	578.55	578.63	578.73	579.00	578.91	578.97	579.25	579.09	578.89	578.45	578.32	577.77
1947	577.70	577.59	577.54	577.56	578.25	578.96	579.27	579.39	579.37	579.06	578.99	578.90
1948	578.21	578.19	578.11	578.51	578.85	579.09	579.19	579.13	578.80	578.28	577.82	577.82
1949	577.21	577.51	577.19	577.33	577.70	577.74	578.00	578.02	577.60	577.30	577.14	576.64
1950	576.61	576.65	576.62	577.05	577.49	577.80	578.10	578.15	578.16	578.21	578.08	577.85
1951	577.98	577.77	578.03	578.29	579.05	579.29	579.56	579.81	579.73	579.75	579.77	579.90
1952	579.89	580.06	579.76	580.12	580.46	580.71	580.73	581.09	580.99	580.68	579.98	579.86
1953	579.77	579.44	579.36	579.54	579.74	580.14	580.44	580.34	580.35	579.94	579.59	579.27
1954	578.97	578.76	578.68	578.97	579.38	579.52	579.94	579.88	579.71	579.70	580.03	579.76
1955	579.65	579.35	579.23	579.31	579.56	579.66	579.74	579.55	579.16	578.61	578.49	578.17
1956	577.81	577.74	577.80	577.78	578.13	578.56	578.71	578.74	578.86	578.39	578.07	577.84
1957	577.43	577.35	577.32	577.26	577.53	577.76	577.99	578.13	577.84	577.67	577.45	577.30
1958	577.05	577.19	577.08	577.10	577.28	577.05	577.26	577.21	576.99	576.94	576.48	576.28
1959	575.99	575.82	575.99	576.13	576.80	577.02	577.07	577.05	577.20	577.01	577.12	577.21

* IGLD - International Great Lakes Datum

Table A.1. Beginning-of-Month Levels at Mackinaw City (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1960	577•24	577•20	577•30	577•17	577•96	578•78	579•10	579•40	579•36	579•06	578•89	578•44
1961	578•05	577•75	577•85	577•83	578•06	578•20	578•27	578•26	578•20	578•25	577•89	577•66
1962	577•49	577•30	577•33	577•40	577•66	577•94	577•93	577•83	577•75	577•36	577•04	576•77
1963	576•41	576•40	576•16	576•42	576•46	576•90	576•93	576•93	576•80	576•64	576•18	575•82
1964	575•77	575•48	575•49	575•35	575•62	575•88	575•95	576•10	575•95	575•95	575•61	575•48
1965	575•43	575•45	575•49	575•66	576•24	576•59	576•77	576•82	576•86	577•15	576•90	577•18
1966	577•13	576•81	576•91	577•33	577•48	577•59	577•69	577•66	577•42	577•02	576•83	576•87
1967	577•04	577•01	576•88	577•13	577•88	577•88	578•45	578•35	578•18	577•87	577•75	577•78
1968	577•77	577•73	577•71	577•68	577•94	578•18	578•54	578•57	578•65	578•81	578•51	578•38
1969	578•45	578•31	578•14	578•32	578•76	579•22	579•66	579•91	579•62	579•23	579•15	578•63
1970	578•53	578•77	578•43	578•43	578•88	579•08	579•21	579•40	579•12	579•24	579•18	579•02
1971	578•84	578•67	578•97	579•09	579•56	579•54	579•84	580•00	579•73	579•63	579•48	579•05
1972	579•38	578•87	578•60	578•94	579•24	579•66	579•84	580•03	580•30	580•26	579•97	579•97

* IGLD - International Great Lakes Datum

Table A.2. Beginning-of-Month Levels at Ludington (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1950	576.65	576.59	576.55	577.07	577.64	577.75	577.91	578.44	578.26	578.20	578.05	577.45
1951	577.77	577.90	578.09	578.30	579.25	579.41	579.52	579.77	580.11	579.75	579.65	579.79
1952	579.90	579.85	579.80	580.04	580.57	580.77	580.91	580.79	580.98	580.54	579.88	579.67
1953	579.59	579.23	579.39	579.66	580.19	580.30	580.40	580.36	580.21	579.95	579.62	579.30
1954	578.75	578.62	578.72	578.86	579.50	579.67	579.95	579.91	579.68	579.81	579.97	579.69
1955	579.64	579.44	579.36	579.22	579.58	579.72	579.72	579.55	578.94	578.52	578.52	577.93
1956	577.73	577.71	577.81	577.81	578.21	578.47	578.76	578.74	578.87	578.37	578.19	577.74
1957	577.45	577.34	577.39	577.37	577.60	577.90	577.90	578.13	577.92	577.58	577.46	577.27
1958	577.34	577.17	577.39	577.14	577.12	577.27	577.25	577.26	576.98	576.58	576.43	576.00
1959	576.02	575.78	576.00	576.20	576.79	577.25	577.23	577.07	577.24	577.09	577.08	577.03
1960	577.19	577.18	577.27	577.25	577.99	578.70	579.04	579.17	579.30	578.98	579.03	578.29
1961	578.18	577.79	577.76	577.88	578.11	578.22	578.38	578.42	578.18	578.17	577.62	577.79
1962	577.31	577.27	577.30	577.53	577.89	578.00	578.06	577.86	577.82	577.42	577.14	576.83
1963	576.48	576.35	576.28	576.60	576.61	576.97	577.00	577.00	576.74	576.66	576.28	575.79
1964	575.54	575.58	575.27	575.37	575.97	576.00	576.01	576.07	575.94	576.02	575.73	575.60
1965	575.44	575.53	575.78	575.82	576.36	576.82	576.81	576.94	576.88	577.30	576.91	576.92
1966	577.03	576.81	577.10	577.44	577.63	577.70	577.81	577.60	577.60	577.01	576.74	576.84
1967	577.06	577.08	576.93	577.24	578.02	578.06	578.47	578.42	578.26	578.00	577.90	577.84
1968	577.66	577.89	577.77	577.75	578.05	578.28	578.69	578.64	578.80	578.59	578.65	578.32
1969	578.43	578.46	578.41	578.27	578.93	579.46	579.94	580.01	579.85	579.40	579.35	578.87
1970	578.96	578.64	578.54	578.60	579.14	579.33	579.44	579.57	579.21	579.26	579.27	579.10
1971	578.97	578.75	578.77	579.33	579.61	579.89	580.08	580.09	579.98	579.84	579.48	579.31
1972	579.33	578.98	579.07	579.00	579.63	579.87	580.04	580.18	580.51	580.32	580.26	579.92

* IGLD - International Great Lakes Datum

Table A.3. Beginning-of-Month Levels at Holland (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ØCT	NØV	DEC
1960	577•15	577•25	577•29	577•37	577•94	578•58	578•99	578•99	579•12	578•88	578•90	578•41
1961	578•23	577•83	577•69	577•92	578•10	578•11	578•31	578•40	578•04	578•08	577•60	577•67
1962	577•27	577•30	577•37	577•59	577•92	577•88	578•04	577•78	577•70	577•39	577•18	576•74
1963	576•40	576•11	576•22	576•53	576•86	576•88	576•93	576•89	576•68	576•45	576•30	575•84
1964	575•47	575•49	575•05	575•38	575•90	575•95	575•93	575•99	575•87	575•84	575•64	575•55
1965	575•30	575•41	575•63	575•73	576•32	576•77	576•79	576•83	576•70	577•13	576•71	576•76
1966	576•91	576•85	577•04	577•39	577•66	577•65	577•71	577•41	577•47	577•02	576•72	576•91
1967	576•94	576•92	576•81	577•11	577•82	578•03	578•34	578•37	578•20	577•97	577•87	577•71
1968	577•56	577•70	577•68	577•60	577•94	578•18	578•52	578•52	578•64	578•41	578•52	578•18
1969	578•30	578•33	578•36	578•08	578•86	579•36	579•75	579•95	579•72	579•28	579•21	578•91
1970	578•95	578•44	578•48	578•46	578•88	579•15	579•24	579•44	579•10	579•16	579•11	578•88
1971	578•83	578•78	578•63	579•06	579•44	579•84	579•96	579•89	580•01	579•65	579•33	579•32
1972	579•18	578•91	579•15	578•95	579•53	579•73	579•89	579•97	580•35	580•13	580•10	579•79

* IGLD - International Great Lakes Datum

Table A.4. Beginning-of-Month Levels at Calumet (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1903	577.48	577.56	577.71	578.35	578.53	579.02	578.63	578.79	578.87	578.90	578.76	578.40
1904	578.03	578.22	578.35	578.59	578.97	579.46	579.69	579.60	579.53	579.16	578.14	578.77
1905	578.50	578.67	578.70	579.00	578.93	579.23	579.60	579.80	579.64	579.37	578.77	579.00
1906	578.66	578.79	578.87	579.08	579.19	579.30	579.45	579.53	579.20	579.34	578.95	578.56
1907	578.92	578.88	578.92	578.81	579.13	579.36	579.29	578.85	578.76	578.75	579.06	578.98
1908	578.44	578.80	579.18	578.76	578.85	579.73	579.66	580.01	579.64	579.26	579.03	578.68
1909	578.33	577.40	578.15	578.09	578.95	579.17	579.28	579.35	579.11	578.73	578.16	578.14
1910	577.80	578.08	577.67	577.99	578.56	578.55	578.68	578.31	578.55	578.03	578.04	578.13
1911	576.90	577.44	577.08	577.35	578.00	577.87	578.05	577.89	577.72	578.05	577.94	577.44
1912	577.44	577.69	577.60	577.40	577.74	578.42	578.78	578.84	578.91	578.57	578.67	578.25
1913	577.99	578.00	578.18	578.35	578.98	579.26	579.29	579.40	579.16	578.96	578.47	578.82
1914	578.08	578.05	578.39	578.42	578.41	578.59	578.89	578.80	578.65	578.38	578.07	577.76
1915	577.32	578.05	577.71	577.56	577.67	577.98	578.07	578.17	577.85	578.31	577.47	577.36
1916	577.39	577.56	577.59	577.77	578.60	578.85	579.33	579.50	578.84	578.59	578.60	578.50
1917	578.29	578.95	578.42	578.76	579.22	579.45	579.78	579.84	579.84	579.66	579.52	579.06
1918	578.91	578.91	579.13	579.34	579.69	580.00	580.22	580.03	579.73	579.47	579.39	578.89
1919	579.38	578.92	578.70	579.36	579.50	579.73	579.79	579.75	579.37	579.00	578.83	578.37
1920	577.45	578.36	578.17	578.59	578.82	578.86	579.10	579.12	579.10	579.19	578.57	578.28
1921	577.91	578.02	577.80	577.94	578.58	578.89	578.64	578.48	578.32	577.86	578.38	577.55
1922	577.58	577.30	577.61	577.71	578.29	578.67	578.69	578.70	578.59	578.17	578.00	577.20
1923	577.22	577.29	577.02	577.19	577.48	577.88	577.85	578.02	577.89	577.91	577.15	576.96
1924	577.12	576.74	576.81	577.07	577.09	577.46	577.57	578.08	577.73	577.45	576.82	576.94
1925	577.02	576.40	576.20	576.47	576.90	576.41	576.70	576.78	576.33	576.44	575.51	575.76
1926	575.33	575.73	575.47	576.14	576.16	576.20	576.65	576.78	576.72	576.75	576.26	576.60
1927	576.58	576.16	576.71	577.05	576.89	577.47	577.67	577.92	577.67	577.20	577.25	577.16
1928	577.27	576.86	576.90	576.78	577.70	577.97	578.38	578.67	578.45	578.33	578.57	578.81
1929	578.93	578.74	578.73	579.30	579.91	580.41	580.34	580.36	580.05	580.04	579.39	578.24

* IGLD - International Great Lakes Datum

Table A.4. Beginning-of-Month Levels at Calumet (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1930	578.52	578.54	578.92	578.76	578.84	579.15	579.38	579.28	579.02	578.58	578.10	577.89
1931	577.34	577.10	577.71	577.63	577.26	577.39	577.28	577.42	576.88	576.56	576.86	576.15
1932	577.25	575.98	576.36	576.17	576.50	576.73	576.67	576.75	576.66	575.98	576.33	575.94
1933	575.56	575.40	575.67	576.01	576.40	576.90	576.95	576.68	576.77	576.17	576.00	575.44
1934	575.86	574.97	575.00	575.63	575.61	576.15	576.25	576.30	575.95	575.93	575.66	575.42
1935	575.63	575.72	575.74	576.40	576.28	576.50	576.93	576.71	576.64	576.19	576.40	576.30
1936	575.78	576.01	576.23	576.42	576.65	576.69	577.06	576.71	576.75	576.81	576.11	576.25
1937	575.60	576.00	575.95	575.99	576.89	576.71	576.89	577.02	576.71	576.58	576.19	575.62
1938	576.27	575.93	576.05	576.26	576.96	577.51	577.72	577.76	577.83	577.83	577.40	577.22
1939	576.64	576.75	577.06	577.05	577.28	577.75	577.90	578.16	578.15	578.00	578.03	577.37
1940	577.08	577.07	577.00	576.69	577.02	577.35	577.51	577.64	577.74	577.62	577.35	577.22
1941	577.06	576.89	576.96	576.99	577.22	577.54	577.25	577.29	576.88	576.67	577.31	577.32
1942	577.35	577.75	577.15	577.36	577.80	578.51	578.37	578.44	578.09	577.98	577.56	577.59
1943	577.64	577.40	577.60	577.92	578.29	578.93	579.45	579.58	579.62	579.63	579.37	578.77
1944	578.44	578.58	578.88	578.44	578.74	578.92	579.19	579.16	578.52	579.00	578.40	578.78
1945	577.90	577.82	577.58	577.91	578.27	579.05	579.21	579.41	579.15	579.10	578.59	578.82
1946	578.85	578.39	578.49	579.35	579.15	579.60	579.24	579.31	578.67	578.65	577.95	578.18
1947	577.79	578.08	577.59	577.73	578.44	578.84	579.18	579.55	579.46	579.15	579.29	578.05
1948	579.25	578.26	578.65	578.74	578.92	579.10	579.06	578.84	578.79	578.57	577.89	577.58
1949	577.42	576.84	577.17	578.00	577.74	577.89	578.06	577.84	577.72	577.11	576.59	576.56
1950	576.65	576.76	576.64	577.03	577.69	577.71	577.83	578.33	578.60	578.14	577.89	577.62
1951	577.45	578.05	578.05	578.20	579.33	579.42	579.48	579.82	580.10	579.72	579.84	579.65
1952	579.14	579.47	579.94	579.85	580.50	580.68	580.98	580.68	580.96	580.42	579.69	579.59
1953	579.52	579.32	579.59	579.90	580.35	580.34	580.18	580.49	580.14	580.02	579.70	579.19
1954	578.54	578.51	578.92	578.70	579.47	579.59	579.79	579.99	579.75	579.74	579.91	579.77
1955	579.41	579.47	579.36	579.25	579.59	579.75	579.59	579.56	579.10	578.64	578.21	577.75
1956	577.70	577.57	577.48	577.80	578.29	578.52	578.57	578.82	578.64	578.30	578.10	577.57
1957	577.49	577.16	577.22	577.44	577.57	577.85	577.83	578.14	577.95	577.52	577.55	577.11
1958	577.75	577.46	577.55	577.26	576.93	577.44	576.99	577.34	576.89	576.38	576.52	575.76
1959	575.99	575.99	575.90	576.44	576.87	577.40	577.41	577.17	577.45	577.29	576.92	576.92

* IGLD - International Great Lakes Datum

Table A.4. Beginning-of-Month Levels at Calumet (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1960	577.34	577.34	577.28	577.64	577.93	578.68	579.14	579.02	579.04	579.04	578.52	578.67
1961	578.31	578.06	577.76	577.97	578.13	578.00	578.31	578.55	577.99	578.05	577.58	577.63
1962	577.17	577.39	577.60	577.76	577.97	577.97	578.25	577.97	577.75	577.60	577.36	576.89
1963	576.43	576.06	576.25	576.61	577.24	576.96	577.02	576.88	576.78	576.54	576.45	576.04
1964	575.40	575.52	574.85	575.49	575.99	576.16	575.93	576.07	576.01	575.90	575.71	575.62
1965	575.47	575.34	575.86	575.96	576.37	576.92	577.01	576.90	576.94	577.07	576.93	576.54
1966	576.91	576.95	577.08	577.44	577.81	577.77	577.85	577.48	577.51	577.13	576.80	577.01
1967	576.84	577.12	577.01	577.10	577.82	578.30	578.41	578.51	578.56	578.13	578.01	577.84
1968	577.67	577.81	577.87	577.69	578.07	578.28	578.40	578.53	578.73	578.30	578.49	578.26
1969	577.89	578.32	578.61	578.07	578.95	579.33	579.83	579.97	579.72	579.34	579.31	579.02
1970	579.12	578.33	578.70	578.77	578.84	579.15	579.28	579.46	579.23	579.34	579.04	578.64
1971	578.84	578.81	578.55	578.98	579.51	580.01	579.97	579.74	580.14	579.71	579.34	579.40
1972	579.20	579.01	579.34	579.00	579.64	579.83	579.99	580.07	580.40	580.22	580.33	579.75

* IGLD - International Great Lakes Datum

Table A.5. Beginning-of-Month Levels at Milwaukee (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1900	578.11	577.56	578.19	577.89	578.21	578.50	578.40	578.72	578.81	578.65	578.80	578.50
1901	578.08	577.81	578.01	578.31	578.66	579.01	578.98	579.08	579.27	578.85	578.43	578.03
1902	577.69	577.75	577.88	577.72	578.04	578.38	578.69	578.98	578.63	578.66	578.18	577.59
1903	577.48	577.59	577.93	578.17	578.34	578.85	578.79	578.74	578.77	578.74	578.52	578.32
1904	577.92	578.07	577.77	578.53	578.86	579.46	579.46	579.36	579.48	578.96	579.01	578.56
1905	578.29	578.26	578.36	578.84	578.75	579.18	579.52	579.73	579.59	579.34	578.56	578.79
1906	578.36	578.58	578.86	578.99	579.18	578.38	579.47	579.55	579.15	579.16	578.74	578.36
1907	578.79	578.81	578.88	578.87	579.10	579.51	579.58	579.46	579.45	579.25	579.09	578.76
1908	578.36	578.68	578.91	578.90	579.02	579.61	579.64	579.89	579.42	578.94	578.70	578.14
1909	577.68	577.91	578.06	578.02	579.00	579.15	579.09	579.16	578.85	578.70	578.30	578.13
1910	578.14	577.93	577.96	578.06	578.58	578.48	578.49	578.40	578.28	578.01	578.05	577.74
1911	577.05	577.26	576.93	577.25	577.79	577.84	578.05	577.86	577.73	577.80	577.64	577.36
1912	577.51	577.38	577.35	577.38	577.77	578.42	578.69	578.62	578.77	578.28	578.47	578.28
1913	578.02	577.97	577.87	578.26	578.96	579.23	579.19	579.22	579.14	578.86	578.36	578.83
1914	578.11	577.95	577.93	578.29	578.34	578.47	578.89	578.80	578.68	578.38	577.99	577.93
1915	577.33	578.14	577.63	577.52	577.56	577.81	577.98	578.10	577.77	578.10	577.53	577.39
1916	577.33	577.21	577.43	577.64	578.42	578.89	579.35	579.39	578.77	578.60	578.55	578.38
1917	578.28	578.72	578.42	578.70	579.07	579.43	579.83	579.97	579.85	579.48	579.16	578.99
1918	578.83	578.73	578.98	579.27	579.52	579.95	579.93	579.91	579.65	579.26	579.07	578.88
1919	579.40	578.69	578.64	578.96	579.41	579.61	579.63	579.47	578.96	578.89	578.63	578.05
1920	577.56	578.25	577.97	578.67	578.70	578.91	579.01	578.98	579.00	578.88	578.61	578.23
1921	578.11	578.14	577.81	578.07	578.49	578.76	578.57	578.23	578.31	577.74	578.02	577.50
1922	577.24	577.38	577.34	577.74	578.40	578.62	578.76	578.73	578.70	578.26	578.02	577.18
1923	577.04	577.11	576.88	576.99	577.40	577.90	577.51	577.92	577.77	577.73	577.04	577.04
1924	577.08	576.65	576.68	576.94	577.06	577.43	577.52	577.80	577.54	577.45	576.90	576.80
1925	576.65	576.24	576.19	576.42	576.64	576.44	576.58	576.70	576.27	576.43	575.61	575.73
1926	575.26	575.63	575.56	576.09	576.15	576.33	576.58	576.79	576.68	576.63	576.38	576.32
1927	576.36	576.09	576.50	576.95	576.92	577.45	577.55	577.74	577.45	577.18	577.09	576.78
1928	576.90	576.69	576.69	577.14	577.72	578.04	578.44	578.50	578.34	578.40	578.55	578.85
1929	578.89	578.71	578.70	579.42	580.03	580.29	580.40	580.38	580.06	579.81	579.58	578.31

* IGLD - International Great Lakes Datum

Table A.5. Beginning-of-Month Levels at Milwaukee (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1930	578.68	578.59	578.79	578.67	578.95	578.96	579.26	579.24	579.04	578.43	578.07	577.61
1931	577.07	577.14	577.27	577.25	577.08	577.17	577.28	577.17	576.75	576.51	576.51	576.13
1932	577.10	575.78	576.28	576.16	576.45	576.78	576.60	576.72	576.40	576.00	576.23	575.85
1933	575.58	575.79	575.70	575.89	576.47	576.71	576.85	576.60	576.59	575.93	576.04	575.37
1934	575.66	575.28	575.33	575.68	575.80	576.16	576.13	576.18	575.98	575.88	575.54	575.47
1935	575.63	575.72	575.75	576.09	576.16	576.38	576.81	576.58	576.52	576.14	576.27	576.06
1936	575.90	575.84	576.11	576.18	576.59	576.68	576.88	576.65	576.73	576.61	576.32	576.19
1937	575.61	575.82	575.91	576.01	576.80	576.67	576.79	576.90	576.74	576.61	576.23	575.62
1938	575.81	575.86	576.01	576.33	576.94	577.51	577.75	577.73	577.83	577.75	577.43	577.10
1939	576.65	577.05	577.02	576.98	577.46	577.90	578.02	578.16	578.19	577.82	577.55	577.25
1940	576.75	576.97	576.93	576.61	576.97	577.25	577.42	577.51	577.65	577.43	577.29	576.99
1941	577.07	576.85	576.86	576.90	577.21	577.43	577.25	577.14	576.78	576.75	577.45	577.30
1942	577.40	577.27	577.08	577.38	577.86	578.40	578.30	578.47	578.09	577.97	577.60	577.57
1943	577.59	577.35	577.48	577.94	578.25	578.97	579.36	579.60	579.65	579.44	579.36	578.87
1944	578.50	578.42	578.56	578.36	578.81	578.92	579.01	578.97	578.66	579.00	578.53	578.46
1945	577.77	577.59	577.64	578.01	578.16	579.03	579.03	579.39	578.99	579.10	578.41	578.82
1946	578.85	578.39	578.49	579.31	579.06	579.26	579.38	579.13	578.63	578.49	577.97	577.98
1947	577.72	577.99	577.45	577.65	578.49	578.77	579.23	579.27	579.28	579.23	579.40	578.27
1948	578.94	578.02	578.32	578.67	578.83	579.07	579.01	578.64	578.77	578.44	577.94	577.55
1949	577.29	576.80	577.46	577.66	577.68	577.82	578.02	577.84	577.47	577.10	576.64	576.32
1950	576.57	576.52	576.47	577.03	577.33	577.59	577.79	578.30	578.25	578.09	577.93	577.34
1951	577.60	577.74	578.04	578.23	579.30	579.39	579.46	579.72	580.29	579.67	579.63	579.78
1952	579.84	579.73	579.88	579.96	580.59	580.73	580.97	580.70	580.99	580.40	579.79	579.67
1953	579.53	579.17	579.56	579.84	580.43	580.35	580.34	580.39	580.08	579.90	579.68	579.24
1954	578.62	578.57	578.80	578.74	579.51	579.84	579.89	579.93	579.83	579.76	579.97	579.72
1955	579.61	579.43	579.30	579.21	579.58	579.64	579.59	579.44	578.86	578.46	578.32	577.88
1956	577.77	577.69	577.70	577.90	578.13	578.44	578.66	578.80	578.68	578.40	578.18	577.70
1957	577.40	577.33	577.37	577.45	577.62	577.87	577.90	578.10	577.99	577.54	577.54	577.17
1958	577.59	577.23	577.45	577.09	576.84	577.12	577.06	577.24	576.76	576.41	576.53	575.76
1959	576.18	575.89	576.00	576.31	576.83	577.32	577.29	577.05	577.29	577.07	576.94	577.07

* IGLD - International Great Lakes Datum

Table A.5. Beginning-of-Month Levels at Milwaukee (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1960	577.36	577.32	577.26	577.47	577.96	578.66	579.06	579.11	579.15	579.12	578.89	578.42
1961	578.27	578.01	577.76	577.95	578.12	578.14	578.37	578.52	578.07	578.07	577.59	577.76
1962	577.21	577.40	577.41	577.66	577.90	577.93	578.11	577.83	577.66	577.57	577.26	576.84
1963	576.57	576.20	576.26	576.64	576.96	576.98	576.98	576.85	576.77	576.59	576.29	575.88
1964	575.44	575.52	575.12	575.46	576.05	576.08	575.97	576.17	575.92	575.99	575.79	575.67
1965	575.52	575.39	575.89	575.98	576.41	576.86	576.88	576.93	576.92	577.18	576.87	576.74
1966	576.99	576.87	577.06	577.47	577.68	577.73	577.77	577.76	577.51	577.04	576.72	576.76
1967	577.01	577.02	576.76	577.22	577.98	578.16	578.42	578.42	578.41	578.17	578.01	577.85
1968	577.42	577.38	577.67	577.72	578.06	578.34	578.53	578.54	578.84	578.50	578.65	578.34
1969	577.94	578.34	578.49	578.13	578.92	579.37	579.72	579.98	579.72	579.36	579.35	578.91
1970	579.10	578.49	578.64	578.62	578.92	579.24	579.29	579.43	579.13	579.29	579.11	579.00
1971	578.99	578.58	578.57	579.24	579.56	579.97	579.95	579.41	579.67	579.71	579.34	579.40
1972	579.20	579.01	579.34	579.00	579.64	579.84	579.96	580.06	580.39	580.24	580.34	579.74

* IGLD - International Great Lakes Datum

Table A.6. Beginning-of-Month Levels at Sturgeon Bay (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1946	578.60	578.72	578.73	579.34	578.99	579.31	579.25	579.15	578.66	578.45	577.93	577.85
1947	577.58	577.91	577.47	577.63	578.40	578.82	579.21	579.31	579.35	579.04	579.18	578.33
1948	578.66	578.20	578.31	578.67	578.89	579.06	579.10	578.78	578.79	578.38	577.86	577.53
1949	577.19	576.95	577.20	577.66	577.75	577.84	577.97	577.84	577.54	577.18	576.72	576.32
1950	576.65	576.59	576.55	577.07	577.64	577.75	577.91	578.46	578.21	578.12	578.07	577.45
1951	577.81	577.83	578.18	578.34	579.22	579.41	579.52	579.78	580.19	579.67	579.62	579.78
1952	579.90	579.88	579.86	580.06	580.57	580.73	580.95	580.76	580.99	580.45	579.85	579.74
1953	579.57	579.13	579.34	579.67	580.30	580.34	580.35	580.38	580.17	579.94	579.63	579.25
1954	578.69	578.63	578.65	578.81	579.48	579.57	579.89	580.00	579.78	579.72	579.99	579.67
1955	579.62	579.39	579.34	579.28	579.64	579.71	579.72	579.48	578.92	578.51	578.39	577.94
1956	577.75	577.70	577.71	577.86	578.17	578.53	578.69	578.75	578.76	578.34	578.17	577.69
1957	577.29	577.22	577.32	577.33	577.60	577.85	577.93	578.16	578.00	577.50	577.47	577.22
1958	577.37	577.20	577.33	577.18	577.10	577.27	577.20	577.26	576.75	576.31	576.36	575.86
1959	575.86	575.56	575.76	576.01	576.62	577.25	577.19	577.05	577.39	577.05	576.96	576.98
1960	577.26	577.16	577.21	577.30	577.96	578.68	579.03	579.13	579.24	579.03	578.91	578.25
1961	578.10	577.78	577.72	577.80	578.03	578.14	578.34	578.51	578.08	578.07	577.42	577.66
1962	577.08	577.12	577.21	577.38	577.77	577.92	578.04	577.82	577.69	577.40	577.10	576.86
1963	576.48	576.30	576.26	576.57	576.61	576.94	576.93	576.90	576.78	576.59	576.19	575.91
1964	575.41	575.51	575.25	575.39	575.94	576.05	576.00	576.07	575.98	575.94	575.71	575.56
1965	575.43	575.35	575.72	575.83	576.26	576.75	576.78	576.88	576.85	577.14	576.77	576.78
1966	576.94	576.70	577.02	577.41	577.60	577.68	577.76	577.49	577.50	576.93	576.62	576.70
1967	576.93	576.96	576.92	577.16	577.93	577.95	578.40	578.39	578.24	578.01	577.80	577.87
1968	577.54	577.82	577.69	577.61	577.94	578.27	578.75	578.37	578.82	578.54	578.68	578.23
1969	577.94	578.36	578.37	578.18	578.89	579.37	579.72	579.90	579.63	579.36	579.31	578.80
1970	578.98	578.61	578.51	578.44	578.89	579.20	579.31	579.44	579.11	579.27	579.16	579.04
1971	578.99	578.51	578.53	579.31	579.54	579.86	579.91	579.95	580.00	579.70	579.27	579.31
1972	579.22	578.95	579.04	578.97	579.60	579.79	579.93	580.02	580.30	580.23	580.22	579.73

* IGLD - International Great Lakes Datum

Table A.7. Beginning-of-Month Levels at Green Bay (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1955	579.64	579.34	579.30	579.20	579.55	579.69	579.63	579.44	578.79	578.44	578.28	577.74
1956	577.69	577.64	577.74	577.85	578.17	578.58	578.72	578.77	578.57	578.25	578.25	577.59
1957	577.21	577.38	577.37	577.45	577.75	577.93	577.78	578.12	577.99	577.46	577.42	576.93
1958	577.57	577.11	577.29	577.17	576.77	577.57	577.08	577.26	576.65	576.11	576.46	576.17
1959	576.06	575.66	575.97	576.25	576.76	577.25	577.38	577.14	577.48	577.29	576.66	576.97
1960	577.27	577.14	577.31	577.34	577.94	578.57	578.97	578.84	579.20	578.83	578.28	578.11
1961	578.05	577.63	577.66	577.79	578.02	578.12	578.42	578.56	577.90	577.96	577.34	577.56
1962	577.07	577.06	577.10	577.42	577.84	577.77	578.12	577.73	577.62	577.39	577.19	576.79
1963	576.52	576.43	576.35	576.72	577.15	576.78	576.84	576.84	576.59	576.26	576.04	575.82
1964	575.30	575.37	575.09	575.26	575.92	576.07	575.85	575.97	575.92	575.82	575.65	575.68
1965	575.46	575.39	575.73	575.95	576.41	576.91	576.76	576.98	576.73	576.97	577.19	576.40
1966	576.82	576.67	577.05	577.42	577.63	577.64	577.74	577.46	577.47	576.83	576.55	576.37
1967	576.85	576.96	576.84	577.18	577.98	578.11	578.36	578.38	578.16	577.91	577.79	577.85
1968	577.47	577.79	577.55	577.53	577.95	578.17	578.25	578.42	578.74	578.26	578.50	577.94
1969	577.59	578.25	578.29	578.01	578.73	579.30	579.71	579.77	579.83	579.35	579.31	578.71
1970	578.96	578.68	578.54	578.52	578.88	579.59	579.29	579.35	579.05	579.15	578.79	578.68
1971	578.84	578.40	578.63	579.39	579.48	580.00	579.96	579.85	580.05	579.70	578.86	579.17
1972	578.62	578.93	578.95	578.93	579.64	579.75	579.85	579.98	580.33	580.08	579.92	579.43

* IGLD - International Great Lakes Datum

Table A.8. Beginning-of-Month Levels at Port Inland (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1966	577.07	576.73	577.07	577.39	577.53	577.65	577.82	577.56	577.48	576.91	576.60	576.64
1967	576.99	576.99	576.99	577.20	577.95	577.87	578.46	578.35	578.12	577.89	577.76	577.90
1968	577.62	577.74	577.54	577.61	577.90	578.22	578.61	578.54	578.78	578.71	578.72	578.36
1969	578.20	578.31	578.23	578.26	578.87	579.38	579.76	579.32	579.67	579.33	579.29	578.78
1970	578.86	578.70	578.47	578.48	578.92	579.19	579.33	579.41	579.07	579.24	579.29	579.27
1971	579.05	578.66	578.91	579.32	579.48	579.69	579.90	580.07	579.93	579.81	579.51	579.11
1972	579.40	578.94	578.61	578.99	579.44	579.79	579.93	580.05	580.35	580.26	580.11	579.83

* IGLD - International Great Lakes Datum

Table A.9. Lake Michigan Beginning-of-Month Levels (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1900	578.26	577.86	578.20	578.10	578.38	578.62	578.60	578.92	579.07	578.94	579.06	578.74
1901	578.37	578.16	578.24	578.48	578.90	579.18	579.24	579.34	579.32	579.00	578.76	578.34
1902	578.04	578.00	578.06	577.97	578.18	578.54	578.83	579.14	578.88	578.74	578.43	578.04
1903	577.82	577.80	578.01	578.35	578.52	578.87	578.87	578.86	578.93	578.96	578.73	578.42
1904	578.07	578.13	578.09	578.65	578.98	579.54	579.68	579.64	579.61	579.26	580.60	578.80
1905	578.54	578.49	578.53	578.87	578.91	579.36	579.66	579.82	579.70	579.51	578.76	578.99
1906	578.64	578.78	578.98	579.07	579.30	579.03	579.64	579.64	579.34	579.27	578.95	578.69
1907	578.89	578.95	578.96	578.93	579.19	579.51	579.63	579.55	579.48	579.32	579.18	578.90
1908	578.60	578.68	578.92	578.98	579.14	579.72	579.82	580.00	579.64	579.22	578.88	578.45
1909	578.06	577.97	578.20	578.16	579.00	579.17	579.25	579.28	578.98	578.76	578.39	578.26
1910	578.21	578.16	578.07	578.17	578.61	578.59	578.67	578.51	578.45	578.13	578.14	577.85
1911	577.32	577.50	577.28	577.39	577.82	578.04	578.21	578.06	577.88	577.87	577.73	577.55
1912	577.62	577.51	577.49	577.43	577.85	578.56	578.57	578.75	578.87	578.60	578.58	578.50
1913	578.26	578.17	578.16	578.49	579.03	579.37	579.42	579.44	579.28	579.00	578.60	578.82
1914	578.26	578.13	578.17	578.34	578.43	578.62	578.95	578.91	578.80	578.55	578.30	578.02
1915	577.54	578.00	577.71	577.59	577.68	577.91	578.09	578.19	578.03	578.19	577.74	577.58
1916	577.48	577.49	577.54	577.79	578.48	578.96	579.39	579.40	578.95	578.85	578.75	578.54
1917	578.46	578.68	578.56	578.77	579.20	579.55	579.97	580.15	580.00	579.63	579.37	579.12
1918	578.97	578.95	579.12	579.41	579.64	580.13	580.12	580.05	579.80	579.44	579.26	579.04
1919	579.31	578.84	578.75	578.99	579.43	579.71	579.67	579.52	579.11	578.91	578.73	578.34
1920	577.89	578.27	578.09	578.66	578.81	579.00	579.13	579.14	579.07	578.92	578.63	578.45
1921	578.22	578.18	578.00	578.03	578.60	578.81	578.71	578.41	578.42	577.98	578.04	577.60
1922	577.45	577.47	577.50	577.73	578.43	578.69	578.80	578.75	578.68	578.36	578.00	577.41
1923	577.30	577.19	577.03	577.14	577.50	577.95	577.83	578.04	577.86	577.78	577.29	577.13
1924	577.03	576.75	576.75	576.97	577.12	577.53	577.64	577.85	577.76	577.53	577.17	576.86
1925	576.72	576.40	576.31	576.44	576.63	576.55	576.70	576.73	576.40	576.39	575.85	575.80
1926	575.46	575.61	575.56	575.88	576.18	576.27	576.71	576.84	576.75	576.72	576.38	576.48
1927	576.45	576.34	576.58	576.89	577.03	577.54	577.71	577.78	577.55	577.30	577.27	577.00
1928	576.93	576.84	576.92	577.18	577.85	578.17	578.52	578.65	578.57	578.54	578.64	578.87
1929	578.85	578.78	578.71	579.15	579.87	580.40	580.51	580.47	580.21	579.92	579.64	578.62

* IGLD - International Great Lakes Datum

Table A.9. Lake Michigan Beginning-of-Month Levels (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1930	578.76	578.70	578.90	578.81	579.05	579.15	579.32	579.29	579.16	578.59	578.20	577.78
1931	577.52	577.26	577.28	577.30	577.24	577.31	577.37	577.26	576.85	576.78	576.63	576.37
1932	576.85	576.11	576.32	576.26	576.53	576.81	576.74	576.78	576.58	576.17	576.26	576.00
1933	575.79	575.82	575.76	575.91	576.44	576.82	576.93	576.76	576.61	576.15	576.07	575.57
1934	575.70	575.45	575.38	575.68	575.93	576.19	576.22	576.20	576.01	576.03	575.67	575.72
1935	575.83	575.80	575.81	576.14	576.23	576.44	576.83	576.74	576.64	576.32	576.34	576.19
1936	576.02	575.98	576.14	576.25	576.57	576.78	576.93	576.74	576.74	576.69	576.42	576.21
1937	575.86	575.90	576.03	576.06	576.71	576.72	576.85	576.90	576.77	576.60	576.28	575.84
1938	575.94	575.92	576.13	576.55	577.02	577.52	577.76	577.78	577.83	577.76	577.49	577.16
1939	576.81	576.97	577.02	577.05	577.43	577.84	578.08	578.17	578.21	577.94	577.72	577.39
1940	576.95	576.98	576.91	576.64	576.97	577.27	577.49	577.55	577.66	577.45	577.27	577.03
1941	577.03	576.92	576.88	576.87	577.21	577.39	577.29	577.20	576.87	576.88	577.30	577.30
1942	577.27	577.22	577.09	577.44	577.83	578.34	578.38	578.46	578.18	578.02	577.73	577.65
1943	577.57	577.43	577.52	577.96	578.26	578.96	579.45	579.66	579.69	579.48	579.30	578.98
1944	578.58	578.47	578.52	578.46	578.77	578.90	579.08	579.03	578.79	578.89	578.53	578.38
1945	577.87	577.66	577.74	578.05	578.23	578.91	579.15	579.33	579.05	579.05	578.57	578.79
1946	578.71	578.55	578.62	579.28	579.02	579.28	579.29	579.16	578.69	578.49	578.01	577.93
1947	577.67	577.91	577.49	577.64	578.41	578.83	579.22	579.35	579.35	579.12	579.24	578.36
1948	578.77	578.15	578.33	578.66	578.87	579.07	579.08	578.80	578.79	578.41	577.88	577.59
1949	577.26	576.97	577.28	577.66	577.72	577.83	578.00	577.87	577.55	577.16	576.74	576.41
1950	576.63	576.61	576.56	577.05	577.56	577.72	577.90	578.35	578.28	578.15	578.01	577.51
1951	577.73	577.85	578.09	578.28	579.23	579.39	579.51	579.78	580.11	579.71	579.68	579.78
1952	579.77	579.81	579.85	580.01	580.55	580.73	580.92	580.79	580.98	580.49	579.84	579.71
1953	579.59	579.24	579.44	579.72	580.23	580.30	580.35	580.39	580.18	579.95	579.64	579.25
1954	578.71	578.62	578.74	578.81	579.47	579.64	579.89	579.95	579.76	579.75	579.98	579.71
1955	579.60	579.41	579.32	579.25	579.59	579.69	579.67	579.51	578.97	578.53	578.38	577.93
1956	577.75	577.68	577.71	577.84	578.18	578.50	578.68	578.77	578.75	578.36	578.15	577.70
1957	577.39	577.28	577.33	577.37	577.59	577.85	577.91	578.13	577.95	577.55	577.49	577.20
1958	577.43	577.24	577.36	577.15	577.04	577.24	577.15	577.26	576.85	576.49	576.46	575.93
1959	576.01	575.78	575.92	576.21	576.77	577.25	577.24	577.08	577.32	577.10	576.99	577.04

* IGLD - International Great Lakes Datum

Table A.9. Lake Michigan Beginning-of-Month Levels (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1960	577.25	577.23	577.26	577.35	577.96	578.68	579.05	579.13	579.21	579.01	578.86	578.38
1961	578.17	577.84	577.75	577.88	578.08	578.14	578.34	578.45	578.09	578.11	577.59	577.69
1962	577.24	577.27	577.33	577.52	577.84	577.93	578.06	577.84	577.72	577.44	577.16	576.82
1963	576.47	576.26	576.24	576.57	576.76	576.93	576.96	576.91	576.75	576.57	576.26	575.87
1964	575.50	575.51	575.19	575.40	575.91	576.02	575.97	576.07	575.94	575.94	575.70	575.58
1965	575.43	575.41	575.73	575.83	576.33	576.79	576.83	576.90	576.86	577.18	576.84	576.82
1966	576.98	576.80	577.05	577.42	577.63	577.69	577.78	577.55	577.51	576.99	576.69	576.78
1967	576.97	577.01	576.90	577.17	577.93	578.04	578.42	578.40	578.27	578.01	577.87	577.83
1968	577.58	577.73	577.69	577.66	577.98	578.25	578.59	578.52	578.77	578.53	578.62	578.27
1969	578.12	578.35	578.38	578.17	578.89	579.37	579.77	579.94	579.71	579.34	579.30	578.85
1970	578.96	578.57	578.54	578.54	578.93	579.22	579.31	579.45	579.13	579.25	579.16	579.00
1971	578.94	578.66	578.67	579.22	579.53	579.86	579.95	579.88	579.94	579.73	579.36	579.29
1972	579.24	578.96	579.05	578.98	579.56	579.80	579.94	580.05	580.37	580.23	580.20	579.79

* IGLD - International Great Lakes Datum

*Table A.10. Lake Michigan Monthly Change in Storage in HCFS - Months**

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1900	-928	844	-232	672	557	-48	743	348	-312	279	-768	-859
1901	-487	206	557	1007	650	144	232	-46	-768	-557	-1007	-696
1902	-93	154	-209	504	836	696	720	-603	-336	-720	-935	-255
1903	-46	540	789	408	812	812	-23	162	72	-534	-744	-812
1904	139	-99	1300	792	1300	336	-93	-70	-839	3110	-4317	-603
1905	-116	103	789	96	1045	720	371	-279	-456	-1741	552	-812
1906	325	514	209	552	-627	1463	1463	-696	-168	-743	-624	464
1907	139	26	-70	624	743	288	-186	-162	-384	-325	-672	-696
1908	186	595	139	384	1346	240	418	-836	-1007	-789	-1031	-905
1909	-209	591	-93	2015	395	192	70	-696	-528	-859	-312	-116
1910	-116	-231	232	1055	-46	192	-371	-139	-768	23	-696	-1230
1911	418	-565	255	1031	511	408	-348	-418	-24	-325	-432	162
1912	-255	-50	-139	1007	1648	24	418	279	-648	-46	-192	-557
1913	-209	-26	766	1295	789	120	46	-371	-672	-928	528	-1300
1914	-302	103	395	216	441	792	-93	-255	-600	-580	-672	-1416
1915	1068	-745	-279	216	534	432	232	-371	384	-1045	-384	-232
1916	23	124	580	1655	1114	1031	23	-1045	-240	-232	-504	-186
1917	511	-308	487	1031	812	1007	418	-348	-887	-603	-600	-348
1918	-46	437	673	552	1137	-24	-162	-580	-863	-418	-528	627
1919	-1091	-231	557	1055	650	-96	-348	-952	-480	-418	-935	-1045
1920	882	-447	1323	360	441	312	23	-162	-360	-673	-432	-534
1921	-93	-463	70	1367	487	-240	-696	23	-1055	139	-1055	-348
1922	46	77	534	1679	603	264	-116	-162	-768	-836	-1415	-255
1923	-255	-411	255	863	1045	-288	487	-418	-192	-1137	-384	-232
1924	-650	650	511	360	952	264	487	-209	-552	-836	-744	-325
1925	-743	-231	302	456	-186	360	70	-766	-24	-1253	-120	-789
1926	348	-128	743	720	209	1055	302	-209	-72	-789	240	905
1927	-255	617	720	336	1184	408	162	-534	-600	-70	-648	-162
1928	-209	198	603	1607	743	839	302	-186	-72	232	552	-46
1929	-162	-180	1021	1727	1230	264	-93	-603	-696	-650	-2446	325

*HCFS-Months - hundreds of cubic feet per second months

*Table A.10. Lake Michigan Monthly Change in Storage in HCFS - Months * (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1930	-139	514	-209	576	232	408	-70	-302	-1367	-905	-1007	-603
1931	-603	51	46	-144	162	144	-255	-952	-168	-348	-624	1114
1932	-1718	521	-139	648	650	-168	93	-464	-983	209	-624	-487
1933	70	-154	348	1271	882	264	-395	-348	-1103	-186	-1199	302
1934	-580	-180	696	600	603	72	-46	-441	48	-836	120	255
1935	-70	26	766	216	487	935	-209	-232	-768	46	-360	-395
1936	-93	397	255	768	487	360	-441	441	-120	-627	-504	-812
1937	93	334	70	1559	23	312	116	-302	-408	-743	-1055	232
1938	-46	540	975	1127	1161	576	46	116	-168	-627	-792	-1346
1939	371	128	70	911	952	576	209	93	-648	-511	-792	-1021
1940	70	-174	-627	792	696	528	139	255	-504	-418	-576	576
1941	-255	-103	-23	815	418	-240	-209	-766	24	975	975	-70
1942	-116	-334	812	935	1184	96	186	-650	-384	-673	-192	-186
1943	-325	231	1021	720	1625	1175	487	70	-504	-418	-768	-928
1944	-255	124	-139	744	302	432	-116	-557	240	-836	-360	-1184
1945	-487	206	720	432	1578	576	418	-650	650	-1114	528	-116
1946	-371	180	1532	-624	603	24	-302	-1091	-480	-1114	-192	-603
1947	557	-1079	348	1847	975	935	302	0	-552	279	-2111	952
1948	-1439	447	766	504	464	24	-650	-23	-911	-1230	-696	-766
1949	-673	797	882	144	255	408	-302	-743	-935	-975	-792	7822
1950	-46	-128	1137	1223	371	432	1045	-162	-312	-325	-1199	511
1951	279	617	441	2279	371	288	627	766	-959	-70	240	-23
1952	93	99	371	1295	418	456	-302	441	-1175	-1509	-312	-279
1953	-812	514	650	1223	162	120	93	-487	-552	-720	-935	-1253
1954	-209	308	162	1583	395	600	139	-441	-24	534	-648	-279
1955	-441	-231	-162	815	232	-48	-371	-1253	-1055	-348	-1079	-418
1956	-162	74	302	815	743	432	209	-46	-935	-487	-1079	-720
1957	-255	128	93	528	603	144	511	-418	-959	-139	-696	534
1958	-441	308	-487	-264	464	-216	255	-952	-863	-70	-1271	186
1959	-534	360	673	1343	1114	-24	-371	557	-528	-255	120	557

*HCFS - Months - hundreds of cubic feet per second months

*Table A.10. Lake Michigan Monthly Change in Storage in HCFS - Months * (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1960	-46	74	209	1463	1671	887	186	186	-480	-348	-1151	-487
1961	-766	-231	302	480	139	480	255	-836	48	-1207	240	-1045
1962	70	154	441	768	209	312	-511	-279	-672	-650	-815	-812
1963	-487	-51	766	456	395	72	-116	-371	-432	-720	-935	-859
1964	23	-794	487	1223	255	-120	232	-302	0	-557	-288	-348
1965	-46	822	232	1199	1068	96	162	-93	768	-789	-48	371
1966	-418	642	859	504	139	216	-534	-93	-1247	-696	216	441
1967	93	-283	627	1823	255	911	-46	-302	-624	-325	-96	-580
1968	348	-99	-70	768	627	815	-162	580	-576	209	-839	-348
1969	534	77	-487	1727	1114	959	395	-534	-887	-93	-1079	255
1970	-905	-77	0	935	673	216	325	-743	288	-209	-384	-116
1971	-650	26	1277	744	766	216	-162	139	-504	-859	-168	-116
1972	-650	223	-162	1391	557	336	255	743	-336	-70	-983	534

*HCFS-Months - hundreds of cubic feet per second months

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