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Lake St. Clair Beginning-of-Month Water Levels and Monthly Rates of Change of Storage

Raymond N. Kelley

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U.S. DEPARTMENT OF COMMERCE
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Elliot Richardson, Secretary

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Boulder, Colorado

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LAKE ST. CLAIR BEGINNING-OF-MONTH WATER LEVELS AND MONTHLY RATES OF CHANGE OF STORAGE

Raymond N. Kelley

Lake St. Clair water level gage data are used to determine beginning-of-month water levels and monthly rates of storage change for the years 1910 through 1975 for scientific and planning purposes. Analysis of the results indicates that additional gages, strategically located, are needed for improved accuracy.

1. INTRODUCTION

The objectives of this study are to establish beginning-of-month levels and rates of change of storage for the lake. Resultant beginning-of-month values are needed for scientific and planning studies in many fields, such as lake hydrology, beach and shore erosion, navigation, hydroelectric power generation, and lake level regulation. Monthly rates of change of lake storage, which are derived from the beginning-of-month levels, are needed in water budget studies involving net basin supplies, groundwater flows and lake evaporation.

Since only two gages were available on the west and south sides of the lake, computations of lake beginning-of-month levels were made using straight averaging in lieu of the Thiessen polygon procedure, which was used in lake level studies of the five Great Lakes. The Thiessen polygon method provides better accuracy and at the same time standardizes computational procedures.

2. METHODOLOGY

The computation of beginning-of-month water levels is based on data from gages located around the perimeter of the lake. Theoretically, these levels should represent the instantaneous level of the entire lake at the beginning-of-the-month. Realistically, an instantaneous true water level for a large lake surface is difficult, if not impossible, to obtain because of short-term variations in wind speed and changes in barometric pressure during small time periods. Error due to these fluctuations is lessened by specifying that the beginning-of-month level for each gage shall be the average of the daily mean water levels of the first day of the month and the last day of the preceding month.

In recent years daily mean water levels from the gages were computed using hourly sampling rates. During the early 1900's, daily levels were derived from tri-daily readings. Very short-term water level oscillations due to wind waves and ship effects are sufficiently filtered out by a stilling well and gage response time of less than 1 minute while longer term variations are maintained. Table 1 lists the gages used, and figure 1 shows their locations.

Table 1. Water Level Gages and Period of Study

Gage Location	Period of Study (daily means)
St. Clair Shores*	1910-1975
Belle River	1961-1975

* Adjusted Windmill Point 1910-1933
Grosse Point Yacht Club 1934-1968

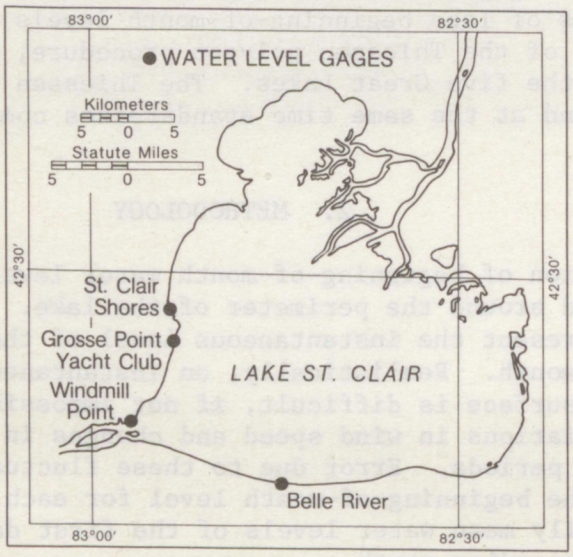

Figure 1. Water level gage locations.

To form a single continuous record for the period of study, the levels assigned to the St. Clair Shores gage are a combination of adjusted Windmill Point to Grosse Point Yacht Club levels from 1910 through 1933, Grosse Point Yacht Club levels from 1934 through 1968, and St. Clair Shores levels from 1969 through 1975. The equation for adjusting Windmill Point levels to Grosse Point Yacht Club is:

$$GPYC = 572.211 + 0.992 (WP - 572.00)$$

No adjustment was necessary in transferring Grosse Point Yacht Club levels to St. Clair Shores because of the proximity of the two locations and the close agreement between their daily mean levels while they operated simultaneously in 1969. Lake St. Clair water level gage analyses conducted in 1972, by using water level transfers during the period April to December, 1961-1971, indicated that the Belle River gage datum was 0.10 ft lower than the Grosse Point Yacht Club. The Grosse Point Yacht Club-Belle River difference of 0.10 ft was coordinated between the United States Lake Survey Center and the Tides and Water Levels, Canadian Hydrographic Service. Adjusted Belle River beginning-of-month levels were obtained by adding a 0.10 correction to each Belle River beginning-of-month level.

Occasional missing daily mean data for the St. Clair Shores and Belle River gages were filled in by three methods: (1) interpolating from the same gage with data from days preceding or succeeding the first or last day of the month, (2) transferring water levels between St. Clair Shores and Belle River, or (3) transferring from adjusted Windmill Point data.

Consideration was given to using either the St. Clair Flats gage or the Minnich's dock gage, both located on the St. Clair River Delta, as a possible third Lake St. Clair gage. This would enable utilization of the Thiessen polygon procedure of determining beginning-of-month levels. However, these gages were excluded because examination of the data disclosed several periods of erratic or missing records.

Lake St. Clair beginning-of-month levels and rates of change of storage were computed from data from one gage, St. Clair Shores, from 1910 through 1960 and two gages, St. Clair Shores and Belle River, from 1961 through 1975.

3. RESULTS

3.1 Effect of Gage Network Size

Beginning-of-month levels computed from the two gage network were compared to the one gage levels during the period 1961 through 1975. The statistical parameters used in the analysis were the standard deviation about zero, the mean, and the maximum differences between the one and two gage beginning-of-month levels.

The maximum deviation of 0.19 ft and the standard deviation of 0.04 ft indicate that greater accuracy could be achieved by increasing the number of gages over the present network. With additional gages placed on the north and east shores of the lake, implementation of the computational procedure set forth by Quinn (1971), using Thiessen polygon weighting factors, could also improve the accuracy over the straight averaging technique.

3.2 Beginning-of-Month Levels

Computed beginning-of-month levels for the two gages are given in tables A.1 and A.2. The Lake St. Clair beginning-of-month levels are presented in table A.3.

3.3 Change of Storage

Monthly changes in storage were computed by multiplying the differences between two consecutive beginning-of-month levels by the area of Lake St. Clair, 430 square miles. Changes of storage were then converted into monthly rates by dividing by the number of seconds in each month. These rates of change are given in table A.4, expressed as hundreds of cubic feet per second months (HCFS-months).

4. CONCLUSIONS AND RECOMMENDATIONS

The beginning-of-month levels and rates of storage change listed in tables A.3 and A.4 are recommended for use in scientific and planning studies and should be updated periodically.

Two additional gages, located along the north and east shores, would provide more balanced coverage and improve the accuracy of Lake St. Clair water levels. An optimum network could be determined only by retrospective analyses after establishing new gages.

5. ACKNOWLEDGMENTS

This study was performed under the general guidance of Frank H. Quinn, Head, and Jan A. Derecki, Project Scientist, Lake Hydrology Group, Great Lakes Environmental Research Laboratory.

6. REFERENCES

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

APPENDIX

Beginning-of-Month Levels and Monthly Rates of Storage Change

Table A.1. Beginning-of-Month Levels at St. Clair Shores in Feet (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1910	571.86	571.84	572.42	573.00	573.64	573.52	573.86	573.64	573.52	573.11	573.00	573.68
1911	571.04	571.35	571.18	572.58	572.78	573.00	573.18	572.92	572.87	572.76	572.53	572.27
1912	572.20	572.44	573.00	573.24	573.41	573.68	573.76	573.54	573.56	573.44	573.29	572.93
1913	572.88	572.88	572.02	573.30	574.44	574.54	574.44	574.30	573.98	573.46	573.18	573.37
1914	573.08	572.12	572.48	573.29	573.28	573.74	573.73	573.69	573.56	573.20	572.83	572.56
1915	572.32	571.74	572.04	572.25	572.48	572.78	572.93	573.10	573.22	573.25	572.66	572.20
1916	572.70	573.10	572.23	573.19	573.39	574.16	574.32	574.19	573.53	573.35	573.02	572.90
1917	574.50	572.96	572.96	573.27	573.08	574.27	575.14	575.36	574.64	573.97	573.68	573.75
1918	573.50	572.24	573.00	572.40	573.24	573.96	573.88	574.18	573.88	574.28	573.50	573.52
1919	573.54	573.50	573.04	573.86	574.17	574.81	574.86	574.28	573.94	573.72	573.52	572.95
1920	571.31	571.41	571.79	572.81	573.37	573.44	573.71	573.78	573.70	573.45	573.18	573.11
1921	573.86	572.92	571.86	573.36	573.84	573.85	573.92	573.55	573.34	572.60	573.01	572.74
1922	572.44	572.04	571.58	573.13	573.40	573.54	573.74	573.62	573.44	573.19	572.79	572.10
1923	572.42	571.31	571.33	571.98	572.41	572.94	573.00	573.00	572.75	572.70	572.22	572.02
1924	572.26	571.77	571.39	572.17	572.54	572.88	573.13	573.15	572.94	572.60	572.09	571.72
1925	571.49	571.04	571.22	572.00	571.97	571.88	572.06	572.09	571.82	571.83	571.38	571.33
1926	570.51	569.89	570.08	571.56	571.70	571.78	572.18	572.29	572.13	572.53	572.26	572.18
1927	572.20	570.80	570.17	572.62	572.50	572.99	573.00	573.17	572.77	572.33	572.12	572.42
1928	572.30	572.12	571.16	572.68	572.67	573.08	573.68	573.68	573.55	573.26	573.27	573.18
1929	573.35	573.53	574.24	573.57	574.97	575.22	575.20	575.24	574.79	574.65	574.10	573.30
1930	572.61	573.66	574.63	574.19	574.50	574.40	574.54	574.40	573.96	573.66	573.18	572.66
1931	572.56	571.12	570.30	571.43	572.46	572.48	572.64	572.68	572.14	572.06	571.72	571.43
1932	572.25	571.96	572.20	571.56	572.22	572.68	572.28	572.41	572.22	571.84	571.82	571.68
1933	572.01	571.72	571.44	572.04	572.52	572.85	572.86	572.60	572.50	572.02	571.77	571.45
1934	571.44	570.26	570.38	570.45	571.58	571.67	571.81	571.75	571.39	571.40	570.88	570.56
1935	571.62	570.21	570.23	571.42	571.50	571.78	572.12	572.05	571.92	571.68	571.42	571.08
1936	570.36	570.20	571.36	571.22	572.00	572.14	572.16	571.92	571.66	571.94	571.57	571.42
1937	571.42	571.99	571.42	571.72	573.02	572.64	573.00	572.88	572.62	572.27	572.00	571.46
1938	571.74	570.98	572.46	572.42	572.66	572.99	573.14	573.20	573.02	572.98	572.66	572.29
1939	572.88	571.38	571.20	572.52	573.10	573.16	573.34	573.32	573.28	573.06	572.63	572.36
1940	572.25	570.88	571.02	571.67	572.43	572.94	573.02	573.02	572.99	572.88	572.48	572.25
1941	572.91	571.04	571.18	572.00	572.44	572.64	572.65	572.59	572.28	572.08	572.09	572.02
1942	572.16	571.54	570.08	572.57	571.99	573.52	573.60	573.68	573.46	573.28	572.96	573.05
1943	573.82	571.92	572.81	573.34	573.80	574.54	574.78	574.98	574.72	574.48	574.24	573.86
1944	573.02	572.80	572.45	573.32	573.96	574.18	574.36	574.12	573.77	573.86	573.40	572.89
1945	573.29	571.76	572.65	573.40	573.69	574.34	574.57	574.56	574.20	574.52	574.06	573.86
1946	574.10	572.00	572.22	574.08	573.89	574.24	574.50	574.40	573.95	573.62	573.46	572.92
1947	573.04	572.82	572.24	573.28	574.05	574.58	574.79	574.84	574.78	574.44	574.20	573.51
1948	573.86	573.19	573.68	574.27	574.28	574.56	574.58	574.38	572.82	573.68	573.18	572.98
1949	574.56	574.24	574.06	574.12	573.32	573.41	573.52	573.40	572.97	572.75	572.34	571.96
1950	572.34	572.93	572.14	573.29	573.89	573.62	573.67	573.70	573.62	573.41	573.20	573.15
1950	572.32	572.93	572.14	573.29	573.89	573.62	573.67	573.69	573.61	573.41	573.20	573.15
1951	573.12	572.85	573.70	574.15	574.63	574.69	574.82	574.86	574.76	574.46	574.41	574.34
1952	575.06	574.35	574.98	575.06	575.49	575.59	575.86	575.68	575.60	575.21	574.47	574.27
1953	574.28	574.32	574.17	574.56	574.86	575.06	575.21	575.18	575.06	574.60	574.34	573.91

*IGLD - International Great Lakes Datum

Table A.1. Beginning-of-Month Levels at St. Clair Shores in Feet (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1954	573.56	572.20	573.70	574.31	574.79	574.65	574.87	574.81	574.66	574.48	574.75	574.44
1955	574.69	574.09	574.62	574.74	574.95	574.90	574.87	574.71	574.41	573.93	573.60	573.15
1956	573.23	570.64	571.61	573.11	574.14	574.16	574.26	574.33	574.35	573.88	573.45	572.90
1957	572.90	571.93	572.92	572.99	573.61	573.64	573.72	573.88	573.56	573.32	572.98	572.56
1958	572.95	570.82	571.73	571.92	572.51	572.66	572.76	572.93	572.68	572.48	572.25	571.72
1959	571.49	571.04	571.31	572.60	572.91	573.13	573.03	572.88	572.87	572.62	572.38	572.28
1960	572.76	571.63	572.50	573.33	573.41	573.94	574.30	574.33	574.28	574.09	573.49	572.96
1961	573.02	572.39	573.26	573.32	574.16	573.94	573.99	574.02	573.79	573.49	572.98	572.90
1962	573.08	571.45	572.03	573.12	573.14	573.16	573.32	573.18	573.03	572.87	572.48	572.36
1963	572.74	571.56	571.51	572.66	572.53	572.60	572.56	572.43	572.27	571.99	571.69	571.44
1964	571.56	570.45	570.35	571.55	572.04	572.10	571.95	571.92	571.84	571.62	571.25	570.93
1965	571.16	570.25	570.70	571.90	572.24	572.38	572.45	572.33	572.36	572.21	571.98	571.85
1966	572.48	572.03	571.99	572.71	573.17	573.22	573.32	573.15	572.97	572.49	572.11	572.19
1967	572.78	572.84	572.50	573.06	573.37	573.65	574.02	573.84	573.68	573.32	573.21	573.36
1968	573.53	573.38	573.28	573.69	573.63	574.12	574.40	574.21	574.05	573.80	573.51	573.69
1969	573.68	574.14	573.85	573.92	574.48	574.84	574.99	575.30	574.95	574.57	574.23	573.92
1970	572.87	573.37	573.30	573.96	574.14	574.39	574.56	574.63	574.40	574.35	574.06	574.01
1971	574.18	573.10	574.06	574.44	574.55	574.79	574.90	574.81	574.87	574.61	574.29	573.97
1972	574.24	574.33	573.91	574.38	574.71	575.08	575.24	575.31	575.29	575.22	575.16	575.04
1973	575.24	575.54	575.23	576.02	575.92	576.04	576.40	576.16	575.91	575.65	575.04	575.09
1974	575.35	575.47	575.36	575.66	575.85	576.05	576.08	575.89	575.66	575.12	574.85	575.08
1975	574.80	575.16	575.23	575.28	575.41	575.50	575.75	575.50	575.77	575.30	574.84	574.32

*IGLD - International Great Lakes Datum

Table A.2. Beginning-of-Month Levels at Belle River in Feet (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1961	573.01	572.35	573.24	573.42	574.14	573.91	573.95	573.99	573.72	573.42	573.03	572.87
1962	573.07	571.43	572.05	573.19	573.11	573.16	573.33	573.18	573.03	572.85	572.54	572.35
1963	572.74	571.54	571.48	572.65	572.92	572.57	572.60	572.49	572.29	571.96	571.82	571.69
1964	571.54	570.41	570.31	571.52	571.96	572.05	571.85	571.85	571.91	571.58	571.15	571.05
1965	571.06	570.15	570.71	571.92	572.24	572.42	572.54	572.31	572.34	572.25	572.23	571.81
1966	572.44	572.09	572.07	572.85	573.29	573.13	573.30	573.06	572.93	572.56	572.12	572.38
1967	572.79	572.84	572.50	573.04	573.30	573.61	574.00	573.75	573.64	573.29	573.17	573.23
1968	573.58	573.40	573.30	573.69	573.54	574.09	574.37	574.10	573.78	573.81	573.37	573.63
1969	573.62	574.09	573.82	573.91	574.48	574.82	575.04	575.29	574.95	574.54	574.09	573.51
1970	572.95	573.38	573.34	573.96	574.11	574.43	574.55	574.63	574.46	574.40	574.11	573.94
1971	574.19	573.12	574.08	574.34	574.51	574.81	574.89	574.77	574.98	574.56	574.28	574.19
1972	574.17	574.28	573.94	574.38	574.66	575.08	575.23	575.29	575.25	575.15	575.12	575.04
1973	575.28	575.43	575.20	576.00	575.84	576.03	576.38	576.12	575.88	575.58	575.14	575.09
1974	575.37	575.55	575.37	575.67	575.85	576.04	576.07	575.89	575.69	575.40	574.81	575.09
1975	574.83	575.16	575.28	575.24	575.36	575.49	575.70	575.45	575.67	575.29	574.72	574.24

*IGLD - International Great Lakes Datum

Table A.3. Lake St. Clair Beginning-of-Month Levels in Feet (IGLD 1955)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1910	571.86	571.84	572.42	573.00	573.64	573.52	573.86	573.64	573.52	573.11	573.00	573.68
1911	571.04	571.35	571.18	572.58	572.78	573.00	573.18	572.92	572.87	572.76	572.53	572.27
1912	572.20	572.44	573.00	573.24	573.41	573.68	573.76	573.54	573.56	573.44	573.29	572.93
1913	572.88	572.88	572.02	573.30	574.44	574.54	574.44	574.30	573.98	573.46	573.18	573.37
1914	573.08	572.12	572.48	573.29	573.28	573.74	573.73	573.69	573.56	573.20	572.83	572.56
1915	572.32	571.74	572.04	572.25	572.48	572.78	572.93	573.10	573.22	573.25	572.66	572.20
1916	572.70	573.10	572.23	573.19	573.39	574.16	574.32	574.19	573.63	573.35	573.02	572.90
1917	574.50	572.96	572.96	573.27	573.08	574.27	575.14	575.36	574.54	573.97	573.68	573.75
1918	573.50	572.24	573.00	572.40	573.24	573.96	573.88	574.18	573.88	574.28	573.50	573.52
1919	573.54	573.50	573.04	573.86	574.17	574.81	574.86	574.28	573.94	573.72	573.52	572.95
1920	571.31	571.41	571.79	572.81	573.37	573.44	573.71	573.78	573.70	573.45	573.18	573.11
1921	573.86	572.92	571.86	573.36	573.84	573.85	573.92	573.55	573.34	572.60	573.01	572.74
1922	572.44	572.04	571.58	573.13	573.40	573.54	573.74	573.62	573.44	573.19	572.79	572.10
1923	572.42	571.31	571.33	571.98	572.41	572.94	573.00	573.00	572.75	572.70	572.22	572.02
1924	572.26	571.77	571.39	572.17	572.54	572.88	573.13	573.15	572.94	572.60	572.09	571.72
1925	571.49	571.04	571.22	572.00	571.97	571.88	572.06	572.09	571.82	571.83	571.38	571.33
1926	570.51	569.89	570.08	571.56	571.70	571.78	572.18	572.29	572.13	572.53	572.26	572.18
1927	572.20	570.80	570.17	572.62	572.50	572.99	573.00	573.17	572.77	572.33	572.12	572.42
1928	572.30	572.12	571.16	572.68	572.67	573.08	573.68	573.68	573.55	573.26	573.27	573.18
1929	573.35	573.53	574.24	573.57	574.97	575.22	575.20	575.24	574.79	574.65	574.10	573.30
1930	572.61	573.66	574.63	574.19	574.50	574.40	574.54	574.40	573.96	573.66	573.18	572.66
1931	572.56	571.12	570.30	571.43	572.46	572.48	572.64	572.68	572.14	572.06	571.72	571.43
1932	572.25	571.96	572.20	571.56	572.22	572.68	572.28	572.41	572.22	571.84	571.82	571.68
1933	572.01	571.72	571.44	572.04	572.52	572.85	572.86	572.60	572.50	572.02	571.77	571.45
1934	571.44	570.26	570.38	570.45	571.58	571.67	571.81	571.75	571.39	571.40	570.88	570.56
1935	571.62	570.21	570.23	571.42	571.50	571.78	572.12	572.05	571.92	571.68	571.42	571.08
1936	570.36	570.20	571.36	571.22	572.00	572.14	572.16	571.92	571.66	571.94	571.57	571.42
1937	571.42	571.99	571.42	571.72	573.02	572.64	573.00	572.88	572.62	572.27	572.00	571.46
1938	571.74	570.98	572.46	572.42	572.66	572.99	573.14	573.20	573.02	572.98	572.66	572.29
1939	572.88	571.38	571.20	572.52	573.10	573.16	573.34	573.32	573.28	573.06	572.63	572.36
1940	572.25	570.88	571.02	571.67	572.43	572.94	573.02	573.02	572.99	572.88	572.48	572.25
1941	572.91	571.04	571.18	572.00	572.44	572.64	572.65	572.59	572.28	572.08	572.09	572.02
1942	572.16	571.54	570.08	572.57	571.99	573.52	573.60	573.68	573.46	573.28	572.96	573.05
1943	573.82	571.92	572.81	573.34	573.80	574.54	574.78	574.98	574.72	574.48	574.24	573.86
1944	573.02	572.80	572.45	573.32	573.96	574.18	574.36	574.12	573.77	573.86	573.40	572.89
1945	573.29	571.76	572.65	573.40	573.69	574.34	574.57	574.56	574.20	574.52	574.06	573.86
1946	574.10	572.00	572.22	574.08	573.89	574.24	574.50	574.40	573.95	573.62	573.46	572.92
1947	573.04	572.82	572.24	573.28	574.05	574.58	574.79	574.84	574.78	574.44	574.20	573.51
1948	573.88	573.19	573.68	574.27	574.28	574.56	574.58	574.38	572.82	573.68	573.18	572.98
1949	574.56	574.24	574.06	574.12	573.32	573.41	573.52	573.40	572.97	572.75	572.34	571.96
1950	572.34	572.93	572.14	573.29	573.89	573.62	573.67	573.70	573.52	573.41	573.20	573.15
1950	572.32	572.93	572.14	573.29	573.89	573.62	573.67	573.69	573.61	573.41	573.20	573.15
1951	573.12	572.85	573.70	574.15	574.63	574.69	574.82	574.86	574.76	574.46	574.41	574.34
1952	575.06	574.35	574.98	575.06	575.49	575.59	575.86	575.68	575.60	575.21	574.47	574.27
1953	574.28	574.32	574.17	574.56	574.86	575.06	575.21	575.18	575.06	574.60	574.34	573.91

*IGLD - International Great Lakes Datum

Table A.3. Lake St. Clair Beginning-of-Month Levels in Feet (IGLD 1955) (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1954	573.56	572.20	573.70	574.31	574.79	574.65	574.87	574.81	574.66	574.48	574.75	574.44
1955	574.69	574.09	574.62	574.74	574.95	574.90	574.87	574.71	574.41	573.93	573.60	573.15
1956	573.23	570.64	571.61	573.11	574.14	574.16	574.26	574.33	574.35	573.88	573.45	572.90
1957	572.90	571.93	572.92	572.99	573.61	573.64	573.72	573.88	573.56	573.32	572.98	572.56
1958	572.95	570.62	571.73	571.92	572.51	572.66	572.76	572.93	572.68	572.48	572.25	571.72
1959	571.49	571.04	571.31	572.60	572.91	573.13	573.03	572.88	572.87	572.62	572.38	572.28
1960	572.76	571.63	572.50	573.33	573.41	573.94	574.30	574.33	574.28	574.09	573.49	572.96
1961	573.02	572.37	573.25	573.37	574.15	573.92	573.97	574.00	573.76	573.45	573.00	572.88
1962	573.08	571.44	572.04	573.16	573.12	573.16	573.32	573.17	573.03	572.86	572.51	572.36
1963	572.74	571.55	571.50	572.66	572.72	572.58	572.58	572.46	572.28	571.98	571.76	571.56
1964	571.55	570.43	570.33	571.54	572.00	572.08	571.90	571.88	571.88	571.60	571.20	570.99
1965	571.11	570.20	570.70	571.91	572.24	572.40	572.50	572.32	572.35	572.23	572.10	571.83
1966	572.46	572.06	572.03	572.78	573.23	573.18	573.31	573.10	572.95	572.52	572.12	572.28
1967	572.78	572.84	572.50	573.05	573.34	573.63	574.01	573.80	573.56	573.30	573.19	573.30
1968	573.56	573.39	573.29	573.69	573.58	574.10	574.38	574.16	573.92	573.80	573.44	573.66
1969	573.65	574.10	573.82	573.91	574.49	574.84	575.02	575.30	574.96	574.56	574.16	573.74
1970	572.91	573.38	573.32	573.96	574.12	574.41	574.56	574.63	574.43	574.38	574.08	573.97
1971	574.18	573.11	574.07	574.39	574.53	574.80	574.90	574.79	574.92	574.58	574.28	574.08
1972	574.20	574.30	573.92	574.38	574.68	575.08	575.24	575.30	575.27	575.18	575.14	575.04
1973	575.28	575.48	575.22	576.01	575.88	576.04	576.39	575.14	575.90	575.62	575.09	575.09
1974	575.36	575.51	575.36	575.66	575.85	576.04	576.08	575.89	575.68	575.26	574.83	575.06
1975	574.82	575.16	575.26	575.26	575.38	575.50	575.72	575.48	575.72	575.30	574.78	574.28

*IGLD - International Great Lakes Datum

*Table A.4. Lake St. Clair Monthly Change in Storage in HCFS-Months**

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1910	-1	29	26	30	-5	16	-10	-5	-19	-5	-15	-73
1911	14	-8	63	9	10	8	-12	-2	-5	-10	-12	-3
1912	11	27	11	8	12	4	-10	1	-6	-7	-17	-2
1913	0	-43	57	53	4	-5	-6	-14	-24	-13	9	-13
1914	-43	18	36	-0	21	-0	-2	-6	-17	-17	-12	34
1915	-71	15	9	11	13	7	8	5	1	-26	-21	22
1916	18	-42	43	9	34	7	-6	-25	-13	-15	-6	72
1917	-69	0	14	-9	53	40	10	-32	-31	-13	3	-11
1918	-56	38	-27	39	32	-4	13	-13	18	-35	1	1
1919	-2	-23	37	14	29	2	-26	-15	-10	-9	-26	-73
1920	4	18	46	26	3	12	3	-4	-12	-12	-3	34
1921	-42	-53	67	22	0	3	-17	-9	-34	18	-12	-13
1922	-18	-23	69	12	6	9	-5	-8	-12	-18	-32	14
1923	-50	1	29	20	24	3	0	-11	-2	-21	-9	11
1924	-22	-18	35	17	15	12	1	-9	-16	-23	-17	-10
1925	-20	9	35	-1	-4	8	1	-12	0	-20	-2	-37
1926	-28	9	66	6	4	18	5	-7	18	-12	-4	1
1927	-63	-31	110	-6	22	0	8	-18	-20	-9	14	-5
1928	-8	-46	68	-0	18	28	0	-6	-13	0	-4	8
1929	8	35	-30	65	11	-1	2	-20	-6	-25	-37	-31
1930	47	48	-20	14	-4	6	-6	-20	-14	-21	-24	-4
1931	-64	-41	51	48	1	7	2	-24	-4	-15	-13	37
1932	-13	11	-29	31	21	-18	6	-9	-18	-1	-6	15
1933	-13	-14	27	22	15	0	-12	-4	-22	-11	-15	-0
1934	-53	6	3	52	4	6	-3	-16	0	-23	-15	47
1935	-63	1	53	4	13	16	-3	-6	-11	-12	-16	-32
1936	-7	55	-6	36	6	1	-11	-12	13	-17	-7	0
1937	26	-28	13	60	-17	17	-5	-12	-16	-12	-25	13
1938	-34	73	-2	11	15	7	3	-8	-2	-14	-17	26
1939	-67	-9	59	27	3	8	-1	-2	-10	-19	-12	-5
1940	-61	7	29	35	23	4	0	-1	-5	-18	-11	30
1941	-84	7	37	20	9	0	-3	-14	-9	0	-3	6
1942	-28	-72	111	-27	68	4	4	-10	-8	-14	4	34
1943	-85	44	24	21	33	11	9	-12	-11	-11	-18	-38
1944	-10	-17	39	30	10	8	-11	-16	4	-21	-24	18
1945	-68	44	34	13	29	11	-0	-16	15	-21	-9	11
1946	-94	11	83	-9	16	12	-4	-20	-15	-7	-25	5
1947	-10	-29	47	36	24	10	2	-3	-16	-11	-32	17
1948	-31	23	26	0	13	1	-9	-70	40	-22	-9	71
1949	-14	-9	3	-37	4	5	-5	-19	-10	-18	-18	17
1950	26	-39	51	28	-12	2	1	-4	-10	-9	-2	-3
1951	-12	42	20	22	3	6	2	-4	-14	-2	-3	32
1952	-32	30	4	20	4	12	-8	-4	-18	-33	-9	0
1953	2	-7	17	14	9	7	-1	-5	-21	-12	-20	-16

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

Table A.4. Lake St. Clair Monthly Change in Storage in HCFS-Months (continued)*

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1954	-61	74	27	22	-6	10	-3	-7	-8	12	-14	11
1955	-27	26	5	10	-2	-1	-7	-13	-22	-15	-21	4
1956	-116	46	67	48	1	5	3	1	-22	-19	-25	0
1957	-43	49	3	29	1	4	7	-14	-11	-15	-19	17
1958	-95	45	9	27	7	5	8	-11	-9	-10	-25	-10
1959	-20	13	58	14	10	-5	-7	0	-12	-11	-5	21
1960	-51	42	37	4	24	17	1	-2	-9	-27	-25	3
1961	-29	44	5	36	-10	2	1	-11	-14	-21	-6	9
1962	-73	30	50	-2	2	7	-7	-6	-8	-16	-7	17
1963	-53	-2	52	3	-6	0	-5	-8	-14	-10	-9	0
1964	-50	-5	54	21	4	-8	-1	0	-13	-18	-10	5
1965	-41	25	54	15	7	5	-8	1	-6	-6	-12	28
1966	-18	-1	34	21	-2	6	-9	-7	-20	-18	7	22
1967	3	-17	25	13	13	18	-9	-6	-17	-5	5	12
1968	-8	-5	18	-5	23	13	-10	-11	-6	-16	10	0
1969	20	-14	4	27	16	8	13	-15	-18	-18	-19	-37
1970	21	-3	29	7	13	7	3	-9	-2	-13	-5	7
1971	-48	48	14	6	12	5	-5	6	-16	-13	-9	5
1972	4	-18	21	14	18	7	3	-1	-4	-2	-5	10
1973	10	-13	35	-6	7	16	-11	-11	-13	-24	0	12
1974	7	-7	13	9	9	2	-9	-9	-19	-19	12	-12
1975	15	5	0	6	5	19	-11	11	-19	-23	-23	31

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

* U.S. Government Printing Office: 1976-677-347/1284 Region 8

Environmental Research LABORATORIES

The mission of the Environmental Research Laboratories is to study the oceans, inland waters, the lower and upper atmosphere, the space environment, and the Earth, in search of the understanding needed to provide more useful services in improving man's prospects for survival as influenced by the physical environment. The following laboratories contribute to this mission.

MESA *Marine EcoSystems Analysis Program Office.* Plans and coordinates regional programs of basic and applied research directed toward the solution of environmental problems which involve the functioning, health and restoration of marine ecosystems.

OCSEA *Outer Continental Shelf Environmental Assessment Program Office.* Plans and directs assessments of the primary environmental impact of energy development along broad areas of the outer continental shelf of the United States; coordinates related research activities of federal, state and private institutions.

W/M *Weather Modification Program Office.* Plans and directs ERL weather modification research for precipitation enhancement and severe storms mitigation; operates ERL's research aircraft.

NHEML *National Hurricane and Experimental Meteorology Laboratory.* Develops techniques for more effective understanding and forecasting of tropical weather. Research areas include: hurricanes and tropical cumulus systems; experimental methods for their beneficial modification.

RFC *Research Facilities Center.* Provides aircraft and related instrumentation for environmental research programs. Maintains liaison with user and provides required operations or measurement tools, logged data, and related information for airborne or selected surface research programs.

(CIRES) *Theoretical Studies Group.* Provides NOAA participation in the Cooperative Institute for Research in Environmental Sciences (CIRES), a joint activity with the University of Colorado. Conducts cooperative research studies of a theoretical nature on environmental problems.

AOML *Atlantic Oceanographic and Meteorological Laboratories.* Research areas include: geology and geophysics of ocean basins and borders, oceanic processes, sea-air interactions and remote sensing of ocean processes and characteristics (Miami, Florida)

PMEL *Pacific Marine Environmental Laboratory* Research areas include: environmental processes with emphasis on monitoring and predicting the effects of man's activities on estuarine, coastal, and near-shore marine processes (Seattle, Washington)

GLERL *Great Lakes Environmental Research Laboratory.* Research areas include: physical, chemical, and biological limnology; lake-air interactions, lake hydrology, lake level forecasting, and lake ice studies (Ann Arbor, Michigan).

GFDL *Geophysical Fluid Dynamics Laboratory.* Research areas include: dynamics and physics of geophysical fluid systems; development of a theoretical basis, through mathematical modeling and computer simulation, for the behavior and properties of the atmosphere and the oceans (Princeton, New Jersey).

APCL *Atmospheric Physics and Chemistry Laboratory.* Research areas include: processes of cloud and precipitation physics; chemical composition and nucleating substances in the lower atmosphere; laboratory and field experiments toward developing feasible methods of weather modification.

NSSL *National Severe Storms Laboratory.* Research is directed toward improved methods of predicting and detecting tornadoes, squall lines, thunderstorms, and other severe local convective phenomena (Norman, Oklahoma).

WPL *Wave Propagation Laboratory.* Research areas include: theoretical research on radio waves, optical waves, and acoustic gravity waves; experimental research and development on new forms of remote sensing.

ARL *Air Resources Laboratories.* Research areas include: diffusion, transport, and dissipation of atmospheric contaminants; development of methods for prediction and control of atmospheric pollution; geophysical monitoring for climatic change (Silver Spring, Maryland).

AL *Aeronomy Laboratory.* Research areas include: theoretical, laboratory, rocket, and satellite studies of the physical and chemical processes controlling the ionosphere and exosphere of the Earth and other planets, and of the dynamics of their interactions with high-altitude meteorology.

SEL *Space Environment Laboratory.* Research areas include: solar-terrestial physics, service and technique development in the areas of environmental monitoring and forecasting.

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