US Army Corps
of Engineers
North Central Division

Great Lakes Levels

Update Letter No. 102 **January 4, 1994**

1993 Annual Summary

A retrospective look at this past year indicates that the Great Lakes generally experienced above average levels in 1993, a repeat of what happened in 1992. Nevertheless, there were major concerns about near-record high water levels on Lake Ontario during the early spring due to heavy precipitation in the lower lake region from December 1992 to May 1993, including an all-time record high supply in April 1993. This necessitated extremely high discharges in the St. Lawrence River, well above those called for in the regulation plan (overdischarging) to mitigate the potential for flooding along the Lake Ontario shoreline. The levels of the upper lakes were generally higher than those of last year. Lake Erie and Lake Ontario started the year with higher levels than those in 1992, with Lake Erie falling and Lake Ontario falling sharply in the last four months of 1993.

Precipitation

The temperatures in the Great Lakes basin during 1993 began the year above average, and continued average to above average into the spring and summer, and finally fell below average in the fall. Precipitation over the Great Lakes basin for 1993, based on preliminary records from the U.S. National Weather Service and Canadian Atmospheric Environment Service for May through December, was slightly above average. However, during the year the basin saw both very wet and very dry periods. Drier periods were generally experienced in the months of February, March, and November and the remaining months were considerably wetter. The total basin wide precipitation for 1993 was 33.5 inches, about 1.2 inches above average. Figure 1 compares the monthly precipitation for 1993 and 1992 to the long-term average for the entire basin.

Lake Levels

The "Monthly Bulletin of Lake Levels for the Great Lakes," which accompanies this Update,

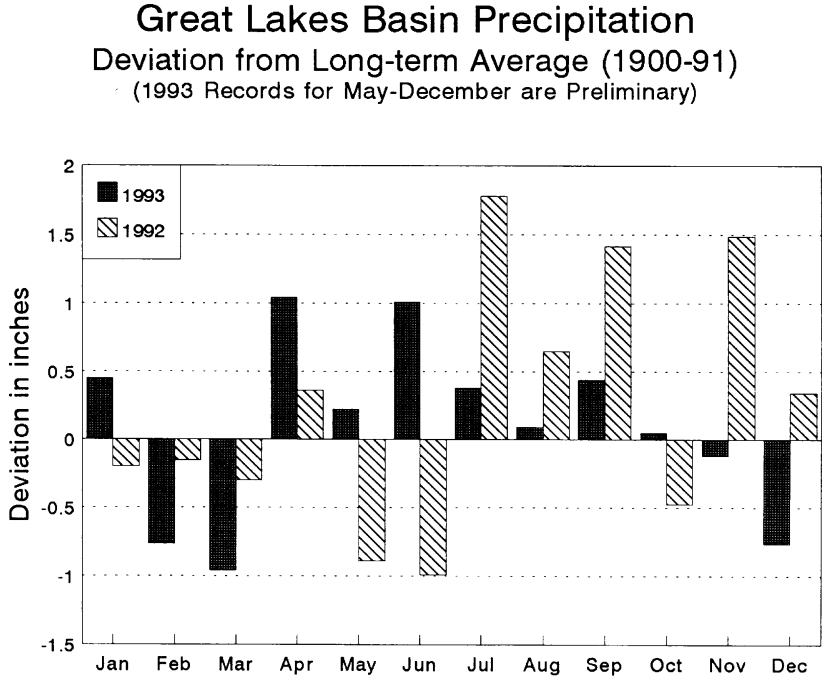

Figure 1

graphically shows the fluctuation of water levels on the Great Lakes for 1992 and 1993. Generally, the level of Lake Superior was at or above its average throughout 1993. Lakes Michigan-Huron, St. Clair, and Erie were above average the entire year. Lake Ontario started 1993 above average and rose sharply until May, when it reached its near record high. From this peak, levels decreased until they reached their long-term average in September.

In 1993, Lake Superior's level paralleled its normal seasonal cycle. The lake started the year about three inches above its average. Record and near record low precipitation in February and March resulted in the lake level dropping, finally reaching its lowest level of the year in April. Beginning in April and extending into mid-summer, the basin received precipitation in amounts often well above average. As a result, Lake Superior peaked in September and ended the year slightly above average.

Lakes Michigan-Huron began 1993 some 7-1/2 inches above average, due to near record supplies in the early winter. Well below average precipitation in February and March resulted in a declining lake level for those months, with the lowest yearly level occurring in March. The lake began its seasonal rise in April 4-1/2 inches above average, and reached its annual peak level in July. During this period, precipitation was above average for the basin, causing the lake to rise at a faster rate than usual. This trend continued, and the lakes ended the year about nine inches above their December long-term average level.

Lake Erie started 1993 about 26 inches above its January long-term average level, due to heavy precipitation and mild temperatures carried over from 1992. The lake continued to rise throughout the winter and spring, reaching its highest level in April, with only a slight drop in February and March. Conditions on the basin during the summer were generally drier than average and the lake level declined from April until it reached its lowest level of the year in November. The lake ended the year about 14 inches above the long-term December level.

Lake Ontario began the year about 19 inches above its January long-term level. The lake continued to rise, with the exception of a minor decline in level in March. One of the primary objectives for the regulation of Lake Ontario, as defined by the Orders of Approval of the International Joint Commission (IJC) and referred to as Criterion (h), is to maintain the monthly average level of Lake Ontario below 247.27 feet. Due to record water supplies to the lake from December 1992 to May 1993, including an all-time record supply in April 1993, the level of Lake Ontario (based on the adjusted mean) exceeded the Criterion (h) level, from April 12, 1993 to July 1, 1993, rising to a peak level of 248.26 feet in May. As a result, the Control Board increased outflows from Lake Ontario at a record rate and the lake level fell sharply, reaching its long-term average level in September. The level dipped slightly below its long-term average in October and November, and ended the year about one inch above its long term average.

Storms

The year 1993 included one storm of note for the Great Lakes basin. This was a late March snowstorm which many have dubbed "the Storm of the Century." This storm dropped more than three feet of snow around much of the Lake Ontario basin, which was already saturated from previous rain and snow events.

A Great Lakes Storm Damage Reporting System (GLSDRS) was also created in 1993. The Chicago District, Corps of Engineers developed a sampling technique whereby a selected group of shoreline property owners are queried by telephone. It is a near "real-time" reporting system for estimating the monetary and physical impacts on residential riparian property caused by storm events and associated flooding and erosion along the U.S. shoreline of the Great Lakes. This system also includes daily receipt of meteorological/ environmental data, immediate post-storm telephone interviews, and issuance of post-storm event reports. A total of 22 surveys were conducted in 1993, on parts of all of the Great Lakes. Over 2,000 respondents provided information. A more detailed overview of the system will be presented in a future Update.

A sample of the reports generated for a storm event which happened on July 29 and 30, showed the following: for Alger and Marquette Counties on Lake Superior, the storm lasted 11 hours, with northwest to north winds of 20.3 knots, and caused damage to nine properties. including landscaping, docks, and other incidental damages; for Chautauqua and Erie Counties on

Lake Erie, the storm lasted 15 hours, with west-southwest winds of 20.3 knots, and caused damage to seven properties, including structure, landscaping, and shore protection structures; and, for Cuyahoga and Lorain Counties on Lake Erie, the storm lasted 20 hours, with west to north-northwest winds of 18.8 knots, and caused damage to 54 properties including structure, contents, vehicle, landscaping, shore protection structures, dock, boat, etc.

Lake Superior Regulation

In 1993, the International Lake Superior Board of Control continued to use Regulation Plan 1977-A as the basis for determining Lake Superior outflows. During March and April, outflows were limited by Criterion (c) of the Orders of Approval. Criterion (c) states that when the monthly mean level of Lake Superior is below 601.7 feet (IGLD 85), the outflow can not be greater than that which would have occurred, at the same elevation, under the outflow conditions which prevailed in 1887. In July, August, and September unintentional deviations from the plan flow, of about 5,000 to 10,000 cubic feet per second (cfs), resulted from unanticipated maintenance and construction work being performed in the intake canals of two of the hydropower plants. Figure 2 shows that during the first six months of the year the outflows were above the long-term average, while the last six months the outflows were slightly below the long-term average.

For all but three months of the year, the setting in the Compensating Works was maintained at one-half gate open, while an additional 500 cfs of water flowed through Gate No. 1 to satisfy water requirements for the fish habitat located on the north side of the remedial wall. Any flow changes during these months resulting from the monthly regulation of Lake Superior, were accomplished by varying the amount of water allocated to hydropower production. The exceptions to this were in June, July, and August when one full gate was opened to meet the total outflow requirements.

An important change took place in January 1993, when the International Lake Superior Board of Control began employing the International Great Lakes Datum 1985 (IGLD 1985) in its operations and reporting procedures. The Board also took this opportunity to switch operations to the metric system.

Lake Ontario Regulation

Regulation of Lake Ontario outflows, by the International St. Lawrence River Board of Control, prevented the lake from reaching record high levels during 1993. Much of its high water condition in early 1993 was the result of severe ice jams in the St. Lawrence River downstream of Montreal throughout much of February. This precluded the release of high outflows. The total basin supplies to Lake Ontario for November 1992, and January and April 1993 exceeded all previous records, with the April value exceeding all records for any month.

The lake level rapidly increased throughout the winter and spring, peaking on May 2 at 248.26 feet; 2.23 feet above the May average, 0.2 foot below the record level for May set in 1952, and 0.97 foot above the maximum level set under the lake's regulation Plan 1958-D. Without regulation, the lake would have set records from January through September and would have peaked in May at 249.38 feet, 0.79 foot higher than the recorded June 1952 peak of 248.59 feet.

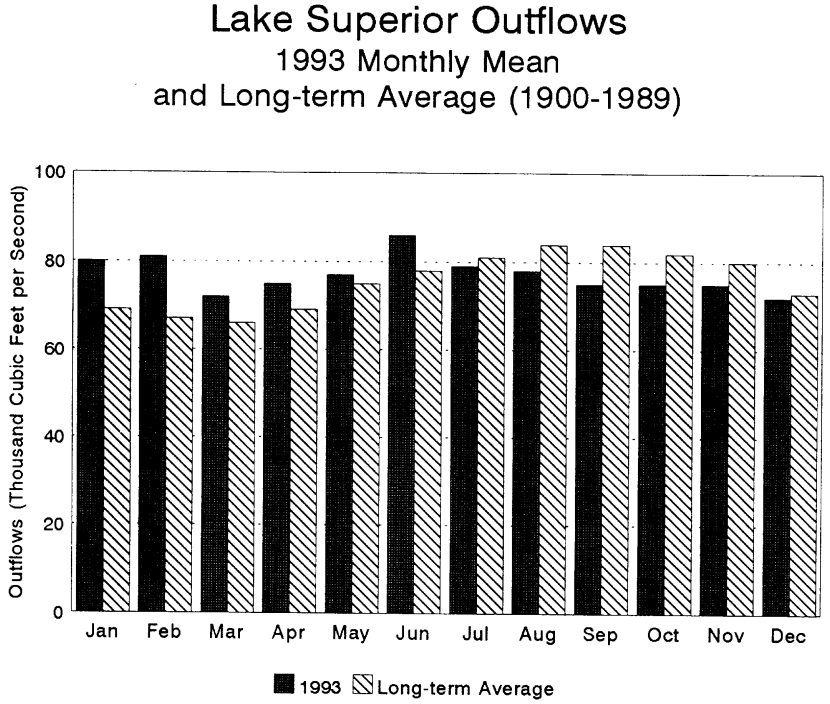

Figure 2

Under directions from the IJC, the International St. Lawrence River Board of Control specified outflows as high as possible in accordance with Criterion (k) which was invoked by the IJC on February 18, 1993. The criterion specified that all possible relief would be provided to riparians upstream and downstream of the project. In May, the outflow during certain specified 24-hour periods was as high as 385,000 cfs which is the highest recorded outflow since regulation began in 1960. During these high flow periods, commercial navigation was temporarily suspended by the Seaway.

As quickly as the lake level rose, it declined due to regulatory actions and a relatively dry summer; the level in September was 245.24 feet, which is also that month's long-term average. Due to the rapid decline in water levels along the St. Lawrence River, the IJC revoked Criterion (k) on August 23. For much of September, complaints were received from recreational boaters near the powerhouse regarding low St. Lawrence River levels resulting from lower Lake Ontario levels and still relatively high outflows.

By early December 1993, the level of Lake Ontario was 0.14 foot (less than two inches) above the long-term average December level. In contrast, the level last year in early December was one foot above average. Figure 3 shows the comparison of 1993 monthly outflows with the long-term average monthly outflows.

The International St. Lawrence River Board of Control also began employing IGLD 85 and the metric system in its operations and reporting in January 1993.

Commercial Navigation

As of November 1993, tonnage passing through the Soo Locks at Sault Ste. Marie, Michigan decreased 5.6 % from the comparable figure for 1992. United States and Canadian vessels carried about 54 and 16 million tons of cargo, respectively, while foreign vessels carried about 3 million tons. Through November 1993, a total of 3,824 cargo vessel transits passed through the locks. This was a decrease of nine percent in comparison to the passages from the previous year. Of these, 2,272 passages were U.S.-flagged vessels, 1,243 were Canadian-flagged, and 309 were foreign vessels (ocean-going or "salties"). In addition to the cargo vessels, there were also 6,678 transits for other types of vessels, such as pleasure craft, Coast Guard, and scientific/research vessels. This was 345 transits more than in 1992. The Corps has the authority to keep the locks open until January 15, so long as commerce requests late closing. Figure 4 shows the passage of a vessel at the Soo Locks.

According to St. Lawrence Seaway Development Corporation's preliminary figures, 29.9 million metric tons of cargo moved through the Montreal-Lake Ontario section of the Seaway in 1993. This total was 140,000 tons more than in 1992. As of December 7, 1993, the total vessel transits were 2,167 for this year (1,323 lakers and 844 ocean vessels).

Seaway officials reported preliminary information on gains and losses for a number of individual cargos during the 1993 season including: iron ore (up 10% to 9,313,000 metric tons); U.S. grain (up 4% to 4,197,000 metric tons); coke (up 21% to 820,000 metric tons); and, petroleum products (down 13% to 904,000 metric tons).

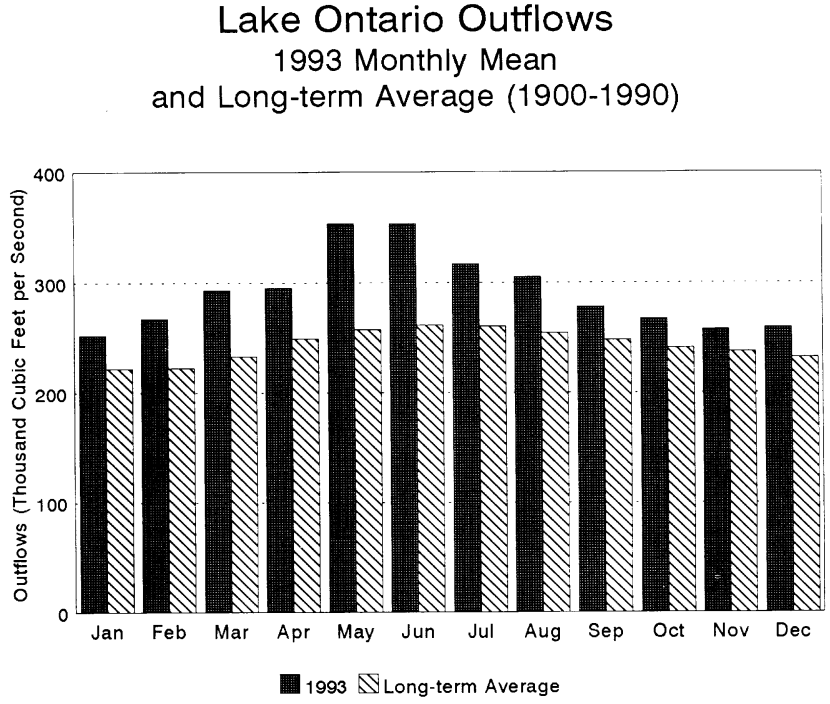

Figure 3

Monthly Bulletin of Lake Levels for the Great Lakes

This past year saw one change in the format of the Monthly Bulletin. Beginning with the February 1993 issue, the most probable levels are being shown as monthly means, as opposed to end of month levels which were used previously. Expect additional changes in 1994, which are intended to make the bulletin even better.

Levels Reference Study

The Levels Reference Study Board presented its final report on Phase II to the IJC on March 31, 1993, after 2-1/2 years of intense study activity and public involvement.

Prior to the presentation of the final report, a second series of public forums were held by the Study Board to discuss a draft of the final report. These were held from February 22 to 25, 1993 in Sault Ste. Marie, Ontario; Chicago, Illinois; Buffalo, New York; and, Dorval, Quebec.

A final public meeting was held by the IJC in Windsor, Ontario, on September 11, 1993. This meeting was intended to allow the general public to offer comments on the Board's final report. The IJC is expected to review the report, evaluate the results and make its own recommendations to the two governments by late February 1994.

Future Update Topics

The Corps of Engineers trusts that these Update Letters are of interest to the readers and are providing a useful service of disseminating information on the Great Lakes basin. Figure 5 shows a listing of the Update Letters from 1993. We would like to hear any suggestions that you may have, on topics that could be addressed in future Updates. Please send your suggestions to the Detroit District, at the address shown at the end of this Update. We look forward to hearing from you and for the continuation of interesting and insightful Updates in the future.

RICHARD W. CRAIG
Colonel, EN
Commanding

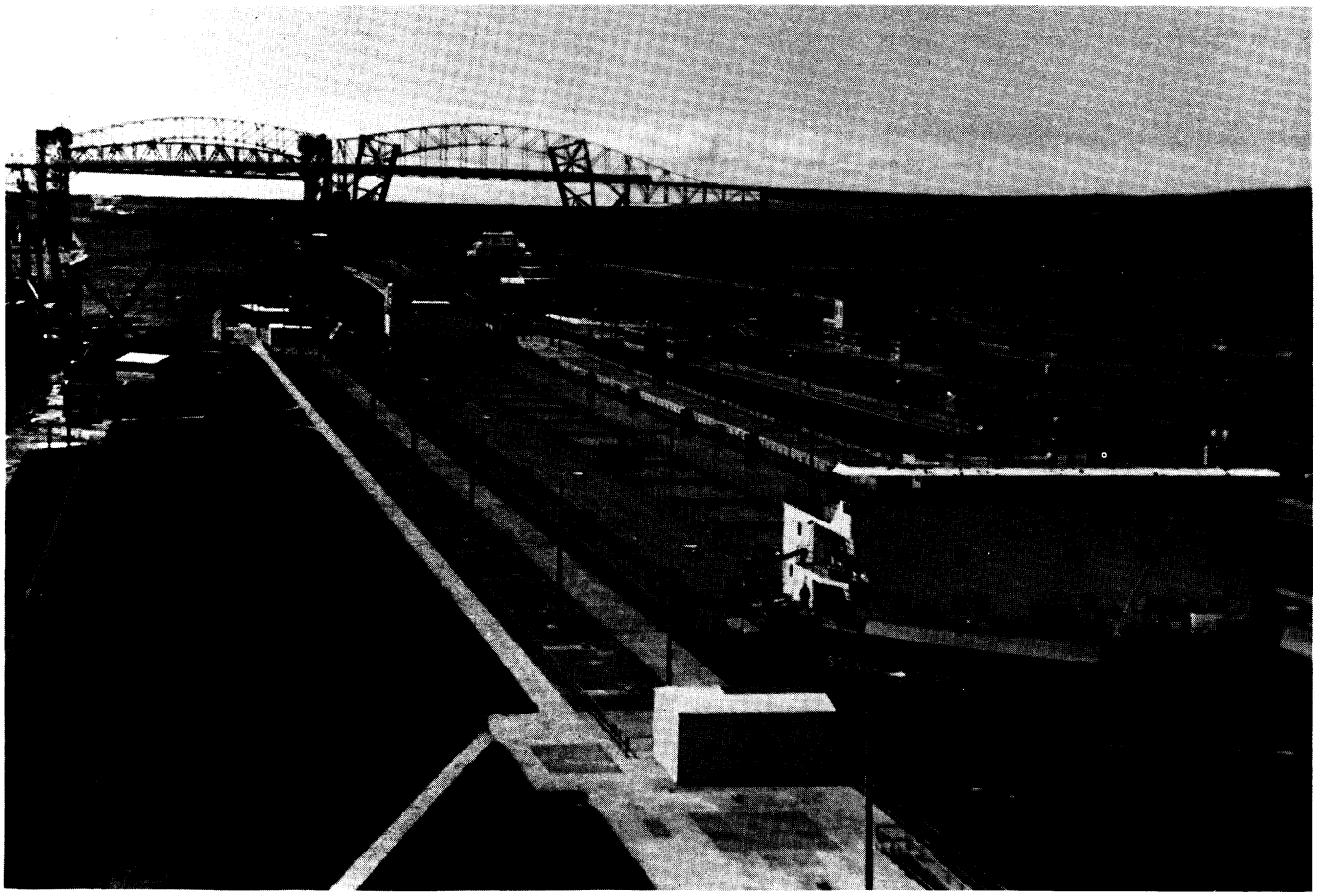

Figure 4. Vessel Passage at the Soo Locks

Figure 5 - 1993 Update Letters

In 1993, the bulletin provided monthly updates on various Great Lakes - St. Lawrence River topics. For 1993, these are as follows:

January - 1992 Annual Summary, No. 90

February - Winter Ice Monitoring on the Great Lakes-St. Lawrence System, No. 91

March - Study of Ice Jams on the Niagara River, No. 92

April - Soo Locks at Sault Ste. Marie, Michigan, No. 93

May - The Twin Ports Duluth-Superior Harbor Minnesota and Wisconsin, No. 94

June - Great Lakes-St. Lawrence River Water Levels Reference Study Board Recommendations, No. 95

July - Aquatic Life of St. Marys River, No. 96

August - Measurement of Record High Flows in the St. Lawrence River, No. 97

September - Lighthouses on the Great Lakes, No. 98

October - The Southwest Passage from Lake Huron to Lake Erie, No. 99

November - The Great Mississippi River Flood of 1993, No. 100

December - The Regulation of the Outflow from Lake Superior, No. 101

Great Lakes Basin Hydrology

During the month of December precipitation on each Great Lakes basin was below average. For the year to date, precipitation is about 4% above average for the entire Great Lakes basin. The net supply of water to each of the Great Lakes in December was above average. Table 1 lists ɔcember precipitation and water supply information for all of the Great Lakes.

In comparison to their long-term (1900-1992) averages, the December monthly mean water levels of Lakes Superior, Michigan-Huron, St. Clair, Erie and Ontario were 1.5, 9, 12, 14 and 1 inches, respectively, above average. Shoreline residents on Lakes St. Clair and Erie, and to a lesser extent Lakes Michigan-Huron, are cautioned to continue to be alert to possible adverse weather conditions, as these could compound an already high lake level situation. Further information and advice will be provided by the Corps of Engineers should conditions worsen.

Table 1
Great Lakes Hydrology[1]

PRECIPITATION (INCHES)								
BASIN	DECEMBER				YEAR-TO-DATE			
	1993[2]	Average (1900-1991)	Diff.	% of Average	1993[2]	Average (1900-1991)	Diff.	% of Average
Superior	1.5	2.0	-0.5	75	30.8	30.3	0.5	102
Michigan-Huron	1.4	2.3	-0.9	61	34.0	32.0	2.0	106
Erie	1.8	2.6	-0.8	69	35.3	34.9	0.4	101
Ontario	2.2	2.9	-0.7	76	35.8	35.1	0.7	102
Great Lakes	1.6	2.4	-0.8	67	33.5	32.3	1.2	104

LAKE	DECEMBER WATER SUPPLIES[3] (CFS)		DECEMBER OUTFLOW[4] (CFS)	
	1993[2]	Average (1900-1989)	1993[2]	Average (1900-1989)
Superior	10,000	-24,000	72,000	73,000
Michigan-Huron	49,000	29,000	195,000[5]	183,000
Erie	33,000	17,000	217,000[5]	199,000
Ontario	50,000	27,000	268,000	231,000

[1]Values (excluding averages) are based on preliminary computations.
[2]Estimated.
[3]Negative water supply denotes evaporation from lake exceeded runoff from local basin.
[4]Does not include diversions.
[5]Reflects effects of ice/weed retardation in the connecting channels.

CFS = cubic feet per second.

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