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A Report

On 1993 Water Levels of the Great Lakes and St. Lawrence River

JUL 2 5 1995

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January 1994

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EXECUTIVE SUMMARY

This report provides an assessment of hydrologic conditions of the Great Lakes - St. Lawrence River system, and the effects of water level fluctuations during 1993.

In the early part of the year, the focus of attention was on the very high water level conditions on Lake Ontario and the St. Lawrence River. Lakes Michigan-Huron, St. Clair and Erie remained well above their long-term average levels throughout 1993, but flood and erosion damages were much less extensive than those on Lake Ontario and the St. Lawrence River. Lake Superior's level remained near average during 1993 and no damage was reported on this lake.

An ice jam in the St. Lawrence River for three weeks in February of 1993 caused serious residential flooding downstream of Montreal and delayed commercial shipping.

In April, record high water supplies raised the level of Lake Ontario to within centimetres of its previous record high, and many shoreline properties sustained flood and erosion damage. Very high outflows were authorized in the first half of the year to help lower the lake level and reduce damage. The unusually high outflows led to further temporary suspensions of commercial shipping on several occasions during May and June. In addition, draw-down effects from sustained high flows in the summer months caused low water level problems for recreational boaters on Lake St. Lawrence between Long Sault and Iroquois.

Lake Ontario began 1993 with extremely high levels but ended the year close to average.

Lake Ontario ended 1993 near its average level for the time of year, with no significant deviations from average anticipated for early 1994. However, if wet conditions were to persist over Lakes Michigan-Huron, St. Clair and Erie through the winter, these lakes could reach extreme highs next spring. Lake Superior's level is expected to remain near average for the early part of 1994.

On March 31, 1993, a six-year International Joint Commission study into fluctuating Great Lakes-St. Lawrence River water levels was completed. The Levels Reference Study Board made 42 recommendations to the Commission. The Commission's report to the Governments of Canada and the United States is expected in early 1994.

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1.0 PURPOSE AND SCOPE

This report summarizes information pertaining to the state of water levels in the Great Lakes - St. Lawrence River system in 1993. It also contains a summary of operations related to Lake Superior and Lake Ontario regulation.

Water level elevations are given in metres referred to International Great Lakes Datum (IGLD) 1985. Water flows are given in cubic metres per second (m^3/s). The tables referred to in the text can be found at the back of this report.

2.0 PHYSICAL FEATURES OF THE GREAT LAKES - ST. LAWRENCE RIVER BASIN

The Great Lakes-St. Lawrence River basin (including land mass and water surface) encompasses more than one million square kilometres (see Figure 1). As shown in Figure 2, the Great Lakes comprise a series of natural reservoirs positioned in a step-wise manner, with Lake Superior the highest and Lake Ontario the lowest. The outflow of Lake Superior is regulated by structures in the St. Marys River between Sault Ste. Marie, Ontario and Sault Ste. Marie, Michigan. The outflow of Lake Ontario is regulated by works in the St. Lawrence River between Cornwall, Ontario and Massena, New York.

The Great Lakes fluctuate according to the climate of the region. Over-lake precipitation, evaporation and runoff are the main factors that affect water levels.

Other natural factors are flow retardation due to ice in winter, or aquatic vegetation in the summer. Weather disturbances also cause short-term fluctuations in water levels. Artificial effects on water levels include regulation of lake outflows, dredging, water diversions,and consumption of water.

3.0 HYDROLOGIC CONDITIONS IN 1993

3.1 Precipitation

Precipitation records show that, on average, about 820 millimetres of precipitation falls on the Great Lakes Basin each year. Table 1 compares the 1993 monthly precipitation for each lake basin with long-term averages. It illustrates that basin-wide precipitation in 1993 was slightly above average, except during February, March, November and December.

However, April precipitation was well above average over all lake basins. February precipitation was particularly low, especially over Lake Superior. Lake Ontario, along with the other lakes, received above average

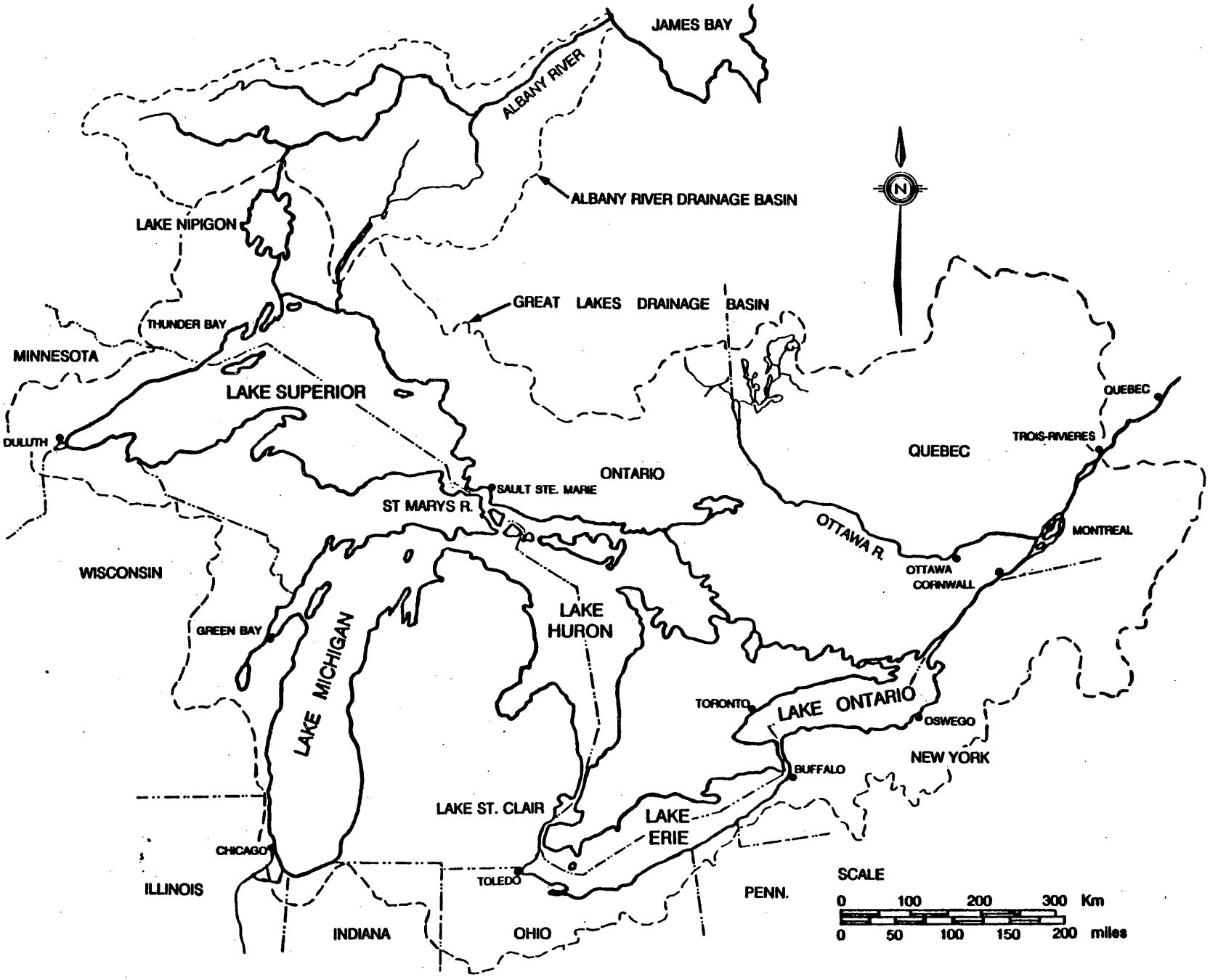


FIGURE 1. **Great Lakes-St. Lawrence River Basin**

precipitation in January and April. This, combined with rapid spring snow melt and very high inflow from Lake Erie, were major factors in the rapid increase in Lake Ontario's April level.

3.2 Outflows

Table 2 lists 1993 monthly outflows from the Great Lakes. Lake Superior outflows were very close to average and were a reflection of the near average lake level conditions during 1993.

The outflows of Lakes Michigan-Huron and Lake Erie were above average as a result of above average lake level conditions. For Lake Erie, the greatest departure from the long-term mean occurred in January, when the level was about 68 cm higher than the average for that time of the year, and again in April when the lake level was [illegible] above average. The January and April outflows exceeded the long-term average values by 1450 m^3/s and 1220 m^3/s, respectively. These differences represented an additional water supply to Lake Ontario equivalent to a 20 cm rise in its level in the month of January and 16 cm rise in April.

As a result of extremely high levels, the outflows of Lake Ontario were above average throughout 1993. New records were set in May and June when the flows reached 10010 m^3/s.

3.3 Water Levels

Figures 3 to 8 at the back of this report show the seasonal fluctuations of the Great Lakes and Montreal Harbour in 1993. Table 3 lists the monthly average levels for the Great Lakes during the year and shows how they compare with the historical data.

In 1993, fluctuations of Lake Superior levels were very close to the long-term seasonal average cycle. Lakes Michigan-Huron, St. Clair and Erie levels were above average throughout the year.

In January 1993, Lake Ontario levels were about 50 cm higher than average and rising. Very little change in the levels took place during February and March. Although the total water supplies to the lake remained very high for these two months, they were offset by high outflows during this period.

High water levels led to above-average outflows for Lakes Erie and Ontario.

In April, Lake Ontario levels rose quickly as a result of rapid snow melt, high precipitation and high inflows from Lake Erie. The total water supply to Lake Ontario for that month (11800 m^3/s) was an all time record high. The outflow during April, although higher than average, was insufficient to offset the inflows to the lake. As a result, the lake's level rose almost 50 cm. By the end of April, the water level was at 74.64 m, some 70 cm higher than the average for that time of year and 2 cm below the maximum for the month of April that was set in 1973. The level rose another centimetre in early May and reached its seasonal peak at 75.65 m on May 8. This level was about 10 cm below the record for the month of May set in 1973.

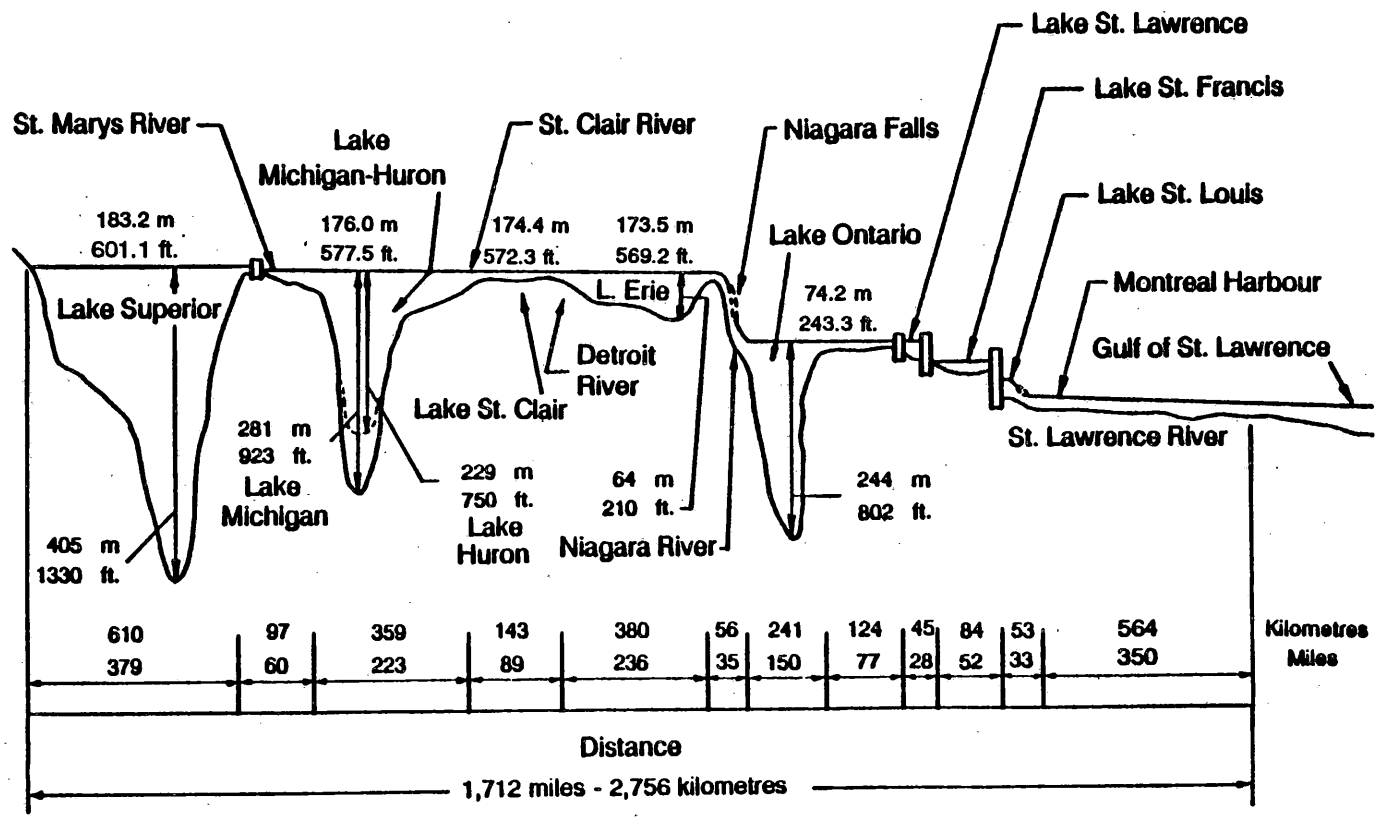


FIGURE 2. **Profile of Great Lakes-St. Lawrence River System**

Lake Ontario's level began a steady decline in mid-May and, by mid-September, its level was at average. Higher supplies in November raised the level to slightly above average in December.

In the first half of 1993, the water level at Montreal Harbour was above average. High levels in February were a result of an ice jam that originated on Lake St. Pierre on February 8 and lasted about three weeks. High levels in April were due to spring freshet of the Ottawa River and local tributaries, which increased the inflows to the St. Lawrence River at Montreal. Harbour levels declined during the second half of the year due to declining flows from both Lake Ontario and the Ottawa River basin.

3.4 Water Supplies to the Great Lakes

Net basin supply is the net effect of over-lake precipitation, drainage basin runoff and evaporation from the lake. Supply units, as listed in Table 4 and Table 5, are in cubic metres per second for each month.

The net basin supplies to Lake Superior for 1993 were near average, while supplies to Lakes Michigan-Huron in 1993 exceeded the long-term average by 6890 m^3/s-months, or 15 cm of additional water to the lakes.

Net basin supplies to Lake Ontario were higher than average in 1993. Compared to the long-term average, the difference is 4370 m^3/s-months, or about 60 cm of additional water to the lake. The inflows to Lake Ontario from Lake Erie for 1993 exceeded the average by 9460 m^3/s-months, or 1.27 m of additional water to Lake Ontario.

4.0 WATER MANAGEMENT ACTIONS

4.1 Lake Superior Regulation

In 1993, the International Lake Superior Board of Control regulated the outflows of Lake Superior according to Regulation Plan 1977-A. Since there were no unusual water supply or water level conditions, the Board did not make any departures from the regulation plan. The gates at the Lake Superior Compensating Works were set at one-half gate open during most of 1993, which is the minimum requirement for the St. Marys Rapids.

4.2 Lake Ontario Regulation

Flow adjustments were necessary in early January to assist ice formation at the Beauharnois-Les Cedres complex, and a large number of flow changes were made throughout the winter in response to ice conditions upstream and downstream of Cornwall. Ice jams near Sorel, Quebec beginning February 9 necessitated reductions in already above-average flows through the remainder of the month.

On February 18, the International Joint Commission invoked Criterion k, which allows for maximum possible outflows in an effort to alleviate high water levels on the lake. However, ice restrictions in the river and reductions of flow to allow for the Ottawa River freshet in

April hampered these operations somewhat. By late April it was possible to maximize outflows.

Record high Lake Ontario outflows called for rare use of the Long Sault Spillway.

Under all but extreme conditions, the Moses-Saunders power dam at Cornwall is able to accommodate the entire Lake Ontario outflow. However, the authorization of record high flows called for use of the nearby Long Sault Spillway between late April and early July to assist in discharging outflow from Lake Ontario.

In May and June, the Commission's International St. Lawrence River Board of Control instituted a program of periodic increases in the already high lake discharge in order to further assist in reducing Lake Ontario's level. The program consisted of 24-hour flow increases twice weekly of up to 10,900 m^3/s, with the balance of the week at 9,900 m^3/s. During these record high flow periods, commercial navigation between Lake Ontario and Montreal was rescheduled to avoid dangerous currents.

The combination of actions to adjust Lake Ontario's outflow resulted in a level 18 cm lower than it otherwise would have been at the time of its May peak. If the emergency actions had not been taken, the lake would have continued to rise to 24 cm above its May level before peaking in early June.

The high outflows also produced adverse effects by drawing down the river level upstream of the regulation structure at Cornwall. This draw down, together with restrictive ice conditions, temporarily reduced the capacity of the pumping station at Ingleside and resulted in several weeks of water rationing for the town's biggest customer, a food processing plant. The draw down effect also caused problems in July and August for recreational boaters on Lake St. Lawrence between Iroquois and Long Sault.

Between July and October, outflows from Lake Ontario, which had previously reached record highs, were reduced to less than those called for in the regulation plan in an effort to raise the Lake St. Lawrence level and improve boating conditions.

From mid-October until the beginning of the freeze up in late December, outflows from Lake Ontario followed the regulation plan.

4.3 Water Management Activities by Environment Canada

Environment Canada's Great Lakes Water Level Communications Centre in Burlington, Ontario, continued its activities in 1993. In September, the format of its monthly news release was changed to a two-page newsletter called, *Level News/Info-Niveau*, covering the level forecast and related topics of interest. The newsletter is mailed with the monthly water level bulletin published by the Canadian Hydrographic Service. The six-month forecasts that appear in the bulletins

are prepared monthly by Environment Canada's Cornwall office.

In the spring of 1993, and particularly during March and April, the Communications Centre responded to a large number of enquiries from the public and the media regarding high water levels on Lake Ontario. In all, the Centre responded to about 250 requests for information relating to water levels in 1993.

Advisories on high and low water levels were issued.

The Cornwall office also handled about 100 calls from shoreline property owners and media concerning high water levels on Lake Ontario in the spring, and low levels on Lake St. Lawrence during the summer. To keep the public up to date on water level conditions and Board actions relative to Lake Ontario regulation, Cornwall staff provided information for several local newspaper articles on the subject. In addition, telephone and on site interviews were conducted with the television media of the Kingston, Ottawa and Montreal area. A special warning about high lake levels was issued in May in co-operation with the Canadian Hydrographic Service, and several media advisories were issued in August concerning low water level conditions on Lake St. Lawrence.

In response to the high water levels on Lakes Ontario and Erie in the spring, and in preparation for potential flooding problems, the Communications Centre prepared a plan for action that outlined the roles and responsibilities of federal and provincial agencies in the event of flooding and high water level emergencies. This plan was prepared in co-operation with other federal and provincial agencies. In addition, criteria and procedures for issuing high water level warnings to the public were reviewed with the Atmospheric Environment Service and the conservation authorities in Ontario.

During the 1993 recreational boating season, the Cornwall office issued six monthly water level bulletins designed specifically for Lake Ontario and the St. Lawrence River. The bulletins, issued jointly with the U.S. Army Corps of Engineers, give water level conditions and forecasts for six sites from Kingston, Ontario to Point Claire on Lake St. Louis in Quebec. The bulletins were distributed to the local media, shore property owners and marinas as a means of keeping local boaters and residents advised of changing level and flow conditions in the river.

Canadian and U.S. water level forecasts will be consistent beginning in 1994.

In 1993, Environment Canada and the U.S. Army Corps of Engineers initiated actions to improve the monthly water level bulletins issued in each country.

In the past, differences in water level data, in historical records and forecasts shown in the two bulletins have caused reader confusion. It is expected that beginning with the January 1994 issue, the bulletins in both countries will contain consistent information.

4.4 International Joint Commission Water Levels Reference Study

After six years of study in two phases, the Levels Reference Study Board submitted its final report to the International Joint Commission on March 31, 1993. The report contains 42 recommendations for actions to deal with fluctuating water levels. The IJC is preparing its own report to governments, which is expected to be completed in early 1994.

The two-part study was undertaken as a result of public concern about high water levels in 1985-1987. However, the report recognizes the need to be prepared for crises of both high and low levels. It notes that global warming could have a significant lowering impact on Great Lakes-St. Lawrence River water levels over the next century.

Environment Canada, through the former Inland Waters Directorate - Ontario Region, was the lead Canadian agency for the $12 million project and supplied the largest portion of Canadian human and financial resources. In the second phase, IWD-OR provided the Canadian Co-chair (former IWD-OR Director, Tony Wagner) and three of four Canadian working committee co-chairs. A number of IWD-OR staff and contractors also contributed to the study effort.

5.0 EFFECTS OF WATER LEVEL FLUCTUATIONS

5.1 Impacts on Shore Properties

There were no reports of widespread flood and erosion damage on the shores of Lakes Superior and Huron during 1993. Due to abnormally high levels on Lake St. Clair and Lake Erie, there were some damages on these lakes. The most severe problems occurred on Lake Ontario and the St. Lawrence River. Appendix A contains information on flood and erosion damage, and Appendix B contains clippings of newspaper articles on this subject.

For Lake Ontario and the St. Lawrence River system, the conditions in 1993 were unlike those of recent years. In spite of maximum possible outflows discharged during the 1992-93 winter and spring, Lake Ontario's level rose nearly to a record maximum. Severe flood and erosion damages were reported by the Niagara Peninsula Conservation Authority (CA), the Prince Edward Region CA, the Hamilton Region CA, and the Halton CA.

Flood damage also occurred at several communities along the St. Lawrence River. These included Glen Walter on Lake St. Francis, Lachine and Chateauguay on Lake St. Louis, and several towns downstream of Montreal.

5.2 Impacts on Commercial Navigation

The ice jam that lasted about three weeks beginning on February 8 in the St. Lawrence River between Montreal and Lake St. Pierre held up 40 commercial vessels. It was reported that another dozen ships were rerouted to other ports. According to one shipping official, the ice jam cost the industry in lost time, extra costs for port and pilotage fees, lost business and missed deadlines.

The record maximum flows that occurred on seven occasions in May and June temporarily suspended ship transits between Lake Ontario and Montreal Harbour. The shipping industry has estimated that the suspension resulted in about 1000 vessel-hours of transit delay.

Shipping problems were limited to the St. Lawrence River.

Except for problems on the St. Lawrence River, no serious problems were experienced by commercial vessels transiting the Great Lakes system. Water levels at Montreal Harbour were generally sufficient for the commercial vessels using the port.

The seaway opening and closing took place in 1993 without serious difficulties. The first vessel transited the lock at the Beauharnois Canal on March 30. The relatively mild weather in December delayed slightly the ice formation in the St. Lawrence River. The last ocean vessel cleared the St. Lambert Lock at Montreal on December 25, and the last laker cleared the lock on December 26.

5.3 Impacts on Recreational Boating

There were no reports by boaters on Lake Erie and the upper Great Lakes of problems with water levels. However, the very high water level conditions on Lake Ontario and in the upper St. Lawrence River prior to the boating season were a subject of concern to marinas. Water overtopped some marina docks and owners were concerned about further worsening of the conditions at the time of the season opening. There were some improvements in the river level beginning in late April when recreational boating activities began.

Recreational boaters were hard hit by the very low water level conditions on Lake St. Lawrence from June until August. The very high flows at the Moses-Saunders plants required by the lake's regulation plan lowered the levels on Lake St. Lawrence extending from Long Sault to Iroquois. Many boaters could not launch their boats or had difficulty putting their boats to shore. Some boats sustained propeller damage as they ventured into shallow areas.

5.4 Impacts on Hydro Power Generation

The hydro-electric facilities at Sault Ste Marie in the St. Marys River utilized all the waters they were allocated by Lake Superior Regulation Plan 1977-A.

The high flows in the Niagara River and the St. Lawrence River resulted in above average hydro-electric power production on the two waterways.

The Long Sault Spillway, located adjacent to the Moses-Saunders power plants at Cornwall, Ontario, was opened on April 28 when the river flow exceeded the capacities at the Moses-Saunders plants. The spillway remained open through July. There was also some spillage in the spring at the Beauharnois-Les Cedres complex (near Montreal) when the river flows exceeded the plants' capacities.

6.0 FORECAST OF FUTURE WATER LEVEL CONDITIONS

A six-month forecast of the water levels of the Great Lakes, Lake St. Clair and Montreal Harbour, prepared on January 4, 1994, is shown in Figures 3-8 at the back to this report. It should be noted that the water levels of the Great Lakes fluctuate according to the weather conditions in the basin. Since it is not possible to accurately forecast weather conditions several months or more in advance, these forecasts are made assuming average, wet and dry weather conditions for the next six months.

Six-month forecast indicates no serious water level problems for the near future.

Assuming the most probable (average) water supplies over the next six months, the levels of Lakes Michigan-Huron, St. Clair and Erie would remain above their respective seasonal average levels throughout the forecast period. Lake Superior levels would remain close to their seasonal values. Lake Ontario levels are expected to rise from average to above average in January and then remain slightly above average to the end of the period. The levels of Lakes Superior and Michigan-Huron are expected to continue their usual seasonal declines and fall a further few centimetres by late winter.

Levels of Lakes Erie and Ontario will likely continue their annual rises which began in January.

The most probable supplies forecast indicates that Montreal Harbour levels are expected to be below average (1967-1991) for the rest of the forecast period. However, the harbour levels are expected to remain above chart datum.

If extremely wet or dry conditions occur over the next six months, water levels would rise above, or fall below those forecast.

7.0 FINDINGS AND CONCLUSIONS

1. The very high water levels on Lake Ontario in the Spring of 1993 were a result of high water supplies to the lake, including the record high supplies in April. The level peaked in early May some 70 cm above average and slightly below the previous record maximum set in 1973. Flood and erosion damages on the Lake Ontario shoreline were reported.

2. The very high water level condition on Lake St. Louis in April was caused by a combination of the Ottawa River freshet and the high flows from Lake Ontario along with heavy local precipitation. Flooding occurred at some communities on Lake St. Louis.

3. Above average water level conditions also occurred on Lakes Erie, St. Clair and Michigan-Huron. There were reports of flood and erosion damage on these lakes, however the extent was much less than on Lake Ontario.

4. The February 1993 ice jam in the St. Lawrence River between Montréal and Lake St. Pierre caused flood damage to 77 homes and resulted in evacuation of some residents. Navigation was also suspended temporarily.

5. The very high Lake Ontario outflows directed by the International St. Lawrence River Board of Control helped reduced the levels of Lake Ontario to 24 cm lower than it would have been with strict application of the regulation plan.

6. The program of extraordinarily high outflows in May and June helped further reduce Lake Ontario's level by 3 cm. The experience from this exercise showed that flows as high as 10900 m^3/s can be discharged. However, seaway traffic between Lake Ontario and Montreal was stopped due to dangerous cross current conditions.

7. The prolonged high outflows from Lake Ontario, combined with a significant reduction in the water supply to the lake in July and August, caused very low water level conditions on Lake St. Lawrence in July through October. This adversely affected riparians and recreational boaters. Flow reductions in late August to early October improved the water levels in the area.

8. In view of the average water level conditions that existed on Lake Superior and Lake Ontario near the end of 1993, no extreme water level conditions are forecast for these two lakes in early 1994.

9. Above average water level conditions on Lakes Michigan-Huron, St. Clair and Erie at the end of 1993 are a signal that if wet weather conditions persist during the winter months, levels on these lakes could begin to cause serious flood and erosion damages in the spring of 1994.

Tables 1 - 5

Table 1

Comparison of 1993 Great Lakes Basin precipitation and the Long-Term Average (millimetres)

Superior Basin

	1993	% of Average	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	45.2	92	49.4	91.4 (1935)	22.5 (1961)
Feb	10.7R	29	37.2	84.4 (1939)	12.3 (1912)
Mar	17.3	39	44.4	101.6 (1979)	9.6 (1910)
Apr	81.8	165	49.2	105.6 (1960)	17.4 (1949)
May	104.9	153	68.6	129.4 (1970)	21.1 (1948)
Jun	90.4	109	83.3	151.4 (1943)	22.7 (1910)
Jly	120.9	147	82.1	141.7 (1952)	27.7 (1936)
Aug	79.2	97	81.6	185.9 (1988)	26.3 (1930)
Sep	82.0	92	89.4	163.5 (1941)	32.7 (1967)
Oct	58.4	85	69.0	122.4 (1982)	15.6 (1947)
Nov	53.1	83	63.8	119.5 (1985)	11.0 (1939)
Dec	38.1	74	51.6	90.1 (1984)	9.0 (1913)
Sum	782.0	102	769.6		

Michigan-Huron Basin

	1993	% of Average	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	68.8	131	52.6	91.8 (1950)	20.5 (1956)
Feb	20.3	46	43.8	86.2 (1908)	14.3 (1969)
Mar	30.2	55	55.2	116.2 (1976)	15.1 (1958)
Apr	98.8	152	65.1	125.6 (1929)	25.6 (1946)
May	85.1	113	75.6	141.6 (1983)	31.0 (1925)
Jun	115.	114	78.5	143.8 (1969)	29.3 (1988)
Jly	91.7	121	75.6	132.2 (1952)	29.9 (1936)
Aug	96.8	124	77.8	136.1 (1972)	23.8 (1927)
Sep	98.8	112	88.2	213.3 (1986)	29.6 (1979)
Oct	79.2	110	72.0	147.4 (1954)	13.9 (1924)
Nov	64.3	92	70.2	127.8 (1985)	18.6 (1904)
Dec	36.1	61	59.0	105.6 (1971)	14.4 (1913)
Sum	885.2	109	813.6		

Source: NOAA, and U.S. Army Corps of Engineers
R denotes new record
All figures are in millimetres rounded to one decimal place.

Table 1 (continued)

Comparison of 1993 Great Lakes Basin precipitation and the Long-Term Average (millimetres)

Erie Basin

	1993	% of Average	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	102.9	168	61.1	160.5 (1950)	14.3 (1961)
Feb	46.5	88	52.9	117.1 (1990)	10.4 (1987)
Mar	73.7	104	70.6	170.6 (1913)	11.0 (1910)
Apr	90.2	114	79.1	152.1 (1961)	23.5 (1946)
May	40.9	49	83.8	175.8 (1943)	16.8 (1934)
Jun	113.3	131	86.6	167.9 (1937)	19.0 (1988)
Jly	77.5	92	84.6	190.5 (1992)	29.3 (1930)
Aug	46.7	58	81.0	179.7 (1975)	33.1 (1969)
Sep	126.5	159	79.8	176.0 (1926)	19.3 (1908)
Oct	70.4	101	69.6	196.2 (1954)	11.2 (1924)
Nov	77.2	108	71.8	191.8 (1985)	9.8 (1904)
Dec	45.7	69	66.7	160.0 (1990)	21.1 (1943)
Sum	911.5	103	887.6		

Ontario Basin

	1993	% of Average	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	91.2	136	67.3	137.2 (1978)	27.6 (1981)
Feb	52.6R	87	60.2	112.5 (1971)	22.9 (1969)
Mar	64.0	94	67.8	143.4 (1936)	18.2 (1915)
Apr	103.6	142	72.9	126.6 (1929)	28.6 (1915)
May	53.6	69	78.2	144.7 (1943)	15.9 (1920)
Jun	102.9	133	77.6	159.1 (1972)	30.3 (1912)
Jly	63.5	80	79.4	159.5 (1992)	31.7 (1933)
Aug	64.5	81	79.3	142.3 (1977)	32.1 (1907)
Sep	90.9	113	80.8	159.2 (1945)	24.3 (1964)
Oct	82.0	107	76.8	211.5 (1955)	12.9 (1963)
Nov	90.4	115	78.5	168.0 (1927)	15.4 (1904)
Dec	57.2	77	74.1	139.9 (1990)	27.0 (1943)
Sum	916.4	103	892.9		

Source: NOAA, and U.S. Army Corps of Engineers
R denotes new record
All figures are in millimetres rounded to one decimal place.

Table 1 (continued)

Comparison of 1993 Great Lakes Basin precipitation and the Long-Term Average (millimetres)

Great Lakes Basin

	1993	% of Average	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	69.6	127	54.6	100.5 (1950)	21.9 (1961)
Feb	24.9	55	45.1	80.1 (1908)	16.8 (1969)
Mar	36.6	66	55.6	110.7 (1976)	15.4 (1910)
Apr	93.5	147	63.5	106.0 (1929)	28.6 (1915)
May	80.8	108	75.0	116.1 (1983)	32.7 (1934)
Jun	106.7	132	80.6	121.1 (1968)	36.5 (1910)
Jly	88.1	112	78.9	123.7 (1992)	31.7 (1936)
Aug	81.5	103	79.4	128.1 (1977)	28.7 (1930)
Sep	97.3	113	86.4	166.2 (1986)	38.9 (1948)
Oct	72.6	102	71.4	127.0 (1954)	20.7 (1924)
Nov	66.0	95	69.6	136.7 (1985)	18.0 (1904)
Dec	40.4	68	59.8	92.5 (1983)	16.9 (1913)
Sum	858.0	105	820.0		

Source: NOAA, and U.S. Army Corps of Engineers
R denotes new record
All figures are in millimetres rounded to one decimal place.

Table 2

Outflows from the Great Lakes in 1992 and 1993
(cubic metres per second)

Lake Superior

	1992	1993	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	2270	2260	1940	2630 (1971)	1250 (1922)
Feb	2270	2290	1910	2610 (1969)	1270 (1922)
Mar	2180	2040	1880	2690 (1969)	1290 (1982)
Apr	2160	2110	1950	2940 (1951)	1300 (1922)
May	2280	2190	2120	3450 (1951)	1250 (1931)
Jun	2320	2430	2190	3480 (1951)	1220 (1922)
Jul	2120	2230	2280	3570 (1938)	1270 (1922)
Aug	2330	2210	2370	3600 (1950)	1270 (1926)
Sep	2200	2110	2370	3570 (1950)	1160 (1955)
Oct	2290	2100	2300	3510 (1968)	1250 (1926)
Nov	2230	2130	2260	3750 (1985)	1250 (1981)
Dec	2120	2040	2070	3170 (1950)	1310 (1981)
Annual	2230	2180	2140		

Lakes Michigan-Huron

	1992	1993	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	4960	5070	4490	6060 (1987)	3060 (1934)
Feb	4900	4760	4370	5720 (1974)	3000 (1942)
Mar	5150	4870	4820	5830 (1986)	3510 (1931)
Apr	5240	5070	5140	6260 (1986)	3600 (1901)
May	5380	5440	5360	6370 (1986)	4390 (1964)
Jun	5320	5630	5460	6430 (1985)	4420 (1964)
Jly	5240	5780	5520	6570 (1974)	4500 (1964)
Aug	5210	5790	5520	6630 (1986)	4530 (1964)
Sep	5100	5770	5480	6600 (1986)	4470 (1933)
Oct	5150	5790	5430	6740 (1986)	4420 (1933)
Nov	5070	5770	5370	6650 (1986)	4390 (1934)
Dec	5210	5510	5180	6230 (1986)	3990 (1935)
Annual	5160	5440	5180		

Table 2 (continued)

Outflows from the Great Lakes in 1992 and 1993
(cubic metres per second)

Lake Erie

	1992	1993	Average 1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	5660	7040	5590	7420 (1987)	4050 (1936)
Feb	5750	6640	5470	7050 (1987)	3340 (1936)
Mar	5970	6690	5630	7480 (1986)	4110 (1934)
Apr	6290	7130	5910	7700 (1974)	4390 (1935)
May	6400	7060	6200	7760 (1974)	4590 (1934)
Jun	6060	6680	6230	7820 (1986)	4560 (1934)
Jly	6260	6760	6120	7670 (1986)	4450 (1934)
Aug	6400	6480	6020	7420 (1986)	4470 (1934)
Sep	6630	6400	5900	7140 (1986)	4450 (1934)
Oct	6480	6320	5800	7450 (1986)	4420 (1934)
Nov	6600	6310	5800	7280 (1986)	4280 (1934)
Dec	6710	6400	5790	7620 (1985)	4330 (1934)
Annual	6270	6660	5870		

Lake Ontario

	1992	1993	Average 1900-1992	Recorded Max and Min (Year) Maximum	Minimum
Jan	6140	7130	6280	8470 (1987)	4700 (1935)
Feb	6370	7560	6340	8160 (1986)	4360 (1936)
Mar	6570	8290	6630	8890 (1991)	5010 (1935)
Apr	6940	8340	7070	9200 (1973)	5070 (1964)
May	7730	10010R	7300	9540 (1973)	4980 (1965)
Jun	7730	10010R	7410	9910 (1973)	5350 (1965)
Jly	7360	8990	7350	9910 (1976)	5520 (1934)
Aug	7790	8650	7190	9340 (1974)	5300 (1934)
Sep	8100	7870	7010	9230 (1986)	5100 (1934)
Oct	8130	7560	6830	9170 (1986)	4960 (1934)
Nov	8300	7270	6710	9570 (1986)	4810 (1934)
Dec	8350	7320	6590	9260 (1986)	4810 (1934)
Annual	7460	8260	6890		

Source: Environment Canada, Ontario Region

Table 3

Comparison of 1992 and 1993 Great Lakes Water Levels with Previous Records (Metres, IGLD-1985)

Lake Superior

	1992	1993	1918-1990	Previous Max and Min Maximum	Previous Max and Min Minimum
Jan	183.37	183.41	183.36	183.70 (1986)	182.83 (1926)
Feb	183.29	183.32	183.30	183.64 (1986)	182.76 (1926)
Mar	183.25	183.24	183.26	183.61 (1986)	182.74 (1926)
Apr	183.22	183.24	183.29	183.68 (1986)	182.72 (1926)
May	183.33	183.37	183.39	183.74 (1986)	182.76 (1926)
Jun	183.37	103.48	183.48	183.77 (1986)	182.85 (1926)
Jul	183.45	183.56	183.54	183.82 (1950)	182.96 (1926)
Aug	183.47	183.62	183.57	183.86 (1950)	183.02 (1926)
Sep	183.52	183.62	183.57	183.86 (1985)	183.12 (1926)
Oct	183.54	183.58	183.54	183.91 (1985)	183.10 (1925)
Nov	183.51	183.52	183.50	183.89 (1985)	183.01 (1925)
Dec	183.47	183.46	183.43	183.81 (1985)	182.92 (1925)

Lakes Michigan-Huron

	1992	1993	1900-1990	Previous Max and Min (Year) Maximum	Previous Max and Min (Year) Minimum
Jan	176.39	176.54	176.36	177.20 (1987)	175.59 (1965)
Feb	176.36	176.51	176.35	177.11 (1986)	175.61 (1964)
Mar	176.39	176.48	176.36	177.12 (1986)	175.58 (1964)
Apr	176.45	176.59	176.45	177.23 (1986)	175.58 (1964)
May	176.53	176.70	176.54	177.27 (1986)	175.71 (1964)
Jun	176.53	176.82	176.61	177.32 (1986)	175.75 (1964)
Jul	176.55	176.91	176.65	177.39 (1986)	175.77 (1964)
Aug	176.54	176.88	176.63	177.41 (1986)	175.77 (1964)
Sep	176.53	176.83	176.38	177.38 (1986)	175.76 (1964)
Oct	176.49	176.76	176.52	177.49 (1986)	175.71 (1964)
Nov	176.52	176.70	176.45	177.39 (1986)	175.65 (1964)
Dec	176.53	176.64	176.41	177.26 (1986)	175.60 (1964)

Table 3 (continued)

Comparison of 1992 and 1993 Great Lakes Water Levels with Previous Records (Metres, IGLD-1985)

Lake St. Clair

	1992	1993	1900-1991	Previous Max and Min (Year) Maximum	Minimum
Jan	175.01	175.40	174.80	175.80 (1986)	173.88 (1936)
Feb	175.04	175.26	174.73	175.81 (1986)	173.89 (1926)
Mar	175.09	175.34	174.85	175.81 (1986)	174.05 (1934)
Apr	175.19	175.42	175.01	175.82 (1986)	174.26 (1901)
May	175.25	175.43	175.09	175.83 (1986)	174.43 (1934)
Jun	175.25	175.48	175.15	175.91 (1986)	174.46 (1934)
Jul	175.33	175.56	175.17	175.93 (1986)	174.50 (1934)
Aug	175.35	175.51	175.13	175.89 (1986)	174.42 (1934)
Sep	175.37	175.44	175.07	175.85 (1986)	174.34 (1934)
Oct	175.24	175.30	174.98	175.97 (1986)	174.27 (1934)
Nov	175.27	175.21	174.89	175.82 (1986)	174.18 (1934)
Dec	175.24	175.22	174.90	175.80 (1986)	174.25 (1925)

Lake Erie

	1992	1993	1900-1990	Previous Max and Min (Year) Maximum	Minimum
Jan	174.09	174.59	173.91	174.85 (1987)	173.19 (1935)
Feb	174.12	174.54	173.91	174.78 (1987)	173.15 (1936)
Mar	174.22	174.55	173.99	174.86 (1986)	173.20 (1934)
Apr	174.34	174.70	174.16	174.97 (1985)	173.37 (1934)
May	174.42	174.67	174.24	174.96 (1986)	173.44 (1934)
Jun	174.42	174.67	174.28	175.04 (1986)	173.45 (1934)
Jul	174.47	174.65	174.27	175.03 (1986)	173.45 (1934)
Aug	174.52	174.54	174.21	174.94 (1986)	173.42 (1934)
Sep	174.52	174.43	174.12	174.85 (1986)	173.38 (1934)
Oct	174.40	174.32	174.02	174.92 (1986)	173.29 (1934)
Nov	174.43	174.26	173.94	174.83 (1986)	173.18 (1934)
Dec	174.45	174.30	173.92	174.86 (1986)	173.16 (1934)

Table 3 (continued)

Comparison of 1992 and 1993 Great Lakes Water Levels with Previous Records (Metres, IGLD-1985)

Lake Ontario

	1992	1993	1900-1992	Previous Max and Min (Year) Maximum	Minimum
Jan	74.44	75.04	74.55	75.17 (1946)	73.82 (1935)
Feb	74.45	75.15	74.58	75.28 (1952)	73.79 (1936)
Mar	74.56	75.14	74.66	75.37 (1952)	73.94 (1935)
Apr	74.85	75.43	74.87	75.65 (1973)	74.04 (1935)
May	75.11	75.61	74.99	75.73 (1952)	74.12 (1935)
Jun	75.05	75.46	75.03	75.77 (1952)	74.20 (1935)
Jul	75.00	75.24	74.99	75.67 (1947)	74.15 (1934)
Aug	75.03	75.01	74.89	75.58 (1947)	74.00 (1934)
Sep	74.98	74.75	74.76	75.42 (1947)	73.90 (1934)
Oct	74.85	74.60	74.64	75.24 (1945)	73.83 (1934)
Nov	74.82	74.52	74.56	75.19 (1945)	73.75 (1934)
Dec	74.86	74.56	74.54	75.20 (1945)	73.76 (1934)

Montreal Harbour (Jetty No.1)

	1992	1993	1967-1991	Previous Max and Min Maximum	Minimum
Jan	6.18	6.78	6.99	8.96 (1968)	6.21 (1989)
Feb	6.43	8.09	7.12	9.04 (1967)	6.34 (1989)
Mar	6.28	7.25	7.15	8.36 (1973)	6.13 (1989)
Apr	6.91	8.17	7.67	8.82 (1976)	6.44 (1989)
May	7.01	7.32	7.44	8.93 (1974)	6.42 (1968)
Jun	6.21	7.26	6.85	8.12 (1974)	5.93 (1988)
Jul	6.11	6.70	6.59	7.49 (1973)	5.72 (1988)
Aug	6.27	6.53	6.49	7.27 (1972)	5.93 (1991)
Sep	6.50	6.27	6.43	7.08 (1986)	5.85 (1991)
Oct	6.60	6.50	6.50	7.16 (1986)	5.82 (1991)
Nov	6.99	6.55	6.61	7.31 (1967)	5.64 (1991)
Dec	6.80	6.50	6.68	7.24 (1972)	5.87 (1978)

Table 4

Lakes Superior and Michigan-Huron Supply Summary

Lake Superior Net Basin Supplies (N.B.S.)

		1992		1993	
	1900-88 Average	N.B.S. (m^3/s)	Difference in Storage (m)	N.B.S. (m^3/s)	Difference in Storage
Jan	-400	-50	0.01	-390	0
Feb	310	-50	-0.01	-1600	-0.06
Mar	1270	820	-0.01	680	-0.02
Apr	4220	3330	-0.03	4850	0.02
May	5240	5190	0	6460	0.04
Jun	4450	2620	-0.06	4180	-0.01
Jul	3680	4420	0.02	4920	0.04
Aug	2860	2810	0	3290	0.01
Sep	2100	3990	0.06	390	-0.05
Oct	1080	1580	0.02	1330	0.01
Nov	540	870	0.01	410	0
Dec	-650	1330	0.06	640	0.04
Sum	24700	26860	0.07	25160	0.01

Lakes Michigan-Huron Net Basin Supplies

		1992		1993	
	1900-88 Average	N.B.S. (m^3/s)	Difference in Storage (m)	N.B.S. (m^3/s)	Difference in Storage
Jan	1500	1860	0.01	3790	0.05
Feb	2520	2700	0	330	-0.05
Mar	5210	4390	-0.02	4260	-0.02
Apr	8130	8560	0.01	9750	0.04
May	7110	3230	-0.09	6470	-0.01
Jun	5780	3080	-0.06	9540	0.08
Jul	3620	4100	0.01	4530	0.02
Aug	1560	2520	0.02	2780	0.03
Sep	910	2540	0.04	180	-0.02
Oct	30	720	0.02	650	0.01
Nov	1020	6950	0.13	1500	0.01
Dec	820	1390	0.01	1330	0.01
Sum	38210	42040	0.09	45110	0.15

Source: International Lake Superior Board of Control
31360 m^3/s-month is equivalent to 1 metre storage on Lake Superior
44690 m^3/s-month is equivalent to 1 metre storage on Lakes Michigan-Huron

Table 5

Lake Ontario Net Basin Supplies

	1900-92 Average	1992 N.B.S. (m^3/s)	1992 Difference in Storage (m)	1993 N.B.S. (m^3/s)	1993 Difference in Storage
Jan	940	850	-0.01	2330	0.19
Feb	1060	820	-0.03	910	-0.02
Mar	2140	2100	0	1750	-0.05
Apr	2670	3280	0.09	4600R	0.26
May	1710	1840	0.02	2000	0.04
Jun	1170	790	-0.05	2080	0.12
Jul	680	1420	0.10	570	-0.01
Aug	240	1330	0.15	140	-0.01
Sep	140	790	0.09	-150	-0.04
Oct	220	620	0.06	390	0.02
Nov	590	2120	0.21	990	0.05
Dec	780	1730	0.13	1070	0.04
Sum	12340	17690	0.75	16680	0.58

Source: International St. Lawrence River Board of Control
7430 m^3/m-months is equivalent to 1 metre storage on Lake Ontario
R denotes new record

Figures 3 - 8

Figure 3. LAKE SUPERIOR MONTHLY MEAN LEVEL

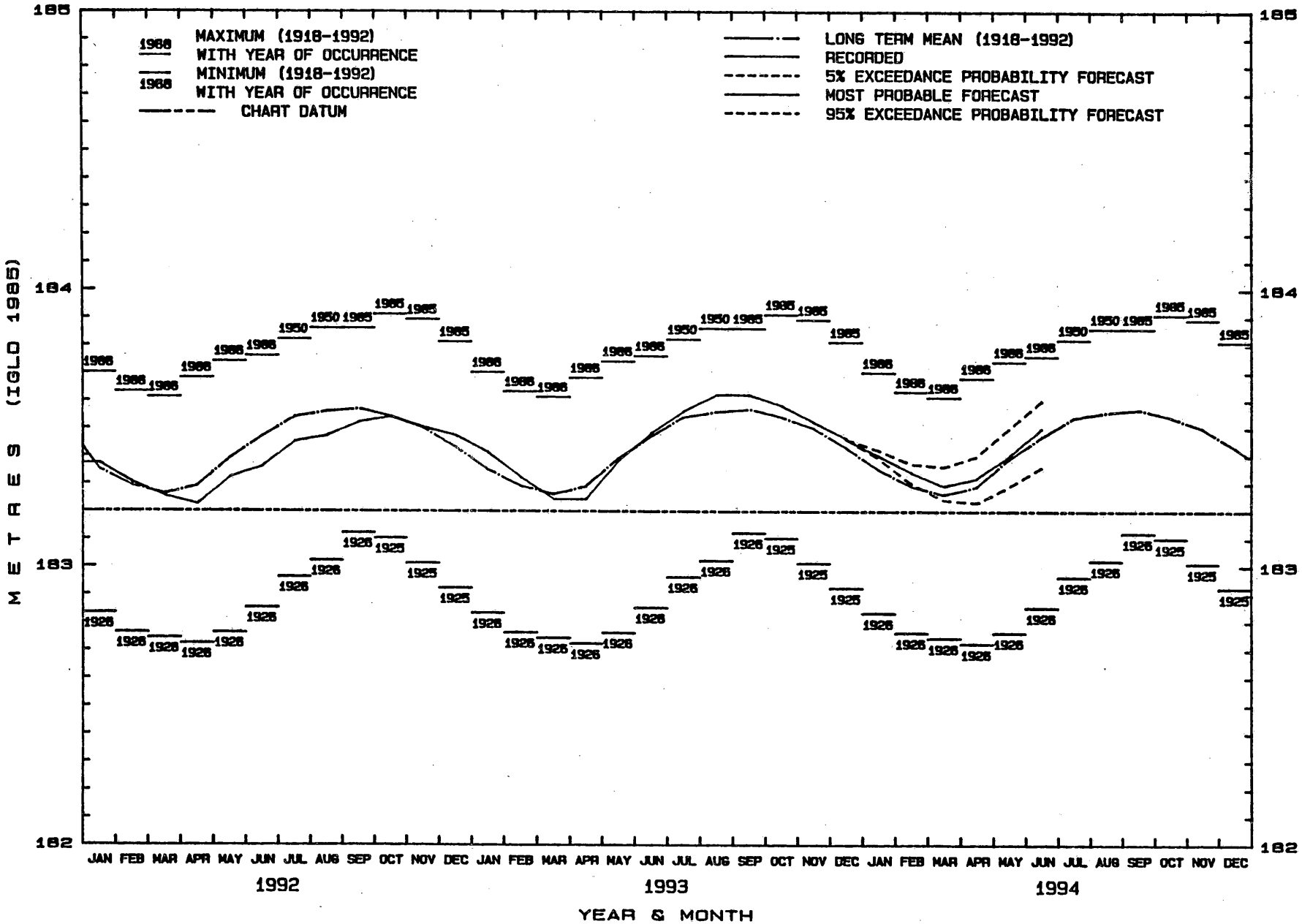


Figure 4. LAKE MICHIGAN-HURON MONTHLY MEAN LEVEL

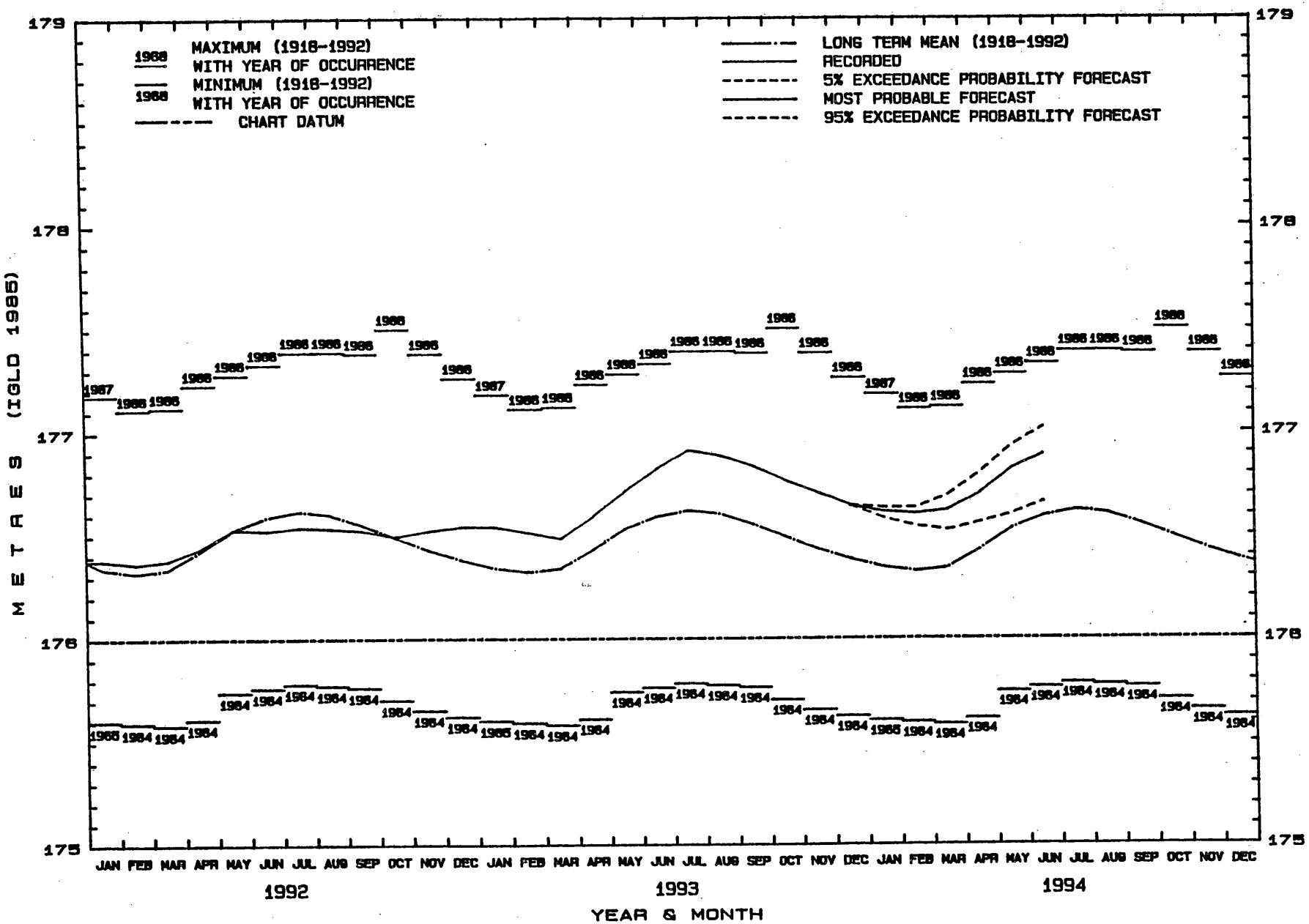


Figure 5. LAKE ST. CLAIR MONTHLY MEAN LEVEL

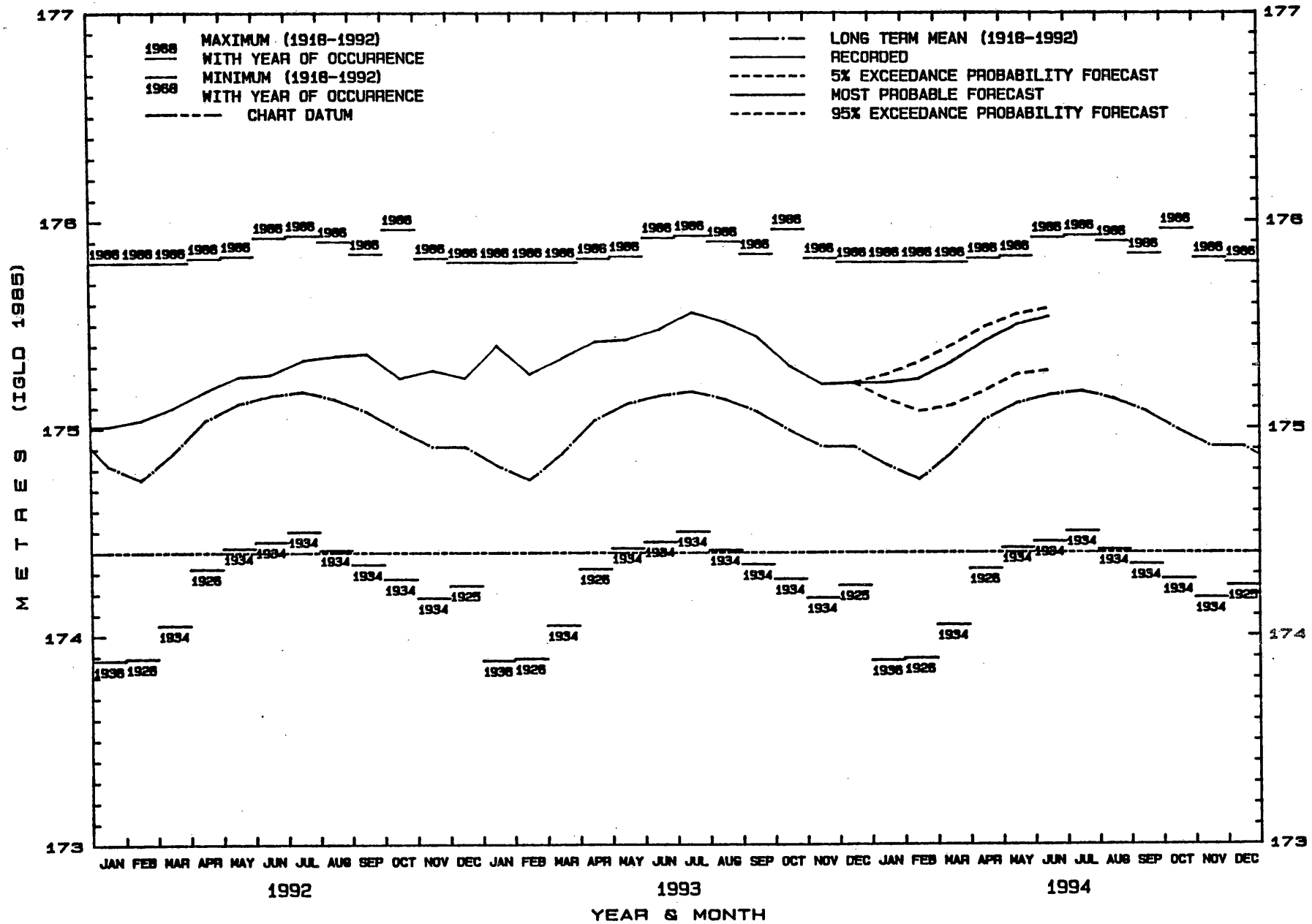


Figure 6. LAKE ERIE MONTHLY MEAN LEVEL

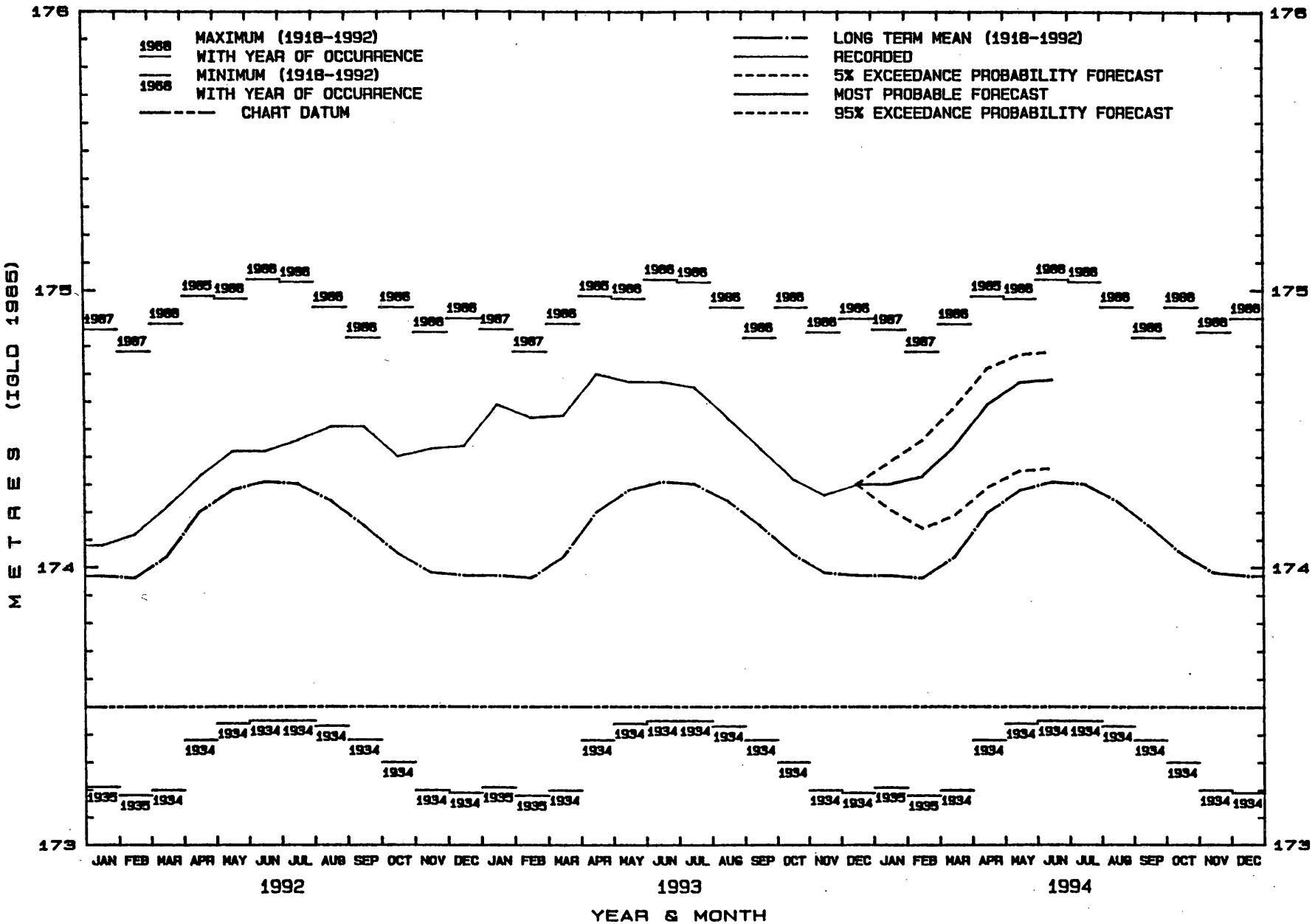


Figure 7. LAKE ONTARIO MONTHLY MEAN LEVEL

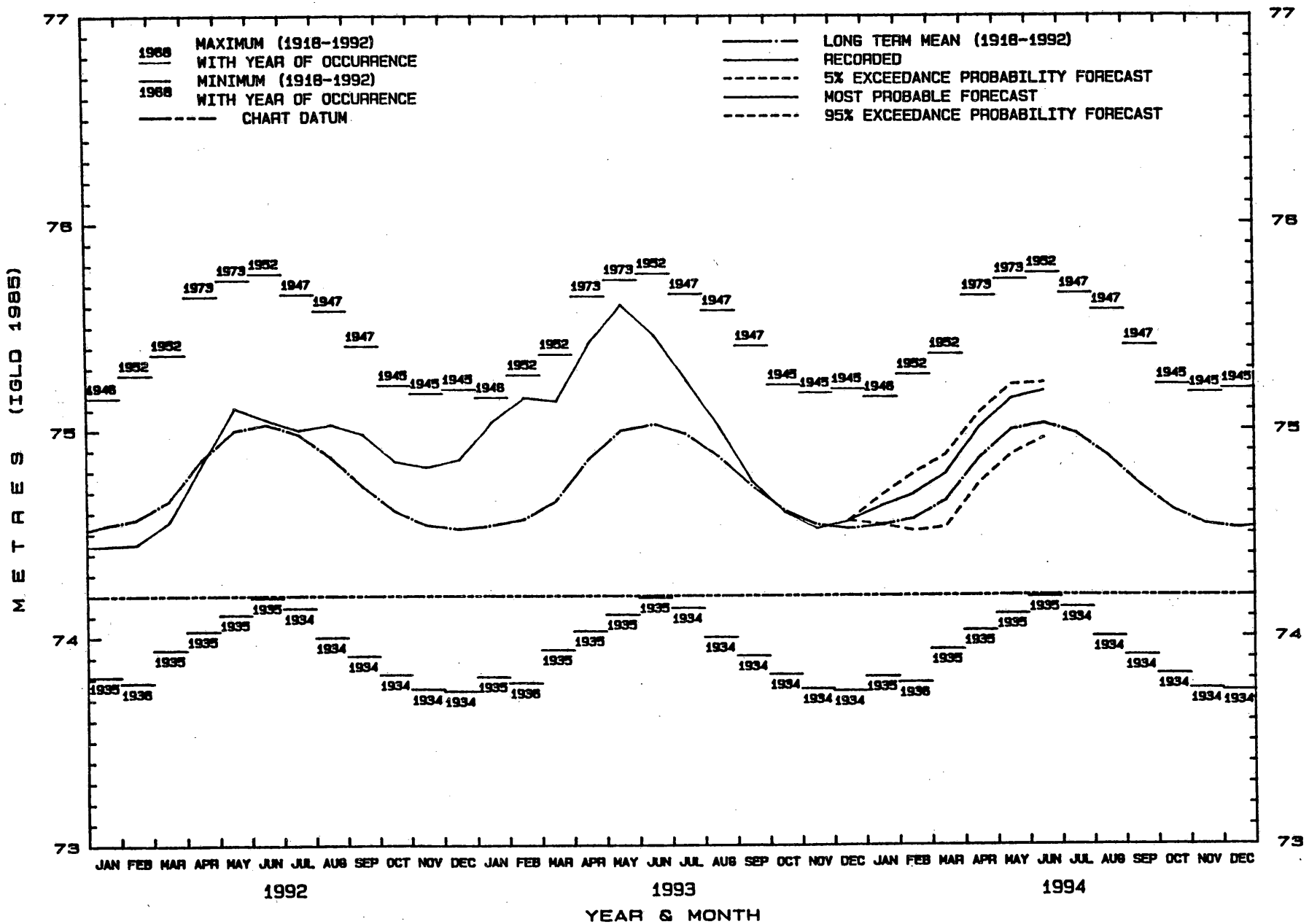
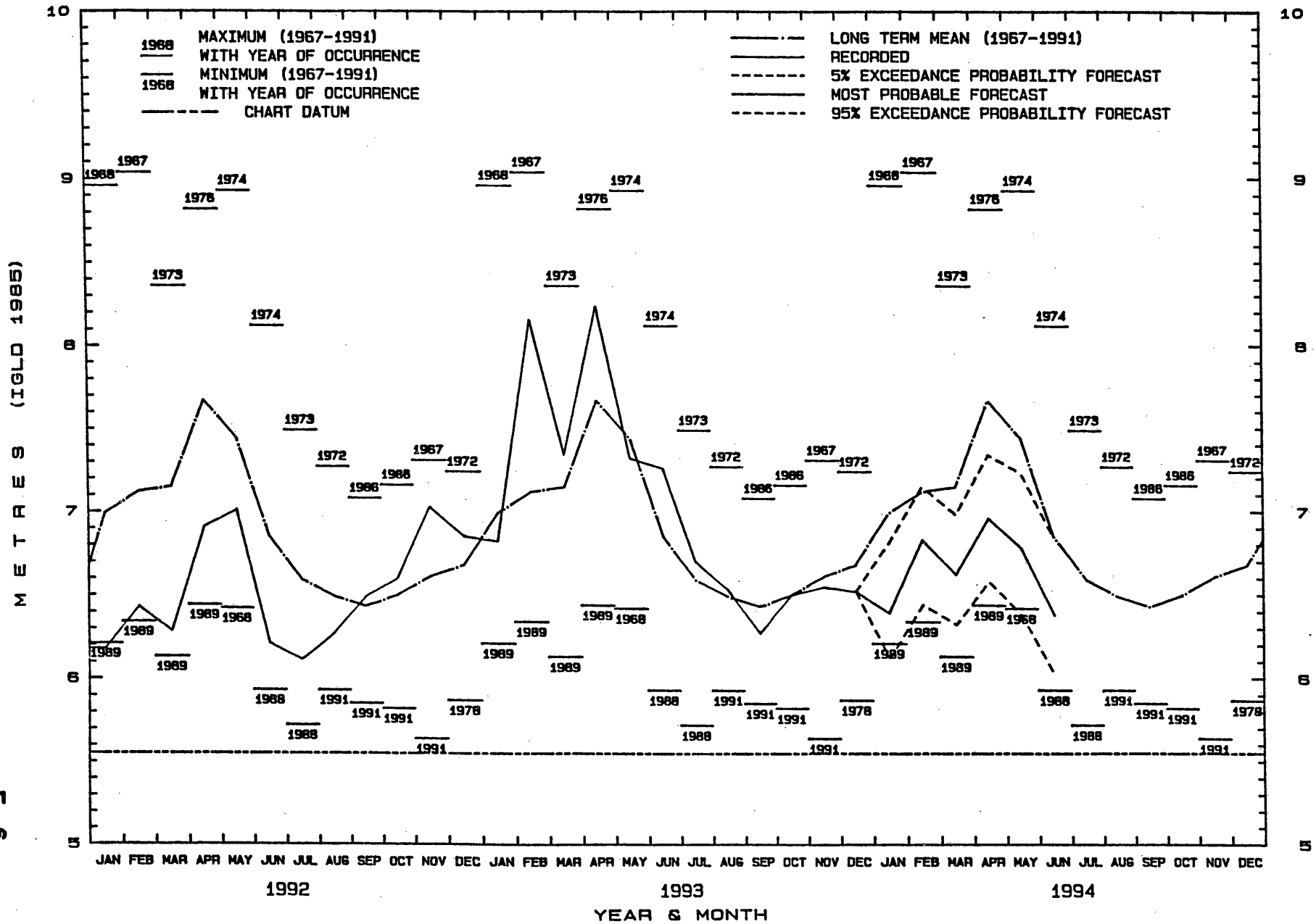


Figure 8. MONTREAL HARBOUR (JETTY NO. 1)



Appendix A

Flood and Erosion Damage

Appendix A

FLOOD AND EROSION DAMAGE

Section 1 of this appendix contains information on flood and erosion damages on Lake Ontario. The information was provided by the Conservation Authorities in Ontario. Section 2 contains information on St. Lawrence River flooding collected by Environment Canada staff in visits to the affected areas.

1. Lake Ontario

In August 1993, Environment Canada requested Conservation Authorities on the shores of Lakes Erie and Ontario to describe damages to shoreline properties as a result of the high lake water levels. The following is a summary of their replies.

(a) Niagara Peninsula Conservation Authority

During the period of high water levels, the Authority spoke to, and met with, a number of residents along the shoreline which extends from Fifty Point to the Niagara River. About 25 properties were inspected. In virtually all instances, the shoreline erosion problems that were encountered, appeared to be a consequence of the high water levels. In discussion with the landowners, most indicated that the damages to their shoreline protection structures were a consequence of high winds during the winter.

For example, during the major storm on March 13 and 14, strong northwest winds generated high waves . Older or poorly designed structures were severely damaged, and some properties were exposed to future storm events.

Unprotected shorelines were also seriously impacted. Along shoreline reaches where high banks exist, this impact was usually represented by the loss of a considerable amount of bank material. This situation was particularly common along agricultural lands within the municipalities of Lincoln and Niagara-on-the-Lake. In view of the property holdings of most farm operations, most landowners were not economically prepared to respond to the situation. Many of the owners were reacting to the loss of property by dumping debris on the face of the bank.

(b) Prince Edward Region Conservation Authority

The major problem was extensive erosion. The high water coupled with heavy wave action resulted in considerable shoreline damage. The Conservation Authority received about 60 shoreline requests for technical advice and financial assistance for shoreline properties throughout the spring. Many were emergency repairs that required immediate action to prevent losses of land. It was not uncommon, according to the Conservation Authority, to see shorelines recede 3 metres at a depth of 1 to 2 metres. This also resulted in

significant sedimentation on spawning beds in some locations.

In the spring, the Authority assisted about 12 residents in acquiring work permits from the Ministry of Natural Resources to carry out emergency repairs. Many others decided to wait until the water level dropped before making their repairs.

The Authority reported that about 10 homes experienced some flooding. Many of these residents took precautions by sandbagging to reduce the damage.

The Authority stated that the highest Lake Ontario water level that it experienced this spring was just under the 1:100 year flood elevation. If that level had been reached, there would have been many more flood related problems. The Authority was also concerned that there was the possibility of a lake surge, given high southwest wind conditions, during the highest period that would have resulted in the 1:100 year flood elevation or higher.

Throughout the spring, the Authority printed in the local newspaper the water elevations and the 5 day wind forecast to help keep shoreline residents informed.

(c) Hamilton Region Conservation Authority

Some erosion damage occurred in the City of Stoney Creek. The area hardest hit was Windermere Avenue. Due to the extensive erosion caused by high levels and wave action, the Authority agreed to co-ordinate a joint application to the Ontario Shoreline Property Assistance Program for funds to design and construct shoreline erosion protection for Windermere Avenue homes fronting on Lake Ontario. The estimated $550,000 cost of protecting the 350 metres of Windermere Avenue shoreline would be shared by the Authority and affected home owners. The Authority also allocated funds for erosion protection of the Fifty Point Conservation Area.

(d) Halton Region Conservation Authority

The Authority reported that damages to the waterfront structures in the City of Burlington resulted in $850,000 repairs. Along the Burlington Beach. Up to 50% of the sandy beach eroded, and there was also erosion to dunes and property behind the beach. At the Burloak Park, there was serious erosion and in some places up to 1 to 2 metres of shoreline was lost.

For the Town of Oakville, repairs costing $110,000 were necessary to its damaged waterfront structures. Some town owned properties which have little or no protection suffered additional erosion with some loss of the property.

Repairs costing $10,000 were carried out at the Oakville Harbours.

In addition to the damage to public shoreline properties, private properties also suffered damage. Few private property owners who have experienced damage requested information or technical advice from the Authority.

(e) Napanee Region Conservation Authority

The Authority reported that its watershed received no flooding damage

and only minimal erosion problems as a result of the above average water levels on Lake Ontario in 1993.

(f) Credit Valley Conservation Authority

The Authority received four specific storm related reports of erosion damage on residential properties, all with some level of existing erosion protection. It also received four general inquiries regarding requirements for new construction of works. These inquiries were also likely in response to spring damage.

(g) Moira River Conservation Authority

The Authority reported that the high water levels in 1993 caused erosion of private properties, damage to docks and public boat ramps. Also there was damage to docks and electrical hook ups at the main docking facilities in the city of Belleville. A total dollar value for the damage was not known, however, damages at Meyer's Pier and the Bay of Quinte Yacht Club were estimated at $30,000.

2. St. Lawrence River

The high flows in the international section of the St. Lawrence River in the fall of 1992 and the first eight months of 1993 were a subject of concern to shore residents. The problems in the St. Lawrence River were complicated by the ice restrictions both upstream and downstream of Cornwall, and the Ottawa River freshet, which increased significantly the flows in the area of Montreal and downstream during April. The following describes the conditions experienced in 1993.

(a) Lake St. Francis

Towards the end of March 1993, water levels on Lake St. Francis began to rise due to several flow increases at Cornwall. An extensive ice cover still existed in the channels at the west end of Lake St. Francis at that time. This restricted the discharge capacity and caused higher levels at the west end of the lake.

On March 31, the water level on Lake St. Francis at Summerstown rose to 47.13 m, 2 cm below the previous maximum instantaneous record. A visit to the area was made by Environment Canada staff on March 30 and again on April 2.

It was estimated that about 10 houses were affected by the high water levels in the Glen Walter area. One house visited had about 15 cm of water in its crawl space. One newly constructed house had a flooded ground floor /basement. At another house the water level rose to the elevation of its wooden deck. The absence of storm and ice action kept the damage to a minimum.

(b) Lake St. Louis

During the period April 8-12, the Ottawa River freshet began and the flow into Lake St. Louis increased significantly. The Lake St. Louis levels at Pointe Claire rose to 22.41 m on April 12 and exceeded the flood threshold level of 22.33 m.

On April 10, Environment Canada staff made a reconnaissance by car of the area between Dorion and Pointe Claire on the north shore of Lake St. Louis. Water levels at Pointe Claire were as high as 22.32 m and there was erosion

damage. In some areas, especially at Pointe Claire, some residential buildings very close to the water experienced basement flooding.

Another rise in the Lake St. Louis level started on April 20 due to very high local runoff and an increase in the flows from the Ottawa River. The Pointe Claire level rose to 22.51 m on April 23. There were reports of extensive flood damage on the lake.

Environment Canada staff made a second visit to the affected Lake St. Louis shoreline on April 30. Discussions were held with the officials from the Village of Maple Grove, the City of Chateauguay, and the Municipality of Lachine to obtain more information.

At Maple Grove, it is estimated that up to 50 houses were affected and about five houses were isolated for a two week period due to impassable roads. Flooding of the sewer system occurred and the village installed emergency pumps.

At Chateauguay at the mouth of the Chateauguay River, the surrounding houses are located on relatively low-lying land. Some parts of the city experienced flooding during the Châteauguay River freshet. The already very high Lake St. Louis water level conditions worsened the conditions at the mouth of the river.

At the Municipality of Lachine, the high water levels on Lake St. Louis combined with strong westerly wind caused extensive flood and erosion damage along the shoreline. In some areas, there was also structural damage.

(c) Between Montreal and Sorel

An ice jam in the St. Lawrence River began on February 8 near Sorel, Quebec. The problem was compounded by very high river flow and severe winter conditions. The level at Sorel rose rapidly and by February 10 it was at 6.36 m, exceeding the flood threshold value of 5.76 m. The level rose further to 6.60 m on February 15. The ice jam lasted about three weeks.

During the ice jam, ship transit was halted at times. According to Sécurité Civile du Quebec, 77 houses between Montreal and Sorel were flooded. Some residents at Repentigny, Lanoraie, Contrecoeur, D'Autray and St. Sulpice were temporarily evacuated.

The ice jam raised the water levels in Montreal Harbour to 9.09 m on February 14, exceeding the flood threshold value of 8.57 m. Flooding of some dock facilities was reported but the damage was not extensive.

(d) Lake St. Pierre

In early 1993, the Lake St. Pierre levels as recorded at Sorel have been above the flood threshold value of 5.76 m, except for the period January 1 - February 2, March 8 - 15 and again March 20 - April 8. During the Ottawa River freshet, the level rose to 7.01 m on April 12. On April 24, the level rose further to 7.06 m due to high river flow and heavy local runoff. According to Environnement Quebec officials, there was some flooding of farmland and roads along the shores of Lake St. Pierre.

Appendix B

Newspaper Clippings

The Globe & Mail, Toronto, Ontario **May 3, 1993**

Islanders ward off a flood

Water levels along the lake are highest in decades

BY MARK PALMER,
DAVID HILDERLEY
and MARTIN POWELL
Special to The Globe and Mail

TORONTO — Wards Island residents spent the weekend sandbagging their Lake Ontario shoreline to prevent flooding, with water levels the highest seen in 20 years.

At most waterfront marinas where sailors were dipping their boats into the water for the first time, moorings were well submerged, and in some places the water was as much as 40 centimetres above last year's levels. On some docks, sailors found themselves wading knee-deep in water.

Roads on the Toronto Islands were flooded, obliging people to detour around them, though some hardy souls preferred to plunge through the water — as much as 30 centimetres deep in some cases.

A beach area south of the island airport was is under water, obliging people to sun themselves with water lapping at their feet. Water washed over the pier at the Islands Marina on Centre Island, and Centreville amusement park also experienced flooding.

"I haven't seen the water levels this high in 20 to 25 years," said Metro Police Constable Terry Cassidy of the island detachment.

Wards residents placed sandbags around the perimeter Saturday to provide a backup system for the dike. No houses near the shore have been affected, but water has covered some streets and caused soil erosion.

The fear is that high winds could push water over the dike and flood the community. Two rows of sandbags, three deep, have been installed, and residents hope drainage pumps behind them will curtail runoff into the community.

'The last thing needed is a spring full of rainy days.'

"There is no immediate danger of flooding because the water level isn't rising that quickly," said Barry Lipton, organizer of the operation.

Mr. Lipton said the community decided to install the sandbags after the water level rose 30 centimetres in a two-week period in April.

Jay Bascom, 46, a lifetime island resident, said the last time flooding occurred was in 1974. After earlier floods, he said, sidewalks were raised to act as barriers to prevent water from running into houses.

The scenario was worse in those days, Mr. Bascom recalled, because there was no sewage system. As water flooded in, septic tank levels would also rise and contribute to the problem.

John Vallentyne, scientist emeritus with the Canada Centre for Inland Waters in Burlington, said a wet summer in 1992 and a snowy winter have contributed to rising waters.

He added that if levels in the other Great Lakes are higher still, Lake Ontario could rise even farther this spring and summer.

Constable Ken Petrie, also a member of the island detachment, said the water has moved up the beach between two and three metres, causing boat hulls at Blockhouse Bay to rise higher.

"People will have to watch their boats," he said. "Getting off . . is a real step down."

At the Centreville amusement park, bumper boats and touring cars were not running on the weekend, and there were no trainrides. Twelve other rides were still running.

At the Highland Yacht Club at Bluffers Park in Scarborough, the water was about 40 centimetres higher than normal and about 7 centimetres over the fixed dock, a club member said.

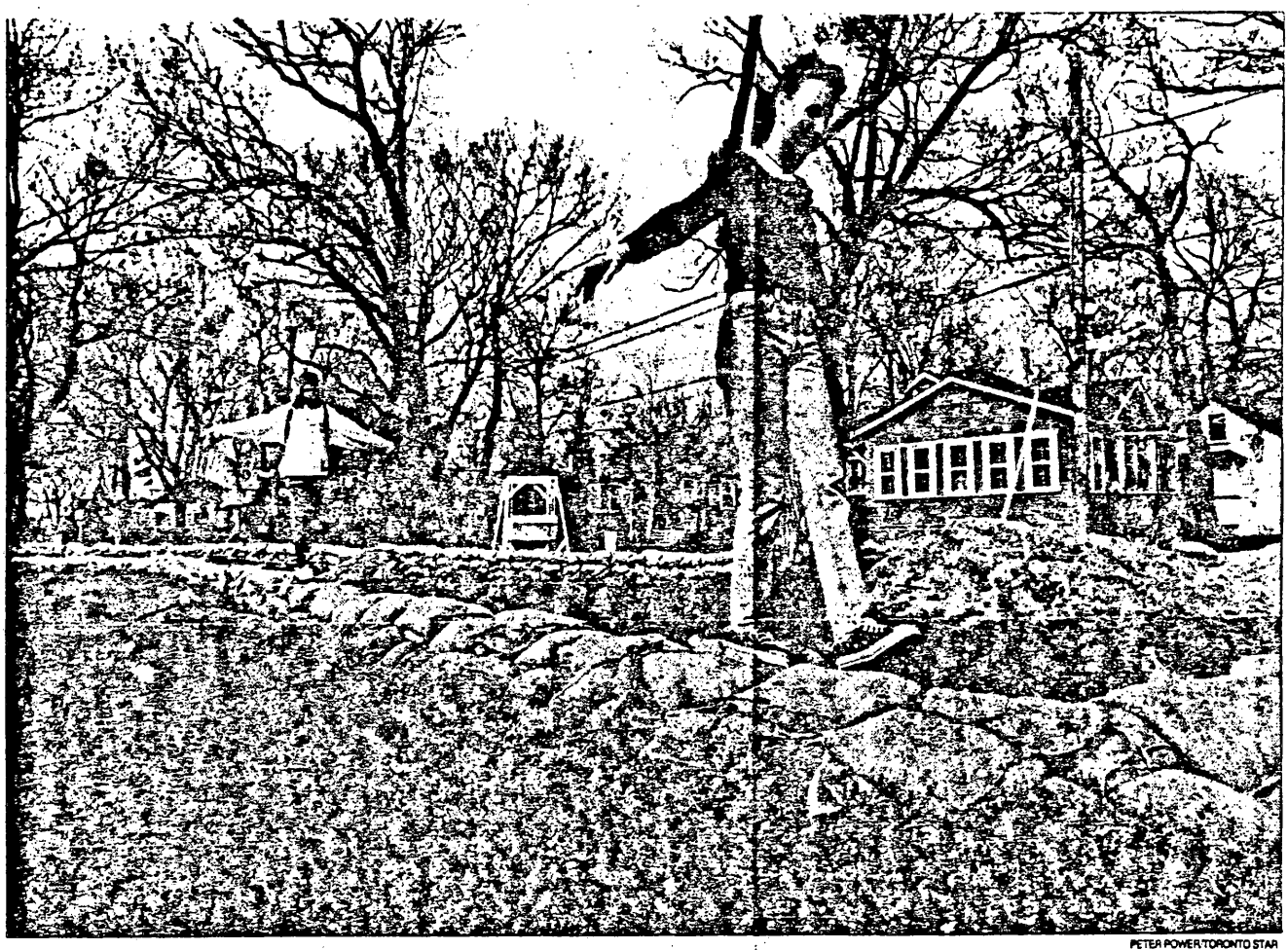
Kim Ross, who has tied up his boat at the club for 12 years, said he has never seen the water so high. Unable to tie up their boats because the docks are under water, people have had to move them to marinas with floating docks.

Marcie Smith, a manager of Oakville's Bronte Harbour Yacht Club, said the water there has also risen considerably, covering some docks and obliging some boat owners to work off of concrete blocks resting on the submerged docks.

The Wards Island residents are hoping for one thing — little or no more spring rain.

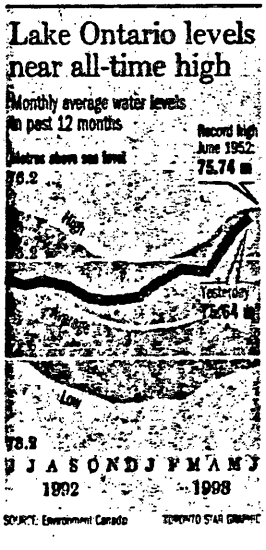
"Everything will likely be fine unless we get a similar spring to last one," Mr. Lipton said.

The Toronto Star, Toronto, Ontario **May 4, 1993**



PETER POWER/TORONTO STAR

SANDY BEACH: Erin Byrne, right, and Morgan Cocoroch, both 13, have some fun with the sandbags helping to protect Ward's Island.



Lake's levels near record highs

By Brian McAndrew
TORONTO STAR

Water levels in Lake Ontario are reaching unusually high levels and long-time waterfront residents say it's part of a double-decade trend.

"It seems to happen every 20 years," Toronto Islands resident Beatrice O'Bryan said yesterday.

"I'm not worried too much. It was worse the last time," added O'Bryan, who has lived on Ward's Island sporadically since the early 1960s.

O'Bryan's memory serves her well.

The last time the lake level rose higher was in 1973, just a touch below the record-setting 1952 level.

Island residents erected sandbags along lakefront breakwalls on the weekend and some front lawns were sporting portable water pumps as a precaution.

So far, no water has flowed through the front door of any island homes.

Several rides, including the train, were forced to close during the inaugural weekend at Centreville amusement park on Centre Island.

"As long as you don't get too close to the edge of the water you're all right," said amusement park supervisor Trish Grice.

Water watchers are hoping a plateau reached during the past few days means the lake level has reached a peak.

A heavy rainstorm or high winds could push the bloated lake beyond its normal boundaries, said Ralph Moulton, manager of Environment Canada's Great Lakes water level communications centre in Burlington.

"We've been fortunate that we haven't had any severe storms lately," Moulton said.

"If we get a really heavy deluge of rain we could get another (increase of) 10 or 15 centimetres (4 to 6 inches)," Moulton said.

That would set a record.

The lake has remained steady at 75.64 metres (248.09 feet) above sea level for the past four days, Moulton said.

The record high set in June, 1952, was 75.74 metres (248.43 feet). The level reached in May of 1973 was marginally lower.

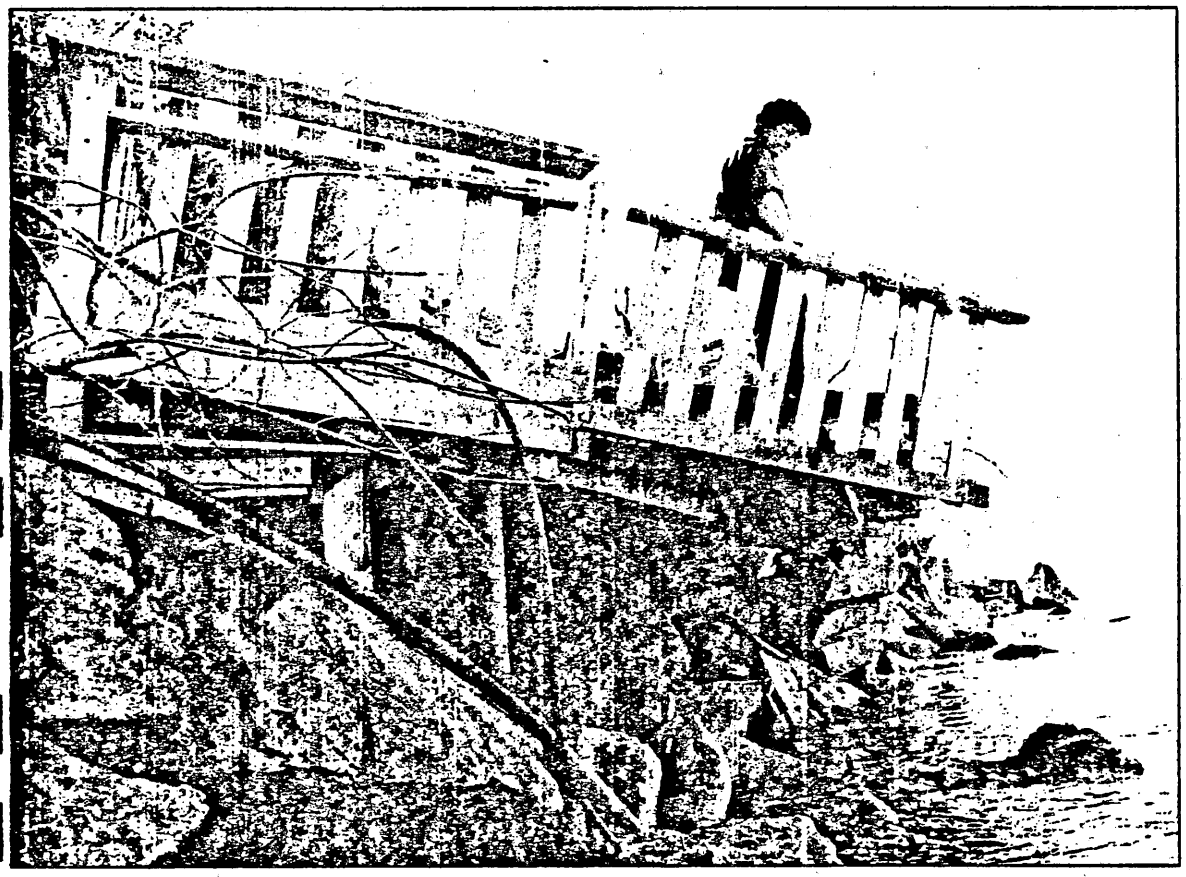
The maximum desirable level is 75.37 metres (247.29 feet), the International Joint Commission noted in a warning in mid-March alerting the Canadian and U.S. governments of increased water levels.

Moulton attributes the current high level to several factors including:

- ☐ An extremely wet summer in 1992;
- ☐ Heavy snowfall in the Lake Ontario drainage basin in January;
- ☐ Increased runoff created by melting snow in March;
- ☐ The surprising "storm of the century" during the March school break that struck much of the U.S. east coast including New York state;
- ☐ Ice jams in the St. Lawrence River that slowed outflow from the lake.

Hamilton Spectator, Hamilton, Ontario **May 8, 1993**
WEEKEND EDITION • Saturday, May 8, 1993

WATER WOES



Barry Gray, The Spectator

Gloria Coulter surveys Lake Ontario from atop a washed-out deck at the Beamsville cottage of Andrea Nadherny-Borutin.

Lake turns lethal for residents

By AGNES BONGERS
The Spectator

"IT LOOKS like a friend now," Kathy Morrison says of the still waters stroking the bottom of the wooden staircase.

But the Lake Ontario calm is deceiving. Its waters have made a crashing invasion this spring on the shorelines of Niagara, Hamilton and Burlington, transforming itself into an enemy for Ms Morrison and most residents living on its edge.

Water has reached critical levels, according to those monitoring it 'round the clock. Within 10 centimetres (four inches) of record levels set in the '50s, Lake Ontario has pushed its boundaries onto properties normally reserved for foot travel.

And without mercy, it has taken no prisoners. Beaches are gobbled up, trees swallowed whole, and massive chunks of land have disappeared.

"We're in trouble," Ms Morrison said. On either side of her lakeside property in west-end St. Catharines, the single mother witnesses the destructive power of Lake Ontario.

The water is 60 to 70 centimetres (more than two feet) above long-term averages for this time of year. As a result, its waves have gutted the toe of the bluff on adjacent properties. The land above — one holding a two-storey house spitting distance away from the edge — appears ready to cave in.

■ Lake Erie: B4
■ Getting help: B5

And Ms Morrison's property is showing signs of following suit.

"We've never, ever seen it like this," says the 10-year shoreline resident. "We're sick and we don't know what to do."

A series of natural phenomena conspired to create the problem, according to Anthony Eberhardt of the U.S. Army Corps of Engineers in Buffalo, which tracks lake levels.

Heavy runoff from winter snows, above-average rainfall in April and ice-jams on the St. Lawrence preventing movement out of the lake all conspired to turn Lake Ontario into the rain barrel of the Great Lakes.

In fact, last month the lake swallowed the highest volume of water ever recorded for one month since records began in 1900, Mr. Eberhardt said.

The effect is a water level above the flood stage, he said.

"It's very high, it's critically high," agrees Peter Yee, head of the Great Lakes-St. Lawrence Regulations Division of Environment Canada in Cornwall.

But it has likely peaked, he said.

For the first time in months, Lake Ontario water levels have not climbed for about a week. The supervisory body Mr. Yee reports to — the International St. Lawrence River Board of Control — has had an impact on this change. The board pulled the plug on Lake Ontario earlier this spring to release record levels of water through the Seaway, Mr. Yee said.

"We're doing everything we can," to offer shoreline residents relief, he said.

In an unusual move, the Board of Control has been monitoring the water level around the clock and altered the flow out of the river more than 100 times this year, sometimes three times a day.

As a result, the board may have created an early peak in lake levels and prevented Lake Ontario from reaching a record high, Mr. Yee said.

Not everyone is convinced of that situation, however. History marks the peak in May or June, providing more than a month's time to climb 10 centimetres.

The record "could easily be outdone if a significant amount of rain falls," said Ruth Edgett, of

☐ Continued on A2

Hamilton Spectator, Hamilton, Ontario **May 8, 1993** (continued)

Lake turns lethal

☐ Continued from A1

the Great Lakes Water Levels Communication Centre in Burlington.

Preparations have already been taken should the levels climb or a storm turn the lake violent. On the U.S. side, the Army Corps of Engineers has met with officials in the vulnerable lakeside community of Rochester, N.Y., to alert them to emergency measures. Similar meetings have taken place between the Niagara Peninsula Conservation Authority and local officials.

"It's like a fire drill," explained authority representative Tony Dimario.

But there is no drill for those living on the water's edge. The damage is already done and the fear of more occurring is real.

In Burlington, sand at the Beachway Park has virtually disappeared; Beach Strip residents in Hamilton have flooded basements and the lake at their doorsteps; high water is undermining the bluff along Lakeshore Road in St. Catharines; and sand bags now protect the dining room and lounge of the Dalhousie Yacht Club.

"It's horrendous, it's a disaster," said 10-year lakeside resident Andrea Nadherny-Borutin, of Beamsville.

High water has stolen land, a sailboat and a wooden deck from her property.

"Water comes up and grabs from underneath and pulls everything away," she said.

At Shoreline Greenhouses Ltd. in St. Catharines, 10-year-old trees were moved root and all from lakeside banks, said owner Gerald Braun. The trees were part of an extensive measure to protect his bluff from erosion caused by rains and spring runoff.

"I thought those trees would last forever," he said. "The lake can do in one year what it takes the rain to do in 10 years."

There are two answers to residents' problems: lower water levels or extensive shoreline protection. The latter is extremely expensive, in the thousands of dollars.

And no one has full control over water levels. Continued draining of Lake Ontario is expected in the short-term. And the lake is expected to reach a normal level by August, Ms Edgett said.

But an extremely wet May could skew that forecast. Only Mother Nature knows.

"What we really have to rely on is a hotter summer than last year and hope things go back to normal," said 19-year Beach Strip resident Michael Gagnon.

"It isn't like a bathtub where you can pull the plug."

■ The Niagara Peninsula Conservation Authority offers advice on how to protect your property from water erosion and flooding. If you live in the Niagara Region, call David Watson at 1-800-263-4760, ext. 237.

Hamilton Spectator, Hamilton, Ontario **May 8, 1993**

Waters high but not dangerous on Erie, Ontario, cottagers hope

JOE MENEGON has watched the waves crash through one stone barrier and climb over another to try to reach his cottage on Peacock Point near Port Dover.

So far he's beat the Lake Erie waters.

And the Hamilton resident anticipates success again this spring despite the high water levels experienced through lakes Erie and Ontario.

Half 1985 level

This time Erie doesn't seem as large a threat. The water level is about 51 centimetres (20 inches) above normal for this time of year, according to Ruth Edgett, of the Great Lakes Water Levels Communication Centre in Burlington.

That is well below record levels, and about half the level reached in 1985, when a disastrous storm caused millions of dollars worth of damage to cottages and homes along Lake Erie shores.

Even if water levels should climb higher in the next month or so, no one anticipates they will reach record levels on Erie.

And the time of year should work in favor of those living along Erie's shores, according to Mr. Menegon. Storms that blow up the massive waves usually occur during the fall and winter, not in late spring, he said.

Still, no one is convinced Erie dwellers are completely out of harm's reach.

"You can get a storm anytime," said Bill Baskerville of the Long Point Conservation Authority. "I'm not really confident we're out of any risk."

Lake Erie residents have experienced the fury of its waters numerous times and have done much to protect their shorelines over the years. That should save them from much of the lake's power, officials said.

Still, cottage owners like Mr. Menegon will keep a watchful eye on water levels.

"Whenever levels are high, you sit back and pray that the winds don't come up," Mr. Menegon said.

Hamilton Spectator, Hamilton, Ontario **May 26, 1993**

Dangerous lake water levels prompt high volume release into St. Lawrence

By AGNES BONGERS
The Spectator

LAKESIDE RESIDENTS are the winners, and shippers the losers in the most recent battle to control high water levels in Lake Ontario.

After a successful test last week, an unprecedented volume of water is being released from Lake Ontario and down the St. Lawrence River in regular, twice-weekly flows that began Monday and will continue indefinitely, authorities report.

The release through a dam at the lake's eastern end should alleviate problems for those living on the lakeshore, but it's already causing problems for ships trying to navigate in the St. Lawrence.

Each Monday and Thursday, authorities plan to release four times the amount of water that normally pours daily over Niagara Falls and into Lake Ontario, said John Derbyshire, spokesman for the U.S. Army Corps of Engineers.

"We want to get out of the danger area," Mr. Derbyshire said, referring to lake levels deemed an emergency by the International Joint Commission.

The water level peaked in early May at about 70 centimetres (more than two feet) above normal, according to Ralph Moulton at the Great Lakes Water Levels Communications Centre in Burlington.

But readings over the long weekend found Lake Ontario had dropped by about seven centimetres (three inches).

While precedent-setting releases were not started until this week, the St. Lawrence River Board of Control has been matching record outflows at every opportunity since January.

Ice jams

But ice jams on the St. Lawrence thwarted those efforts, while record input into Lake Ontario in April through rains and spring runoff raised the lake enough to create serious risk of flooding and storm damage, Mr. Derbyshire said.

The lake level must now be lowered by about 30 centimetres (one foot) before authorities put the plug back, Mr. Derbyshire said. That is expected to happen "toward the fall," providing normal summer weather conditions occur, he said.

Another cool, wet summer like last year, and there could be more problems with the lake, he noted.

Lake dwellers — who have lost beaches, are experiencing flooding and face erosion damage — are a priority concern for the control board, he said.

Shippers are not.

The St. Lawrence Seaway Authority is closing a section of the waterway each day water flows are increased because of the stronger current, said information officer Gay Hemsley. Vessels are being rescheduled or must simply wait out the closures, she said.

While shippers are unhappy with the delays, Ms Hemsley stressed the seaway authority is "as much a victim in all of this as they are."

This is just one more hardship for the authority facing already low traffic volumes due to the recession and troubles with Russian grain shipments.

But for firms such as GLBC Inc. in St. Catharines, closing a section of the seaway means additional costs due to delayed shipments.

Already, GLBC had had one vessel trapped in last week's test, causing a delay of 12 to 18 hours and $12,000 to $13,000 in additional operating costs, said president David Gardiner.

"We're not happy with it, but we understand the imperative," he said.

Standard-Freeholder, Cornwall, Ontario **May 29, 1993**

Seaway opens up water floodgates

Great Lakes water level too high

By JACKI LEROUX
Staff Writer

An emergency operation has begun within the Lake Ontario river system which will see the St. Lawrence Seaway Authority opening some of its dams to increase waterflow downstream towards Montreal.

John Kroon, director of operations, said this is the first time in the history of the Seaway that an operation of this nature has been carried out.

"It's a once-in-a-hundred-years situation," he said.

Because of an exceedingly high water level in Lake Ontario, the International Joint Commission, the multi-governmental body responsible for water levels in the Great Lakes, has ordered the outflow from the system to be increased.

That means dams at Iroquois, Long Sault and the R. H. Saunders at Cornwall will be opened for two 24-hour periods a week until mid- to late-June.

"That's provided we don't get major rainfall between now and then," Kroon said.

He said as a result of the high water levels, communities bordering Lake Ontario on the United States side have reported between $8 and $10 million in property damage.

"This is considered to be an emergency operation."
—John Kroon, St. Lawrence Seaway

Some homes around the Kingston and Gananoque areas have experienced severe flooding and there has been some erosion of major beaches there.

The high water level is attributed to the heavy rainfall last summer and the large snowfall this past winter, Kroon said.

The outflow operation, which began May 20, will increase the flow to 385,000 cubic feet to 350,000 cubic feet of water a second.

Kroon said this is the first time in the history of the Great Lakes system that an excess of 350,000 cubic feet a second, previously considered the maximum, has been undertaken.

"This is considered to be an emergency operation," he said.

Commercial navigational traffic will be scheduled around the two 24-hour periods, he said, since it is considered dangerous for ships to travel on the water with such rapid flow.

"The shipping industry wants to be part of the solution and not part of the problem. That's why they're co-operating," said Kroon.

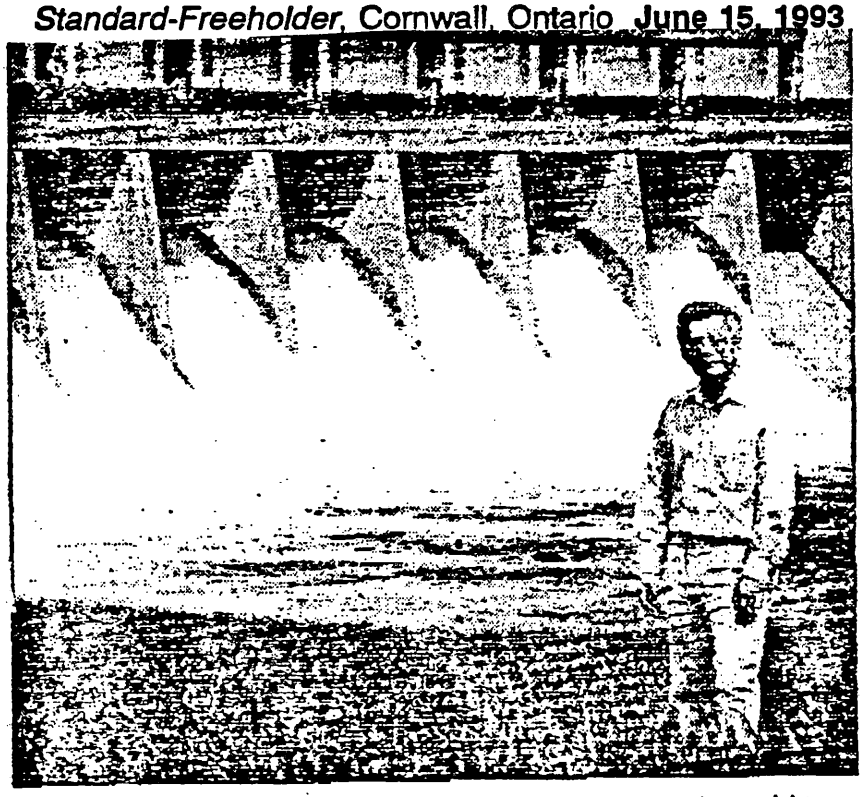
He said recreational boaters around the Iroquois dam especially could experience navigational problems when the dams are open.

"With the increased flow, there are treacherous currents around that dam. Boaters should use the lock to go through," he advised.

"The currents will be much higher elsewhere as well, but it should not affect small boaters too much," he said.

The dams will be open from 8 p.m. Mondays to 8 p.m. Tuesdays, and 8 p.m. Thursdays to 8 p.m. Fridays.

Standard-Freeholder, Cornwall, Ontario June 15, 1993



Engineer Peter Yee at the Long Sault Spillway, where water flow is rare sight.

Water levels remain high but emergency has passed

BY SULTAN JESSA
Staff Writer

Extremely high flows in the St. Lawrence River continue. But improved Lake Ontario water level conditions will end the need for water flows at the Long Sault Spillway, according to Environment Canada engineer Peter Yee.

The record-high flows have resulted in the opening of the gates at the Long Sault Spillway, which is rarely used unless the river flow exceeds the capacity of the Moses-Saunders generating stations.

Yee, head of Great Lakes - St. Lawrence Regulation Division of Environment Canada, said Lake Ontario levels peaked in early May at 75.65 metres and since then declined by 15 cm.

Since May 20, the Lake Ontario outflows were increased to an unprecedented rate of 10,900 cubic metres per second for a 24-hour duration twice weekly.

These actions helped lower the lake's level. But Yee says Mother Nature was mostly responsible for the decline.

He said the May rainfall on the Lake Ontario basin was below average and Lake Erie, a major source of Lake Ontario's water, also saw its outflows decline during the month.

The present Lake Ontario level is 48 cm. above the seasonal average and the risk of serious property damages on Lake Ontario remains high, Yee said.

His office is a technical arm of the International St. Lawrence River Board of Control which oversees the regulation of the outflows of Lake Ontario.

"With Lake Ontario level expected to continue to decline, the board, has decided to terminate at the end of the week the program of flow increases," Yee said. "After that, the flow will continue to remain at 9,900 cubic metres per second, which matches the previous maximum in July 1976."

An emergency operation has been underway within the Lake Ontario river system which saw the St. Lawrence Seaway Authority opening some of its dams to increase waterflow downstream towards Montreal.

This was the first time in the history of the Seaway that an operation of this nature had been carried out.

Standard-Freeholder, Cornwall, Ontario **September 3, 1993**

Water levels remain dangerously low here

Holiday weekends are a favorite time for recreational boaters.

But when sails are raised, caution is often thrown to the wind.

Environment Canada is warning boaters upstream from Cornwall that water levels are still dangerously low and will probably remain so for the rest of the boating season.

The International Joint Commission allowed its International St. Lawrence River Board of Control recently to begin reducing the flow of water through Cornwall's Moses-Saunders power dam.

Flow at the dam had been increased to maximum levels early this year to fight high water levels in Lake Ontario.

This was the largest contributing factor to the eventual near-record low water levels upstream from the dam, between Cornwall and Iroquois.

Since reducing the flow at the dam, water levels stopped bottoming out and improved slightly last week, said Reg Young, water resources technologist.

But, as of Thursday, levels are still about 50 cm. below normal.

Peter Yee, head of Environment Canada's Great Lakes-St. Lawrence regulation division, said the board met again Wednesday and has decided to continue gradually reducing the flow at the dam for the next several weeks, beginning at midnight tonight.

"This is a very unusual step for them, especially at this time of year, but they want to help the boaters," Yee said.

The board's move may help boost water levels.

"At least it should stop any more rapid decline," Yee said.

However, even with the new measures, water levels will remain low for the rest of the season.

"Boaters should still be very cautious," Yee said.

In many areas, objects previously well submerged are now much closer to the surface.

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