Great Lakes Diversions and Consumptive Uses

Annex G

Evaluation of Diversion Management Scenarios and Consumptive Water Use Projections

Report to the International Joint Commission

by the
International Great Lakes Diversions and Consumptive Uses Study Board
(Under the Reference of February 21, 1977)

September 1981

CONVERSION FACTORS

(ENGLISH TO METRIC UNITS)

1 cubic foot per second (cfs) = 0.028317 cubic metres per second (cms)

1 cfs-month = 0.028317 cms-month

1 foot = 0.30480 metres

1 inch = 2.54 centimetres

1 mile (statute) = 1.6093 kilometres

1 ton (short) = 907.18 kilograms

1 ton (long) = 1016.40 kilograms

1 square mile = 2.5900 square kilometres

1 acre - foot = 1233.5 cubic metres

1 gallon (U.S.) = 3.7853 litres

1 gallon (Imperial) = 4.5459 litres

1 acre = 4047 square metres

Great Lakes
Diversions and Consumptive Uses

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SYNOPSIS

On May 3, 1977, the International Joint Commission (IJC), at the request of the governments of the United States and Canada, established the International Great Lakes Diversions and Consumptive Uses Study Board to investigate the effect on the water levels and outflows of the Great Lakes of: existing and proposed new or changed diversions into, out of and within the Great Lakes basin; and existing and reasonably foreseeable patterns of consumptive uses. This Annex contains supporting and supplementary data to that presented in the Board's main report.

The purpose of this Annex is to document the detailed hydrologic, economic and environmental evaluations for selected diversion management scenarios and the hydrologic evaluation of consumptive water use projections. Thirteen out of a total of 43 scenarios were chosen for detailed hydrologic evaluation in the context of the criteria developed by the International Great Lakes Levels Board. These criteria paraphrase the water level and outflow requirements of the existing IJC Orders of Approval for Lakes Superior and Ontario and include similar information for Lakes Michigan-Huron and Erie. Ten of these 13 scenarios were selected for economic evaluation and one, designated as the maximum-effect diversion scenario, was evaluated environmentally. The major economic interests evaluated were (1) coastal zone; (2) navigation; (3) hydro-electric power; and, (4) recreational beaches and boating. The techniques for evaluation of economic impacts on these interests were developed by the International Lake Erie Regulation Study Board. The environmental evaluation covered the subjects of fisheries, wildlife/wetland and water quality. Much of the information and determinations advanced by the Environmental Subcommittee results from the application of the findings documented by the International Lake Erie Study Board, particularly for the lower Great Lakes, and the U.S. Study on Increased Lake Michigan Diversion at Chicago. The findings and conclusions of these evaluations are summarized in the main report. Similarly, this Annex contains additional hydrologic evaluations of consumptive water use projections to that presented in the main report. Evaluated herein are high and low projections about the most likely projection (MLP).

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Text of February 21, 1977 Reference from the Governments of the United States and Canada.

ANNEX B

Text of the International Joint Commission Directive of May 10, 1977 to the International Great Lakes Diversions and Consumptive Uses Study Board.

ANNEX C

Series of Newsletters "Diversions" and Report on Public Workshops.

ANNEX D

Prior Reports that were Pertinent or of Special Interest to this Study.

ANNEX E

State, Provincial and Federal Agencies that Participated in this Study, Including a Listing of Participants.

ANNEX F

(bound separately)

Consumptive Water Use - A Documentation of the Methodology used in Consumptive Uses Projections.

ANNEX G

(bound separately)

Evaluation of Diversion Management Scenarios and Consumptive Water Use Projections - A Documentation of the Detailed Hydrologic, Economic and Environmental Evaluation of Selected Diversion Management Scenarios and the Hydrologic Evaluations of Consumptive Water Use Projections.

LIST OF APPENDICES TO MAIN REPORT

(bound separately)

APPENDIX A - COORDINATED BASIC DATA

A documentation of the coordinated basic data developed and employed in this study. It describes the methods and techniques employed in obtaining the water supply data and development of the basis-of-comparison. It also contains tabulations of the final basis-of-comparison data and tabulations of the basic data employed in their derivation.

APPENDIX B - COMPUTER MODELS-GREAT LAKES

A documentation of computer "software" containing a complete program listing of one program developed uniquely for this study as well as a tabulation of two standard programs used. The programs themselves are stored in the United States at the offices of the Detroit District, Corps of Engineers, Detroit, Michigan, and in Canada at the offices of the Inland Waters Directorate, Federal Department of the Environment, Ottawa, Ontario.

APPENDIX C - DIVERSION MANAGEMENT SCENARIOS

A documentation of the monthly mean levels and flows data of 13 diversion management scenarios selected for detailed hydrologic evaluation.

GREAT LAKES DIVERSIONS AND CONSUMPTIVE USES

ANNEX G

EVALUATION OF DIVERSION MANAGEMENT SCENARIOS AND CONSUMPTIVE WATER USE PROJECTIONS

1 Introduction

This Annex is part of the final report of the International Great Lakes Diversions and Consumptive Uses Board, dated September, 1981. The Annex documents the detailed hydrologic, economic and environmental evaluation of selected management scenarios and the hydrologic evaluation of consumptive water use projections made under the February 21, 1977 Reference from the two governments to the International Joint Commission and was summarized in Section 8 of the main report.

All data which were used during the course of this study, including contributory reports, are filed in the United States at the offices of the Detroit District, Corps of Engineers and in Canada at the offices of the Inland Waters Directorate, Federal Department of Environment, Ottawa, Ontario.

2 Hydrologic Evaluation

The International Great Lakes Levels Board, in its December 7, 1973 report, developed a set of criteria to facilitate hydrologic evaluation of the Great Lakes system. The criteria paraphrase the level and outflow requirements of the existing IJC's Orders of Approval for Lakes Superior and Ontario and include similar information for Lakes Michigan-Huron and Erie. In the following evaluation of selected diversion management scenarios, these criteria are employed for uniformity in presentation and for direct comparison with prior studies.

2.1 Summary of Extremes

Shown in Table G-1 are the extreme levels which would have occurred had any of the existing diversions (singularly or in combination) not been in existence over the period 1900-1976. In other words, the differences between these scenarios and the basis-of-comparison represent a measure of the effects of the existing diversions on the system. Tables G-2 through G-8 reflect the extreme levels which would have been obtained had the management scenarios which alter diversion rates whenever the water supply to the upper Great Lakes is above normal, shown in Figure 7-2 of the main report, been in operation over the period 1900-1976. Table G-9 compares the extremes that would have occurred under the basis-of-comparison (singularly and in combination) with those extremes that would have occurred under a basis-of-comparison which reflects the current rates. Shown also in these tables are the mean and range of levels for each of those scenarios.

Table G-1
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(WITHOUT A TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 0 CHI 3200 WELL 7000 (1)	LL/O 5000 CHI 3200 WELL 0 (2)	LL/O 5000 CHI 0 WELL 7000 (3)	LL/O 0 CHI 0 WELL 0 (4)
LAKE SUPERIOR					
Mean	600.44	600.25	600.48	600.51	600.37
Max	601.93	601.83	601.93	601.93	601.84
Min	598.69	597.88	598.72	598.75	597.99
Range	3.24	3.95	3.21	3.18	3.85
LAKES MICHIGAN-HURON					
Mean	578.27	577.94	578.40	578.48	578.28
Max	581.16	580.83	581.28	581.36	581.20
Min	575.46	575.07	575.60	575.70	575.43
Range	5.70	5.76	5.68	5.66	5.77
LAKE ERIE					
Mean	570.76	570.53	571.08	570.90	571.00
Max	573.60	573.37	573.91	573.75	573.84
Min	568.10	567.84	568.45	568.25	568.36
Range	5.50	5.53	5.46	5.50	5.48
LAKE ONTARIO (without deviations)					
Mean	244.73	244.53	244.73	244.83	244.67
Max	249.47	248.34	249.49	251.29	248.98
Min	241.59	240.22	241.58	242.07	241.10
Range	7.88	8.12	7.91	9.22	7.88

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-2
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 2500 CHI 3200 WELL 7000	LL/O 0 CHI 3200 WELL 7000 (5)	LL/O 5000 CHI 0 WELL 7000	LL/O 5000 CHI 6600 WELL 7000	LL/O 5000 CHI 8700 WELL 7000 (7)
LAKE SUPERIOR						
Mean	600.44	600.40	600.36	600.48	600.40	600.38
Max	601.93	601.88	601.83	601.93	601.93	601.92
Min	598.69	598.57	598.42	598.70	598.63	598.60
Range	3.24	3.31	3.41	3.23	3.30	3.32
LAKES MICHIGAN-HURON						
Mean	578.27	578.19	578.11	578.37	578.16	578.10
Max	581.16	581.02	580.92	581.19	580.96	580.86
Min	575.46	575.42	575.39	575.65	575.41	575.40
Range	5.70	5.60	5.53	5.54	5.55	5.46
LAKE ERIE						
Mean	570.76	570.70	570.65	570.83	570.68	570.64
Max	573.60	573.51	573.44	573.64	573.48	573.40
Min	568.10	568.07	568.05	568.23	568.07	568.05
Range	5.50	5.44	5.39	5.41	5.41	5.35
LAKE ONTARIO (without deviations)						
Mean	244.73	244.67	244.64	244.77	244.66	244.64
Max	249.47	248.93	248.53	249.65	248.82	248.40
Min	241.59	241.30	241.18	241.94	241.26	241.19
Range	7.88	7.63	7.35	7.71	7.56	7.21

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-3
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 5000 CHI 3200 WELL 0 (6)	LL/O 5000 CHI 3200 WELL 9000	LL/O 2500 CHI 0 WELL 7000	LL/O 2500 CHI 6600 WELL 7000	LL/O 2500 CHI 8700 WELL 7000
LAKE SUPERIOR						
Mean	600.44	600.46	600.43	600.43	600.37	600.35
Max	601.93	601.93	601.93	601.89	601.88	601.88
Min	598.69	598.71	598.68	598.63	598.57	598.53
Range	3.24	3.22	3.25	3.26	3.31	3.35
LAKES MICHIGAN-HURON						
Mean	578.27	578.33	578.25	578.29	578.08	578.02
Max	581.16	581.24	581.10	581.19	580.83	580.73
Min	575.46	575.52	575.46	575.49	575.39	575.36
Range	5.70	5.72	5.64	5.70	5.44	5.37
LAKE ERIE						
Mean	570.76	570.92	570.71	570.77	570.62	570.58
Max	573.60	573.87	573.50	573.63	573.37	573.31
Min	568.10	568.11	568.09	568.10	568.05	568.03
Range	5.50	5.76	5.41	5.33	5.32	5.28
LAKE ONTARIO (without deviation)						
Mean	244.73	244.72	244.73	244.74	244.62	244.60
Max	249.47	249.32	249.44	249.65	248.36	248.27
Min	241.59	241.65	241.52	241.59	241.15	241.02
Range	7.88	7.67	7.92	8.06	7.21	7.25

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-4
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 0 CHI 0 WELL 7000	LL/O 0 CHI 6600 WELL 7000	LL/O 0 CHI 8700 WELL 7000 (8)	LL/O 5000 CHI 0 WELL 9000	LL/O 5000 CHI 6600 WELL 9000
LAKE SUPERIOR						
Mean	600.44	600.39	600.32	600.30	600.46	600.39
Max	601.93	601.83	601.83	601.83	601.93	601.93
Min	598.69	598.41	598.32	598.34	598.72	598.61
Range	3.24	3.42	3.51	3.49	3.21	3.32
LAKES MICHIGAN-HURON						
Mean	578.27	578.21	577.99	577.94	578.35	578.14
Max	581.16	580.95	580.71	580.61	581.27	580.91
Min	575.46	575.57	575.34	575.32	575.50	575.41
Range	5.70	5.38	5.37	5.29	5.77	5.50
LAKE ERIE						
Mean	570.76	570.72	570.57	570.53	570.78	570.63
Max	573.60	573.47	573.31	573.24	573.63	573.37
Min	568.10	568.18	568.01	568.00	568.12	568.06
Range	5.50	5.29	5.30	5.24	5.51	5.31
LAKE ONTARIO (without deviation)						
Mean	244.73	244.68	244.58	244.55	244.80	244.67
Max	249.47	248.72	248.24	248.05	250.91	248.78
Min	241.59	241.68	240.85	240.74	241.66	241.26
Range	7.88	7.04	7.39	7.31	9.25	7.52

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-5
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 2500 CHI 0 WELL 9000	LL/O 2500 CHI 3200 WELL 9000	LL/O 5000 CHI 8700 WELL 9000	LL/O 2500 CHI 6600 WELL 9000	LL/O 2500 CHI 8700 WELL 9000
LAKE SUPERIOR						
Mean	600.44	600.42	600.40	600.37	600.36	600.34
Max	601.93	601.89	601.88	601.92	601.88	601.88
Min	598.69	598.63	598.60	598.59	598.57	598.52
Range	3.24	3.26	3.28	3.33	3.31	3.36
LAKES MICHIGAN-HURON						
Mean	578.27	578.27	578.17	578.08	578.06	578.00
Max	581.16	581.16	580.99	580.83	580.79	580.70
Min	575.46	575.46	575.42	575.39	575.37	575.35
Range	5.70	5.70	5.57	5.44	5.42	5.35
LAKE ERIE						
Mean	570.76	570.73	570.65	570.59	570.58	570.54
Max	573.60	573.55	573.43	573.32	573.29	573.22
Min	568.10	568.09	568.07	568.05	568.04	568.02
Range	5.50	5.46	5.36	5.27	5.25	5.20
LAKE ONTARIO (without deviation)						
Mean	244.73	244.74	244.68	244.64	244.62	244.60
Max	249.47	249.64	248.96	248.41	248.38	248.27
Min	241.59	241.61	241.31	241.20	241.08	240.98
Range	7.88	8.03	7.65	7.21	7.30	7.29

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-6

LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS

(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)

LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 0 CHI 0 WELL 9000	LL/O 0 CHI 3200 WELL 9000	LL/O 0 CHI 6600 WELL 9000	LL/O 0 CHI 8700 WELL 9000 (9)	LL/O 5000 CHI 8700 WELL 0
LAKE SUPERIOR						
Mean	600.44	600.38	600.35	600.31	600.29	600.40
Max	601.93	601.84	601.83	601.83	601.83	601.93
Min	598.69	598.47	598.41	598.37	598.31	598.62
Range	3.24	3.37	3.42	3.46	3.52	3.31
LAKES MICHIGAN-HURON						
Mean	578.27	578.19	578.09	577.98	577.92	578.16
Max	581.16	581.05	580.88	580.68	580.59	580.97
Min	575.46	575.43	575.38	575.34	575.31	575.43
Range	5.70	5.62	5.50	5.34	5.28	5.54
LAKE ERIE						
Mean	570.76	570.67	570.60	570.52	570.48	570.80
Max	573.60	573.47	573.35	573.22	573.15	573.68
Min	568.10	568.07	568.05	568.01	568.00	568.07
Range	5.50	5.40	5.30	5.21	5.15	5.61
LAKE ONTARIO (without deviations)						
Mean	244.73	244.69	244.64	244.58	244.55	244.64
Max	249.47	249.14	248.56	248.24	248.07	248.34
Min	241.59	241.39	241.13	240.89	240.74	241.43
Range	7.88	7.75	7.43	7.35	7.33	6.91

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-7
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 5000 CHI 0 WELL 0	LL/O 5000 CHI 6600 WELL 0	LL/O 2500 CHI 0 WELL 0	LL/O 2500 CHI 3200 WELL 0	LL/O 2500 CHI 8700 WELL 0
LAKE SUPERIOR						
Mean	600.44	600.49	600.42	600.45	600.42	600.37
Max	601.93	601.94	601.93	601.89	601.89	601.88
Min	598.69	598.77	598.66	598.69	598.62	598.58
Range	3.24	3.17	3.27	3.20	3.27	3.30
LAKES MICHIGAN-HURON						
Mean	578.27	578.43	578.22	578.35	578.25	578.08
Max	581.16	581.41	581.07	581.30	581.12	580.84
Min	575.46	575.54	575.45	575.51	575.47	575.39
Range	5.70	5.87	5.62	5.79	5.65	5.45
LAKE ERIE						
Mean	570.76	570.99	570.84	570.93	570.86	570.74
Max	573.60	573.99	573.75	573.92	573.79	573.59
Min	568.10	568.14	568.08	568.12	568.09	568.04
Range	5.50	5.85	5.67	5.80	5.70	5.55
LAKE ONTARIO (without deviation)						
Mean	244.73	244.78	244.67	244.73	244.68	244.60
Max	249.47	250.54	248.62	249.50	248.83	248.08
Min	241.59	241.66	241.57	241.71	241.59	241.17
Range	7.88	8.88	7.05	7.79	7.24	6.91

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-8
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
LAKE LEVELS (FEET)

	Basin-of-Comparison	LL/O 2500 CHI 6600 WELL 0	LL/O 0 CHI 0 WELL 0	LL/O 0 CHI 3200 WELL 0	LL/O 0 CHI 6600 WELL 0	LL/O 0 CHI 8700 WELL 0	LL/O 5000 CHI 3200 WELL 2600 (10)
LAKE SUPERIOR							
Mean	600.44	600.39	600.41	600.38	600.34	600.33	600.45
Max	601.93	601.88	601.84	601.84	601.83	601.83	601.93
Min	598.69	598.61	598.48	598.46	598.39	598.38	598.70
Range	3.24	3.27	3.36	3.38	3.44	3.45	3.23
LAKES MICHIGAN-HURON							
Mean	578.27	578.14	578.27	578.17	578.10	578.00	578.31
Max	581.16	580.93	581.20	581.02	580.87	580.72	581.17
Min	575.46	575.42	575.47	575.42	575.40	575.36	575.53
Range	5.70	5.51	5.73	5.60	5.47	5.36	5.64
LAKE ERIE							
Mean	570.76	570.79	570.88	570.81	570.76	570.69	570.86
Max	573.60	573.66	573.84	573.72	573.61	573.52	573.62
Min	568.10	568.06	568.09	568.07	568.05	568.02	568.31
Range	5.50	5.60	5.75	5.65	5.56	5.50	5.31
LAKE ONTARIO (without deviations)							
Mean	244.73	244.63	244.68	244.64	244.61	244.58	244.74
Max	249.47	248.30	248.96	248.41	248.23	247.98	249.58
Min	241.59	241.33	241.56	241.33	241.21	241.05	241.47
Range	7.88	6.97	7.40	7.08	7.02	6.93	8.11

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

Table G-9
LONG LAC/OGOKI - CHICAGO - WELLAND CANAL COMBINATIONS
(WITHOUT A TRIGGER)
LAKE LEVELS (FEET)

	Basis-of-Comparison	LL/O 5600 CHI 3200 WELL 7000 (11)	LL/O 5000 CHI 3200 WELL 9400 (12)	LL/O 5600 CHI 3200 WELL 9400 (13)
LAKE SUPERIOR				
Mean	600.44	600.46	600.42	600.44
Max	601.93	601.95	601.93	601.95
Min	598.69	598.73	598.66	598.72
Range	3.24	3.22	3.27	3.23
LAKES MICHIGAN-HURON				
Mean	578.27	578.31	578.22	578.26
Max	581.16	581.19	581.10	581.14
Min	575.46	575.50	575.42	575.47
Range	5.70	5.69	5.68	5.67
LAKE ERIE				
Mean	570.76	570.78	570.64	570.67
Max	573.60	573.63	573.49	573.52
Min	568.10	568.12	567.97	568.00
Range	5.50	5.51	5.52	5.52
LAKE ONTARIO (without deviations)				
Mean	244.73	244.75	244.73	244.75
Max	249.47	249.60	249.42	249.62
Min	241.59	241.69	241.59	241.69
Range	7.88	7.91	7.83	7.93

(1) Denotes scenario, including its identification number, selected for detailed hydrologic evaluation.

2.1.1 Long Lac/Ogoki Diversions

Table G-1 shows the extreme levels which would have occurred on the Great Lakes had the Long Lac/Ogoki Diversions never been in existence. The table shows the effect of these diversions individually reduced to zero and in combination with the other two major diversions reduced to zero. Scenario (1) shows a reduction in the extreme values and an increase in the range of levels on each lake. In combination with the other two diversions reduced to zero, Scenario (4), it shows an increase in the range of levels on each lake, except Lakes Erie and Ontario. This scenario also shows a reduction in the minimum levels on all lakes, except for Lake Erie. The impact on the maximum levels varies, increasing on Lakes Michigan-Huron and Erie, while decreasing on Lakes Superior and Ontario.

Table G-2 shows the extreme levels which would occur on the Great Lakes had the diversions from the Long Lac/Ogoki been reduced to zero or to a rate of 2,500 cfs, during periods of above normal water supply within the system. The table shows a general compression of the range of levels (except for Lake Superior) with a lowering of the maximum and minimum levels in comparison to those under the basis-of-comparison. The lowering of the maximum level (except for Lake Superior) would be greater than the impact on the minimum level.

These effects are also generally true for Long Lac/Ogoki impacts evaluated in combination with changes in the rates of diversion at the Lake Michigan diversion at Chicago and at the Welland Canal (see Tables G-3 through G-8).

Table G-9 shows the impact of the actual average annual Long Lac/Ogoki Diversions rate in comparison to the rate assumed under the basis-of-comparison. The table shows that the extremes and average levels would be higher as a result of the additional 600 cfs. The maximum impact of this increase is felt on Lake Ontario, due to regulation, which imposed restrictions on maximum and minimum outflow releases.

2.1.2 Lake Michigan Diversion at Chicago

Table G-1 shows the extreme levels which would have occurred on the Great Lakes had the Lake Michigan Diversion at Chicago never come into being, identified as Scenario 3. The table shows that the individual effect of this diversion, had it not been in existence, is to raise the mean levels and extreme levels of all of the Great Lakes, the greatest effect being on the maximum level of Lakes Michigan-Huron. However, the greatest effect on the extreme levels is on Lake Ontario. This is due to the method of regulation on that lake. When placed in combination with the other diversions, that is, reducing all diversions to zero, the impact is moderated or balanced somewhat.

Table G-2 shows the extreme levels of the Great Lakes which would occur had the diversion from Lake Michigan been reduced from the present rate to zero or increased from the present rate to an average annual value of 8,700 cfs, during periods of above normal supply within the system. The table shows that the maximum levels on Lake Superior would be affected very little by any of the actions depicted, but the minimum and range would be affected. On all lakes downstream from this point (in the case of an increased diversion) the range of levels would be decreased. In each of these lakes the impact on the maximum level would be greater than the impact on the minimum level. These facts are also generally true for the Lake Michigan Diversion in combination with changes in rates at the other major diversions, Long Lac/Ogoki and Welland Canal, (see Tables G-3 through G-8). All scenarios on these tables show that if the Lake Michigan Diversion at Chicago were reduced to zero the effect would be to raise the Great Lakes regime of levels.

2.1.3 Welland Canal Diversion

Referring to Table G-1, Scenario 2 shows the effects on the Great Lakes levels if it is assumed that this diversion had never been in existence. The table shows very little impact on Lake Ontario, with the maximum impact on Lake Erie and diminishing impacts upstream. The little impact shown on Lake Ontario is due to the natural balancing on Lake Erie; i.e., as the lake rises, water outflows increase. When the ultimate effect is reached, the outflow is the same as given by the stage/discharge relationship of the Niagara River plus the Welland Canal outflow. As in the scenarios discussed above, the impact of the closure of the Welland Canal would be moderated somewhat by placing this scenario in combination with the closure of the other diversions.

Table G-3 shows the extreme levels of the Great Lakes which would occur had the Welland Canal diversion been increased to 9,000 cfs from 7,000 cfs, during periods of high water supplies to the lakes. The table shows that the maximum levels of Lake Erie would be lower by 0.10 foot with lesser impacts on the other lakes. Also shown in this table and in Tables G-7 and 8 are the impacts on the lake levels if the Welland Canal flow was reduced to zero during periods of high supply. As noted in Section 4, the Welland Canal provides the only navigation route between Lakes Erie and Ontario and hence these scenarios do not provide a viable alternative. These scenarios will not be discussed further herein. Also, shown in Table G-8 is a scenario identified as (10) which was developed to reduce flows during periods of low water supply on the lakes. This scenario shows that the minimum level on Lake Erie and all upstream lakes would be raised. Scenario 10 further shows very little impact on the maximum level. However, this is not the case on Lake Ontario; the maximum was raised, the minimum lowered and the range expanded. Tables G-4 through G-8 show the impacts of varying the Welland Canal flow in combination with variation in other diversion rates. As has been previously stated, varying diversions in combination has the effect of moderating impacts. This is also true of the Welland Canal in combination with other diversion scenarios.

Table G-9 compares the extreme levels of projected (currently in effect) Welland Canal flows with the values employed in the basis-of-comparison. Referring to the table, and in particular the scenario identifed as (12), it shows that the general regime of the system would have been lowered as a result of this action. In the scenario identified as (13), the impact would be moderated somewhat, due to the increased inflow from the Long Lac/Ogoki system.

2.2 Selected Scenarios

From the total array of scenarios tested, the following have been selected for detailed hydrologic review.

a. Four scenarios which show the impact of the existing diversions:

	Diversion	Rate (cfs)
Scenario 1 -	Long Lac/Ogoki	0
	Lake Michigan at Chicago	3,200
	Welland Canal	7,000
Scenario 2 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	3,200
	Welland Canal	0
Scenario 3 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	0
	Welland Canal	7,000
Scenario 4 -	Long Lac/Ogoki	0
	Lake Michigan at Chicago	0
	Welland Canal	0

b. Five scenarios which would alter diversion rates whenever the water supply to the upper Great Lakes is above normal:

	Diversion	Rate (cfs)
Scenario 5 -	Long Lac/Ogoki	0
	Lake Michigan at Chicago	3,200
	Welland Canal	7,000
Scenario 6 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	3,200
	Welland Canal	9,000
Scenario 7 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	8,700
	Welland Canal	7,000
Scenario 8 -	Long Lac/Ogoki	0
	Lake Michigan at Chicago	8,700
	Welland Canal	7,000
Scenario 9 -	Long Lac/Ogoki	0
	Lake Michigan at Chicago	8,700
	Welland Canal	9,000

c. A scenario which would alter the diversion rates whenever the water supply to the upper Great Lakes is below normal:

Scenario 10 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	3,200
	Welland Canal	2,600

Three scenarios for comparison of the current (1979) Long Lac/Ogoki and Welland Canal diversions rates, with those employed in the basis-of-comparion:

	Diversion	Rate (cfs)
Scenario 11 -	Long Lac/Ogoki	5,600
	Lake Michigan at Chicago	3,200
	Welland Canal	7,000
Scenario 12 -	Long Lac/Ogoki	5,000
	Lake Michigan at Chicago	3,200
	Welland Canal	9,400
Scenario 13 -	Long Lac/Ogoki	5,600
	Lake Michigan at Chicago	3,200
	Welland Canal	9,400

2.3 IJC Criteria Evaluation

As noted previously, the International Great Lakes Levels Board developed a set of criteria to facilitate hydrologic evaluation of the Great Lakes system. Using these criteria, the above 13 scenarios were evaluated by lake. This evaluation is discussed in the following paragraphs.

2.3.1 Lake Superior Criteria

The following paragraphs evaluate the impact of the diversion management scenarios on the IJC Orders of Approval of May 26 and 27, 1914 as compared to conditions under the basis-of-comparison. All elevations in the Orders of Approval have been converted to IGLD (1955).

Criterion (a) - The Commission's Orders require that the regulated outflow from Lake Superior shall be such as to maintain the levels of Lake Superior as nearly as may be between levels 600.5 and 602.0 feet, and in such manner as not to interfere with navigation.

The maximum and minimum monthly mean levels of Lake Superior, occurring under the scenarios selected for detailed evaluation, are shown in Table G-10. Scenarios 1 to 4 are evaluations of the impact of the basis-of-comparison diversion rates singularly and in combination. The table shows that removing the Long Lac/Ogoki Diversions totally from the system (Scenario 1) would lower the Lake Superior maximum level by 0.10 foot, the minimum by 0.81 foot and the mean by 0.19 foot; removing the Welland Canal (Scenario 2) would raise the Lake Superior minimum level by 0.03 foot and the mean by 0.04 foot; removing the Lake Michigan Diversion

Table G-10
LONG LAC/OGOKI - CHICAGO-WELLAND CANAL COMBINATIONS
(WITHOUT A TRIGGER)
SUMMARY OF EXTREMES - LAKE LEVELS (FEET)

SCENARIOS

	Basis-of-Comparison	1 LL/O 0 CHI 3200 WELL 7000	2 LL/O 5000 CHI 3200 WELL 0	3 LL/O 5000 CHI 0 WELL 7000	4 LL/O 0 CHI 0 WELL 0	11 LL/O 5600 CHI 3200 WELL 7000	12 LL/O 5000 CHI 3200 WELL 9400	13 LL/O 5600 CHI 3200 WELL 9400
LAKE SUPERIOR								
Mean	600.44	600.25	600.48	600.51	600.37	600.46	600.42	600.44
Max	601.93	601.83	601.93	601.93	601.84	601.95	601.93	601.95
Min	598.69	597.88	598.72	598.75	597.99	598.73	598.66	598.72
Range	3.24	3.95	3.21	3.18	3.85	3.22	3.27	3.23
LAKES MICHIGAN-HURON								
Mean	578.27	577.94	578.40	578.48	578.28	578.31	578.22	578.26
Max	581.16	580.83	581.28	581.36	581.20	581.19	581.10	581.14
Min	575.46	575.07	575.60	575.70	575.43	575.50	575.42	575.47
Range	5.70	5.76	5.68	5.66	5.77	5.69	5.68	5.67
LAKE ERIE								
Mean	570.76	570.53	571.08	570.90	571.00	570.78	570.64	570.67
Max	573.60	573.37	573.91	573.75	573.84	573.63	573.49	573.52
Min	568.10	567.84	568.45	568.25	568.36	568.12	567.97	568.00
Range	5.50	5.53	5.46	5.50	5.48	5.51	5.52	5.52
LAKE ONTARIO (without deviations)								
Mean	244.73	244.53	244.73	244.83	244.67	244.75	244.73	244.75
Max	249.47	248.34	249.49	251.29	248.98	249.60	249.42	249.62
Min	241.59	240.22	241.58	242.07	241.10	241.69	241.59	241.69
Range	7.88	8.12	7.91	9.22	7.88	7.91	7.83	7.93

Table G-10 (Con't)
LONG LAC/OGOKI - CHICAGO-WELLAND CANAL COMBINATIONS
(USING SUPPLY AS INDICATOR & MICHIGAN-HURON AS TRIGGER)
SUMMARY OF EXTREMES - LAKE LEVELS (FEET)

SCENARIOS

	Basis-of-Comparison	5 LL/O 0 CHI 3200 WELL 7000	6 LL/O 5000 CHI 3200 WELL 9000	7 LL/O 5000 CHI 8700 WELL 7000	8 LL/O 0 CHI 8700 WELL 7000	9 LL/O 0 CHI 8700 WELL 9000	10 LL/O 5000 CHI 3200 WELL 2600
LAKE SUPERIOR							
Mean	600.44	600.36	600.43	600.38	600.30	600.29	600.45
Max	601.93	601.83	601.93	601.92	601.83	601.83	601.93
Min	598.69	598.42	598.68	598.60	598.34	598.31	598.70
Range	3.24	3.41	3.25	3.32	3.49	3.52	3.23
LAKES MICHIGAN-HURON							
Mean	578.27	578.11	578.25	578.10	577.94	577.92	578.31
Max	581.16	580.92	581.10	580.86	580.61	580.59	581.17
Min	575.46	575.39	575.46	575.40	575.32	575.31	575.53
Range	5.70	5.53	5.64	5.46	5.29	5.28	5.64
LAKE ERIE							
Mean	570.76	570.65	570.71	570.64	570.53	570.48	570.86
Max	573.60	573.44	573.50	573.40	573.24	573.15	573.62
Min	568.10	568.05	568.09	568.05	568.00	568.00	568.31
Range	5.50	5.39	5.41	5.35	5.24	5.15	5.31
LAKE ONTARIO (without deviations)							
Mean	244.73	244.64	244.73	244.64	244.55	244.55	244.74
Max	249.47	248.53	249.44	248.40	248.05	248.07	249.58
Min	241.59	241.18	241.52	241.19	240.74	240.74	241.47
Range	7.88	7.35	7.92	7.21	7.31	7.33	8.11

at Chicago (Scenario 3) would raise the Lake Superior minimum level by 0.06 foot and the mean by 0.07 foot. The table further shows that taking all three in combination (Scenario 4) would have a net effect of lowering the maximum level of Lake Superior by 0.09 foot, the minimum by 0.70 foot and the mean level by 0.07 foot.

Scenarios 5, 6, 7, 8 and 9 which manage the diversions in such a way as to reduce the water supply to the Great Lakes, show that the maximum, minimum and mean level would be lowered by varying amounts. The maximum hydrologic impact would be felt under Scenario 9; which reduces the Long Lac/Ogoki Diversions to zero, increases the Lake Michigan Diversion at Chicago to 8,700 cfs, and increases the outflow from Lake Erie through the Welland to 9,000 cfs.

Scenario 10, which reduces the flow through the Welland Canal during periods of below normal water supply, was developed to determine the degree that low levels could be supported; i.e., permitting navigation between Lakes Erie and Ontario. This scenario shows a slight raising of the Lake Superior minimum and mean levels with no impact on the maximum level.

Scenarios 11 to 13 reflect changes which have occurred in the diversion rates since the beginning of the study. Scenario 13, which deals with the changes in combination, shows that the increased rates would have raised the minimum level of Lake Superior slightly in comparison to the basis-of-comparison. Scenarios 11 and 12 show the individual impacts.

Another factor which is of considerable importance with respect to this criterion is the frequency of occurrence of high and low levels. Tables G-11 and G-12 compare the conditions under each of the scenarios with the basis-of-comparison.

Evaluation of High Levels. Table G-11 shows the frequency of occurrence of levels above a Lake Superior level of 601.5 feet for each of the scenarios. A review of Scenarios 1 to 4 (comparisons of individual diversion rates under the basis-of-comparison) shows an increase in frequency of high levels under Scenarios 2 and 3, where the outflow from the system is reduced. Under Scenarios 1 and 4 the reverse is true, where water supply would be removed from the system.

Scenarios 5, 6, 7, 8 and 9 generally show a reduction in the frequency of occurrence of high levels, with the maximum reductions occurring under Scenarios 8 and 9. Both of these scenarios would reduce the inflow from Long Lac/Ogoki to zero and increase the outflow out of Lake Michigan to 8,700 cfs. The difference between these two scenarios is that under Scenario 9 the Welland Canal is increased to 9,000 cfs. There would be no impact on the frequency of high levels due to this action.

Scenario 10 would reduce the Welland Canal flow during periods of low water supply. The impact of this reduction in flow transcends the low supply period and would slightly increase the frequency of high levels over and above the basis-of-comparison.

Lake Superior CRITERION (a)

Table G-11
MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
602.0	0	0	0	0	0
601.9	1	0	1	1	0
601.8	1	1	1	1	1
601.7	2	1	2	3	1
601.6	9	2	11	13	3
601.5	18	4	23	26	13
Maximum	601.93	601.83	601.93	601.93	601.84

Lake Superior CRITERION (a)(Cont.)

Table G-11 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
602.0	0	0	0	0	0
601.9	1	0	1	1	0
601.8	1	1	1	1	1
601.7	2	1	2	2	1
601.6	9	2	8	4	2
601.5	18	8	20	13	4
Maximum	601.93	601.83	601.93	601.92	601.83

Lake Superior CRITERION (a)(Cont.)

Table G-11 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
602.0	0	0	0	0	0	0
601.9	1	0	1	1	1	1
601.8	1	1	1	1	1	1
601.7	2	1	2	2	2	2
601.6	9	2	10	10	8	10
601.5	18	4	19	21	17	18
Maximum	601.93	601.83	601.93	601.95	601.93	601.95

Lake Superior CRITERION (a)

Table G-12

MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

ALL MONTHS

Monthly Mean Level	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
600.0	211	293	190	179	233
599.5	49	107	44	40	75
599.0	6	28	5	4	21
598.5	0	10	0	0	8
598.0	0	3	0	0	1
Minimum	598.69	597.88	598.72	598.75	597.99

APRIL-NOVEMBER

Monthly Mean Level	Basis-of-Comparison	Scenario 1	Scenario 2	Scenario 3	Scenario 4
600.0	85	136	74	69	100
599.5	18	47	16	16	36
599.0	2	15	2	2	11
598.5	0	4	0	0	4
598.0	0	1	0	0	1
Minimum	598.70	597.88	598.73	598.76	597.99

Lake Superior CRITERION (a)(Cont.)

Table G-12 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

ALL MONTHS

Monthly Mean Level	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
600.0	211	244	218	243	264
599.5	49	64	48	60	244
599.0	6	15	7	9	16
598.5	0	2	0	0	3
598.0	0	0	0	0	0
Minimum	598.69	598.42	598.68	598.60	598.34

APRIL-NOVEMBER

Monthly Mean Level	Basis-of-Comparison	Scenario 5	Scenario 6	Scenario 7	Scenario 8
600.0	85	102	91	102	113
599.5	18	29	17	25	36
599.0	2	6	2	3	7
598.5	0	1	0	0	1
598.0	0	0	0	0	0
Minimum	598.70	598.43	598.69	598.61	598.35

Lake Superior CRITERION (a)(Cont.)

Table G-12 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

ALL MONTHS

Monthly Mean Level	Basis-of-Comparison	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
		LL/O 0	LL/O 5,000	LL/O 5,600	LL/O 5,000	LL/O 5,600
		CHI. 8,700	CHI. 3,200	CHI. 3,200	CHI. 3,200	CHI. 3,200
		WELL. 9,000	WELL. 2,600	WELL. 7,000	WELL. 9,400	WELL. 9,400
600.0	211	266	202	203	222	211
599.5	49	76	46	46	54	47
599.0	6	18	6	5	7	6
598.5	0	4	0	0	0	0
598.0	0	0	0	0	0	0
Minimum	598.69	598.31	598.70	598.73	598.66	598.72

APRIL-NOVEMBER

Monthly Mean Level	Basis-of-Comparison	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
600.0	85	114	80	81	92	86
599.5	18	36	16	16	22	16
599.0	2	7	2	2	2	2
598.5	0	2	0	0	0	0
598.0	0	0	0	0	0	0
Minimum	598.70	598.32	598.71	598.74	598.67	598.73

Under Scenarios 11, 12 and 13, the frequency of occurrence of high levels reflect the diversion input location. Scenario 11, would increase the diversion into Lake Superior above the basis-of-comparison with the most extreme increase in the frequency of high levels; Scenario 12 would provide a minor reduction, since the flow is increased out of Lake Erie; and, Scenario 13 would show little impact, as the increases tend to offset each other.

Evaluation of Low Levels. Table G-12 shows the frequency of occurrence of levels below a Lake Superior level of 600.00 feet for each of the scenarios being evaluated. Scenarios 1 and 4 would increase the number of times that the lake is below 600.0 feet; while Scenarios 2 and 3 would decrease the frequencies of low levels. This is due to the fact that there is a net gain in water supply to the upper lakes as a result of reduction in the outflows at the Lake Michigan Diversion at Chicago and through the Welland Canal, while in the case of Scenarios 1 and 4, there is a net loss, due to reduction in the Long Lac/Ogoki Diversions.

As noted above, there was a reduction in the frequency of occurrence of high levels (Scenarios 5, 6, 7, 8 and 9), due to removal of water from the system. These scenarios increase the frequency of occurrence of low levels for the same reason, and because of the inability of the system to restore equilibrium over a short time span.

Scenario 10, which would reduce the loss of water to the upper part of the system, also would reduce the frequency of occurrence of low levels. The impact on the absolute minimum would be small.

Scenario 11 shows a reduction in the frequency of low levels, due to the increased water supply from the Long Lac/Ogoki Diversions. Under Scenario 12, an increase is shown; but Scenario 13, which deals with the diversions in combination, offsets and improves upon the low water situation.

Criterion (b) - The Commission's Orders specify that, to guard against unduly high stages of water in the lower St. Marys River, the excess discharge at any time over and above that which would have occurred at a like stage of Lake Superior prior to 1887, shall be restricted so that elevation of the water surface immediately below the locks shall not be greater than 582.9 feet.

In the test of the Lake Superior portion of the scenarios presented herein, over the period 1900-1976, the maximum levels at the U. S. Slip gauge below the lock are shown in Table G-13.

Table G-13

MAXIMUM LEVEL - U. S. SLIP GAUGE

Scenarios	Elevation
Basis-of-Comparison	582.32
Scenario 1	582.00
Scenario 2	582.43
Scenario 3	582.50
Scenario 4	582.32
Scenario 5	582.05
Scenario 6	582.33
Scenario 7	582.14
Scenario 8	582.00
Scenario 9	581.95
Scenario 10	582.34
Scenario 11	582.36
Scenario 12	582.29
Scenario 13	582.32

Criterion b has therefore been satisfied by all scenarios.

Criterion (c) - The maximum open-water (May-November) outflow from Lake Superior shall not exceed 65,000 cfs, plus 16 gates of the Compensating Works open. This maximum limitation was also applicable under the basis-of-comparison.

Table G-14 compares the results of the scenarios presented herein with those of the basis-of-comparison and indicates that this criterion has been satisfied by all the scenarios presented.

Criterion (d) - The maximum winter outflow (December-April) from Lake Superior shall not be greater than 85,000 cfs. This maximum limitation was also applicable under the basis-of-comparison.

Table G-15 shows that this criterion has been generally satisfied by all scenarios presented.

Criterion (e) - The minimum outflow from Lake Superior shall not be less than 55,000 cfs.

Table G-16 compares the frequency of occurrences of flows less than 65,000 cfs under each of the scenarios and the basis-of-comparison. It shows that all scenarios would satisfy this requirement. However, it should be noted that those scenarios which reduce the water supply within the system would increase the frequency of minimum flows.

An additional requirement contained in the May 26-27, 1914 Orders of Approval, states:

Lake Superior CRITERION (c)

Table G-14

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
MAY-NOVEMBER 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow (Thousands of cfs)	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
125	0	0	0	0	0
120	3	2	5	5	2
115	43	21	48	48	30
110	68	38	72	78	47
105	94	56	98	105	63
110	133	83	137	141	89
Maximum	123,000	122,000	123,000	123,000	122,000

Lake Superior CRITERION (c)(Cont.)

Table G-14 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
MAY-NOVEMBER 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow (Thousands of cfs)	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
125	0	0	0	0	0
120	3	2	3	3	2
115	43	29	41	38	24
110	68	50	68	64	51
105	94	69	96	85	66
100	133	110	128	129	104
Maximum	123,000	122,000	123,000	123,000	122,000

Table G-14 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
MAY-NOVEMBER 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow (Thousands of cfs)	Basis-of-Comparison	Scenario 9 LL/O 0, CHI. 8,700, WELL. 9,000	Scenario 10 LL/O 5,000, CHI. 3,200, WELL. 2,600	Scenario 11 LL/O 5,600, CHI. 3,200, WELL. 7,000	Scenario 12 LL/O 5,000, CHI. 3,200, WELL. 9,400	Scenario 13 LL/O 5,600, CHI. 3,200, WELL. 9,400
125	0	0	0	0	0	0
120	3	2	3	3	3	3
115	43	24	42	45	40	44
110	68	51	69	75	67	73
105	94	68	94	101	93	102
100	133	103	133	137	129	135
Maximum	123,000	122,000	123,000	123,000	123,000	123,000

Lake Superior CRITERION (d)

Table G-15

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
DECEMBER-APRIL 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow (Thousands of cfs)	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
85	3	3	4	2	3
84	8	8	10	5	5
83	11	15	11	6	5
82	14	16	14	10	6
81	27	21	26	23	10
80	42	24	39	37	17
Maximum	86,000	86,000	87,000	87,000	87,000

Table G-15 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
DECEMBER-APRIL 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow (Thousands of cfs)	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
85	3	6	3	6	4
84	8	12	8	12	12
83	11	16	11	16	16
82	14	18	14	19	18
81	27	27	27	29	25
80	42	34	42	41	31
Maximum	86,000	87,000	86,000	87,000	86,000

Table G-15 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
DECEMBER-APRIL 1900-1976

NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

Monthly Mean Flow	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
(Thousands of cfs)						
85	3	4	3	3	3	3
84	8	12	9	9	7	9
83	11	16	11	11	11	11
82	14	18	14	14	14	14
81	27	25	27	26	27	26
80	42	31	42	43	42	42
Maximum	86,000	86,000	86,000	86,000	86,000	86,000

Lake Superior CRITERION (e)

Table G-16

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW OUTFLOW SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
(Thousands of cfs)					
65,000	155	280	163	167	297
58,000	155	280	163	167	297
55,000	0	0	0	0	0

Lake Superior CRITERION (e)(Cont.)

Table G-16 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW OUTFLOW SHOWN

Monthly Mean Outflow	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
(Thousands of cfs)					
65,000	155	225	155	146	213
58,000	155	225	155	146	213
55,000	0	0	0	0	0

Lake Superior CRITERION (e)(Cont.)

Table G-16 (Cont.)

MONTHLY MEAN OUTFLOW FROM LAKE SUPERIOR
1900-1976

NUMBER OF OCCURRENCES BELOW OUTFLOWN SHOWN

Monthly Mean Level (Thousands of cfs)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
65,000	155	217	163	155	153	147
58,000	155	217	163	155	153	147
55,000	0	0	0	0	0	0

"At all times said Board shall determine the amount of water available for power purposes. Said Board will cause the amount of water so used to be reduced whenever, in its opinion, such reductions are necessary in order to prevent unduly low stages of water in Lake Superior, and will fix the amounts of such reductions; provided, that whenever the monthly mean level of the lake is less than 602.1 (600.5 IGLD 1955) above said mean tide, the total discharge permitted shall be no greater than that which it would have been at the prevailing stage and under the discharge conditions which obtained prior to 1887; provided further, before any flow of primary water on either side of the river is reduced, the use of all secondary water shall be discontinued."

This requirement could not be evaluated because it would depend upon discretionary action of the International Lake Superior Board of Control and a definition of unduly low stages.

2.3.2 Lakes Michigan-Huron Criteria

The following paragraphs give the evaluation of effects of the various scenarios on Lakes Michigan-Huron, employing criteria formulated by the IGLLB for this purpose:

Criterion (a) - Consistent with other requirements, reduce the frequency of occurrence of high Lakes Michigan-Huron levels.

Table G-17 compares the maximum level and the frequency of occurrence of levels above level 579.0 feet, under the various scenarios evaluated in this study. Scenarios 1, 2, 3 and 4 evaluate the impact of the present diversion rates singularly and in combination. Table G-17 shows that reducing the Long Lac/Ogoki Diversions to zero (Scenario 1) throughout the period of record reduces the maximum level of Lakes Michigan-Huron by 0.33 foot and reduces the frequency of occurrence of levels above 579.0 feet by 37 percent; Lake Michigan Diversion at Chicago reduction (Scenario 3) would increase the maximum level by 0.20 foot and would increase the frequency of occurrence of high levels by 24 percent; and, the Welland Canal reduction (Scenario 2) would cause the lake to rise by 0.12 foot and increases the frequency of high levels by 16 percent. However, taking these reductions in combination (Scenario 4) causes the maximum level to rise only 0.04 foot with very little impact on the frequency of occurrence of high levels.

Under Scenarios 5, 6, 7, 8 and 9 the maximum level and the frequency of occurrence of high levels on Lakes Michigan-Huron would be reduced. The maximum lowering would occur under Scenarios 9. Scenario 10 is an intermediate condition under the Welland Canal alternative, and it raises the high levels of Lakes Michigan-Huron and would increase the frequency of occurrence of these levels through backwater from Lake Erie.

Scenarios 11, 12 and 13 evaluate the basis-of-comparison rates against those which currently exist. Table G-17 indicates that the

Lakes Michigan-Huron CRITERION (a)

Table G-17

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
(Feet)					
581.4	0	0	0	0	0
581.0	4	0	9	10	4
580.6	17	4	25	28	16
580.2	35	19	43	47	35
579.8	69	36	89	110	69
579.4	144	75	178	198	144
579.0	256	162	298	318	259
Maximum Level	581.16	580.83	581.28	581.36	581.20

Lakes Michigan-Huron CRITERION (a)(Cont.)

Table G-17 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
581.4	0	0	0	0	0
581.0	4	0	3	0	0
580.6	17	8	13	8	1
580.2	35	24	33	22	12
579.8	69	42	67	39	29
579.4	144	109	139	98	57
579.0	256	198	249	191	141
Maximum Level	581.16	580.92	581.10	580.86	580.61

Lakes Michigan-Huron CRITERION (a)(Cont.) Table G-17 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVEL SHOWN

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
581.4	0	0	0	0	0	0
581.0	4	0	5	5	2	4
580.6	17	0	19	19	13	16
580.2	35	11	35	36	33	35
579.8	69	28	74	73	66	69
579.4	144	54	155	155	136	142
579.0	256	135	270	275	248	257
Maximum Level	581.16	580.59	581.17	581.19	581.10	581.14

deviation in the Long Lac/Ogoki Diversions from the basis-of-comparison average has raised (Scenario 11) the levels of Lakes Michigan-Huron, while the deviation occurring in the Welland Canal has lowered (Scenario 12) the levels. In combination the two effects are offset. This is due to the fact that the net effect of reducing the three diversions from 5,600; 3,200 and 9,400 cfs to 5,000; 3,200 and 7,000 cfs increases the water supply in the system.

Criterion (b) - Consistent with other requirements, reduce the frequency of occurrence of low Lakes Michigan-Huron levels, especially during the navigation season (April-November).

Table G-18 presents the results of the tests of the various scenarios over the evaluation period under criterion (b). Scenarios 1, 2, 3 and 4 evaluate the impacts of the individual diversions singularly and in combination. The table shows a lowering caused by reducing the Long Lac/Ogoki Diversions to zero, and a raising of the levels by reducing the Lake Michigan and Welland Canal Diversions to zero. The net effect shows a slight lowering of the minimum value, but a reduction (Scenario 4) in the occurrence of levels below low water datum (LWD).

Scenarios 5, 6, 7, 8 and 9 would all lower the minimum level and increase the frequency of levels below LWD. The maximum impact would occur under Scenario 9, where the minimum level would be lowered 0.15 foot. During the navigation season, levels below LWD are increased 75 percent.

Scenario 10, which reduces the flow through the Welland Canal during periods of low supply, increases the minimum level and reduces the frequency of the low level (below LWD) by 15 percent.

Table G-18 shows that under Scenarios 11, 12, and 13 the increased flow from Long Lac/Ogoki (Scenario 11) provides benefits to navigation by raising the minimum levels and by reducing the frequency of occurrence of low levels. However, this benefit is lost when the Welland Canal flow is increased (Scenario 12), but balanced when both these increases are taken in combination (Scenario 13).

2.3.3 Lake Erie Criteria

The following paragraphs give the evaluation of effects of the various scenarios on Lake Erie, employing criteria formulated for this purpose:

Criterion (a) - Consistent with other requirements, reduce the frequency of occurrence of high Lake Erie levels.

Table G-19 presents the results of the testing of the various scenarios over the historic water supply period under criterion (a). The table shows that the individual effect (Scenario 1) of reducing the Long Lac/Ogoki Diversions to zero is to lower the high levels of Lake Erie 0.23 foot and reduce the frequency of levels above 572.0. However, taking this reduction in combination with the reduction of the Lake Michigan Diversion at Chicago and the Welland Canal results in a net increase in levels (Scenario 4). Scenarios 2 and 3 reflect the individual impacts of these

Lakes Michigan-Huron CRITERION (b)

Table G-18

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

APRIL-NOVEMBER

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 1 LL/O 0, CHI. 3,200, WELL. 7,000	Scenario 2 LL/O 5,000, CHI. 3,200, WELL. 0	Scenario 3 LL/O 5,000, CHI. 0, WELL. 7,000	Scenario 4 LL/O 0, CHI. 0, WELL. 0
576.8 LWD	40	82	26	23	36
576.4	14	32	12	9	12
576.0	4	12	2	2	4
575.6	0	4	0	0	1
575.2	0	0	0	0	0
Minimum	575.62	575.21	575.76	575.86	575.58

ALL-MONTHS

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 1	Scenario 2	Scenario 3	Scenario 4
576.8 LWD	91	154	67	56	81
576.4	38	77	29	23	34
576.0	16	32	13	12	14
575.6	4	13	0	0	5
575.2	0	4	0	0	0
Minimum	575.46	575.07	575.60	575.70	575.43

Lakes Michigan-Huron CRITERION (b)(Cont.)

Table G-18 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

APRIL-NOVEMBER

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 5 LL/O 0, CHI. 3,200, WELL. 7,000	Scenario 6 LL/O 5,000, CHI. 3,200, WELL. 9,000	Scenario 7 LL/O 5,000, CHI. 8,700, WELL. 7,000	Scenario 8 LL/O 0, CHI. 8,700, WELL. 7,000
576.8 LWD	40	56	43	58	70
576.4	14	14	14	15	21
576.0	4	7	4	7	10
575.6	0	1	0	1	1
575.2	0	0	0	0	0
Minimum	575.62	575.55	575.62	575.56	575.48

ALL-MONTHS

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 5	Scenario 6	Scenario 7	Scenario 8
576.8 LWD	91	112	95	116	138
576.4	38	43	36	44	59
576.0	16	19	16	19	24
575.6	4	7	5	9	12
575.2	0	0	0	0	0
Minimum	575.46	575.39	575.46	575.40	575.32

Lakes Michigan-Huron CRITERION (b)(Cont.)

Table G-18 (cont.)

MONTHLY MEAN WATER LEVELS OF LAKES MICHIGAN-HURON
1900-1976

NUMBER OF OCCURRENCES BELOW LEVEL SHOWN

APRIL-NOVEMBER

Monthly Mean Level	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
(Feet)						
576.8 LWD	40	70	34	36	48	43
576.4	14	22	13	14	14	14
576.0	4	10	3	4	7	4
575.6	0	1	0	0	1	0
575.2	0	0	0	0	0	0
Minimum	575.62	575.47	575.69	575.66	575.58	575.63

ALL-MONTHS

Monthly Mean Level	Basis-of-Comparison	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
576.8 LWD	91	138	83	83	101	94
576.4	38	62	32	35	40	36
576.0	16	25	15	16	19	16
575.6	4	12	2	4	6	5
575.2	0	0	0	0	0	0
Minimum	575.46	575.31	575.53	575.50	575.42	575.47

Lake Erie CRITERION (a)

Table G-19

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVELS SHOWN

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 1 LL/O 0, CHI. 3,200, WELL. 7,000	Scenario 2 LL/O 5,000, CHI. 3,200, WELL. 0	Scenario 3 LL/O 5,000, CHI. 0, WELL. 7,000	Scenario 4 LL/O 0, CHI. 0, WELL. 0
573.0	16	8	32	24	29
572.8	27	15	44	33	37
572.6	37	24	68	50	58
572.4	55	34	94	74	84
572.2	78	48	124	95	111
572.0	108	74	163	126	148
Maximum	573.60	573.37	573.91	573.75	573.84

Lake Erie CRITERION (a)(Cont.)

Table G-19 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVELS SHOWN

Monthly Mean Level	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
(Feet)					
573.0	16	10	12	8	4
572.8	27	17	23	16	9
572.6	37	30	32	27	20
572.4	55	39	43	37	27
572.2	78	59	69	55	42
572.0	108	86	97	84	66
Maximum	573.60	573.44	573.50	573.40	573.24

Lake Erie CRITERION (a)(Cont.)

Table G-19 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES ABOVE LEVELS SHOWN

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
573.0	16	2	17	18	11	13
572.8	27	7	28	29	20	22
572.6	37	11	38	37	32	32
572.4	55	23	60	59	39	44
572.2	78	35	85	82	65	68
572.0	108	54	120	113	92	95
Maximum	573.60	573.15	573.62	573.63	573.49	573.52

latter two diversions. From the table it can be concluded that the major impact is as a result of the reduction in Welland Canal flow.

Scenarios 5, 6, 7, 8 and 9 would alter the diversion rates during periods of high water supply within the upper portion of the system. Table G-19 shows that the maximum reduction would occur under Scenario 9, reducing the maximum level by 0.45 foot and the frequency of levels above 572.0 feet by 50 percent. All other combinations (Scenario 5, 6, 7 and 8) have a lesser impact.

Scenario 10, which is an attempt to improve the low water situation by reducing the Welland Canal flow during periods of low water supply, has a small impact on the high levels; increasing the maximum level by 0.02 foot and the frequency of levels above 572.0 by 11 percent.

Scenarios 11, 12 and 13 in Table G-19, which compare current conditions with the basis-of-comparison, show that the Long Lac/Ogoki (Scenario 11) has slightly increased the Lake Erie levels and the frequency of occurrence of levels above 572.0 feet. However, taken in combination with the Welland Canal flow increase (Scenario 13) the net impact is a reduction of the maximum level by 0.08 foot and a reduction in the frequency of levels above 572.0 feet by 12 percent.

Criterion (b) - Consistent with other requirements, reduce the frequency of occurrence of low Lake Erie levels, especially during the navigation season (April-November).

Table G-20 shows the degree of satisfaction of this criterion under each of the scenarios. Scenarios 1, 2, 3 and 4 show the impact of the current diversion rates. These scenarios show that the Long Lac/Ogoki Diversions have raised the minimum level (Scenario 1) of Lake Erie by 0.26 foot; the Lake Michigan Diversion at Chicago (Scenario 3) has lowered the levels 0.15 foot; and the Welland Canal has lowered (Scenario 2) Lake Erie 0.35 foot; with a net lowering effect (Scenario 4) of 0.25 foot.

Scenarios 5, 6, 7, 8 and 9 show a general lowering and an increase in the frequency of low levels. The maximum impact is shown under Scenario 9, which would lower the minimum value by 0.10 foot and would increase the frequency of low levels (below LWD) during the navigation season by 43 percent.

Scenario 10, which was developed to offset the impact of low Lake Erie levels, would raise the minimum level during the navigation season by 0.20 foot and reduce the frequency below LWD by 67 percent.

As previously noted, Scenarios 11, 12 and 13 were developed to evaluate existing conditions with those under the basis-of-comparison, both individually and in combination. Table G-20 shows that the Long Lac/Ogoki Diversions increase (Scenario 11) the extreme low levels slightly, but has little impact on the frequency of occurrence of levels below LWD. However, Scenario 12 does effect Lake Erie below LWD and lowers the minimum level by 0.13 foot during the navigation season. This impact would be offset somewhat, when the two effects shown under Scenarios 11 and 12 are taken in combination (Scenario 13). However, the minimum level would still be

Lake Erie CRITERION (b)

Table G-20

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES BELOW LEVELS SHOWN

APRIL-NOVEMBER

Monthly Mean Level	Basis-of-Comparison	Scenario 1	Scenario 2	Scenario 3	Scenario 4
		LL/O 0	LL/O 5,000	LL/O 5,000	LL/O 0
		CHI. 3,200	CHI. 3,200	CHI. 0	CHI. 0
		WELL. 7,000	WELL. 0	WELL. 7,000	WELL. 0
(Feet)					
569.0	8	20	3	5	3
568.8	4	11	1	3	2
568.6 LWD	3	5	0	1	1
568.4	1	3	0	0	0
568.2	0	1	0	0	0
Minimum	568.32	568.06	568.67	568.47	568.57

ALL-MONTHS

Monthly Mean Level	Basis-of-Comparison	Scenario 1	Scenario 2	Scenario 3	Scenario 4
569.0	30	54	18	25	21
568.8	24	35	4	18	11
568.6 LWD	15	24	1	4	3
568.4	4	17	0	1	1
568.2	1	5	0	0	0
568.0	0	1	0	0	0
Minimum	568.10	567.84	568.45	568.25	568.36

Lake Erie CRITERION (b)(Cont.)

Table G-20 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES BELOW LEVELS SHOWN

APRIL-NOVEMBER

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 5 LL/O 0, CHI. 3,200, WELL. 7,000	Scenario 6 LL/O 5,000, CHI. 3,200, WELL. 9,000	Scenario 7 LL/O 5,000, CHI. 8,700, WELL. 7,000	Scenario 8 LL/O 0, CHI. 8,700, WELL. 7,000
569.0	8	11	8	10	14
568.8	4	5	5	5	5
568.6 LWD	3	3	3	3	3
568.4	1	1	1	1	1
568.2	0	0	0	0	0
Minimum	568.32	568.27	568.31	568.27	568.22

ALL-MONTHS

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 5	Scenario 6	Scenario 7	Scenario 8
569.0	30	35	31	35	41
568.8	24	26	25	26	27
568.6 LWD	15	18	15	19	21
568.4	4	7	4	7	10
568.2	1	1	1	1	2
568.0	0	0	0	0	0
Minimum	568.10	568.05	568.09	568.05	568.00

Lake Erie CRITERION (b)(Cont.)

Table G-20 (Cont.)

MONTHLY MEAN WATER LEVELS OF LAKE ERIE
1900-1976

NUMBER OF OCCURRENCES BELOW LEVELS SHOWN

APRIL-NOVEMBER

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
569.0	8	15	4	7	15	13
568.8	4	5	3	4	5	5
568.6 LWD	3	3	1	3	3	3
568.4	1	1	0	1	1	1
568.2	0	0	0	0	0	0
Minimum	568.32	568.22	568.52	568.34	568.19	568.22

ALL-MONTHS

Monthly Mean Level (Feet)	Basis-of-Comparison	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
569.0	30	43	24	29	40	38
568.8	24	27	15	24	27	26
568.6 LWD	15	21	4	15	21	20
568.4	4	10	1	3	10	8
568.2	1	2	0	1	3	2
568.0	0	0	0	0	1	0
Minimum	568.10	568.00	568.31	568.12	567.97	568.00

lowered by 0.10 foot during the navigation season and the frequency of levels below LWD would be increased.

2.3.4 Lake Ontario Criteria

The criteria and supplementary requirement stated hereunder have been extracted directly from a 1963 report of the International St. Lawrence River Board of Control to the International Joint Commission, entitled "Regulation of Lake Ontario Plan 1958-D." These criteria and the tests of regulation plans by that Board related to the 1860-1954 period. For evaluation purposes in this study, the period of study is 1900-1976, as noted in Section 5, and the basis-of-comparison includes the current operating plan (1958-D) as designed for the period 1900-1976. In the following paragraphs, each criterion and supplementary requirement of regulation is stated, followed by a discussion with tables showing the degree to which each scenario fulfills these requirements in comparison with the current plan for the regulation of Lake Ontario.

Criterion (a) - the regulated outflow from Lake Ontario from April 1 to December 15 shall be such as not to reduce the minimum level of Montreal Harbour below that which would have occurred in the past with the supplies to Lake Ontario since 1860 adjusted to a condition assuming a continuous diversion out of the Great Lakes basin of 3,100* cubic feet per second at Chicago and a continuous diversion into the Great Lakes basin annually of 5,000 cubic feet per second from the Albany River basin.

Lake St. Louis outflows are representative of the levels of Montreal Harbour. A comparison of the minimum monthly mean outflows from Lake St. Louis with the basis-of-comparison data will indicate the degree to which the criterion has been satisfied. To assess the effect of regulation on low water levels of Montreal Harbour, it has been customary in the studies conducted by the International St. Lawrence River Board of Control to compare the frequency of occurrence of outflows from Lake St. Louis below 230,000 cfs.

Table G-21 shows that any alteration in the Long Lac/Ogoki Diversions rate or in the Lake Michigan Diversion at Chicago rate will have an effect as far downstream as Lake St. Louis on the St. Lawrence River. This effect is demonstrated under Scenarios 1 and 3; scenarios which evaluate the rates in the basis-of-comparison. Scenario 1 (which reduces the water supply to the system) would increase the frequency of low levels, while Scenario 3 (which would increase the water supply) would reduce the frequency of low levels. Scenario 2, which deals with the Welland Canal, shows no impact, due to the natural regulation of Lake Erie and its effect on its total outflow. Scenario 4, which combines the effect of these scenarios, shows an increase in frequency of low levels. This is due to the fact that there would be a net loss of water supply to the system of 1,800 cfs (net balance of Long Lac/Ogoki-Chicago alterations).

Scenarios 5, 6, 7, 8 and 9, which would alter the diversion rates during high water supply, show a duplication to the basis-of-comparison (Scenario 6) or a generally lowering and increase in the frequency of low flows; the degree of which is dependent upon the total volume of loss of water to the system.

*Changed to 3,200 cfs in this study.

Table G-21

MONTHLY MEAN OUTFLOWS FROM ST. LOUIS
APRIL 1 - DECEMBER 15 (1900 - 1976)

NUMBER OF OCCURRENCES BELOW FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
230	29	42-1/2	29	21	34-1/2
225	15-1/2	26-1/2	15-1/2	14	16-1/2
220	11	14	11	7	12
215	5	10	5	2	7
210	0	2	0	0	0
205	0	0	0	0	0
200	0	0	0	0	0
195	0	0	0	0	0
Minimum	211	207	211	212	210

Lake Ontario CRITERION (a)(Cont.)

Table G-21 (Cont.)

MONTHLY MEAN OUTFLOWS FROM ST. LOUIS
APRIL 1 - DECEMBER 15 (1900 - 1976)

NUMBER OF OCCURRENCES BELOW FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
230	29	33-1/2	29	33-1/2	38-1/2
225	15-1/2	16-1/2	15-1/2	16-1/2	19-1/2
220	11	12	11	12	13
215	5	5	5	5	7
210	0	0	0	0	0
205	0	0	0	0	0
200	0	0	0	0	0
195	0	0	0	0	0
Minimum	211	210	211	210	210

Lake Ontario CRITERION (a)(Cont.)

Table G-21 (Cont.)

MONTHLY MEAN OUTFLOWS FROM ST. LOUIS
APRIL 1 - DECEMBER 15 (1900 - 1976)

NUMBER OF OCCURRENCES BELOW FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
230	29	38-1/2	29	28	29	28
225	15-1/2	21-1/2	15-1/2	15-1/2	15-1/2	15-1/2
220	11	13	11	11	11	11
215	5	7	5	5	5	5
210	0	1	0	0	0	0
205	0	0	0	0	0	0
200	0	0	0	0	0	0
195	0	0	0	0	0	0
Minimum	211	209	210	211	211	211

Scenario 10, which would reduce the flow through the Welland Canal during periods of low supply, duplicates the frequency of low flows under the basis-of-comparison, but would reduce the minimum value. This is due to the timing of releases from Lake Erie in conjunction with lack of response, under Lake Ontario regulation, due to a reduction in water supply.

Scenarios 11, 12 and 13 reflect the same pattern of impacts experienced under Scenarios 1, 2, 3 and 4; i.e., whenever the water supply is reduced an increase in low flows occurs, and whenever the water supply is increased, conditions would improve (Scenarios 11 and 13). Scenario 12 shows no effect, since any reduction in Welland Canal flow would be shifted to the Niagara River and hence, due to natural regulation of Lake Erie, the total outflow remains the same.

Criterion (b) - The regulated winter outflows from Lake Ontario from December 15 to March 31 shall be as large as feasible and shall be maintained so that the difficulties of winter operation are minimized.

Table G-22 contains the evaluation results of the various scenarios. The table shows that, since all scenarios employed Plan 1958-D without deviation, all maximum and minimum values are identical. However, there would be an effect on the average value, the magnitude of which would be dependent upon whether the water supply to the system has been increased (reduction to zero as is the case under the Lake Michigan Diversion at Chicago; or an increasing of the Welland Canal diversion above 7,000 cfs).

Criterion (c) - The regulated outflow from Lake Ontario during the annual spring break-up in Montreal Harbour and in the river downstream shall not be greater than would have occurred assuming supplies of the past as adjusted.

In applying this criterion, consideration must be given to the ice breaking activities which take place each year in the St. Lawrence Ship Channel. Past records show that the annual break-up in Montreal Harbour generally has occurred during the first half of April. The ice breaking activities in recent years have tended to modify the application of this criterion, either by advancing the time of ice break-up into March or by minimizing the serious flooding which can result at the time of the break-up. Table G-23 compares the results obtained under the various scenarios with the basis-of-comparison for the Lake Ontario releases.

Table G-23 shows that all scenarios, regardless of the way the diversions rates have been altered, produce the same maximum outflow from Lake Ontario during March and the first half of April. This is due to the operation under regulation Plan 1958-D, which restricts releases to specific maximum rates during those periods. However, the evaluation shows an impact on the frequency of occurrence under the various scenarios.

Scenarios 1, 2, 3 and 4 evaluate the effect of the basis-of-comparison and shows that as water is retained in the system (Scenario 3)

Lake Ontario CRITERION (b)

Table G-22

WINTER OUTFLOWS FROM LAKE ONTARIO (1900-1976)
(IN THOUSANDS OF CUBIC FEET PER SECOND)

	Basis-of-Comparison			Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000			Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0			Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000			Scenario 4 LL/O 0 CHI. 0 WELL. 0		
Period	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
Dec. 15 - 31	260	210	224	260	210	223	260	210	224	260	210	226	260	210	224
January	220	210	215	220	210	214	220	210	215	220	210	215	220	210	214
February	260	207	228	260	207	225	260	207	228	260	207	230	260	207	227
March	280	204	234	280	204	229	280	204	233	280	204	236	280	204	232

Lake Ontario CRITERION (b)(Cont.)

Table G-22 (Cont.)

WINTER OUTFLOWS FROM LAKE ONTARIO (1900-1976)
(IN THOUSANDS OF CUBIC FEET PER SECOND)

	Basis of Comparison			Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000			Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000			Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000			Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000		
Period	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
Dec. 15 - 31	260	210	224	260	210	224	260	210	224	260	210	224	260	210	223
January	220	210	215	220	210	214	220	210	215	220	210	214	220	210	214
February	260	207	228	260	207	227	260	207	228	260	207	227	260	207	225
March	280	204	234	280	204	232	280	204	234	280	204	232	280	204	229

Lake Ontario CRITERION (b)(Cont.)

Table G-22 (Cont.)

WINTER OUTFLOWS FROM LAKE ONTARIO (1900-1976)
(IN THOUSANDS OF CUBIC FEET PER SECOND)

Period	Basis-of-Comparison			Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000			Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600			Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000			Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400			Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400		
	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
Dec. 15 - 31	260	210	224	260	210	223	287	188	226	260	210	225	260	210	224	260	210	225
January	220	210	215	220	210	214	255	185	217	220	210	215	220	210	215	220	210	215
February	260	207	228	260	207	225	285	182	228	260	207	229	260	207	228	260	207	229
March	280	204	234	280	204	229	300	179	234	280	204	234	280	204	234	280	204	234

Lake Ontario CRITERION (c)

Table G-23

MEAN MARCH OUTFLOWS FROM LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
250	20	14	20	25	20
260	12	10	12	14	10
270	7	6	7	8	6
280	0	0	0	0	0
290	0	0	0	0	0
Maximum	280	280	280	280	280

MEAN FIRST HALF APRIL OUTFLOWS FROM LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 1	Scenario 2	Scenario 3	Scenario 4
250	28	23	28	31	28
260	16	13	16	21	15
270	11	10	11	12	10
280	6	6	7	9	6
290	5	4	5	6	4
Maximum	305	305	305	305	305

Table G-23 (Cont.)

MEAN MARCH OUTFLOWS FROM LAKE ONTARIO (1900-1976)

NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
250	20	17	21	16	15
260	12	10	12	10	9
270	7	6	7	6	6
280	0	0	0	0	0
290	0	0	0	0	0
Maximum	280	280	280	280	280

MEAN FIRST HALF APRIL OUTFLOWS FROM LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 5	Scenario 6	Scenario 7	Scenario 8
250	28	27	28	25	21
260	16	15	16	15	13
270	11	10	11	10	9
280	6	6	7	6	6
290	5	4	5	4	3
Maximum	305	305	305	305	305

Lake Ontario CRITERION (c)(Cont.)

Table G-23 (Cont.)

MEAN MARCH OUTFLOWS FROM LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
250	20	15	22	23	21	23
260	12	9	13	12	12	12
270	7	6	8	7	7	7
280	0	0	0	0	0	0
290	0	0	0	0	0	0
Maximum	280	280	280	280	280	280

MEAN FIRST HALF APRIL OUTFLOWS FROM LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES ABOVE FLOW SHOWN

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Scenario 13
250	28	22	28	29	28	29
260	16	13	17	17	16	17
270	11	9	11	11	11	11
280	6	6	7	7	6	7
290	5	3	6	6	5	6
Maximum	305	305	305	305	305	305

the frequency of high flows will increase. If water is prevented from reaching the system (Scenario 1), the frequency would be reduced. Scenario 4, which reflects the net impact of the Lake Michigan Diversion at Chicago (+3,200) and Long Lac/Ogoki Diversions (-5,000), shows a reduction in frequency.

Scenarios 5, 6, 7, 8 and 9 generally duplicate or lower the number of occurrences of high flow. As a result, diversion management would provide some relief to downstream interests, (Scenario 8 provides maximum lowering). Scenario 10, which reduces the flow through the Welland Canal during periods of low supply, shows that as water is retained in the system the frequency of high flows will increase. Scenarios 11, 12 and 13 (comparison of basis-of-comparison against the 1979 rates) show an increase in the frequency as a net effect (Scenario 13).

Criterion (d) - The regulated outflow from Lake Ontario during the annual flood discharge from the Ottawa River shall not be greater than the discharge that would have occurred assuming supplies of the past as adjusted.

This criterion is included to protect the riparian interests on Lake St. Louis, in Montreal Harbour, and on the river downstream. Past records show that the maximum level of Lake St. Louis each year, influenced to a significant extent by the flood flow of the Ottawa River, has occurred about 60 percent of the time in the month of May, with the remainder of the occurrences of seriously high conditions in April and June. Table G-24 indicates the extent to which this criterion has been met by the various scenarios presented herein.

As noted above, the outflow from Lake Ontario is restricted to fixed maximum rates under Plan 1958-D. Hence, during April, May and June the maximum outflow from Lake Ontario produced under the various scenarios are identical to the basis-of-comparison. However, as in the case of the evaluation under the criterion (c), the frequency of occurrence of high flows would be affected. In general, under scenarios which retain water in the system (those scenarios which reduce the Lake Michigan Diversion at Chicago) the frequency is increased, while those scenarios which reduce water supplies (reduction of Long Lac/Ogoki Diversions to zero) would reduce the frequency of occurrence of high flows. The evaluation of the net effect (Scenario 13) of the basis-of-comparison against the 1979 diversion rates shows a slight increase in the frequency of high outflows. In general, the frequency of high outflows from Lake St. Louis follows the same pattern. However, the maximum values are affected somewhat, due to the timing and residual effect of upstream diversion alterations.

Criterion (e) - Consistent with other requirements, the minimum regulated outflows from Lake Ontario shall be such as to secure the maximum dependable flow for power.

Table G-25 shows the minimum releases occurring under each of the scenarios evaluated. The table shows some minor variation between scenarios. These variations are caused by a residual effect on water reaching Lake Ontario by alteration in the diversion rates. In all cases, the releases are in accordance with Plan 1958-D.

Lake Ontario CRITERION (d)

Table G-24

MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO AND LAKE ST. LOUIS
APRIL, MAY AND JUNE (1900-1976)
NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

LAKE ONTARIO

OutFlow	Basis-of-Comparison			Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000			Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0			Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000			Scenario 4 LL/O 0 CHI. 0 WELL. 0		
(Thousands of CFS)	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June
260	22	31	30	17	26	29	21	31	30	30	34	31	19	30	30
270	13	24	27	11	20	24	12	23	27	16	26	29	11	21	27
280	9	15	22	7	13	16	9	14	22	11	18	24	9	14	20
290	6	10	13	4	7	11	6	11	13	6	12	17	6	9	13
300	4	5	7	3	4	6	4	5	7	4	8	9	4	5	6
310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	308	310	310	308	310	310	308	310	310	308	310	310	308	310	310

LAKE ST. LOUIS

380	8	14	4	6	14	4	8	14	4	10	16	7	6	14	4
390	5	13	4	5	13	3	5	13	4	5	13	4	5	13	3
400	4	12	2	3	9	2	4	12	2	4	12	2	4	12	2
410	2	8	1	2	7	1	2	8	1	3	10	1	2	7	1
420	2	4	1	1	4	1	2	4	1	2	5	1	1	4	1
430	1	3	1	1	2	1	1	3	1	1	4	1	1	2	1
440	1	2	0	1	2	0	1	2	0	1	2	1	1	2	0
450	1	0	0	1	0	0	1	0	0	1	1	0	1	0	0
Maximum	453	450	439	453	450	434	453	450	439	453	451	442	453	450	437

Lake Ontario CRITERION (d)(Cont.)

Table G-24 (Cont.)

MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO AND LAKE ST. LOUIS
APRIL, MAY AND JUNE (1900-1976)
NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

LAKE ONTARIO

OutFlow	Basis of Comparison			Scenario 5 LL/O 0, CHI. 3,200, WELL. 7,000			Scenario 6 LL/O 5,000, CHI. 3,200, WELL. 9,000			Scenario 7 LL/O 5,000, CHI. 8,700, WELL. 7,000			Scenario 8 LL/O 0, CHI. 8,700, WELL. 7,000		
(Thousands of CFS)	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June
260	22	31	30	18	29	30	23	31	30	18	27	30	15	26	29
270	13	24	27	11	20	25	13	23	27	11	20	24	11	19	24
280	9	15	22	9	14	19	9	15	23	9	12	19	7	11	16
290	6	10	13	6	7	11	6	11	13	6	7	11	4	7	9
300	4	5	7	3	5	6	4	5	7	3	5	6	2	3	5
310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	308	310	310	308	310	310	308	310	310	308	310	310	308	310	310

LAKE ST. LOUIS

OutFlow	Basis April	Basis May	Basis June	S5 April	S5 May	S5 June	S6 April	S6 May	S6 June	S7 April	S7 May	S7 June	S8 April	S8 May	S8 June
380	8	14	4	6	14	4	8	14	4	6	14	4	5	14	4
390	5	13	4	5	13	3	5	13	4	5	13	3	5	13	3
400	4	12	2	4	11	2	4	12	2	4	11	2	3	9	2
410	2	8	1	2	7	1	2	8	1	2	7	1	2	7	1
420	2	4	1	1	4	1	2	4	1	1	4	1	1	4	1
430	1	3	1	1	2	1	1	3	1	1	2	1	1	2	1
440	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0
450	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0
Maximum	453	450	439	453	450	437	453	450	438	453	450	437	450	449	434

Table G-24 (Cont.)

MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO AND LAKE ST. LOUIS
APRIL, MAY AND JUNE (1900-1976)
NUMBER OF OCCURRENCES ABOVE OUTFLOW SHOWN

LAKE ONTARIO

OutFlow	Basis-of-Comparison			Scenario 9 LL/O 0, CHI. 8,700, WELL. 9,000			Scenario 10 LL/O 5,000, CHI. 3,200, WELL. 2,600			Scenario 11 LL/O 5,600, CHI. 3,200, WELL. 7,000			Scenario 12 LL/O 5,000, CHI. 3,200, WELL. 9,400			Scenario 13 LL/O 5,600, CHI. 3,200, WELL. 9,400		
(Thousands of CFS)	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June
260	22	31	30	16	26	29	23	30	30	23	31	30	22	31	30	23	31	30
270	13	24	27	11	19	24	13	24	27	13	26	27	13	23	27	13	26	27
280	9	15	22	8	11	16	10	15	23	10	15	23	9	15	22	10	15	23
290	6	10	13	5	7	9	6	11	13	6	11	13	6	11	13	6	11	13
300	4	5	7	2	3	5	4	5	7	4	5	7	4	5	7	4	5	7
310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	308	310	310	308	310	310	308	310	310	308	310	310	308	310	310	308	310	310

LAKE ST. LOUIS

OutFlow	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June
380	8	14	4	5	14	4	8	14	4	8	15	4	8	14	4	8	15	4
390	5	13	4	5	13	3	5	13	4	5	13	4	5	13	4	5	13	4
400	4	12	2	3	9	2	4	12	2	4	12	2	4	12	2	4	12	2
410	2	8	1	2	7	1	2	8	1	2	8	1	2	8	1	2	8	1
420	2	4	1	1	4	1	2	4	1	2	4	1	2	4	1	2	5	1
430	1	3	1	1	2	1	1	3	1	1	4	1	1	3	1	1	4	1
440	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0
450	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0
Maximum	453	450	439	450	449	434	453	450	438	453	450	439	453	450	439	453	450	439

Lake Ontario CRITERION (e)

Table G-25

MINIMUM MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO
IN THOUSANDS OF CFS (1900-1976)

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
January	210	210	210	210	210
February	207	207	207	207	207
March	204	204	204	204	204
April	188	188	188	188	188
May	188	188	188	188	188
June	193	190	193	195	192
July	200	194	200	203	197
August	201	196	201	204	198
September	201	195	201	204	198
October	194	193	194	196	194
November	198	198	198	198	198
December	210	210	210	210	210
Mean (All Months)	199.50	197.75	199.50	200.58	198.67
Mean (Oct.-Mar. Incl.)	203.83	203.67	203.83	204.17	203.83

Table G-25 (Cont.)

MINIMUM MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO
IN THOUSANDS OF CFS (1900-1976)

Outflow (Thousands of CFS)	Basis-of-Comparison	Scenario 5 LL/O 0, CHI. 3,200, WELL. 7,000	Scenario 6 LL/O 5,000, CHI. 3,200, WELL. 9,000	Scenario 7 LL/O 5,000, CHI. 8,700, WELL. 7,000	Scenario 8 LL/O 0, CHI. 8,700, WELL. 7,000
January	210	210	210	210	210
February	207	207	207	207	207
March	204	204	204	204	204
April	188	188	188	188	188
May	188	188	188	188	188
June	193	192	193	192	192
July	200	198	200	199	197
August	201	200	201	200	198
September	201	199	200	199	198
October	194	194	194	194	193
November	198	198	198	198	198
December	210	210	210	210	210
Mean (All Months)	199.50	199.00	199.42	199.08	198.58
Mean (Oct.-Mar. Incl.)	203.83	203.83	203.83	203.83	203.67

Lake Ontario CRITERION (e)(Cont.)

Table G-25 (Cont.)

MINIMUM MONTHLY MEAN OUTFLOWS FROM LAKE ONTARIO
IN THOUSANDS OF CFS (1900-1976)

Outflow	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
(Thousands of CFS)						
January	210	210	210	210	210	210
February	207	207	207	207	207	207
March	204	204	204	204	204	204
April	188	188	188	188	188	188
May	188	188	188	188	188	188
June	193	191	193	193	193	193
July	200	196	200	201	200	201
August	201	198	201	202	201	202
September	201	197	200	201	201	201
October	194	193	194	194	194	194
November	198	198	198	198	198	198
December	210	210	210	210	210	210
Mean (All Months)	199.50	198.33	199.42	199.67	199.50	199.67
Mean (Oct.-Mar. Incl.)	203.83	203.67	203.83	203.83	203.83	203.83

Criterion (f) - Consistent with other requirements, the maximum regulated outflow from Lake Ontario shall be maintained as low as possible to reduce channel excavation to a minimum.

The most important consideration in connection with Criterion (f) is that the scenarios should not produce more critical conditions than those under the current operating plan. Since the regulated releases, under evaluation of the scenarios presented herein, where determined in accordance with the limitation curves of Plan 1958-D, the conditions produced would be no more critical than those of the basis-of-comparison. Hence, this criterion would be satisfied by all scenarios.

Criterion (g) - Consistent with other requirements, the levels of Lake Ontario shall be regulated for the benefit of property owners on the shores of Lake Ontario in the United States and Canada so as to reduce the extremes of stage which have been experienced.

Table G-26 shows results consistent with those obtained under the other criteria. In those cases where water is retained in the system, the maximum and minimum levels would be increased. Those scenarios which reduce the water supply in the system, in comparison to those under the basis-of-comparison, lower the maximum and minimum levels. Scenario 13, which evaluates the net effect of the basis-of-comparison against the 1979 conditions, shows an expanded range and a raising of the maximum, mean, and minimum stages.

Criterion (h) - The regulated monthly mean level of Lake Ontario shall not exceed an elevation of 246.77 feet with the supplies of the past as adjusted.

Table G-27 shows that all the scenarios and the basis-of-comparison would exceed the 246.77 feet limit. Table G-27 shows the number of times this would occur under each of the scenarios. Table G-27 shows that the maximum impact would be felt under Scenario 3 (where the Lake Michigan Diversion at Chicago is reduced to zero).

Criterion (i) - Under regulation, the frequency of occurrences of monthly mean elevations of approximately 245.77 feet and higher on Lake Ontario shall be less than would have occurred in the past with the supplies of the past as adjusted and with present channel conditions in the Galop Rapids reach of the International Rapids Section of the St. Lawrence River.

Table G-28 shows the number of times that each scenario would exceed 245.77 feet. The table follows the water supply reduction/increase pattern. Scenarios 1, 4, 5, 7, 8 and 9 would have less occurrences than under the basis-of-comparison; while Scenarios 2, 3, 6, 10, 11, 12 and 13 would have more occurrences.

Criterion (j) - The regulated level of Lake Ontario on 1 April shall not be lower than elevation 242.77 feet. The regulated mean level of the lake from 1 April to 30 November shall be maintained at or above an elevation of 242.77 feet.

Lake Ontario CRITERION (g)

Table G-26

MONTHLY MEAN LEVELS OF LAKE ONTARIO (1900-1976)

Water Levels	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
Mean	244.73	244.53	244.73	244.83	244.67
Maximum	249.47	248.34	249.49	251.29	248.98
Minimum	241.59	240.22	241.58	242.07	241.10
Range	7.88	8.12	7.91	9.22	7.88

Lake Ontario CRITERION (g)(Cont.)

Table G-26 (Cont.)

MONTHLY MEAN LEVELS OF LAKE ONTARIO (1900-1976)

Water Levels	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
Mean	244.73	244.64	244.73	244.64	244.55
Maximum	249.47	248.53	249.44	248.40	248.05
Minimum	241.59	241.18	241.52	241.19	240.74
Range	7.88	7.35	7.92	7.21	7.31

Lake Ontario CRITERION (g)(Cont.)

Table G-26 (Cont.)

MONTHLY MEAN LEVELS OF LAKE ONTARIO (1900-1976)

Water Levels	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
Mean	244.73	244.55	244.74	244.75	244.73	244.75
Maximum	249.47	248.07	249.58	249.60	249.42	249.62
Minimum	241.59	240.74	241.47	241.69	241.59	241.69
Range	7.88	7.33	8.11	7.91	7.83	7.93

Lake Ontario CRITERION (h)

Table G-27

MONTHLY MEAN LEVELS OF LAKE ONTARIO (1900-1976)

NUMBER OF OCCURRENCES ABOVE ELEVATION 246.77

PLAN							OCCURRENCES
Basis-of-Comparison							38
Scenario 1	LL/O	0	CHI.	3,200	WELL.	7,000	23
Scenario 2	LL/O	5,000	CHI.	3,200	WELL.	0	38
Scenario 3	LL/O	5,000	CHI.	0	WELL.	7,000	50
Scenario 4	LL/O	0	CHI.	0	WELL.	0	30
Scenario 5	LL/O	0	CHI.	3,200	WELL.	7,000	26
Scenario 6	LL/O	5,000	CHI.	3,200	WELL.	9,000	37
Scenario 7	LL/O	5,000	CHI.	8,700	WELL.	7,000	26
Scenario 8	LL/O	0	CHI.	8,700	WELL.	7,000	17
Scenario 9	LL/O	0	CHI.	8,700	WELL.	9,000	17
Scenario 10	LL/O	5,000	CHI.	3,200	WELL.	2,600	39
Scenario 11	LL/O	5,600	CHI.	3,200	WELL.	7,000	39
Scenario 12	LL/O	5,000	CHI.	3,200	WELL.	9,400	37
Scenario 13	LL/O	5,600	CHI.	3,200	WELL.	9,400	39

Lake Ontario CRITERION (i)

Table G-28

MONTHLY MEAN LEVELS OF LAKE ONTARIO (1900-1976)
NUMBER OF OCCURRENCES EQUAL TO OR ABOVE ELEVATION 245.77

PLAN							OCCURRENCES
Basis of Comparison							130
Scenario 1	LL/O	0	CHI.	3,200	WELL.	7,000	103
Scenario 2	LL/O	5,000	CHI.	3,200	WELL.	0	136
Scenario 3	LL/O	5,000	CHI.	0	WELL.	7,000	140
Scenario 4	LL/O	0	CHI.	0	WELL.	0	125
Scenario 5	LL/O	0	CHI.	3,200	WELL.	7,000	117
Scenario 6	LL/O	5,000	CHI.	3,200	WELL.	9,000	131
Scenario 7	LL/O	5,000	CHI.	8,700	WELL.	7,000	115
Scenario 8	LL/O	0	CHI.	8,700	WELL.	7,000	101
Scenario 9	LL/O	0	CHI.	8,700	WELL.	9,000	98
Scenario 10	LL/O	5,000	CHI.	3,200	WELL.	2,600	133
Scenario 11	LL/O	5,600	CHI.	3,200	WELL.	7,000	135
Scenario 12	LL/O	5,000	CHI.	3,200	WELL.	9,400	131
Scenario 13	LL/O	5,600	CHI.	3,200	WELL.	9,400	134

Table G-29 shows that none of the scenarios nor the basis-of-comparison would attain the 242.77 feet elevation on 1 April, and only Scenario 3 would attain it during the navigation season. However, Scenarios 11 and 13 would improve upon the basis-of-comparison.

Criterion (k) - In the event that future supplies occur in excess of the supplies of the past as adjusted, the works in the International Rapids Section shall be operated to provide all possible relief to the riparian owners upstream and downstream. In the event of future supplies less than the supplies of the past as adjusted, the works in the International Rapids Section shall be operated to provide all possible relief to navigation and power interests.

All plans presented herein were developed using the supplies of the past, as adjusted. This criterion refers to magnitudes and sequences of supplies in the future that may be more critical than those of the past. Since this criterion refers to future conditions, it cannot be evaluated.

2.3.5 Lake St. Louis Low Water Levels

One supplementary requirement of regulation relates to Lake St. Louis low water levels and states that "The project works shall be operated in such a manner as to provide no less protection for navigation and riparian interests downstream than would have occurred under preproject conditions with supplies of the past as adjusted, as defined in Criterion (a) herein."

Table G-30 presents the results obtained under each of the scenarios. The table shows that all scenarios would produce a minimum elevation within 0.2 foot of the basis-of-comparison value. The maximum impact on the frequency of occurrence of low levels occurs under Scenario 1 and 8, which would remove water from the system. Scenario 3 provides for the maximum improvement in reducing the frequency of low levels (scenario which reduces the Lake Michigan Diversion at Chicago to zero).

3 Economic Evaluation

As noted in Section 8 of the main report, from the total array of scenarios tested, various scenarios were selected for detailed hydrologic, economic and environmental evaluation. From the 13 scenarios selected for detailed hydrologic evaluation, 10 were selected for detailed economic evaluation. Presented below and summarized in Tables 8-5 to 8-7 of the main report is detailed economic information which was received from the International Lake Erie Regulation Study Board. This information is presented and analyzed herein by interests -- Coastal Zone, Navigation, Power and Recreational Beaches and Boating.

3.1 Coastal Zone

Table G-31 shows the impact on the coastal zone interests of the various scenarios evaluated. The table shows that, under Scenario 1 (which is an evaluation of an existing condition), if the Long Lac/Ogoki Diversions were not adding water supply to the system a net annual benefit of approximately $4.8 million would be obtained. The United States benefit

Lake Ontario CRITERION (j)

Table G-29

LAKE ONTARIO WATER LEVELS

MINIMUM 1 APRIL & MINIMUM MONTHLY MEAN APRIL-NOVEMBER

PLAN							MINIMUM 1 APRIL	MINIMUM MONTHLY MEAN APR-NOV
Basis of Comparison							241.90	242.31
Scenario 1	LL/O	0	CHI.	3,200	WELL.	7,000	240.42	240.81
Scenario 2	LL/O	5,000	CHI.	3,200	WELL.	0	241.89	242.30
Scenario 3	LL/O	5,000	CHI.	0	WELL.	7,000	242.44	242.87
Scenario 4	LL/O	0	CHI.	0	WELL.	0	241.36	241.77
Scenario 5	LL/O	0	CHI.	3,200	WELL.	7,000	241.46	241.81
Scenario 6	LL/O	5,000	CHI.	3,200	WELL.	9,000	241.83	242.24
Scenario 7	LL/O	5,000	CHI.	8,700	WELL.	7,000	241.47	241.88
Scenario 8	LL/O	0	CHI.	8,700	WELL.	7,000	241.00	241.41
Scenario 9	LL/O	0	CHI.	8,700	WELL.	9,000	241.00	241.41
Scenario 10	LL/O	5,000	CHI.	3,200	WELL.	2,600	241.78	242.19
Scenario 11	LL/O	5,600	CHI.	3,200	WELL.	7,000	242.01	242.43
Scenario 12	LL/O	5,000	CHI.	3,200	WELL.	9,400	241.90	242.31
Scenario 13	LL/O	5,600	CHI.	3,200	WELL.	9,400	242.01	242.43

Table G-30

LAKE ST. LOUIS LOW WATER LEVELS
JUNE, JULY, AUGUST, SEPTEMBER
1900-1976
NUMBER OF MONTHS BELOW VALUE SHOWN

Stage	Basis-of-Comparison	Scenario 1 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 2 LL/O 5,000 CHI. 3,200 WELL. 0	Scenario 3 LL/O 5,000 CHI. 0 WELL. 7,000	Scenario 4 LL/O 0 CHI. 0 WELL. 0
67.0	77	97	77	65	81
66.5	36	47	36	34	39
66.0	8	17	8	6	9
65.5	0	2	0	0	2
65.0	0	0	0	0	0
MINIMUM	65.55	65.35	65.55	65.65	65.46

SUPPLEMENTAL CRITERION (Cont.)

Table G-30 (Cont.)

LAKE ST. LOUIS LOW WATER LEVELS
JUNE, JULY, AUGUST, SEPTEMBER
1900-1976
NUMBER OF MONTHS BELOW VALUE SHOWN

Stage	Basis-of-Comparison	Scenario 5 LL/O 0 CHI. 3,200 WELL. 7,000	Scenario 6 LL/O 5,000 CHI. 3,200 WELL. 9,000	Scenario 7 LL/O 5,000 CHI. 8,700 WELL. 7,000	Scenario 8 LL/O 0 CHI. 8,700 WELL. 7,000
67.0	77	84	74	86	96
66.5	36	39	36	40	51
66.0	8	8	8	8	9
65.5	0	1	0	1	2
65.0	0	0	0	0	0
MINIMUM	65.55	65.49	65.53	65.49	65.45

Table G-30 (Cont.)

LAKE ST. LOUIS LOW WATER LEVELS
JUNE, JULY, AUGUST, SEPTEMBER
1900-1976
NUMBER OF MONTHS BELOW VALUE SHOWN

Stage	Basis-of-Comparison	Scenario 9 LL/O 0 CHI. 8,700 WELL. 9,000	Scenario 10 LL/O 5,000 CHI. 3,200 WELL. 2,600	Scenario 11 LL/O 5,600 CHI. 3,200 WELL. 7,000	Scenario 12 LL/O 5,000 CHI. 3,200 WELL. 9,400	Scenario 13 LL/O 5,600 CHI. 3,200 WELL. 9,400
67.0	77	90	76	72	77	73
66.5	36	48	37	35	36	35
66.0	8	11	8	7	9	7
65.5	0	2	0	0	0	0
65.0	0	0	0	0	0	0
MINIMUM	65.55	65.43	65.53	65.56	65.55	65.56

Table G-31
COASTAL ZONE EVALUATION
(Annual Value in $1000)

Scenarios

	1		5		6		7		8		9		10		11		12		13	
	LL/0	0 (c)	LL/0	0 (t)	LL/0	5000(c)	LL/0	5000(c)	LL/0	0 (t)	LL/0	0 (t)	LL/0	5000(c)	LL/0	5600(c)	LL/0	5000(c)	LL/0	5600(c)
	CHI	3200(c)	CHI	3200(c)	CHI	3200(c)	CHI	8700(t)	CHI	8700(t)	CHI	8700(t)	CHI	3200(c)	CHI	3200(c)	CHI	3200(c)	CHI	3200(c)
	WELL	7000(c)	WELL	7000(c)	WELL	9000(t)	WELL	7000(c)	WELL	7000(c)	WELL	9000(t)	WELL	2600(t)	WELL	7000(c)	WELL	9400(c)	WELL	9400(c)
	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN
LAKE SUPERIOR																				
Erosion	64	-	31	-	2	-	22	-	50	-	44	-	-5	0	-7	-	5	-	-2	-
Inundation	79	-	41	-	2	-	31	-	67	-	73	-	-10	0	-13	-	5	-	-5	-
Pumping	-3	-5	-1	-2	-	0	-1	-2	-2	-4	-2	-4	0	0	0	1	0	-1	0	0
Subtotal	140	-5	71	-2	4	0	52	-2	115	-4	115	-4	-15	0	-20	1	10	-1	-7	0
LAKE MICHIGAN																				
Erosion	574	-	331	-	39	-	359	-	663	-	692	-	-63	-	-72	-	77	-	6	-
Inundation	216	-	132	-	16	-	143	-	259	-	271	-	-23	-	-27	-	32	-	4	-
Pumping (a)	-101	-	-48	-	-5	-	-52	-	-100	-	-106	-	12	-	11	-	-12	-	0	-
Subtotal	689	-	415	-	50	-	450	-	822	-	857	-	-74	-	-88	-	97	-	10	-
LAKE HURON																				
Erosion	215	30	127	17	16	2	137	16	250	34	261	34	-24	-3	-27	-3	29	4	3	1
Inundation	270	43	175	33	22	5	190	33	336	53	350	53	-27	-4	-25	-6	41	8	6	2
Pumping	-	-48	-	-22	-	-3	-	-24	-	-46	-	-49	-	6	-	6	-	-7	-	-1
Subtotal	485	25	302	28	38	4	327	25	586	41	611	38	-51	-1	-52	-3	70	5	9	2
LAKE ST. CLAIR																				
Erosion	48	-	29	-	8	-	32	-	57	-	64	-	-12	-	-7	-	16	-	10	-
Inundation	217	194	154	146	47	48	172	147	294	250	323	262	-26	-21	-28	-27	69	68	42	43
Pumping	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal	265	194	183	146	55	48	204	147	351	250	387	262	-38	-21	-35	-27	85	68	52	43
LAKE ERIE																				
Erosion	582	19	347	10	167	5	384	10	699	22	834	25	-175	-7	-79	-3	281	9	214	7
Inundation	679	98	386	64	184	32	423	65	780	121	928	137	-233	-24	-82	-12	340	49	259	38
Pumping	-61	-19	-30	-10	-13	-4	-32	-10	-61	-19	-74	-23	28	8	7	2	-31	-10	-23	-7
Subtotal	1,200	98	703	64	338	33	775	65	1,418	124	1,688	139	-380	-23	-154	-13	590	48	450	38
LAKE ONTARIO																				
Erosion	685	65	574	50	10	-3	589	51	799	75	799	74	-90	-9	-101	-10	27	2	-107	-10
Inundation	357	521	298	464	4	-29	327	486	431	581	429	577	-48	-92	-52	-109	16	34	-58	-132
Pumping	-3	-63	-2	-25	-	3	-2	-25	-3	-57	-3	-54	0	3	0	6	0	0	0	6
Subtotal	1,039	523	870	489	14	-29	914	512	1,227	599	1,225	597	-138	-98	-153	-113	43	36	-165	-136
ST. LAWRENCE																				
Inundation	-	145	-	116	-	28	-	110	-	81	-	102	-	14	-	-20	-	-2	-	-20
TOTAL BENEFITS																				
Erosion	2,168	114	1,439	77	242	4	1,523	77	2,518	131	2,694	133	-369	-19	-293	-16	435	15	124	-2
Inundation	1,818	1,001	1,186	823	275	84	1,286	841	2,167	1,086	2,374	1,131	-367	-127	-227	-174	503	157	248	-69
Pumping	-168	-135	-81	-59	-18	-4	-87	-61	-166	-126	-185	-130	40	17	18	15	-43	-18	-23	-2
Total	3,818	980	2,544	841	499	84	2,722	857	4,519	1,091	4,883	1,134	-696	-129	-502	-175	895	154	349	-73
Grand Total	4,798		3,385		583		3,579		5,610		6,017		-825		-677		1,049		276	

(a) Lake Huron pumping cost included with Lake Michigan
(c) Continuous
(t) On trigger

is about four times that of the Canadian benefit. Most of the United States benefit is located on Lakes Erie and Ontario, while that for Canada is on Lake Ontario.

Scenarios 5, 6, 7, 8 and 9 reflect the impacts on the coastal zone interest of varying the diversion rates during periods of high water supply to the Great Lakes. Table G-31 shows that the maximum benefit is derived under Scenario 9, which removes the greatest quantity of water from the upper portion of the system. The table shows that the United States benefit is about four times that of the Canadian benefit. This ratio is also the approximate relationship between benefits to both countries that would be obtained under Scenarios 5, 6, 7 and 8. On the United States side the majority of the benefit would be obtained on Lakes Erie and Ontario, while in Canada the majority of the benefit would be obtained on Lakes St. Clair and Ontario.

Scenario 10, which would reduce the outflow through the Welland Canal to 2,600 cfs, shows a net loss to the coastal zone interest. The major impact of this reduction is on Lakes Erie and Ontario; the lakes immediately upstream and downstream of the diversion.

Table G-31 shows that under Scenarios 11, 12 and 13, as the supply of water is increased (as in Scenario 11) the losses to the coastal zone interests would increase. This impact is balanced and turned to a benefit under Scenario 13, when both diversion increases are applied in combination. However, this scenario would still produce losses to Canada with the majority of that loss being on Lake Ontario. Under this scenario a loss would also occur to the United States coastal zone interests on Lakes Superior and Ontario.

3.2 Navigation

Table G-32 provides the impacts on navigation by country for the years 1985, 2000 and 2035. The evaluations are based on an 8-1/2 percent interest rate and an increase in the price of fuel of five percent greater than the rate of inflation for the first twenty years of project life (1985-2005). The table shows that only two scenarios (10 and 11) would produce system benefits to navigation. Both of these scenarios would raise the water levels of Lakes Superior, Michigan-Huron and Erie; Scenario 10 by reducing the Welland Canal Diversion and Scenario 11 by putting more water into the system through the Long Lac/Ogoki Diversions than under the basis-of-comparison. Scenario 1 would produce the greatest loss, since it removes the largest volume of water from the system (5000 cfs). The table also shows that the impact (benefits/loss) to the United States would be about twice that of Canada under all scenarios, except under Scenario 13. Scenario 13 shows the loss to Canada about four times that of the United States. This scenario also produces the smallest impact of any of the scenarios evaluated.

Table G-33 shows a navigation evaluation for Scenario 9 by route for the year 1985. This table shows that, in comparison with the basis-of-comparison regime of levels, the greatest economic impact is sustained on the upper lakes. This is primarily because the volume of traffic is greater on these lakes.

Table G-32
NAVIGATION EVALUATION
(Values in $1000)

Scenarios

	1		5		6		7		8	
	LL/O 0 (c)		LL/O 0 (t)		LL/O 5000(c)		LL/O 5000(c)		LL/O 0 (t)	
	CHI 3200(c)		CHI 3200(c)		CHI 3200(c)		CHI 8700(t)		CHI 8700(t)	
	WELL 7000(c)		WELL 7000(c)		WELL 9000(t)		WELL 7000(c)		WELL 7000(c)	
	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN
1985	-7,950	-4,283	-3,126	-1,517	-276	-139	-2,757	-1,294	-6,077	-2,972
Total	-12,233		-4,643		-415		-4,051		-9,049	
2000	-13,245	-7,160	-5,240	-2,576	-442	-242	-4,564	-2,202	-10,123	-5,023
Total	-20,405		-7,816		-684		-6,766		-15,146	
2035	-18,249	-10,881	-7,411	-3,453	-702	-338	-6,952	-2,982	-14,590	-7,728
Total	-29,130		-10,864		-1,040		-9,934		-22,318	
Present Worth 1985	-131,489	-72,013	-51,256	-25,331	-4,456	-2,376	-45,248	-21,669	-101,137	-50,449
	-203,502		-76,587		-6,832		-66,917		- 151,586	
Equivalent Annual Cost 1985-2035	-11,369	-6,226	- 4,432	-2,190	-385	-205	-3,912	-1,874	-8,745	-4,362
	-17,595		-6,622		-590		- -5,786		-13,107	

	9		10		11		12		13	
	LL/O 0 (t)		LL/O 5000(c)		LL/O 5600(c)		LL/O 5000(c)		LL/O 5600(c)	
	CHI 8700(t)		CHI 3200(c)		CHI 3200(c)		CHI 3200(c)		CHI 3200(c)	
	WELL 9000(t)		WELL 2600(t)		WELL 7000(c)		WELL 9400(c)		WELL 9400(c)	
	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN	U.S.	CAN
1985	-6,431	-3,197	+871	+535	+819	+411	-883	-516	-24	-94
Total	-9,628		+1,406		+1,230		-1,399		-118	
2000	-10,715	-5,427	+1,450	+895	+1,382	+695	-1,459	-864	-18	-156
Total	-16,142		+2,345		+2,077		-2,323		-174	
2035	-16,014	-7,303	+2,086	+1,313	+1,946	+1,072	-2,127	-1,274	-113	-202
Total	-23,317		+3,399		+3,018		-3,401		-315	
Present Worth 1985	-105,741	-53,400	+14,486	+8,953	+13,708	+6,982	-14,636	-8,647	-333	-1,538
	-159,141		+23,439		+20,690		-23,283		-1,871	
Equivalent Annual Cost 1985-2035	-9,143	-4,617	+1,252	+774	1,185	604	- 1,266	-748	-29	-133
	-13,760		+2,026		+1,789		-2,014		-162	

(c) Continuous
(t) On trigger

Table G-33
EFFECT OF SCENARIO 9
ON COMMERCIAL NAVIGATION
BY TRAFFIC ROUTE (1985)

(Transportation Cost Difference Between Scenario 9
and Basis-of-Comparison)
(Value in $1000)

Route	Equivalent Annual Cost
Superior	-80
Michigan-Huron	-1,800
Erie	-90
Ontario	-60
Superior - Michigan-Huron	-1,530
Superior - Michigan-Huron Erie	-2,540
Superior - Michigan-Huron Erie Ontario	-960
Michigan-Huron Erie	-1,600
Michigan-Huron Erie Ontario	-480
Erie Ontario	-490
Total	-9,630

3.3 Power

Table G-34 shows the impacts on power by country and by system. The table shows that under Scenarios 1, 5, 7, 8, 9 and 10 net losses would be incurred to the system. Under each of those scenarios water supply to the system would be reduced. Under those scenarios which would reduce the Long Lac/Ogoki to zero (Scenarios 1 and 5), but retain the other diversions at their current rates, the losses to Canada exceed those to the United States. This is due to the fact that under the exchange of notes in 1940, Canada has a 5,000 cfs entitlement to the Long Lac/Ogoki water on the Niagara River; and for the purposes of this study it was assumed that any reduction in flow would be taken from this amount. This is in addition to accepting this reduction in flow through the Nipigon Plants and the associated losses. However, under those scenario which affect rates at the other diversion sites, losses to United States power exceed those incurred by Canada. This is mainly due to the higher United States incremental economic factor for replacement power (see discussion in main report).

Scenarios 6, 11, 12 and 13 would provide net benefits to the system. Scenario 6 would produce minor losses to the United States portion of the system, with a substantial benefit to Canada. This is mainly due to Ontario Hydro's use of the increase in water flowing through the Welland Canal. Scenarios 11, 12 and 13 evaluate the increased availability of water due to increased diversions through Long Lac/Ogoki and the Welland Canal. Scenario 12 reflects the same condition described under Scenario 6 above.

The power evaluation was carried out by the Lake Erie Board's Power Subcommittee in accordance with the methodology described in Appendix E of the Lake Erie Board's final report. Paragraphs 3.3.1 through 3.3.6 of this Annex contain additional information with respect to assumptions and methodology that were developed by the Power Subcommittee for the economic evaluation of this study. Paragraph 3.3.7 is a summary of the determination of unit energy and capacity values, and paragraph 3.3.8 contains the results of the evaluation.

3.3.1 St. Marys River Plants, Assumptions

The assumptions with respect to the diversion of water was the same as described in Appendix E of the International Lake Erie Regulation Study Board Report. That is, the effect of reducing the Long Lac/Ogoki Diversions would be shared equally between the power plants in the United States and Canada.

3.3.2 Niagara River Plants, Assumptions

(a) For any Lake Erie outflow, the diversion entitlement for Canada and United States would be determined as follows:

(1) When the Long Lac/Ogoki Diversions were reduced to zero on trigger (2500 cfs on average):

Canada entitlement = 1/2 (adjusted Lake Erie outflow - falls flow + 2500)

Table G-34
POWER EVALUATION
(Values in $1,000)

	Scenarios									
	1 LL/O 0 (c) CHI 3200(c) WELL 7000(c)	5 LL/O 0 (t) CHI 3200(c) WELL 7000(c)	6 LL/O 5000(c) CHI 3200(c) WELL 9000(t)	7 LL/O 5000(c) CHI 8700(t) WELL 7000(c)	8 LL/O 0 (t) CHI 8700(t) WELL 7000(c)	9 LL/O 0 (t) CHI 8700(t) WELL 9000(t)	10 LL/O 5000(c) CHI 3200(c) WELL 2600(t)	11 LL/O 5600(c) CHI 3200(c) WELL 7000(c)	12 LL/O 5000(c) CHI 3200(c) WELL 9400(c)	13 LL/O 5600(c) CHI 3200(c) WELL 9400(c)
United States										
New York System										
St. Lawrence	-14,491	-6,854	-39	-7,547	-14,581	-14,658	+22	+1,675	+34	+1,664
Niagara	0	0	0	-29,844	-29,844	-29,844	0	+6,393	0	+6,393
Upper Michigan										
St. Marys	-66	-34	+2	+10	-24	-25	-3	+3	+2	+7
Total U.S.	-14,557	-6,888	-37	-37,381	-44,449	-44,527	+19	+8,071	+36	+8,064
Canada										
Ontario System (energy)										
St. Lawrence	-1,907	-905	-7	-998	-1,924	-1,936	-1	+217	+3	+213
Niagara	-9,343	-4,226	+1,061	-1,963	-6,510	-5,683	-2,013	+465	+1,488	+2,023
St. Marys	-113	-51	+4	+34	-21	-22	-9	+3	+7	+16
Nipigon	-6,998	-3,567	0	0	-3,567	-3,567	0	+840	0	+840
Aquasabon	-3,100	-1,634	0	0	-1,634	-1,634	0	+373	0	+373
Total Energy	-21,461	-10,383	+1,058	-2,927	-13,656	-12,842	-2,023	+1,898	+1,498	+3,465
Total Capacity	-2,642	-1,966	-48	-235	-2,240	-2,322	-1,960	+68	-16	+43
Quebec System (energy)										
St. Lawrence	-1,586	-780	0	-857	-1,640	-1,644	-8	+193	0	+194
Total Canada	-25,689	-13,129	+1,010	-4,019	-17,536	-16,808	-3,991	+2,159	+1,482	+3,702
Total U.S. and Canada	-40,246	-20,017	+973	-41,400	-61,985	-61,335	-3,972	+10,230	+1,518	+11,766

(c) Continuous
(t) On trigger

United States entitlement = 1/2 (adjusted Lake Erie outflow - falls flow - 2500)

(2) When Long Lac/Ogoki Diversions were reduced to zero continuously:

Canada entitlement = 1/2 (adjusted Lake Erie outflow - falls flow)
United States entitlement = 1/2 (adjusted Lake Erie outflow - falls flow)

(3) When Long Lac/Ogoki Diversions were 5,000 cfs or 5,600 cfs continuously, the diversion entitlements were as shown in Appendix E, Section 3.2.3(3) namely:

Canada entitlement = 1/2 (adjusted Lake Erie outflow - falls flow + 5,000)
United States entitlement = 1/2 (adjusted Lake Erie outflow - falls flow - 5,000)

Thus the effect of reducing the Long Lac/Ogoki Diversions would be borne by the Canadian power interest. The effect of increasing the diversion from 5,000 to 5,600 cfs would be shared equally between Canada and the United States.

(b) The effect of increasing the Lake Michigan Diversion at Chicago would be shared equally between Canada and the United States.

(c) When the Welland Canal flow is increased to 9,000 cfs or 9,400 cfs, the diversion to Decew Falls generating station would be 6,800 cfs each month. Thus the effect of increasing the Welland Canal flow would be borne by the Canadian power plants, with no effect to the U.S. power plant.

3.3.3 Moses-Saunders (St. Lawrence) Power Plants, Assumptions

The effect of altering any diversion would be shared equally between Canada and the United States.

3.3.4 Beauharnois-Les Cedres (St. Lawrence) Power Plants, Assumptions

Since the Beauharnois-Les Cedres power plants use the total flow of the St. Lawrence River, the full effect of altering the diversions would be borne by the Quebec System.

3.3.5 Nipigon River Power Plants

3.3.5.1 General Description

There are three hydro-electric generating stations on the Nipigon River, which flows south from Lake Nipigon some 34 miles into Lake Superior. These generating stations, Pine Portage, Cameron Falls, and Alexander Falls are owned and operated by Ontario Hydro. They have a combined installed capacity of some 265,950 kW. Any reduction in the Ogoki Diversion will ultimately reduce the output of these plants.

3.3.5.2 Assumptions

In any month that the Ogoki Diversion would be reduced to zero, there would be no change in the elevation of Lake Nipigon and the Nipigon River flow would be reduced by 3,700 cfs for that same month.

3.3.5.3 Peak and Energy Outputs

The peak and energy outputs were determined for each plant, for each month of the period of record, January 1944 through December 1976, using a methodology developed by Ontario Hydro. For the basis-of-comparison, monthly peak and energy outputs were determined from the observed flows. For those scenarios in which the Ogoki Diversion was reduced to zero, monthly peak and energy outputs were determined from observed flows minus 3,700 cfs. Thus the average annual loss was computed for the 33 year period, 1944 to 1976, and assumed to apply over the longer period 1900 to 1976. Similarly the loss in dependable peak capacity was determined by an examination of December and January peak outputs computed from the basis-of-comparison and each diversion scenario.

3.3.6 Aguasabon River Plants

3.3.6.1 General Description

The Long Lac Diversion flows south from Long Lake down the Aguasabon River to Lake Superior and is utilized by one hydro-electric plant, Aguasabon generating station, with an installed capacity of 40,500 kW.

3.3.6.2 Assumptions

In any month that the Long Lac Diversion would be reduced to zero, the outflow from Long Lake would be reduced by 1,300 cfs.

3.3.6.3 Peak and Energy Outputs

Peak and energy outputs were determined for each month of the period of record 1944 to 1976 by a methodology developed by Ontario Hydro. Basis-of-comparison outputs were determined from observed flows and outputs. For those scenarios where the diversion would be reduced to zero, they were computed from basis-of-comparison flows minus 1,300 cfs. Thus, the loss in average annual energy and peak capacity was determined for the 33 year period 1944 to 1976 and was assumed to apply over the 77 year period 1900 to 1976.

3.3.7 Determination of Unit Energy and Capacity Values

3.3.7.1 Definitions

Energy value; energy is the average amount of power (Av. MW) that is produced over a period of time; e.g., Av. MW x HRS/yr = average annual energy (MWh). The value of the gain or loss in energy is essentially the cost of fossil or nuclear fuel required to produce the equivalent amount of energy, and is expressed in mills/kWh.

Capacity value; capacity or peak power is the amount of power required (MW) to meet the maximum peak load demands. The value of the gain or loss in peak load meeting capability is therefore the annual value of the capital and the operation and maintenance (O & M) costs of providing additional new thermal generation or capacity, expressed as dollars/kW/yr.

3.3.7.2 Basis of Evaluation

The Lake Erie Board established an Ad-Hoc Economics Subcommittee to determine and recommend certain economic factors and criteria to serve as a common basis of evaluation. The energy and capacity values used for evaluating the effects of regulation plans on hydro-electric power were computed in accordance with these recommendations. An explanation of their determination is given for each power system in Appendix E of the Lake Erie Regulation Board's study report. The values are summarized below:

Annual Amortized Energy and Capacity Values
Used for Evaluating Effects of Diversion
Scenarios on Hydro-Electric Power Generation

	Energy Values			Capacity
	Mills/kWh			Value
Power System	day	night	composite	$/kW/year
Upper Michigan			3.36	28.33
New York State			110.60	70.00
Ontario	17.24	12.12	15.53	33.08
Quebec			7.568	-

3.3.8 Evaluation of Diversion Scenarios

3.3.8.1 General

This section presents the results of the detailed economic evaluation of the ten selected diversion scenarios. Each scenario was evaluated in accordance with the methodology described in the preceeding paragraphs 3.3.1 to 3.3.7. The basis-of-comparison was the same as that used in the Lake Erie Regulation Board Study with the exception that for this study Lake Ontario was regulated in accordance with 1958-D - without discretionary deviations which have occurred over the study period.

3.3.8.2 Adjustments to Energy Benefits

Under the sequence of supply (1900-1976) assumed for this study, the elevations of each of the lakes at the end of the period (December 1976) were different than under the basis-of-comparison. Consequently the actual long-term mean outflow of each diversion scenario was different than the basis-of-comparison average value by varying amounts up to 732 cfs. A sensitivity analysis indicated that this anomaly impacted on the results of the study, and therefore an adjustment was made to the computed average annual energy benefits/losses at the U.S. and Canadian St. Lawrence River generating stations and at the Ontario plants on the Niagara River. No adjustment was necessary at the U.S. plant on the Niagara River because the computed energy benefits/losses were based on flow differences. No adjustment was computed for the St. Marys River plants because they were small and their effect was almost negligible.

The adjusted benefits/losses in average annual energy production and the benefits/losses in peak load meeting capability together with their corresponding annual amortized and present worth values are summarized for each diversion scenario on Tables G-35 to G-44.

The computed energy and peak values for each power system are listed on Tables G-45 to G-53. The adjustments to the computed energy differences for the St. Lawrence River plants and for the Niagara River - Ontario plants are shown on Tables G-54 to G-59.

3.4 Recreational Beaches and Boating

Tables G-60 and G-61 show the impacts on recreational beaches and boating, as developed for this study by the International Lake Erie Regulation Study (ILERS) Board. The evaluation of the changing water level and outflow regimes was carried out only for the lower lakes (below Lake Huron) and the St. Lawrence River. Emphasis was placed on the Lakes St. Clair and Erie areas, as recreation in these areas would be mostly affected by changes in water levels. Since little marina or recreational boating data were available, an inventory was conducted to compile the necessary information. Due to funding limitations, this inventory was not carried out in Canada. The study of effects on recreational beaches in the United States covers the same areas as that for boating. In Canada, the study was confined mostly to the areas of Lakes St. Clair and Erie because of financial constraints.

The two tables (G-60 and G-61) show that the impacts are about equal and opposite; that which is beneficial to beaches is detrimental to boating. The tables also show that the major impacts are in the Lakes St. Clair-Erie areas. Table G-60 also shows that the impact on the United States and Canada shores are about equal (conclusion drawn from one scenario). Furthermore, one could conclude from these tables that as water is removed from the system, benefits to recreational beaches would occur, but in turn, losses to recreational boating would result.

Table G-35

POWER EVALUATION

DIVERSION SCENARIO - 1 LL/O 0 (c) Chi 3200 (c) Well 7000 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	- 7.3		- 113			
Niagara	- 582.7		- 9,343			
St. Lawrence	- 125.1		- 1,907			
Sub Total	- 715.1	-34.85	-11,363	-1,153	-12,516	-144,755
Nipigon	- 450.6	θ	- 6,998	θ	- 6,998	- 80,936
Aguasabon	- 199.6	-45.00	- 3,100	-1,489	- 4,589	- 53,075
Total	-1,365.3	-79.85	-21,461	-2,642	-24,103	-278,766
Quebec System						
St. Lawrence	- 209.6	-	- 1,586	-	- 1,586	- 18,346
Total Canada	-1,574.9	-79.85	-23,047	-2,642	-25,689	-297,112
New York System						
Niagara	θ	θ	θ	θ	θ	θ
St. Lawrence	- 125.1	- 9.50	-13,836	- 655	-14,491	-167,597
Total	- 125.1	- 9.50	-13,836	- 655	-14,491	-167,597
Upper Michigan	- 18.6	- 0.10	- 63	- 3	- 66	- 763
Total US	- 143.7	- 9.60	-13,899	- 658	-14,557	-168,360
Total Can + US	-1,718.6	-89.45	-36,946	-3,300	-40,246	-465,472

(c) = continuous
(t) = on trigger

Table G-36

POWER EVALUATION

DIVERSION SCENARIO - 5 LL/O 0 (t) Chi 3200 (c) Well 7000 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000 Annual Amortized Value Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	- 3.3		- 51			
Niagara	- 263.5		- 4,226			
St. Lawrence	- 59.6		- 905			
Sub Total	- 326.4	-14.42	- 5,182	- 477	- 5,659	- 65,450
Nipigon	- 229.7	θ	- 3,567	θ	- 3,567	- 41,255
Aguasabon	- 105.2	-45.00	- 1,634	-1,489	- 3,123	- 36,119
Total	- 661.3	-59.42	-10,383	-1,966	-12,349	-142,824
Quebec System						
St. Lawrence	- 103.0	θ	- 780	θ	- 780	- 9,016
Total Canada	- 764.3	-59.42	-11,163	-1,966	-13,129	-151,840
New York System						
Niagara	θ	θ	θ	θ	θ	θ
St. Lawrence	- 59.6	- 3.75	- 6,592	- 262	- 6,854	- 79,271
Total	- 59.6	- 3.75	- 6,592	- 262	- 6,854	- 79,271
Upper Michigan	- 9.4	- 0.07	- 32	- 2	- 34	- 393
Total US	- 69.0	- 3.82	- 6,624	- 264	- 6,888	- 79,664
Total Can + US	- 833.3	-63.24	-17,787	-2,230	-20,017	-231,504

(c) = continuous
(t) = on trigger

Table G-37

POWER EVALUATION

DIVERSION SCENARIO - 6   LL/O 5000 (c)   Chi 3200 (c)   Well 9000 (t)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION
AND PEAK LOAD MEETING CAPABILITY
AND CORRESPONDING
ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	+ 0.3		+ 4			
Niagara	+ 72.5		+1,061			
St. Lawrence	- 0.3		- 7			
Sub Total	+ 72.5	- 1.46	+1,058	- 48	+ 1,010	+ 11,681
Nipigon	θ	θ	θ	θ	θ	θ
Aguasabon	θ	θ	θ	θ	θ	θ
Total	+ 72.5	- 1.46	+1,058	- 48	+ 1,010	+ 11,681
Quebec System						
St. Lawrence	θ	θ	θ	θ	θ	θ
Total Canada	+ 72.5	- 1.46	+1,058	- 48	+ 1,010	+ 11,681
New York System						
Niagara	θ	θ	θ	θ	θ	θ
St. Lawrence	- 0.3	- 0.08	- 33	- 6	- 39	- 451
Total	- 0.3	- 0.08	- 33	- 6	- 39	- 451
Upper Michigan	+ 0.5	θ	+ 2	θ	+ 2	+ 23
Total US	+ 0.2	- 0.08	- 31	- 6	- 37	- 428
Total Can + US	+ 72.7	- 1.54	+1,027	- 54	+ 973	+ 11,253

(c) = continuous
(t) = on trigger

Table G-38

POWER EVALUATION

DIVERSION SCENARIO - 7   LL/O 5000 (c)   Chi 8700 (t)   Well 7000 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION
AND PEAK LOAD MEETING CAPABILITY
AND CORRESPONDING
ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	+ 2.2		+ 34			
Niagara	- 122.7		- 1,963			
St. Lawrence	- 65.6		- 998			
Sub Total	- 186.1	- 7.11	- 2,927	- 235	- 3,162	- 36,570
Nipigon	θ	θ	θ	θ	θ	θ
Aguasabon	θ	θ	θ	θ	θ	θ
Total	- 186.1	- 7.11	- 2,927	- 235	- 3,162	- 36,570
Quebec System						
St. Lawrence	- 113.2	θ	- 857	θ	- 857	- 9,908
Total Canada	- 299.3	- 7.11	- 3,784	- 235	- 4,019	- 46,478
New York System						
Niagara	- 265.2	- 7.33	-29,331	- 513	-29,844	
St. Lawrence	- 65.6	- 4.17	- 7,255	- 292	- 7,547	
Total	- 330.8	-11.50	-36,586	- 805	-37,391	-432,449
Upper Michigan	+ 2.4	+ 0.07	+ 8	+ 2	+ 10	+ 116
Total US	- 328.4	-11.43	-36,578	- 803	-37,381	-432,333
Total Can + US	- 627.7	-18.54	-40,362	-1,038	-41,400	-478,811

(c) = continuous
(t) = on trigger

Table G-39

POWER EVALUATION

DIVERSION SCENARIO - 8 LL/O 0 (t) Chi 8700 (t) Well 7000 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	- 1.3		- 21			
Niagara	- 406.4		- 6,510			
St. Lawrence	- 126.4		- 1,924			
Sub Total	- 534.1	-22.69	- 8,455	- 751	- 9,206	-106,473
Nipigon	- 229.7	θ	- 3,567	θ	- 3,567	- 41,255
Aguasabon	- 105.2	-45.00	- 1,634	-1,489	- 3,123	- 36,119
Total	- 869.0	-67.69	-13,656	-2,240	-15,896	-183,847
Quebec System						
St. Lawrence	- 216.7	θ	- 1,640	θ	- 1,640	- 18,968
Total Canada	-1,085.7	-67.69	-15,296	-2,240	-17,536	-202,815
New York System						
Niagara	- 265.2	- 7.33	-29,331	- 513	-29,844	-345,163
St. Lawrence	- 126.4	- 8.58	-13,980	- 601	-14,581	-168,638
Total	- 391.6	-15.91	-43,311	-1,114	-44,425	-513,811
Upper Michigan	- 7.2	θ	- 24	θ	- 24	- 278
Total US	- 398.8	-15.91	-43,335	-1,114	-44,449	-514,089
Total Can + US	-1,484.5	-83.60	-58,631	-3,354	-61,985	-716,904

(c) = continuous
(t) = on trigger

Table G-40

POWER EVALUATION

DIVERSION SCENARIO - 9   LL/O 0 (t)   Chi 8700 (t)   Well 9000 (t)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	- 1.4		- 22			
Niagara	- 347.9		- 5,683			
St. Lawrence	- 127.1		- 1,936			
Sub Total	- 476.4	-25.18	- 7,641	- 833	- 8,474	- 98,007
Nipigon	- 229.7	θ	- 3,567	θ	- 3,567	- 41,255
Aguasabon	- 105.2	-45.00	- 1,634	-1,489	- 3,123	- 36,119
Total	- 811.3	-70.18	-12,842	-2,322	-15,164	-175,381
Quebec System						
St. Lawrence	- 217.2	θ	- 1,644	θ	- 1,644	- 19,011
Total Canada	-1,028.5	-70.18	-14,486	-2,322	-16,808	-194,392
New York System						
Niagara	- 265.2	- 7.33	-29,331	- 513	-29,844	-345,163
St. Lawrence	- 127.1	- 8.58	-14,057	- 601	-14,658	-169,529
Total	- 392.3	-15.91	-43,388	-1,114	-44,502	-514,692
Upper Michigan	- 7.4	θ	- 25	θ	- 25	- 289
Total US	- 399.7	-15.91	-43,413	-1,114	-44,527	-514,981
Total Can + US	-1,428.2	-86.09	-57,899	-3,436	-61,335	-709,373

(c) = continuous
(t) = on trigger

Table G-41

POWER EVALUATION

DIVERSION SCENARIO - 10 LL/O 5000 (c) Chi 3200 (c) Well 2600 (t)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
			Value of Difference - $1000			
	Average Annual Energy gWh	Peak Capacity MW	Annual Amortized Value Energy	Annual Amortized Value Peak	Annual Amortized Value Total	Present Worth of Total
Ontario System						
St. Marys	- 0.6		- 9			
Niagara	- 137.7		- 2,013			
St. Lawrence	+ 0.2		- 1			
Sub Total	- 138.1	-59.25	- 2,023	-1,960	- 3,983	- 46,066
Nipigon	θ	θ	θ	θ	θ	θ
Aguasabon	θ	θ	θ	θ	θ	θ
Total	- 138.1	-59.25	- 2,023	-1,960	- 3,983	- 46,066
Quebec System						
St. Lawrence	- 1.0	θ	- 8	θ	- 8	- 88
Total Canada	- 139.1	-59.25	- 2,031	-1,960	- 3,991	- 46,154
New York System						
Niagara	θ	θ	θ	θ	θ	θ
St. Lawrence	+ 0.2	θ	+ 22	θ	+ 22	+ 254
Total	+ 0.2	θ	+ 22	θ	+ 22	+ 254
Upper Michigan	- 0.7	θ	- 3	θ	- 3	- 35
Total US	- 0.5	θ	+ 19	θ	+ 19	+ 219
Total Can + US	- 139.6	-59.25	- 2,012	-1,960	- 3,972	- 45,935

(c) = continuous

(t) = on trigger

Table G-42

POWER EVALUATION

DIVERSION SCENARIO - 11 LL/O 5600 (c) Chi 3200 (c) Well 7000 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	+ 0.2		+ 3			
Niagara	+ 29.0		+ 465			
St. Lawrence	+ 14.3		+ 217			
Sub Total	+ 43.5	+ 2.07	+ 685	+ 68	+ 753	+ 8,709
Nipigon	+ 54.1	θ	+ 840	θ	+ 840	+ 9,715
Aguasabon	+ 24.0	θ	+ 373	θ	+ 373	+ 4,314
Total	+ 121.6	+ 2.07	+ 1,898	+ 68	+ 1,966	+ 22,738
Quebec System						
St. Lawrence	+ 25.5	θ	+ 193	θ	+ 193	+ 2,232
Total Canada	+ 147.1	+ 2.07	+ 2,091	+ 68	+ 2,159	+ 24,970
New York System						
Niagara	+ 57.8	θ	+ 6,393	θ	+ 6,393	+ 73,939
St. Lawrence	+ 14.3	+ 1.33	+ 1,582	+ 93	+ 1,675	+ 19,372
Total	+ 72.1	+ 1.33	+ 7,975	+ 93	+ 8,068	+ 93,311
Upper Michigan	+ 1.0	θ	+ 3	θ	+ 3	+ 35
Total US	+ 73.1	+ 1.33	+ 7,978	+ 93	+ 8,071	+ 93,346
Total Can + US	+ 220.2	+ 3.40	+10,069	+ 161	+10,230	+118,316

(c) = continuous
(t) = on trigger

Table G-43

POWER EVALUATION

DIVERSION SCENARIO - 12 LL/O 5000 (c) Chi 3200 (c) Well 9400 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
	Average Annual Energy gWh	Peak Capacity MW	Value of Difference - $1000: Annual Amortized Value: Energy	Peak	Total	Present Worth of Total
Ontario System						
St. Marys	+ 0.5		+ 7			
Niagara	+ 105.8		+ 1,488			
St. Lawrence	+ 0.2		+ 3			
Sub Total	+ 106.5	- 0.49	+ 1,498	- 16	+ 1,482	+ 17,140
Nipigon	θ	θ	θ	θ	θ	θ
Aguasabon	θ	θ	θ	θ	θ	θ
Total	+ 106.5	- 0.49	+ 1,498	- 16	+ 1,482	+ 17,140
Quebec System						
St. Lawrence	θ	θ	θ	θ	θ	θ
Total Canada	+ 106.5	- 0.49	+ 1,498	- 16	+ 1,482	+ 17,140
New York System						
Niagara	θ	θ	θ	θ	θ	θ
St. Lawrence	+ 0.2	+ 0.17	+ 22	+ 12	+ 34	+ 393
Total	+ 0.2	+ 0.17	+ 22	+ 12	+ 34	+ 393
Upper Michigan	+ 0.7	θ	+ 2	θ	+ 2	+ 23
Total US	+ 0.9	+ 0.17	+ 24	+ 12	+ 36	+ 416
Total Can + US	+ 107.4	- 0.32	+ 1,522	- 4	+ 1,518	+ 17,556

(c) = continuous
(t) = on trigger

Table G-44

POWER EVALUATION

DIVERSION SCENARIO - 13 LL/O 5600 (c) Chi 3200 (c) Well 9400 (c)

COMPARED TO BASIS-OF-COMPARISON

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

AND PEAK LOAD MEETING CAPABILITY

AND CORRESPONDING

ANNUAL AMORTIZED AND PRESENT WORTH VALUE

	Difference from the Basis-of-Comparison					
			Value of Difference - $1000			
	Average Annual Energy gWh	Peak Capacity MW	Annual Amortized Value Energy	Annual Amortized Value Peak	Annual Amortized Value Total	Present Worth of Total
Ontario System						
St. Marys	+ 1.0		+ 16			
Niagara	+ 137.7		+ 2,023			
St. Lawrence	+ 14.1		+ 213			
Sub Total	+ 152.8	+ 1.31	+ 2,252	+ 43	+ 2,295	+ 26,543
Nipigon	+ 54.1	θ	+ 840	θ	+ 840	+ 9,715
Aguasabon	+ 24.0	θ	+ 373	θ	+ 373	+ 4,314
Total	+ 230.9	+ 1.31	+ 3,465	+ 43	+ 3,508	+ 40,572
Quebec System						
St. Lawrence	+ 25.6	θ	+ 194	θ	+ 194	+ 2,241
Total Canada	+ 255.9	+ 1.31	+ 3,659	+ 43	+ 3,702	+ 42,813
New York System						
Niagara	+ 57.8	θ	+ 6,393	θ	+ 6,393	
St. Lawrence	+ 14.1	+ 1.50	+ 1,559	+ 105	+ 1,664	
Total	+ 71.9	+ 1.50	+ 7,952	+ 105	+ 8,057	+ 93,184
Upper Michigan	+ 2.1	θ	+ 7	θ	+ 7	+ 81
Total US	+ 74.0	+ 1.50	+ 7,959	+ 105	+ 8,064	+ 93,265
Total Can + US	+ 329.9	+ 2.81	+11,618	+ 148	+11,766	+136,078

(c) = continuous
(t) = on trigger

Table G-45

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

ONTARIO SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

	Diversion Scenarios			Average Annual Energy - (gWh)			Difference from Basis-of-Comparison - (gWh)		
				Daytime	Nighttime	Total	Daytime	Nighttime	Total
Basis-of-Comparison	LL/O	5000 (c)	St. Marys	262.2	131.1	393.3			
	Chi.	3200 (c)	Niagara	10,253.5	2,609.0	12,862.5			
	Wel.	7000 (c)	St. Lawrence	4,501.0	1,937.9	6,438.9			
			Total	15,016.7	4,678.0	19,694.7			
1	LL/O	0 (c)	St. Marys	257.3	128.7	386.0	- 4.9	- 2.4	- 7.3
	Chi.	3200 (c)	Niagara	9,817.6	2,476.4	12,294.0	-435.9	-132.6	-568.5
	Wel.	7000 (c)	St. Lawrence	4,431.3	1,892.6	6,323.9	- 69.7	- 45.3	-115.0
			Total	14,506.2	4,497.7	19,003.9	-510.5	-180.3	-690.8
5	LL/O	0 (t)	St. Marys	260.0	130.0	390.0	- 2.2	- 1.1	- 3.3
	Chi.	3200 (c)	Niagara	10,058.5	2,550.4	12,608.9	-195.0	- 58.6	-253.6
	Wel.	7000 (c)	St. Lawrence	4,470.9	1,916.9	6,387.8	- 30.1	- 21.0	- 51.1
			Total	14,789.4	4,597.3	19,386.7	-227.3	- 80.7	-308.0
6	LL/O	5000 (c)	St. Marys	262.4	131.2	393.6	+ 0.2	+ 0.1	+ 0.3
	Chi.	3200 (c)	Niagara	10,290.0	2,646.3	12,936.3	+ 36.5	+ 37.3	+ 73.8
	Wel.	9000 (t)	St. Lawrence	4,501.2	1,938.5	6,439.7	+ 0.2	+ 0.6	+ 0.8
			Total	15,053.6	4,716.0	19,769.6	+ 36.9	+ 38.0	+ 74.9
7	LL/O	5000 (c)	St. Marys	263.7	131.8	395.5	+ 1.5	+ 0.7	+ 2.2
	Chi.	8700 (t)	Niagara	10,168.4	2,583.1	12,751.5	- 85.1	- 25.9	-111.0
	Wel.	7000 (c)	St. Lawrence	4,468.1	1,915.2	6,383.3	- 32.9	- 22.7	- 55.6
			Total	14,900.2	4,630.1	19,530.3	-116.5	- 47.9	-164.4

(c) = continuous

(t) = on trigger

Table G-46

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

ONTARIO SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

Diversion Scenarios			Average Annual Energy - (gWh) Daytime	Nighttime	Total	Difference from Basis-of-Comparison - (gWh) Daytime	Nighttime	Total
Basis-of-Comparison	LL/O 5000 (c)	St. Marys	262.2	131.1	393.3			
	Chi. 3200 (c)	Niagara	10,253.5	2,609.0	12,862.5			
	Wel. 7000 (c)	St. Lawrence	4,501.0	1,937.9	6,438.9			
		Total	15,016.7	4,678.0	19,694.7			
8	LL/O 0 (t)	St. Marys	261.3	130.7	392.0	- 0.9	- 0.4	- 1.3
	Chi. 8700 (t)	Niagara	9,959.5	2,519.8	12,479.3	-294.0	- 89.2	-383.2
	Wel. 7000 (c)	St. Lawrence	4,435.0	1,893.6	6,328.6	- 66.0	- 44.3	-110.3
		Total	14,655.8	4,544.1	19,199.9	-360.9	-133.9	-494.8
9	LL/O 0 (t)	St. Marys	261.3	130.6	391.9	- 0.9	- 0.5	- 1.4
	Chi. 8700 (t)	Niagara	9,981.4	2,554.6	12,536.0	-272.1	- 54.4	-326.5
	Wel. 9000 (t)	St. Lawrence	4,434.9	1,893.8	6,328.7	- 66.1	- 44.1	-110.2
		Total	14,677.6	4,579.0	19,256.6	-339.1	- 99.0	-438.1
10	LL/O 5000 (c)	St. Marys	261.8	130.9	392.7	- 0.4	- 0.2	- 0.6
	Chi. 3200 (c)	Niagara	10,185.9	2,538.5	12,724.4	- 67.6	- 70.5	-138.1
	Wel. 2600 (t)	St. Lawrence	4,500.3	1,938.5	6,438.8	- 0.7	+ 0.6	- 0.1
		Total	14,948.0	4,607.9	19,555.9	- 68.7	- 70.1	-138.8

(c) = continuous
(t) = on trigger

Table G-47

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

ONTARIO SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

Diversion Scenarios				Average Annual Energy - (gWh)			Difference from Basis-of-Comparison - (gWh)		
				Daytime	Nighttime	Total	Daytime	Nighttime	Total
Basis-of-Comparison	LL/O	5000 (c)	St. Marys	262.2	131.1	393.3			
	Chi.	3200 (c)	Niagara	10,253.5	2,609.0	12,862.5			
	Wel.	7000 (c)	St. Lawrence	4,501.0	1,937.9	6,438.9			
			Total	15,016.7	4,678.0	19,694.7			
11	LL/O	5600 (c)	St. Marys	262.3	131.2	393.5	+ 0.1	+ 0.1	+ 0.2
	Chi.	3200 (c)	Niagara	10,274.5	2,615.4	12,889.9	+ 21.0	+ 6.4	+ 27.4
	Wel.	7000 (c)	St. Lawrence	4,509.3	1,943.5	6,542.8	+ 8.3	+ 5.6	+ 13.9
			Total	15,046.1	4,690.1	19,736.2	+ 29.4	+ 12.1	+ 41.5
12	LL/O	5000 (c)	St. Marys	262.5	131.3	393.8	+ 0.3	+ 0.2	+ 0.5
	Chi.	3200 (c)	Niagara	10,295.0	2,675.2	12,970.2	+ 41.5	+ 66.2	+107.7
	Wel.	9400 (c)	St. Lawrence	4,501.8	1,938.4	6,440.2	+ 0.8	+ 0.5	+ 1.3
			Total	15,059.3	4,744.9	19,804.2	+ 42.6	+ 66.9	+109.5
13	LL/O	5600 (c)	St. Marys	262.9	131.4	394.3	+ 0.7	+ 0.3	+ 1.0
	Chi.	3200 (c)	Niagara	10,318.2	2,682.4	13,000.6	+ 64.7	+ 73.4	+138.1
	Wel.	9400 (c)	St. Lawrence	4,509.4	1,943.7	6,453.1	+ 8.4	+ 5.8	+ 14.2
			Total	15,090.5	4,757.5	19,848.0	+ 73.8	+ 79.5	+153.3

(c) = continuous
(t) = on trigger

Table G-48

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

ONTARIO SYSTEM

DIFFERENCE IN PEAK LOAD MEETING CAPABILITY

	Basis-of-Comparison	Diversion Scenarios 1	5	6	7	8
MEAN - MW	3010.66	2976.73	2996.31	3009.22	3003.25	2988.03
ST. DEV. - MW	68.6473	86.5156	70.0805	69.0290	67.6428	70.0390
ΔLMC_{MH} - MW	-	-33.93	-14.35	-1.44	-7.16	-22.63
ΔV_H	-	-2772.51	-198.83	+52.55	+136.90	-193.01
ΔLMC_{VH} - MW	-	-0.9242	-0.0663	-0.0175	+0.0466	-0.0643
$\Sigma(\Delta LMC)$ - MW	-	-34.85	-14.42	-1.46	-7.11	-22.69

NOTE: $\Sigma(\Delta LMC)$ = Difference in peak load meeting capability
= Difference in December hydraulic mean + difference in December hydraulic variance
= $\Delta LMC_{MH} + \Delta LMC_{VH}$

Table G-49

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

ONTARIO SYSTEM

DIFFERENCE IN PEAK LOAD MEETING CAPABILITY

	Basis-of-Comparison	Diversion Scenarios				
		9	10	11	12	13
MEAN - MW	3010.66	2985.57	2954.84	3012.69	3010.08	3011.86
ST. DEV. - MW	68.6473	70.6403	122.5269	67.8820	66.6079	66.1041
ΔLMC_{MH} - MW	-	-25.09	-55.82	+2.03	-0.58	+1.20
ΔV_H	-	277.60	-10300.39	+104.48	+275.83	+342.70
ΔLMC_{VH} - MW	-	-0.0925	-3.433	+0.0348	+0.0919	+0.1142
$\Sigma(\Delta LMC)$ - MW	-	-25.1825	-59.25	+2.07	-0.49	+1.31

NOTE: $\Sigma(\Delta LMC)$ = Difference in peak load meeting capability
= Difference in December hydraulic mean + difference in December hydraulic variance
= $\Delta LMC_{MH} + \Delta LMC_{VH}$

Table G-50

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

QUEBEC SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION

	Diversion Scenarios-cfs			Average Annual	Difference from
	LL/O	Chi.	Wel.	Energy - gWh	Basis-of-Comparison - (gWh)
Basis-of-Comparison	5000(c)	3200(c)	7000(c)	11500.5	
1	0(c)	3200(c)	7000(c)	11308.5	-192.0
5	0(t)	3200(c)	7000(c)	11413.6	- 86.9
6	5000(c)	3200(c)	9000(t)	11503.4	2.9
7	5000(c)	8700(t)	7000(c)	11405.7	- 94.8
8	0(t)	8700(t)	7000(c)	11312.9	-187.6
9	0(t)	8700(t)	9000(t)	11313.6	-186.9
10	5000(c)	3200(c)	2600(t)	11500.0	- 0.5
11	5600(c)	3200(c)	7000(c)	11525.6	25.1
12	5000(c)	3200(c)	9400(c)	11502.9	2.4
13	5600(c)	3200(c)	9400(c)	11526.6	26.1

(c) = continuous
(t) = on trigger

TABLE G-51

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

NEW YORK STATE SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY
AND
PEAK LOAD MEETING CAPABILITY

	Diversion Scenarios - cfs				Difference from Basis-of-Comparison	
	LL/O	Chi.	Wel.		Average Annual Energy = gWh	Peak Capacity - MW
Basis-of-Comparison	5000 (c)	3200 (c)	7000 (c)			
1	0 (c)	3200 (c)	7000 (c)	Niagara	0	0
				St. Lawrence	-125.1	-9.50
				Total	-125.1	-9.50
5	0 (t)	3200 (c)	7000 (c)	Niagara	0	0
				St. Lawrence	- 59.6	-3.75
				Total	- 59.6	-3.75
6	5000 (c)	3200 (c)	9000(t)	Niagara	0	0
				St. Lawrence	- 0.3	-0.08
				Total	- 0.3	-0.08
7	5000 (c)	8700 (t)	7000 (c)	Niagara	-265.2	-7.33
				St. Lawrence	- 65.6	-4.17
				Total	-330.8	-11.50
8	0 (t)	8700 (t)	7000 (c)	Niagara	-265.2	-7.33
				St. Lawrence	-126.4	-8.58
				Total	-391.6	-15.91

(c) = continuous

(t) = on trigger

Table G-52

POWER EVALUATION

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

NEW YORK STATE SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY
AND
PEAK LOAD MEETING CAPABILITY

	Diversion Scenarios - cfs				Difference from Basis-of-Comparison	
	LL/O	Chi.	Wel.		Average Annual Energy - gWh	Peak Capacity - MW
Basis-of-Comparison	5000 (c)	3200 (c)	7000 (c)			
9	0 (t)	8700 (t)	9000 (t)	Niagara	-265.2	-7.33
				St. Lawrence	-127.1	-8.58
				Total	-392.3	-15.91
10	5000 (c)	3200 (c)	2600 (t)	Niagara	0	0
				St. Lawrence	+0.2	0
				Total	+0.2	0
11	5600 (c)	3200 (c)	7000 (c)	Niagara	+57.8	0
				St. Lawrence	+14.3	+1.33
				Total	+72.1	+1.33
12	5000 (c)	3200 (c)	9400 (c)	Niagara	0	0
				St. Lawrence	+0.2	+0.17
				Total	+0.2	+0.17
13	5600 (c)	3200 (c)	9400 (c)	Niagara	+57.8	0
				St. Lawrence	+14.1	+ 1.50
				Total	+71.9	+ 1.50

(c) = continuous
(t) = on trigger

Table G-53

DIVERSION SCENARIOS COMPARED TO BASIS-OF-COMPARISON

UPPER MICHIGAN SYSTEM

DIFFERENCE IN AVERAGE ANNUAL ENERGY PRODUCTION
AND
PEAK LOAD MEETING CAPABILITY

	Diversion Scenarios-cfs					Difference from Basis-of-Comparison	
	LL/O	Chi.	Wel.	Average Annual Energy gWh	Peak Capacity MW	Average Annual Energy gWh	Peak Capacity MW
Basis-of-Comparison	5000(c)	3200(c)	7000(c)	379.3	29.26(5)		
1	0(c)	3200(c)	7000(c)	360.7	29.16	-18.6	-0.10
5	0(t)	3200(c)	7000(c)	369.9	29.20	- 9.4	-0.07
6	5000(c)	3200(c)	9000(t)	379.8	29.27	+ 0.5	θ
7	5000(c)	8700(t)	7000(c)	381.6	29.33	+ 2.4	+0.07
8	0(t)	8700(t)	7000(c)	372.1	29.27	+ 7.2	θ
9	0(t)	8700(t)	9000(t)	371.9	29.27	- 7.4	θ
10	5000(c)	3200(c)	2600(t)	378.6	29.26	- 0.7	θ
11	5600(c)	3200(c)	7000(c)	380.3	29.27	+ 1.0	θ
12	5000(c)	3200(c)	9400(c)	380.0	29.27	+ 0.7	θ
13	5600(c)	3200(c)	9400(c)	381.4	29.28	+ 2.1	θ

(c) = continuous
(t) = on trigger

Table G-54

POWER EVALUATION

ONTARIO SYSTEM - NIAGARA RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY FOR DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Erie Mean Outflow from Basis-of-Comparison = 207,175 cfs

Diversion Scenario	Lake Erie Mean Outflow: from Diversion Scenario (cfs)	Difference from Basis-of-Comparison: Predicted (cfs)	Computed (cfs)	Diff. (cfs)	Canada Share (cfs)	Incremental Economy Factor (kW/cfs)		Average Annual Energy: Adjustment (gWh)	Δ B.C. Before Adjustment (gWh)	Δ B.C. After Adjustment (gWh)
1 LL/O 0 (c)	202,421	-5000	-4754	-246	-123	13.29	day	-9.5	-435.9	-445.4
Chi. 3200 (c)							night	-4.7	-132.6	-137.3
Wel. 7000 (c)							total	-14.2	-568.5	-582.7
5 LL/O 0 (t)	204,863	-2500	-2312	-188	-94	12.02	day	-6.6	-195.0	-201.6
Chi. 3200 (c)							night	-3.3	-58.6	-61.9
Wel. 7000 (c)							total	-9.9	-253.6	-263.5
6 LL/O 5000 (c)	207,201	0	+26	+26	+13	11.04	day	-0.9	+36.5	+35.6
Chi. 3200 (c)							night	-0.4	+37.3	+36.9
Wel. 9000 (t)							total	-1.3	+73.8	+72.5
7 LL/O 5000 (c)	204,687	-2750	-2488	-262	-131	10.18	day	-7.8	-85.1	-92.9
Chi. 8700 (t)							night	-3.9	-25.9	-29.8
Wel. 7000 (c)							total	-11.7	-111.0	-122.7
8 LL/O 0 (t)	202,369	-5250	-4806	-444	-221	11.96	day	-15.5	-294.0	-309.5
Chi. 8700 (t)							night	-7.7	-89.2	-96.9
Wel. 7000 (c)							total	-23.2	-383.2	-406.4

(c) = Continuous (t) = on Trigger

Table G-55

POWER EVALUATION

ONTARIO SYSTEM - NIAGARA RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY
FOR
DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Erie Mean Outflow from Basis-of-Comparison = 207,175 cfs

Diversion Scenario	Lake Erie Mean Outflow from Diversion Scenario	Lake Erie Mean Outflow: Difference from Basis-of-Comparison: Predicted	Computed	Diff.	Canada Share	Incremental Economy Factor		Average Annual Energy: Adjustment	Δ B.C. Before Adjustment	Δ B.C. After Adjustment
	cfs	cfs	cfs	cfs	cfs	kW/cfs		gWh	gWh	gWh
9 LL/O 0 (t)	202,402	-5250	-4773	-477	-238	10.24	day	-14.2	-272.1	-286.3
Chi. 8700 (t)							night	-7.2	-54.4	-61.6
Wel. 9000 (t)							total	-21.4	-326.5	-347.9
10 LL/O 5000 (c)	207,166	0	-9	-9	-4	11.04	day	+0.3	-67.6	-67.3
Chi. 3200 (c)							night	+0.1	-70.5	-70.4
Wel. 2600 (t)							total	+0.4	-138.1	-137.7
11 LL/O 5600 (c)	207,741	+600	+566	-34	-17	11.04	day	+1.1	+21.0	+22.1
Chi. 3200 (c)							night	+0.5	+6.4	+6.9
Wel. 7000 (c)							total	+1.6	+27.4	+29.0
12 LL/O 5000 (c)	207,216	0	+41	+41	+20	11.04	day	-1.3	+41.5	+40.2
Chi. 3200 (c)							night	-0.6	+66.2	+65.6
Wel. 9400 (c)							total	-1.9	+107.7	+105.8
13 LL/O 5600 (c)	207,783	+600	+608	+8	+4	11.04	day	-0.3	+64.7	+64.4
Chi. 3200 (c)							night	-0.1	+73.4	+73.3
Wel. 9400 (d)							total	-0.4	+138.1	+137.7

(c) = Continuous (t) = on Trigger

Table G-56

POWER EVALUATION

ONTARIO OR NEW YORK SYSTEM - ST. LAWRENCE RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY FOR DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Ontario Mean Outflow from Basis-of-Comparison = 241,880 cfs

Diversion Scenario			Lake Ontario Mean Outflow from Diversion Scenario	Difference from Basis-of-Comparison: Predicted	Computed	Diff.	Can. or US Share	Incremental Economy Factor		Average Annual Energy: Adjustment	Δ B.C. Before Adjustment	Δ B.C. After Adjustment
			cfs	cfs	cfs	cfs	cfs	kW/cfs		gWh	gWh	gWh
1	LL/O	0 (c)	237,285	-5000	-4595	-405	-202	5.71	day	-6.7	-69.7	-76.4
	Chi.	3200 (c)							night	-3.4	-45.3	-48.7
	Wel.	7000 (c)							total	-10.1	-115.0	-125.1
5	LL/O	0 (t)	239,738	-2500	-2142	-358	-179	5.44	day	-5.7	-30.0	-35.8
	Chi.	3200 (c)							night	-2.8	-21.0	-23.8
	Wel.	7000 (c)							total	-8.5	-51.1	-59.6
6	LL/O	5000 (c)	241,926	0	+46	+46	+23	5.45	day	-0.7	+0.2	-0.5
	Chi.	3200 (c)							night	-0.4	+0.6	+0.2
	Wel.	9000 (t)							total	-1.1	+0.8	-0.3
7	LL/O	5000 (c)	239,549	-2750	-2331	-209	-105	5.44	day	-6.7	-32.9	-39.6
	Chi.	8700 (t)							night	-3.3	-22.7	-26.0
	Wel.	7000 (c)							total	-10.0	-55.6	-65.6
8	LL/O	0 (t)	237,299	-5250	-4581	-669	-334	5.49	day	-10.7	-66.0	-76.7
	Chi.	8700 (t)							night	-5.4	-44.3	-49.7
	Wel.	7000 (c)							total	-16.1	-110.3	-126.4

(c) = Continuous (t) = on Trigger

Table G-57

POWER EVALUATION

ONTARIO OR NEW YORK SYSTEM - ST. LAWRENCE RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY
FOR
DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Ontario Mean Outflow from Basis-of-Comparison = 241,880 cfs

Diversion Scenario			Lake Ontario Mean Outflow from Diversion Scenario	Difference from Basis-of-Comparison: Predicted	Computed	Diff.	Can. or US Share	Incremental Economy Factor	Average Annual Energy	Adjustment	Δ B.C. Before Adjustment	Δ B.C. After Adjustment
			cfs	cfs	cfs	cfs	cfs	kW/cfs		gWh	gWh	gWh
9	LL/O	0 (t)	237,329	-5250	-4551	-699	-350	5.52	day	-11.3	-66.1	-77.4
	Chi.	8700 (t)							night	-5.6	-44.1	-49.7
	Wel.	9000 (t)							total	-16.9	-110.2	-127.1
10	LL/O	5000 (c)	241,866	0	-14	-14	-7	5.45	day	+0.2	-0.7	-0.5
	Chi.	3200 (c)							night	+0.1	+0.6	+0.7
	Wel.	2600 (t)							total	+0.3	-0.1	+0.2
11	LL/O	5600 (c)	242,462	+600	+582	-18	-9	5.45	day	+0.3	+8.3	+8.6
	Chi.	3200 (c)							night	+0.1	+5.6	+5.7
	Wel.	7000 (c)							total	+0.4	+13.9	+14.3
12	LL/O	5000 (c)	241,928	0	+48	+48	+24	5.45	day	-0.7	+0.8	+0.1
	Chi.	3200 (c)							night	-0.4	+0.5	+0.1
	Wel.	9400 (c)							total	-1.1	+1.3	+0.2
13	LL/O	5600 (c)	242,485	+600	+605	+5	+2	5.45	day	-0.1	+8.4	+8.3
	Chi.	3200 (c)							night	0	+5.8	+5.8
	Wel.	9400 (c)							total	-0.1	+14.2	+14.1

(c) = Continuous (t) = on Trigger

Table G-58

POWER EVALUATION

QUEBEC SYSTEM - ST. LAWRENCE RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY
FOR
DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Ontario Mean Outflow from Basis-of-Comparison = 241,859 cfs

Diversion Scenario	Lake Ontario Mean Outflow from Diversion Scenario	Difference from Basis-of-Comparison: Predicted	Computed	Diff.	Canada Share	Incremental Economy Factor		Average Annual Energy: Adjustment	Δ B.C. Before Adjustment	Δ B.C. After Adjustment
	cfs	cfs	cfs	cfs	cfs	kW/cfs		gWh	gWh	gWh
1 LL/O 0 (c)	237,285	-5000	-4574	-426	-426	4.70	day			
Chi. 3200 (c)							night			
Wel. 7000 (c)							total	-17.6	-192.0	-209.6
5 LL/O 0 (t)	239,750	-2500	-2109	-391	-391	4.70	day			
Chi. 3200 (c)							night			
Wel. 7000 (c)							total	-16.1	-86.9	-103.0
6 LL/O 5000 (c)	241,936	0	+77	-77	-77	4.30	day			
Chi. 3200 (c)							night			
Wel. 9000 (t)							total	-2.9	+2.9	0
7 LL/O 5000 (c)	239,556	-2750	-2303	-447	-447	4.70	day			
Chi. 8700 (t)							night			
Wel. 7000 (c)							total	-18.4	-94.8	-113.2
8 LL/O 0 (t)	237,315	-5250	-4544	-706	-706	4.70	day			
Chi. 8700 (t)							night			
Wel. 7000 (c)							total	-29.1	-187.6	-216.7

(c) = Continuous (t) = On Trigger

Table G-59

POWER EVALUATION

QUEBEC SYSTEM - ST. LAWRENCE RIVER PLANTS

ADJUSTMENT TO AVERAGE ANNUAL ENERGY
FOR
DIFFERENCE BETWEEN PREDICTED AND COMPUTED MEAN OUTFLOWS

Lake Ontario Mean Outflow from Basis-of-Comparison = 241,859 cfs

Diversion Scenario	Lake Ontario Mean Outflow from Diversion Scenario	Difference from Basis-of-Comparison Predicted	Computed	Diff.	Canada Share	Incremental Economy Factor		Average Annual Energy Adjustment	Δ B.C. Before Adjustment	Δ B.C. After Adjustment
	cfs	cfs	cfs	cfs	cfs	kW/cfs		gWh	gWh	gWh
9 LL/O 0 (t)	237,341	-5250	-4518	-732	-732	4.72	day			
Chi. 8700 (t)							night			
Wel. 9000 (t)							total	-30.3	-186.9	-217.2
10 LL/O 5000 (c)	241,876	0	+17	-17	-17	3.36	day			
Chi. 3200 (c)							night			
Wel. 2600 (t)							total	-0.5	-0.5	-1.0
11 LL/O 5600 (c)	242,451	+600	+592	+8	+8	4.83	day			
Chi. 3200 (c)							night			
Wel. 7000 (c)							total	+0.4	+25.1	+25.5
12 LL/O 5000 (c)	241,914	0	+55	-55	-55	4.98	day			
Chi. 3200 (c)							night			
Wel. 9400 (c)							total	-2.4	+2.4	0
13 LL/O 5600 (c)	242,471	+600	+612	-12	-12	4.37	day			
Chi. 3200 (c)							night			
Wel. 9400 (c)							total	-0.5	+26.1	+25.6

(c) = Continuous (t) = On Trigger

Table G-60
RECREATIONAL BEACH EVALUATION
(Annual Values in $1000)

Scenarios

	5 LL/O 0 CHI 3200 WELL 7000	6 LL/O 5000 CHI 3200 WELL 9000	7 LL/O 5000 CHI 8700 WELL 7000	9 LL/O 0 CHI 8700 WELL 9000	13 LL/O 5600 CHI 3200 WELL 9400
Waterway					
United States					
St. Lawrence River	4	-1	3	7	-2
Lake Ontario	1	-26	26	40	-33
Niagara River	2	0	4	5	-1
Lake Erie	737	629	615	1,734	620
Detroit River	3	6	3	1	2
St. Clair (Lake & River)	9	2	8	20	5
Total (U.S.)	756	610	659	1,807	591
Canada					
St. Lawrence River	*	*	*	*	*
Lake Ontario	*	*	*	241	*
Niagara River	*	*	*	*	*
Lake Erie	*	*	*	823	*
Detroit River	*	*	*	*	*
St. Clair (Lake & River)	*	*	*	56	*
Total (Canada)	*	*	*	1,120	*
GRAND TOTAL	756	610	659	2,927	591

*Data Not Available

Table G-61
RECREATIONAL BOATING
(Annual Values in $1000)

Scenarios

	5	6	7	9	13
	LL/O 0 CHI 3200 WELL 7000	LL/O 5000 CHI 3200 WELL 9000	LL/O 5000 CHI 8700 WELL 7000	LL/O 0 CHI 8700 WELL 9000	LL/O 5600 CHI 3200 WELL 9000
Waterway					
United States					
St. Lawrence River	-12	4	5	-21	-9
Lake Ontario	+71	53	-7	-53	81
Niagara River	0	1	-2	-7	1
Lake Erie	-356	-229	-403	-851	-154
Detroit River	-47	-16	-38	-119	-30
Lake St. Clair	-191	-55	-273	-503	-111
St. Clair River	-44	-11	-49	-81	-10
Total (U.S.)	-579	-253	-767	-1,635	-232
Canada					
St. Lawrence River	*	*	*	*	*
Lake Ontario	*	*	*	*	*
Niagara River	*	*	*	*	*
Lake Erie	*	*	*	*	*
Detroit River	*	*	*	*	*
Lake St. Clair	*	*	*	*	*
St. Clair River	*	*	*	*	*
Total (Canada)	*	*	*	*	*

*Data Not Available

4 Environmental Evaluation

The maximum-effect diversion scenario, Scenario 9, was evaluated for environmental impact through literature search, simplified models, extrapolation and application of the findings documented by the ILERS Board and the United States Study on Increased Lake Michigan Diversion at Chicago. Additional study data, simplified models, and excerpts from literature references supporting the evaluations, determinations and conclusions expressed in the main report are presented herein.

4.1 Fisheries

Table G-62 illustrates the large variety of forage, sport, and commercial fish species that could be affected during certain life-cycle periods by a reduction in lake water levels. Lower water levels may adversely impact fish populations in these areas; however, attempts of studies to relate specie strength with lake levels have borne mixed results. For example, one study to relate yellow perch year-class strength with lake levels in Saginaw Bay could not establish a relationship; other studies recently conducted in western Lake Erie have been able to interrelate such conditions for several species common to that area. Also, it is known that with losses of certain vegetation types and changes in shallow water habitat, fish populations subsequently change.

4.2 Wetlands

The studies conducted by Jaworski, et al (1979)[15], at specific Great Lakes wetland areas, indicate that, in addition to the changes in total wetland area associated with various lake levels, changes also occur in the relative importance of the four major vegetation zones identified in the Jaworski study. Table G-63 outlines the changes noted in the area of these vegetative zones as related to lake level stages. The general responses of the seven wetland types (illustrated in Figure 2-3 of the main report) to a consistent decrease in water levels are presented in Table G-64.

The effect of lake level changes on wetland vegetation with respect to the diversion scenario using data from the Dickinson Island Marsh and Toussaint Marsh studies are displayed in Figures G-1 and G-2. Lake levels are relative to the long-term basis-of-comparison mean. The lines representing the different regulation plans are for a high four year period and a low four year period. These graphs do not consider lower levels for longer durations (10-15 years) that may occur with changes in the diversion rates.

Within the Great Lakes system, the area most likely to be affected by lake level changes is the shallow water area (nearshore zone). This zone is defined as the area down to the five fathom (30 ft.) depth contour. Charts showing the relative distribution of this zone in the Great Lakes are displayed in Figures G-3 through G-7.

Table G-62
FISH USE OF SHALLOW WATER HABITAT DURING
CRITICAL LIFE PERIODS
(AFTER HARTLEY AND VAN VOOREN, 1979)*

Spawning (shallow protected, with vegetation)	Nursery sand-mud, silt	Feeding	Overwintering (protected with vegetation)	Migration (in and out of small tributaries)
banded killifish	x	x	x	
bigmouth buffalo		x		x
black bullhead	x	x	x	x
black crappie	x	x	x	
blacknose shiner	x	x	x	
bluegill sunfish	x	x	x	
bluntnose minnow	x		x	
bowfin	x	x	x	
brindled madton	x	x	x	
brook silversides	x	x	x	
brown bullhead	x	x	x	x
carp	x	x		x
central mudminnow	x	x	x	
fathead minnow	x	x	x	
golden shiner	x	x		
goldfish	x	x		x
grass pickerel	x	x	x	x
green sunfish	x		x	
gr. side darter	x	x	x	
Iowa darter	x	x	x	
lake chubsucker	x	x	x	
largemouth bass	x	x	x	
muskellunge	x	x		
northern pike	x	x	x	x
pugnose shiner	x	x	x	
pumpkinseed sunfish	x	x	x	
quillback	x	x		x
spotfin shiner	x		x	
yellow bullhead	x	x	x	x
	channel catfish			x
	channel darter			
	gizzard shad			x
	longnose gar	x	x	
	logperch			
	spotted gar	x	x	
	tadpole madton	x	x	
		white crappie	x	
				alewife
				coho salmon
				golden redhorse
				northern redhorse
				rainbow trout
				silver lamprey
				silver redhorse
				smelt
				whitebass
				white sucker

*Hartley, S. M., and A. R. Van Vooren, 1979. The Fish Potentials, Special Management Areas, and their Interactions with Dredge Spoil Sites in Lake Erie. Administrative Report, Ohio Department of Natural Resources.

Table G-63
COMPOSITION OF THE WETLAND VEGETATION BY LAKE LEVEL STAGE, IN MEAN PERCENT OF TOTAL WETLAND AREA**

Vegetation Type	Low Water	Average Level	High Water
Open Water, incl. Submersed and Floating-Leaved	15.3%	26.9%	46.6%
Emergent, incl. Cattail	34.5	30.0	19.4
Sedge Marsh, Meadow	22.5	15.5	8.9
Shrub/Forested Wetland	16.1	15.2	14.3

NOTE: Die-back areas were included in the live category.

** From Jaworski, et al (1979). Failure of the classification to total 100% at any lake level stage is due to the inclusion of developed areas in the wetland total.

Table G-64

GENERAL RESPONSE OF WETLAND TYPES TO LOWERED WATER LEVELS 1/

Wetland Types	Lowered Water Levels
OPEN SHORELINE	A lowering of water levels would result in a lakeward shift of vegetation zones, leaving a dry zone (shrub/tree) at the landward edge. Emergents and sedge/meadow zones would become more prevalent.
UNRESTRICTED BAY	Lowered water levels would encourage the growth of dense emergents at the expense of open-water aquatics.
SHALLOW-SLOPING BEACH	A lowering of water levels may result in vegetation zone shifts over large areas, with extensive sections of the wetlands exhibiting more mesophytic vegetative characteristics. Critical wildlife areas could experience significant damage.
RIVER DELTA	Lower water levels would cause a lakeward shift of vegetation zones, but sedge/meadow zones would be more prevalent at the expense of open-water aquatics.
RESTRICTED RIVERINE	These wetlands would become dominated by emergent and sedge/meadow zones in response to lowered water levels.
LAKE-CONNECTED INLAND	Lowering of the long-term water levels would result in the loss of wetland along the landward perimeter. Sedge/meadow and emergent zones would become prevalent for longer periods and the diversity of wildlife would be reduced. Effects of lowered lake levels may be more severe in this Wetland Type.
PROTECTED	Natural. These wetlands would exhibit denser emergent vegetation and an increase in the extent of the sedge/meadow zones. Dyked. These wetlands could shift to denser emergent vegetation with extreme lowering. Management techniques could offset slightly lowered water levels.

1/ International Lake Erie Regulation Study Board's investigations.

Expected Vegetation Structure at Various Lake Levels for Dickinson Island Marsh (Type 4) Lake St. Clair

LOW PERIOD IS 1963-1966, HIGH PERIOD IS 1973-1976

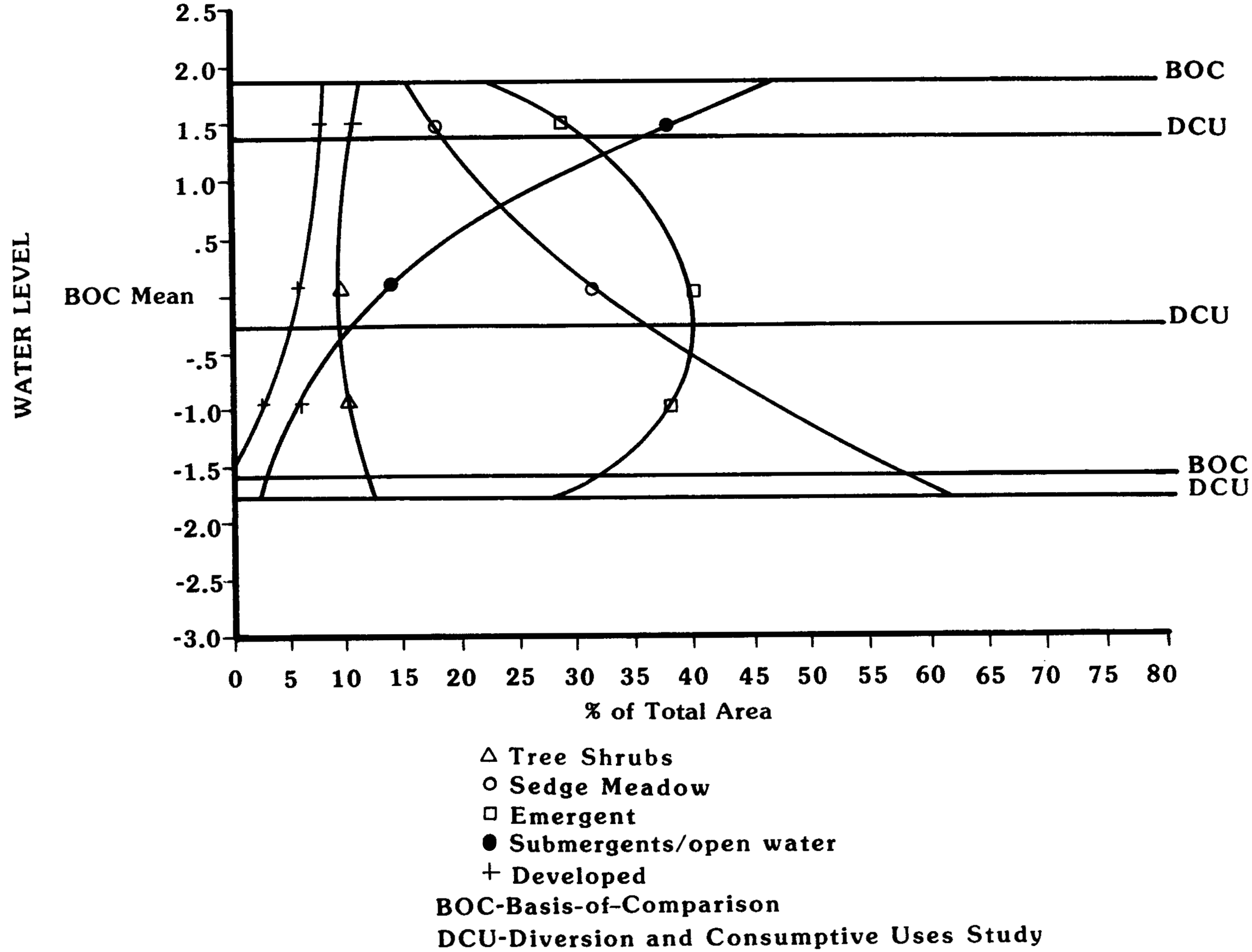
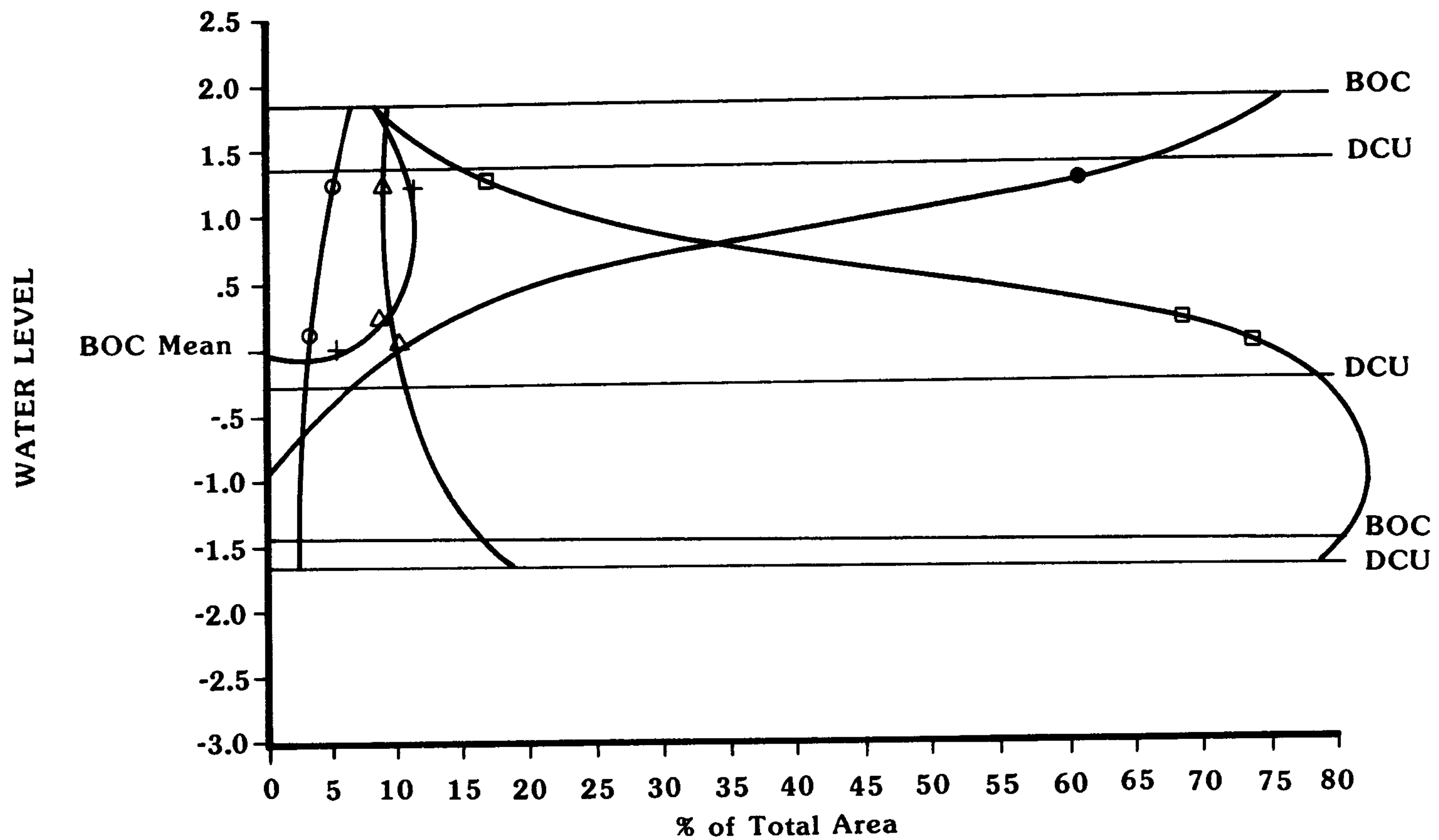


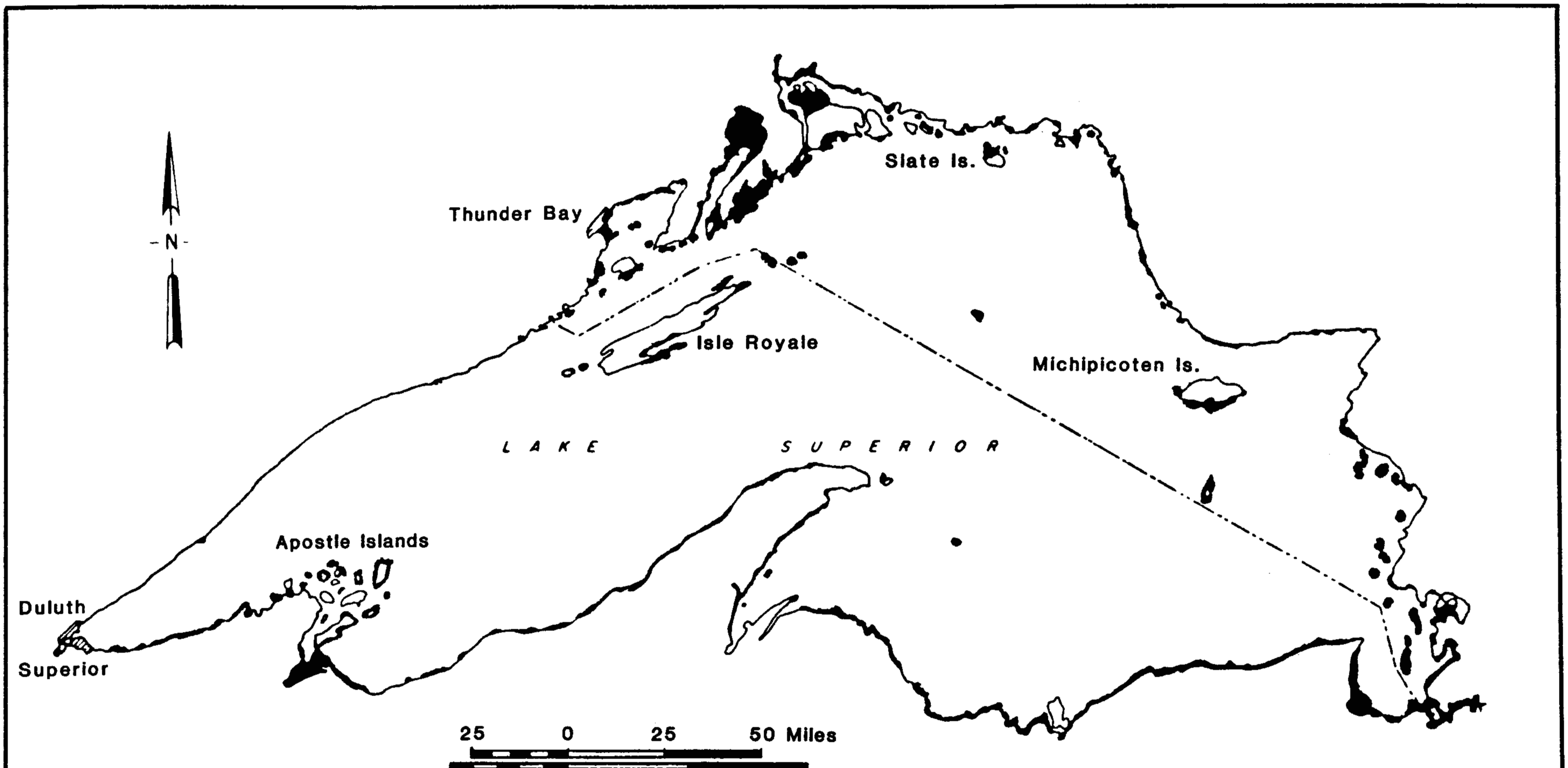
Figure G-1

Expected Vegitation Structure at Various Lake Levels for Toussaint Marsh (Type 7) Lake Erie

LOW PERIOD IS 1933-1936, HIGH PERIOD IS 1973-1976



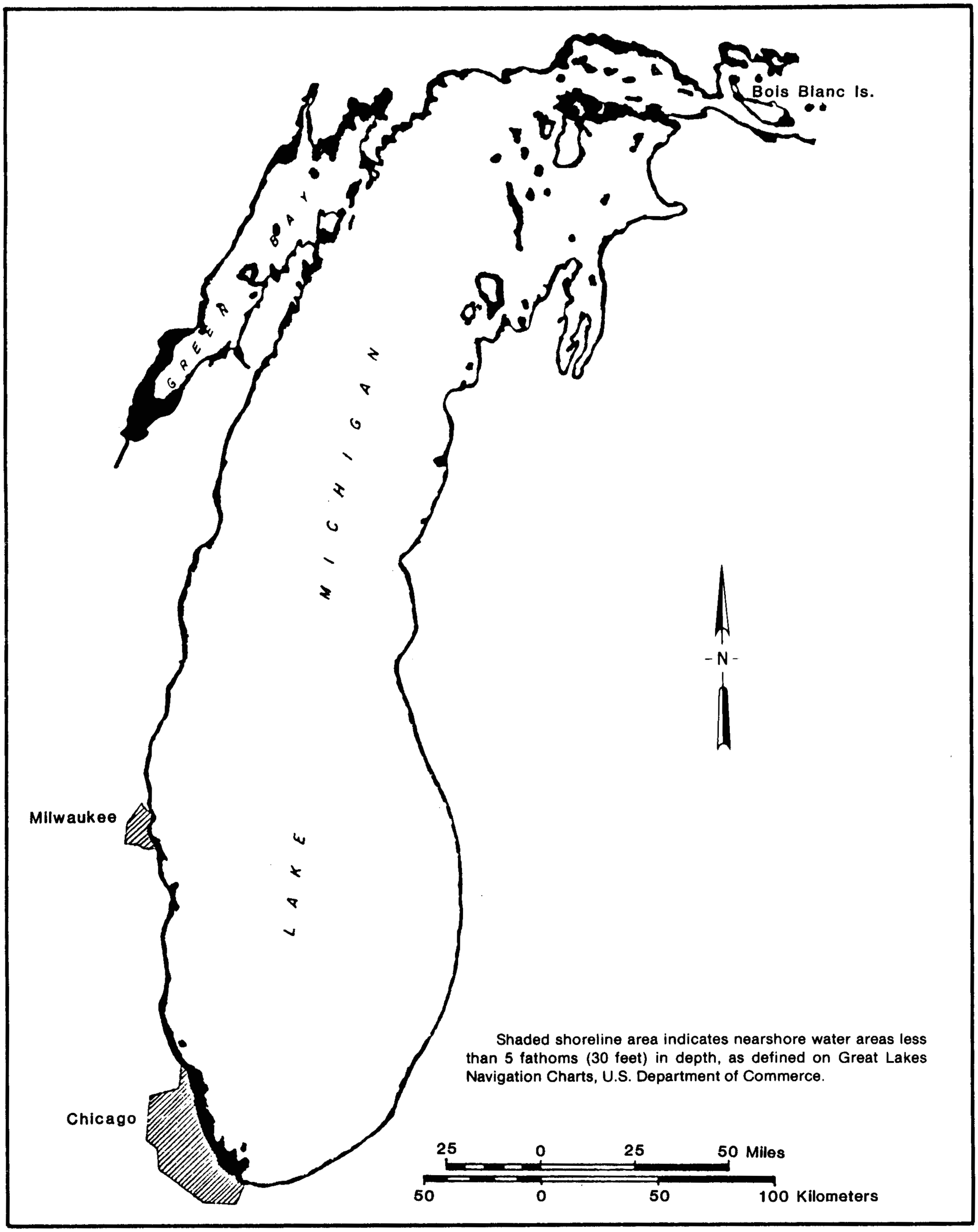
△ Tree Shrubs
○ Sedge Meadow
□ Emergent
● Submergents/open water
+ Developed
BOC-Basis-of-Comparison
DCU-Diversions and Consumptive Uses Study



Shaded shoreline area indicates nearshore water areas less than 5 fathoms (30 feet) in depth, as defined on Great Lakes Navigation Charts, U.S. Department of Commerce.

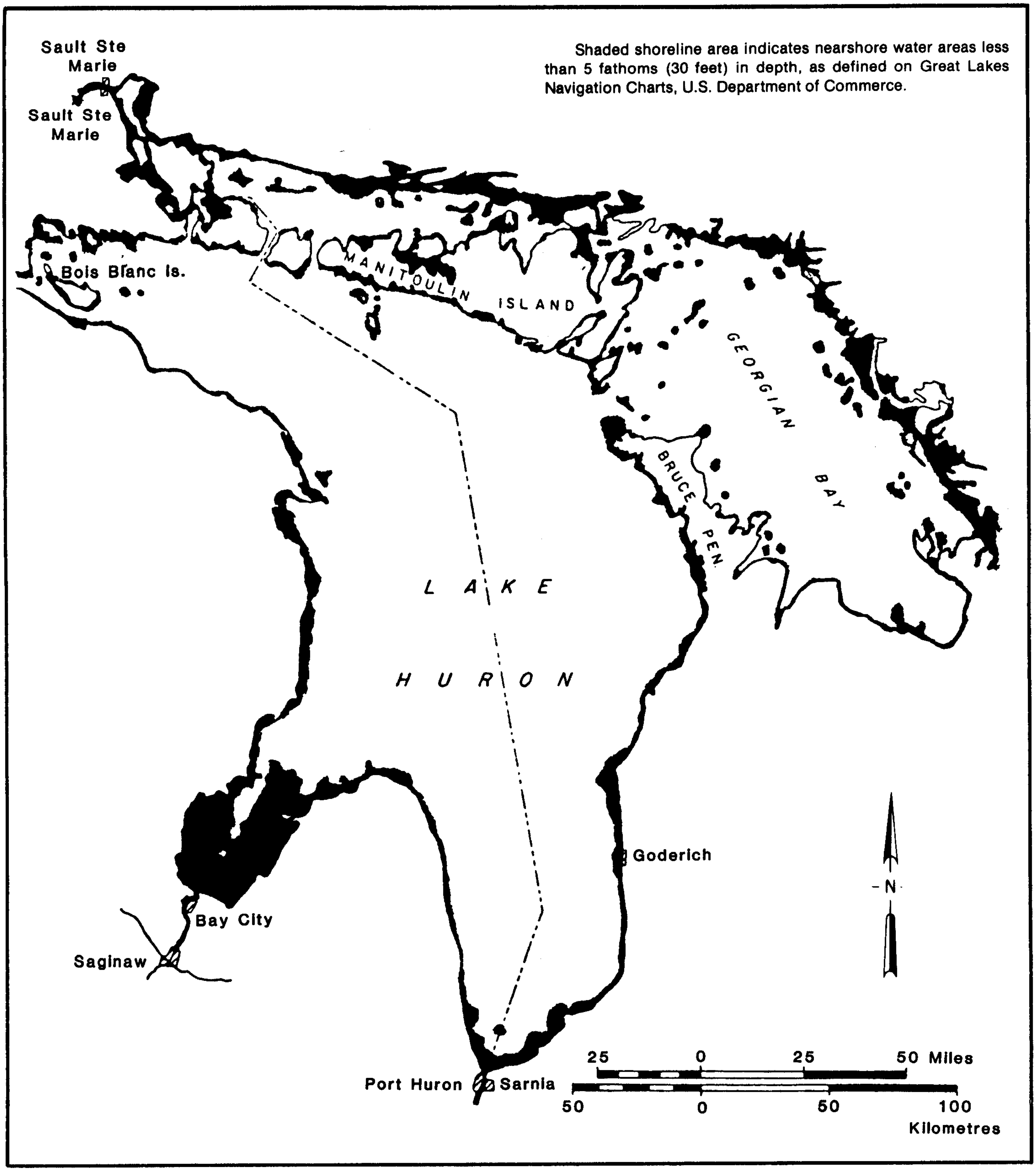
Lake Superior - Nearshore Area

Figure G-3



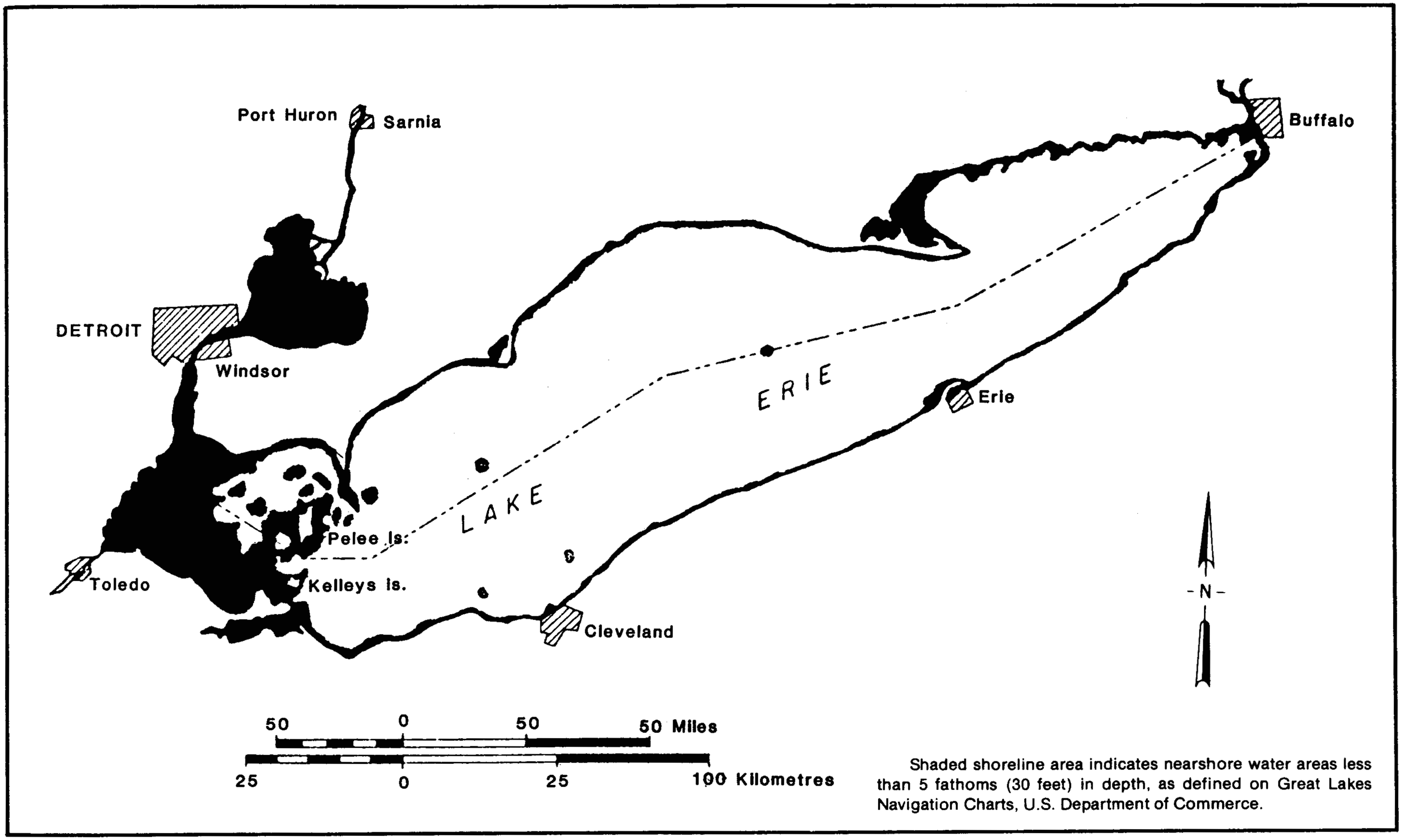
Lake Michigan - Nearshore Area

Figure G-4



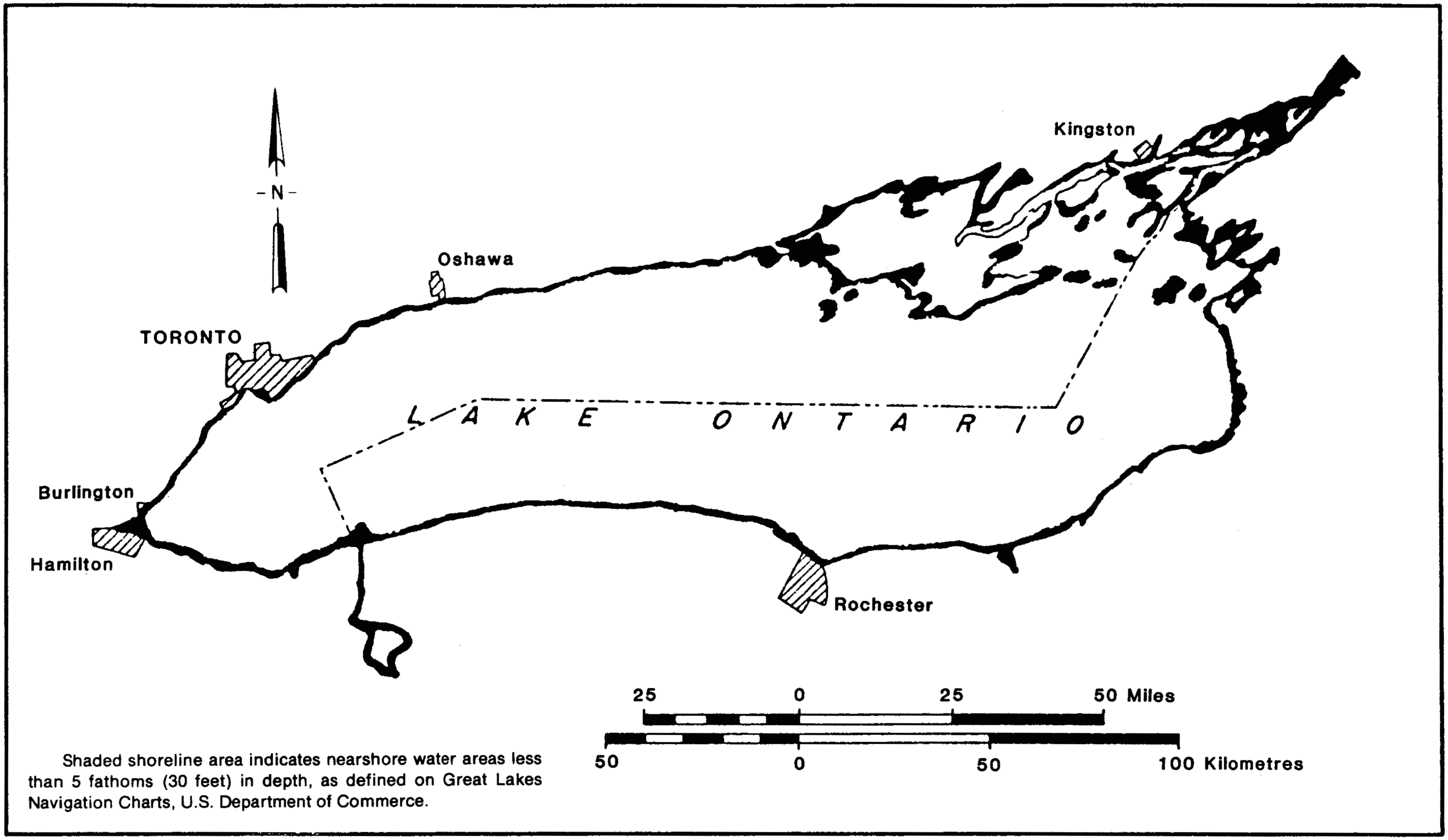
Lake Huron - Nearshore Area

Figure G-5



Lake Erie - Nearshore Area

Figure G-6



Shaded shoreline area indicates nearshore water areas less than 5 fathoms (30 feet) in depth, as defined on Great Lakes Navigation Charts, U.S. Department of Commerce.

Figure G-7

Lake Ontario - Nearshore Area

4.3 Water Quality

4.3.1 Turbidity

Statistically significant correlations were identified between total toe-of-the-bluff energy, which is a function of lake level, and mean monthly turbidity, measured at a water treatment plant on the north shore of the Central Basin of Lake Erie. The derived correlations were applicable only for the months March through August plus November. Due to limited data the equations may be subject to a substantial degree of error. For the maximum-effect diversion scenario the resulting turbidity values are shown in Table G-65.

4.3.2 Cladophora

Table G-66 summarizes the analysis of the Cladophora production in the Lake Erie Bass Islands region where such growth is most prolific. Figure G-8 illustrates the annual production for the maximum-effect diversion scenario and the percentage deviation from basis-of-comparison production.

5 Hydrologic Evaluation of Consumptive Use

Section 6 of the main report describes the current (1975) consumptive use of water within the Great Lakes basin. The section also presents three possible consumptive use projections (high, most likely, and low) to the year 2035. Section 8 of the main report describes the hydrologic effect of the most likely projection. Contained herein are additional hydrologic evaluations for the most likely projection, as well as evaluations for the high and low projections.

5.1 Evaluation Technique

Briefly, the evaluation technique consisted of the following procedures.

a. Adjusting the recorded 1916-1976 water supplies to reflect the projected consumptive use and the routing of these reduced water supplies through the system. Employment of this technique assumed a repeat of the historic water supply sequence in the future.

b. Adjusting the recorded water supplies (1916-1976) to reflect the projected consumptive use at selected points in time and the routing of these reduced water supplies through the system. Employment of this technique would provide a number of evaluations of consumptive use, with the given sequence, at various levels of consumptive use.

c. Adjusting the recorded water supplies (1916-1976) to reflect the progressively increasing consumptive use with cut-off at selected points in time, and the routing of these reduced water supplies through the system. Employment of this technique would provide a number of evaluations of

Table G-65
TURBIDITY EVALUATION OF MAXIMUM-EFFECT DIVERSION SCENARIO FOR THE NORTH SHORE OF THE CENTRAL BASIN OF LAKE ERIE, 1967 - 1976*

	BASIS-OF-COMPARISON	MAXIMUM-EFFECT DIVERSION SCENARIO
Mean Turbidity for Period of Evaluation	22.3 JTU	20.8 JTU**
Mean Turbidity change for Period of Evaluation	x	-1.5 JTU
Mean Percentage Change	x	-6.7%
Greatest Monthly JTU Change	x	-10.5 JTU
Percentage change	x	-11.1%

* Months of January, February, September, October, and December have been excluded from calculations.

**JTU = Jackson Turbidity Units: the measurement of turbidity based on the light path through a suspension (of water) that just causes the image of the flame of a standard candle to disappear. The longer the light path, the lower the turbidity.

Table G-66
MEAN ANNUAL *CLADOPHORA* PRODUCTION IN BASS ISLANDS REGION OF LAKE ERIE AS INFLUENCED BY MAXIMUM-EFFECT DIVERSION SCENARIO
(TONS/YEAR)

	BASIS-OF-COMPARISON	MAXIMUM-EFFECT DIVERSION SCENARIO	Difference
Mean Annual Production	13,012	13,193	+181 (1.4%)
Maximum Annual Increase	13,012	13,770	+758 (7.1%)
Maximum Annual Decrease	13,012	12,914	-98 (0.7%)

Bass Islands Cladophora Production for Maximum-Effect Diversion Scenario

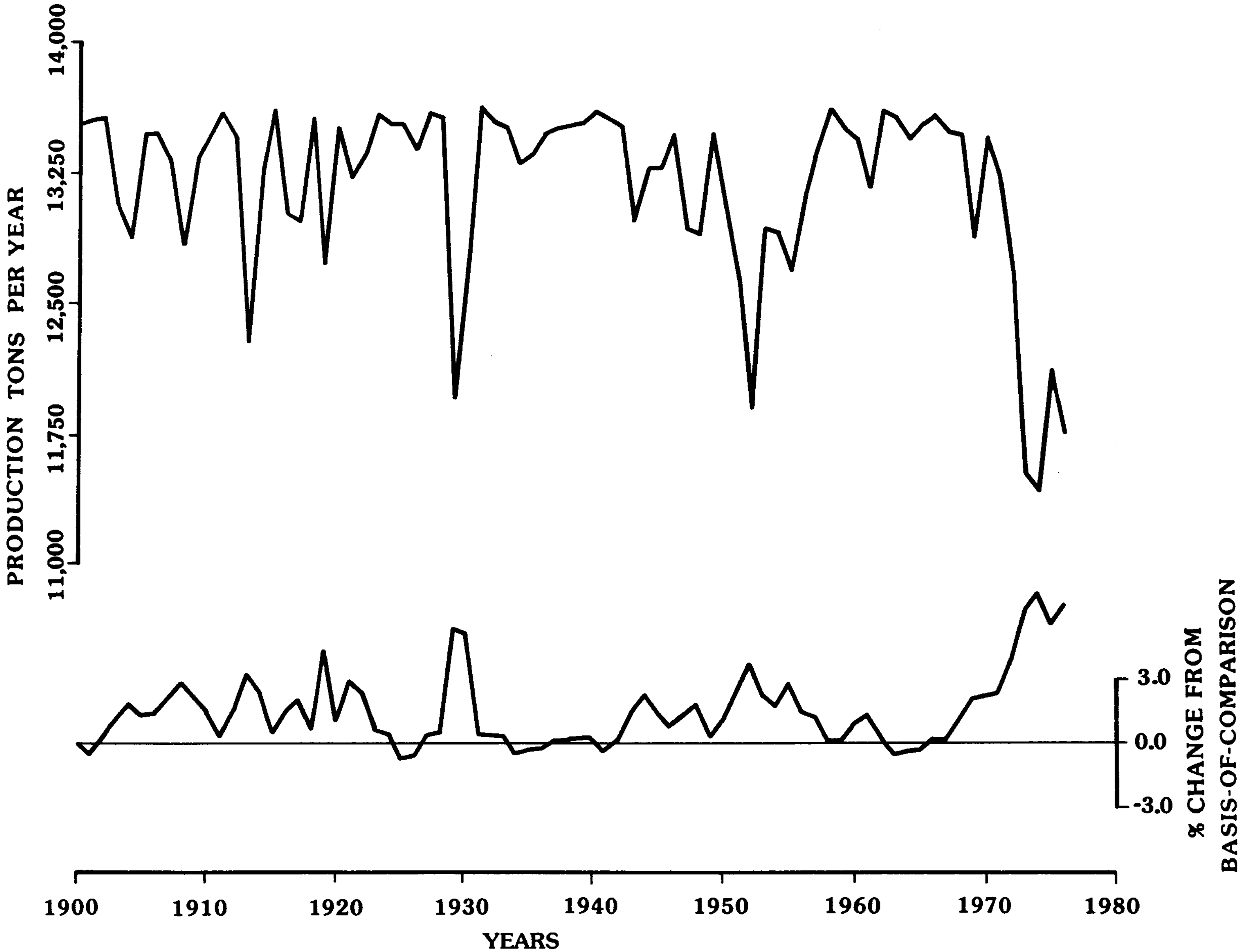


Figure G-8

consumptive use which reflect an increasing effect along with a possible limit to this use in the future. However, the technique is deficient in that it assumes a repeat of the historic water supply sequence.

d. Adjusting the period (1916-1976) average water supplies to reflect the projected consumptive use at selected points in time, and the routing of each through the system. Employment of this method eliminates the consideration of sequences.

e. Adjusting the period (1916-1976) average water supplies to reflect the projected progressively increasing consumptive use with cut-off at selected points in time, and the routing of these reduced water supplies through the system. Employment of this method recognizes that consumptive use may increase with time, but may be limited in time. The technique, by employing the average supply, eliminates the consideration of changing magnitude and sequences.

5.2 Results of Evaluation

The techniques employed to obtain the projected high, most likely and low estimates of consumptive use are outlined in Section 6 of the main report and detailed in Annex F. These projections are shown in Figures G-9, 10, and 11. Figure G-9 shows that for the most likely projection there would be very little increase (small in magnitude) in consumptive use from the Lake Superior basin over the 60 year evaluation period; Lakes Michigan-Huron would increase five-fold; Lake Erie four and one half times; and Lake Ontario nine times. Overall there would be a five-fold increase.

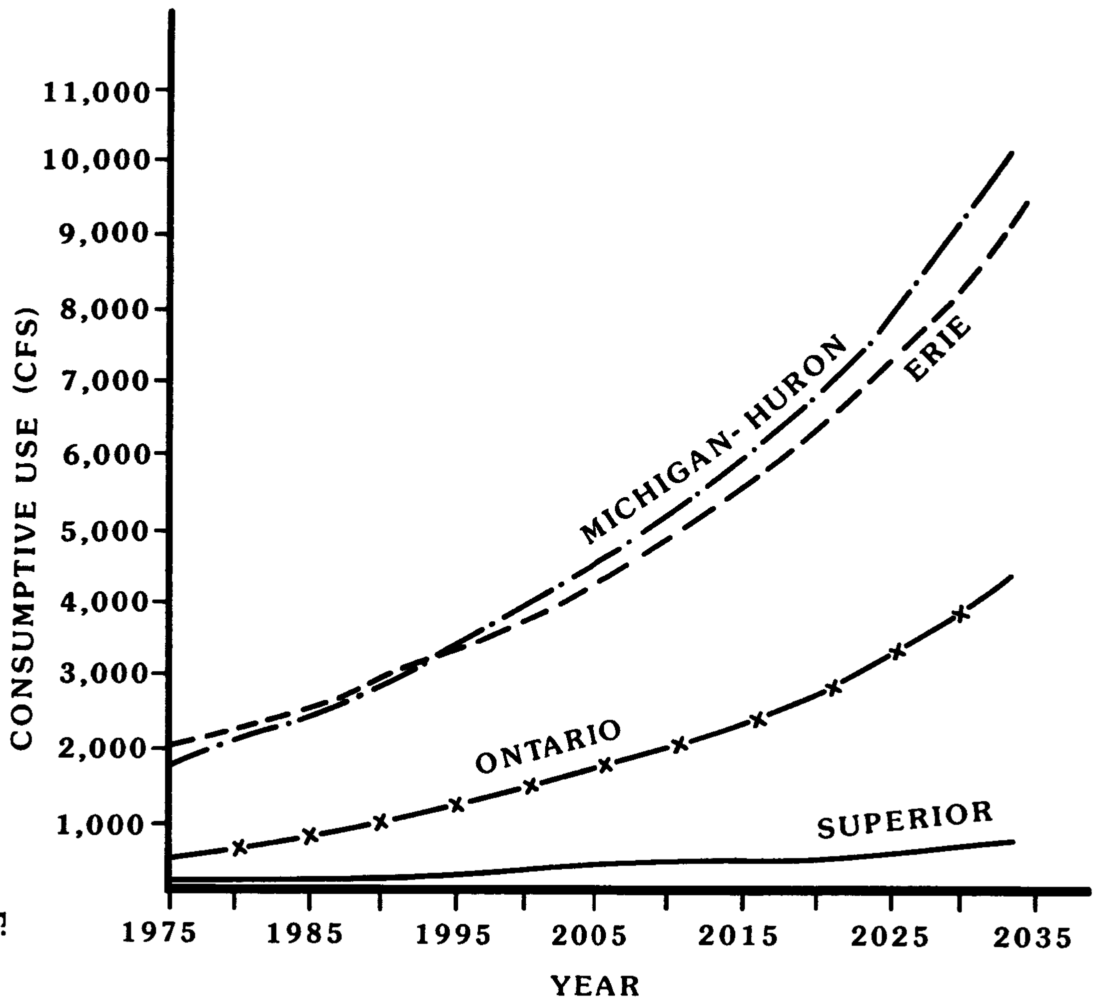
Figure G-10 presents the high projection. It shows that, over the 60 year projection period, the consumptive use from Lake Superior would increase from approximately 240 cfs to 1230 cfs, a five-fold increase; Lakes Michigan-Huron from 1960 cfs to 13,820 cfs, a six-fold increase; Lake Erie from 2210 cfs to 13,500 cfs, a six-fold increase; and Lake Ontario would increase 16 times from 530 cfs to 8000 cfs. Overall, consumptive use (under the high projection) would increase by a factor of seven.

Figure G-11 presents the low projection. It shows a slight increase in water losses from Lake Superior (240 cfs to 700 cfs); a three-fold increase for Lakes Michigan-Huron (1960 cfs to 6960 cfs); a two and one-half increase (2210 cfs to 5590 cfs) for Lake Erie; and an increase in use for Lake Ontario from 530 cfs to 3060 cfs. Overall, the low projection produces a four-fold increase in consumptive use over the 60 year period.

Presented in Tables G-67 to G-78 and described in the listing below are the impacts on Great Lakes levels and flows, if the projected increases in consumptive use become a fact (assuming a repeat of the historic water supplies).

a. Table G-67, column a shows the impact of the MLP by applying technique "a" to the historic water supplies. The table shows that the levels and flows would be lowered. The maximum impact would be felt on Lake Ontario, with the range being expanded by 1.28 feet. This table also contains the impact of the MLP by applying technique "b" to the historic water supplies. Here again there is a general lowering of all levels and

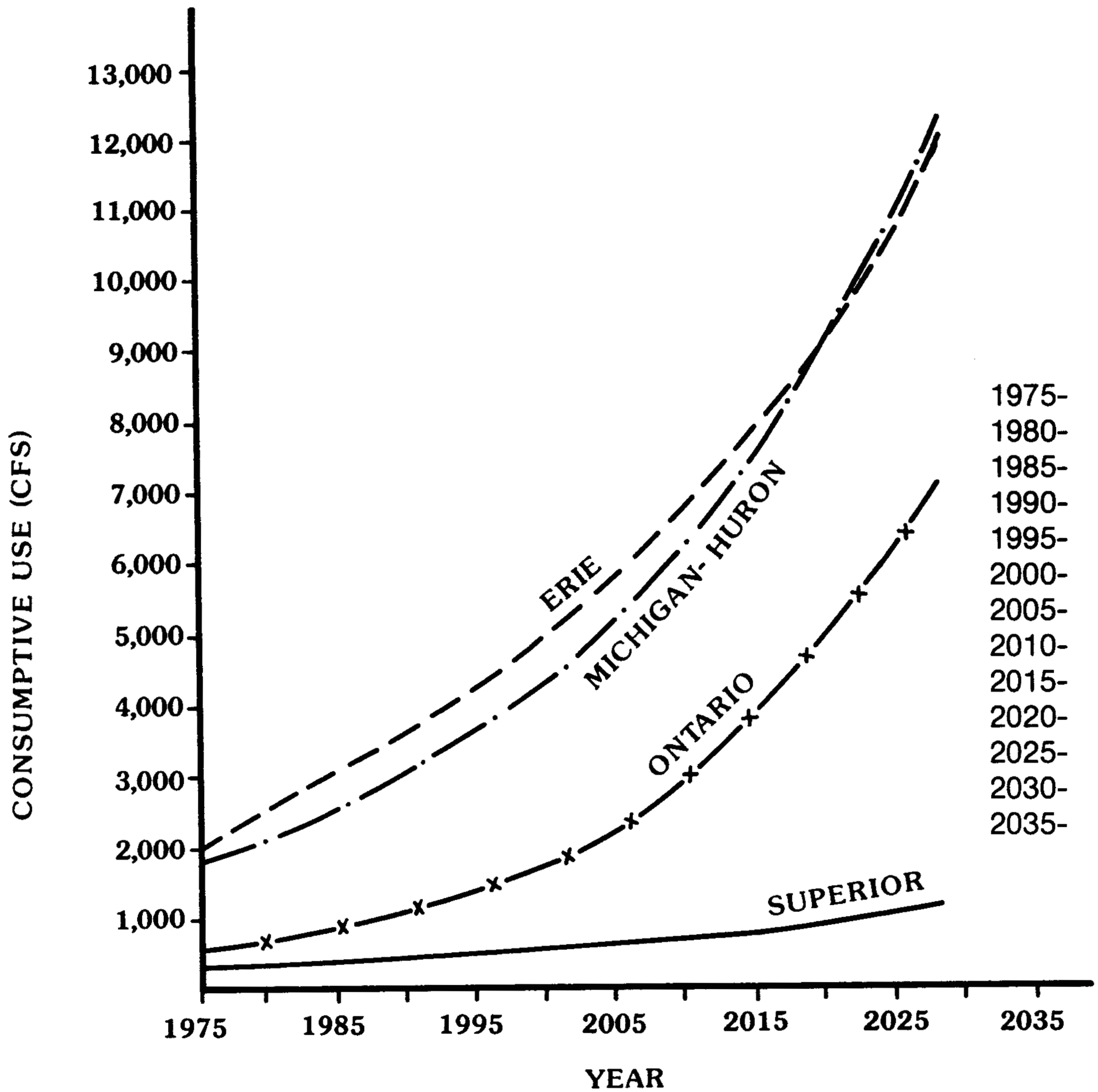
Projected Range of Consumptive Water Uses
Most Likely Projection (MLP)



	SUP	M-H	ER	ONT	TOTAL
1975-	240	1960	2210	530	4940
1980-	260	2290	2420	640	5610
1985-	290	2620	2690	770	6380
1990-	320	3020	3100	940	7390
1995-	350	3560	3520	1130	8560
2000-	380	4140	4000	1370	9890
2005-	420	4670	4550	1620	11300
2010-	460	5360	5150	1920	12900
2015-	500	6150	5850	2280	14800
2020-	550	7020	6380	2750	16900
2025-	600	8050	7470	3280	19400
2030-	670	9190	8380	3840	22100
2035-	740	10550	9490	4570	25400

Figure G-9

Projected Range of Consumptive Water Uses
High Projection



	SUP	M-H	ER	ONT	TOTAL
1975-	240	1960	2210	530	4940
1980-	270	2370	2700	740	6080
1985-	310	2790	3220	930	7250
1990-	350	3290	3840	1170	8650
1995-	400	3870	4490	1440	10200
2000-	440	4500	5180	1750	11900
2005-	500	5210	5970	2180	13900
2010-	580	6090	6850	2690	16200
2015-	660	7100	7820	3280	18900
2020-	790	8430	8990	4270	22500
2025-	930	9960	10300	5390	26600
2030-	1080	11650	11700	6600	31100
2035-	1230	13820	13500	8000	36500

Figure G-10

Projected Range of Consumptive Water Uses

Low Projection

	SUP	M-H	ER	ONT	TOTAL
1975-	240	1960	2210	530	4940
1980-	260	2270	2290	620	5440
1985-	290	2540	2390	730	5950
1990-	320	2890	2510	850	6570
1995-	350	3280	2680	980	7290
2000-	380	3670	2870	1120	8040
2005-	410	3980	3180	1290	8860
2010-	450	4320	3540	1470	9780
2015-	490	4700	3900	1680	10800
2020-	550	5180	4270	1980	12000
2025-	600	5690	4670	2310	13300
2030-	650	6260	5120	2670	14700
2035-	700	6930	5590	3060	16300

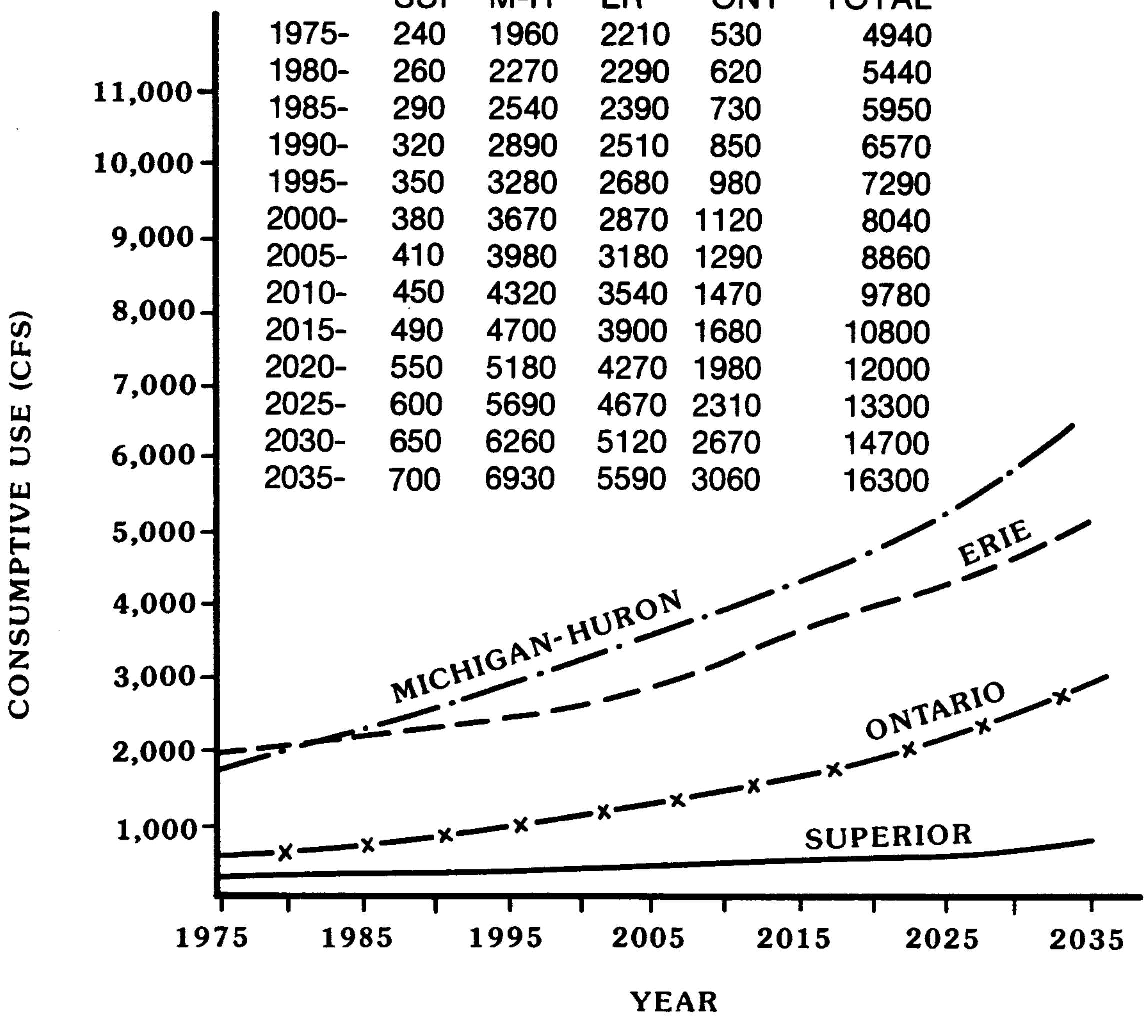


Figure G-11

an increase in the range of levels, with the Lake Ontario range expanding by 5.68 feet (under the 60 year condition). The table also shows a reduction in the outflows from Lake Ontario approximately equal to the increase in consumptive use (19,000 cfs vs. 20,500).

b. Tables G-68 and G-69 present the results of applying techniques "a" and "b" to the historic water supplies, using the high and low projections of consumptive use. Both tables show the accumulated effect as you progress downstream. The marked impact on Lake Ontario reflects the fixed minimum flows limitation employed under regulation and the need to revise the plan of regulation if the projected consumptive use become a reality.

c. Tables G-70, 71 and 72 present the results of applying technique "c" to the historic water supplies, using the MLP, high and low projections of consumptive use. Comparing the results shown in the b column of Table G-67 with those shown in the c column of Table of G-70 indicate a moderating effect under technique "c" as compared to the "b" technique. This was to be expected, since under technique "c" the consumptive use is increasing with time, but with a cut-off at selected points in time.

d. All six of the above tables, as noted, use the historic water supplies. The tables show that there would be a continuing impact with time under "b"; however, under "c" the magnitude of the consumptive use in the latter years have shifted the maximum stage occurrence. This demonstrates the problem with the employment of a given set of water supplies in the evaluation.

e. Tables G-73 (MLP), G-74 (high range) and G-75 (low range) demonstrates the impact employing an average water supply condition for the total period and routing under technique "d".

f. Tables G-76 (MLP), G-77 (high range) and G-78 (low range) show the impact on the levels and flows using technique "e."

g. The above noted six tables produce impacts on the mean level similar to that produced by routing the actual historic water supplies.

5.3 Summary.

In summary, it can be concluded from these evaluations that the magnitude of decrease in levels and flows is directly related to the projected reduction in water supplies caused by increases in consumptive use. As noted from the tables, an increase in consumptive use, throughout the basin, will result in a reduction in outflow from Lake Ontario by an equivalent amount.

Table G-67

EVALUATION OF PROJECTED (MLP) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		b-10		b-20		b-30		b-40		b-50		b-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.30	77	600.36	77	600.33	77	600.30	77	600.26	77	600.20	77	600.13	77
Max.	601.65	120	601.60	120	601.65	120	601.64	120	601.61	120	601.60	120	601.51	119	601.49	118
Min.	598.67	55	598.65	55	598.62	55	598.60	55	598.56	55	598.52	55	598.48	55	598.40	55
Range	2.98	65	2.95	65	3.03	65	3.04	65	3.05	65	3.08	65	3.03	64	3.09	63
LAKES MICHIGAN-HURON																
Mean	578.17	184	577.90	181	578.09	183	578.01	182	577.91	181	577.80	179	577.63	178	577.42	175
Max.	581.13	232	580.91	230	581.06	231	580.97	230	580.88	228	580.74	226	580.57	224	580.35	221
Min.	575.47	112	575.01	110	575.38	111	575.29	110	575.19	109	575.07	107	574.89	105	574.66	103
Range	5.66	120	5.90	120	5.68	120	5.68	120	5.69	119	5.67	119	5.68	119	5.69	118
LAKE ERIE																
Mean	570.73	207	570.44	201	570.65	205	570.57	203	570.47	201	570.34	199	570.18	195	569.96	191
Max.	573.59	270	572.94	257	573.52	269	573.42	266	573.34	264	573.20	261	573.03	257	572.81	252
Min.	568.09	152	567.75	148	568.01	150	567.92	148	567.81	146	567.68	144	567.49	140	567.25	136
Range	5.50	118	5.19	109	5.51	119	5.50	118	5.53	118	5.52	117	5.54	117	5.56	116
LAKE ONTARIO																
Mean	244.74	241	244.23	234	244.67	240	244.56	237	244.38	235	244.13	232	243.58	227	242.30	222
Max.	249.42	310	247.16	310	248.89	310	248.39	310	248.10	310	247.77	310	247.36	310	247.02	310
Min.	241.58	188	238.04	188	240.99	188	240.40	188	239.71	188	238.74	188	237.19	188	233.50	188
Range	7.84	122	9.12	122	7.90	122	7.99	122	8.39	122	9.03	122	10.17	122	13.52	122

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-68

EVALUATION OF PROJECTED (HIGH RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		b-10		b-20		b-30		b-40		b-50		b-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.27	77	600.36	77	600.32	77	600.27	77	600.22	77	600.13	77	600.01	76
Max.	601.65	120	601.60	120	601.66	120	601.62	120	601.60	120	601.57	119	601.48	118	601.42	118
Min.	598.67	55	598.65	55	598.62	55	598.58	55	598.53	55	598.47	55	598.38	55	598.26	55
Range	2.98	65	2.95	65	3.04	65	3.04	65	3.07	65	3.10	64	3.10	63	3.16	63
LAKES MICHIGAN-HURON																
Mean	578.17	184	577.81	180	578.07	183	577.97	181	577.85	180	577.69	178	577.43	175	577.09	172
Max.	581.13	232	580.90	229	581.05	231	580.91	229	580.80	227	580.63	225	580.36	221	579.96	219
Min.	575.47	112	574.84	110	575.37	111	575.25	110	575.12	108	574.95	106	574.68	103	574.31	99
Range	5.66	120	6.06	119	5.68	120	5.66	119	5.68	119	5.68	119	5.68	118	5.65	120
LAKE ERIE																
Mean	570.73	207	570.33	198	570.62	204	570.50	202	570.37	199	570.20	196	569.94	190	569.59	183
Max.	573.59	270	572.91	256	573.50	268	573.36	265	573.23	262	573.06	258	572.79	252	572.43	244
Min.	568.09	152	567.53	144	567.98	149	567.85	147	567.70	144	567.51	141	567.23	136	566.84	129
Range	5.50	118	5.38	112	5.52	119	5.51	118	5.53	118	5.55	117	5.56	116	5.59	115
LAKE ONTARIO																
Mean	244.74	241	243.88	231	244.63	239	244.46	236	244.19	232	243.65	228	241.90	220	236.86	211
Max.	249.42	310	246.97	310	248.81	310	248.27	310	247.89	310	247.41	310	246.92	310	246.30	301
Min.	241.58	188	235.03	188	240.79	188	239.99	188	238.86	188	237.40	188	231.83	188	219.23	188
Range	7.84	122	11.94	122	8.02	122	8.28	122	9.03	122	10.01	122	15.09	122	27.07	113

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-69
EVALUATION OF PROJECTED (LOW RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		b-10		b-20		b-30		b-40		b-50		b-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.33	77	600.37	77	600.36	77	600.33	77	600.31	77	600.28	77	600.25	77
Max.	601.65	120	601.63	120	601.65	120	601.67	120	601.63	120	601.62	120	601.60	120	601.58	120
Min.	598.67	55	598.66	55	598.64	55	598.62	55	598.58	55	598.57	55	598.56	55	598.51	55
Range	2.98	65	2.97	65	3.01	65	3.05	65	3.05	65	3.05	65	3.04	65	3.07	65
LAKES MICHIGAN-HURON																
Mean	578.17	184	578.01	182	578.12	183	578.07	182	578.01	182	577.95	181	577.87	180	577.77	179
Max.	581.13	232	580.95	230	581.11	231	581.04	230	580.99	229	580.90	228	580.82	227	580.72	226
Min.	575.47	112	575.20	111	575.42	112	575.37	111	575.30	110	575.24	110	575.15	108	575.04	107
Range	5.66	120	5.75	119	5.69	119	5.67	119	5.69	119	5.66	118	5.67	115	5.68	119
LAKE ERIE																
Mean	570.73	207	570.58	204	570.69	206	570.65	205	570.59	204	570.52	202	570.44	201	570.34	199
Max.	573.59	270	573.26	263	573.56	269	573.51	268	573.46	267	573.38	265	573.30	263	573.20	261
Min.	568.09	152	568.00	150	568.05	151	568.01	150	567.94	149	567.87	148	567.78	146	567.67	144
Range	5.50	118	5.26	113	5.51	118	5.50	118	5.52	118	5.51	117	5.52	117	5.53	117
LAKE ONTARIO																
Mean	244.74	241	244.47	238	244.70	240	244.65	239	244.58	238	244.48	236	244.31	234	244.07	231
Max.	249.42	310	247.93	310	249.14	310	248.90	310	248.56	310	248.30	310	248.01	310	247.71	310
Min.	241.58	188	239.74	188	241.33	188	240.97	188	240.60	188	240.04	188	239.34	188	238.47	188
Range	7.84	122	8.19	122	7.91	122	7.93	122	7.96	122	8.26	122	8.67	122	9.24	122

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-70

EVALUATION OF PROJECTED (MLP) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		c-10		c-20		c-30		c-40		c-50		c-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.30	77	600.36	77	600.34	77	600.32	77	600.31	77	600.30	77	600.30	77
Max.	601.65	120	601.60	120	601.65	120	601.64	120	601.61	120	601.60	120	601.60	120	601.60	120
Min.	598.67	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55
Range	2.98	65	2.95	65	2.98	65	2.99	65	2.96	65	2.95	65	2.95	65	2.95	65
LAKES MICHIGAN-HURON																
Mean	578.17	184	577.90	181	578.10	183	578.04	182	577.99	182	577.94	181	577.91	181	577.90	181
Max.	581.13	232	580.91	230	581.07	231	580.97	230	580.91	230	580.91	230	580.91	230	580.91	230
Min.	575.47	112	575.01	110	575.39	111	575.30	110	575.19	110	575.07	110	575.01	110	575.01	110
Range	5.66	120	5.90	120	5.69	120	5.67	120	5.72	120	5.84	120	5.90	120	5.90	120
LAKE ERIE																
Mean	570.73	207	570.44	201	570.66	205	570.60	204	570.54	203	570.49	202	570.46	201	570.44	201
Max.	573.59	270	572.94	257	573.53	269	573.42	266	573.34	264	573.20	261	573.04	258	572.94	257
Min.	568.09	152	567.75	148	568.01	150	567.95	149	567.95	149	567.85	149	567.75	148	567.75	148
Range	5.50	118	5.19	109	5.50	119	5.47	117	5.39	115	5.35	112	5.29	110	5.19	109
LAKE ONTARIO																
Mean	244.74	241	244.23	234	244.66	240	244.57	238	244.47	237	244.35	236	244.24	235	244.23	234
Max.	249.42	310	247.16	310	248.93	310	248.39	310	248.12	310	247.77	310	247.36	310	247.16	310
Min.	241.58	188	238.04	188	240.99	188	240.41	188	239.72	188	238.75	188	238.04	188	238.04	188
Range	7.84	122	9.12	122	7.86	122	7.98	122	8.40	122	9.02	122	9.32	122	9.12	122

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-71

EVALUATION OF PROJECTED (HIGH RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		c-10		c-20		c-30		c-40		c-50		c-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.27	77	600.36	77	600.33	77	600.31	77	600.29	77	600.27	77	600.27	77
Max.	601.65	120	601.60	120	601.66	120	601.62	120	601.62	120	601.60	120	601.60	120	601.60	120
Min.	598.67	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55	598.65	55
Range	2.98	65	2.95	65	3.01	65	2.97	65	2.97	65	2.95	65	2.95	65	2.95	65
LAKES MICHIGAN-HURON																
Mean	578.17	184	577.81	180	578.08	183	578.00	182	577.94	181	577.88	181	577.83	180	577.81	180
Max.	581.13	232	580.90	229	581.05	231	580.91	229	580.90	229	580.90	229	580.90	229	580.90	229
Min.	575.47	112	574.84	110	575.37	111	575.25	110	575.12	110	574.95	110	574.84	110	574.84	110
Range	5.66	120	6.06	119	5.68	120	5.66	119	5.78	119	5.95	119	6.06	119	6.06	119
LAKE ERIE																
Mean	570.73	207	570.33	198	570.63	205	570.54	203	570.47	201	570.41	200	570.35	199	570.33	198
Max.	573.59	270	572.91	256	573.50	268	573.36	265	573.23	262	573.06	258	572.91	256	572.91	256
Min.	568.09	152	567.53	144	567.98	150	567.89	148	567.88	148	567.70	146	567.53	144	567.53	144
Range	5.50	118	5.38	112	5.52	118	5.47	117	5.35	114	5.36	112	5.38	112	5.38	112
LAKE ONTARIO																
Mean	244.74	241	243.88	231	244.63	239	244.50	237	244.35	235	244.15	233	243.89	232	243.88	231
Max.	249.42	310	246.97	310	248.81	310	248.27	310	247.89	310	247.41	310	246.98	310	246.97	310
Min.	241.58	188	235.03	188	240.79	188	239.97	188	238.85	188	237.38	188	235.05	188	235.03	188
Range	7.84	122	11.94	122	8.02	122	8.30	122	9.04	122	10.03	122	11.93	122	11.94	122

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-72

EVALUATION OF PROJECTED (LOW RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING ACTUAL WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		a		c-10		c-20		c-30		c-40		c-50		c-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.39	77	600.33	77	600.37	77	600.36	77	600.35	77	600.34	77	600.33	77	600.33	77
Max.	601.65	120	601.63	120	601.65	120	601.67	120	601.64	120	601.63	120	601.63	120	601.63	120
Min.	598.67	55	598.66	55	598.66	55	598.66	55	598.66	55	598.66	55	598.66	55	598.66	55
Range	2.98	65	2.97	65	2.99	65	3.01	65	2.98	65	2.97	65	2.97	65	2.97	65
LAKES MICHIGAN-HURON																
Mean	578.17	184	578.01	182	578.13	183	578.09	183	578.06	182	578.03	182	578.02	182	578.01	182
Max.	581.13	232	580.95	230	581.11	231	581.05	230	580.99	230	580.95	230	580.95	230	580.95	230
Min.	575.47	112	575.20	111	575.42	112	575.37	111	575.30	111	575.24	111	575.20	111	575.20	111
Range	5.66	120	5.75	119	5.69	119	5.68	119	5.69	119	5.71	119	5.75	119	5.75	119
LAKE ERIE																
Mean	570.73	207	570.58	204	570.69	206	570.66	205	570.63	205	570.60	204	570.59	204	570.58	204
Max.	573.59	270	573.26	263	573.56	269	573.52	268	573.46	267	573.38	265	573.30	264	573.26	263
Min.	568.09	152	568.00	150	568.05	151	568.02	150	568.02	150	568.02	150	568.00	150	568.00	150
Range	5.50	118	5.26	113	5.51	118	5.50	118	5.44	117	5.36	115	5.30	114	5.26	113
LAKE ONTARIO																
Mean	244.74	241	244.47	238	244.70	240	244.67	240	244.61	239	244.54	238	244.48	238	244.47	238
Max.	249.42	310	247.93	310	249.15	310	248.90	310	248.56	310	248.29	310	248.01	310	247.93	310
Min.	241.58	188	239.74	188	241.19	188	240.97	188	240.61	188	240.03	188	239.74	188	239.74	188
Range	7.84	122	8.19	122	7.96	122	7.93	122	7.95	122	8.26	122	8.27	122	8.19	122

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-73

EVALUATION OF PROJECTED (MLP) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		d-10		d-20		d-30		d-40		d-50		d-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.36	77	600.42	77	600.39	77	600.36	77	600.32	77	600.26	77	600.18	77
LAKES MICHIGAN-HURON																
Mean	578.19	184	577.93	181	578.12	183	578.04	182	577.94	181	577.83	180	577.67	178	577.46	175
LAKE ERIE																
Mean	570.75	207	570.47	201	570.68	205	570.59	204	570.50	201	570.37	199	570.21	195	569.99	191
LAKE ONTARIO																
Mean	244.50	242	244.65	234	244.50	240	244.49	238	244.50	235	244.55	232	244.98	228	245.64	222

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-74

EVALUATION OF PROJECTED (HIGH RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		d-10		d-20		d-30		d-40		d-50		d-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.32	77	600.41	77	600.38	77	600.33	77	600.28	77	600.18	76	600.06	76
LAKES MICHIGAN-HURON																
Mean	578.19	184	577.84	180	578.10	183	578.00	182	577.88	180	577.72	179	577.47	176	577.13	172
LAKE ERIE																
Mean	570.75	207	570.36	199	570.65	205	570.53	202	570.40	199	570.23	196	569.97	190	569.62	184
LAKE ONTARIO																
Mean	244.50	242	244.89	231	244.50	239	244.50	236	244.53	233	244.93	228	245.74	220	246.32	211

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-75

EVALUATION OF PROJECTED (LOW RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		d-10		d-20		d-30		d-40		d-50		d-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.39	77	600.43	77	600.41	77	600.39	77	600.37	77	600.34	77	600.31	77
LAKES MICHIGAN-HURON																
Mean	578.19	184	578.04	182	578.15	183	578.10	183	578.04	182	577.98	181	577.90	180	577.81	179
LAKE ERIE																
Mean	570.75	207	570.61	204	570.72	206	570.68	205	570.62	204	570.55	203	570.47	201	570.37	199
LAKE ONTARIO																
Mean	244.50	242	244.50	238	244.50	241	244.49	240	244.50	238	244.50	236	244.51	234	244.59	231

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-76

EVALUATION OF PROJECTED (MLP) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		e-10		e-20		e-30		e-40		e-50		e-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.36	77	600.42	77	600.40	77	600.38	77	600.37	77	600.36	77	600.36	77
LAKES MICHIGAN-HURON																
Mean	578.19	184	577.93	181	578.13	183	578.07	182	578.02	182	577.97	181	577.94	181	577.93	181
LAKE ERIE																
Mean	570.75	207	570.47	201	570.69	206	570.62	204	570.57	203	570.52	202	570.49	201	570.47	201
LAKE ONTARIO																
Mean	244.50	242	244.65	234	244.50	240	244.49	238	244.50	237	244.52	236	244.61	235	244.65	234

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-77
EVALUATION OF PROJECTED (HIGH RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		e-10		e-20		e-30		e-40		e-50		e-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.32	77	600.42	77	600.39	77	600.37	77	600.35	77	600.33	77	600.32	77
LAKES MICHIGAN-HURON																
Mean	578.19	184	577.84	180	578.11	183	578.03	182	577.97	181	577.91	181	577.86	180	577.84	180
LAKE ERIE																
Mean	570.75	207	570.36	199	570.66	205	570.57	203	570.50	202	570.43	200	570.38	199	570.36	199
LAKE ONTARIO																
Mean	244.50	242	244.89	231	244.50	239	244.50	237	244.52	235	244.67	233	244.85	232	244.89	231

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

Table G-78

EVALUATION OF PROJECTED (LOW RANGE) CONSUMPTIVE USE ON LEVELS AND FLOWS, USING AVERAGE WATER SUPPLY CONDITIONS FOR THE PERIOD 1916-1976

	Basis-of-Comparison (1916-1976)		d		e-10		e-20		e-30		e-40		e-50		e-60	
LAKE SUPERIOR	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs	feet	cfs
Mean	600.45	77	600.39	77	600.43	77	600.42	77	600.41	77	600.40	77	600.39	77	600.39	77
LAKES MICHIGAN-HURON																
Mean	578.19	184	578.04	182	578.15	183	578.12	183	578.09	182	578.06	182	578.05	182	578.04	182
LAKE ERIE																
Mean	570.75	207	570.61	204	570.72	206	570.69	205	570.66	205	570.63	204	570.61	204	570.61	204
LAKE ONTARIO																
Mean	244.50	242	244.50	238	244.50	241	244.49	240	244.50	239	244.50	239	244.50	238	244.50	238

COLUMN DESIGNATION - The letter designation refers to the evaluation procedure used and is the same letter as that utilized to identify the procedure under paragraph 5.1. The number refers to the year of the projection employed.

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