

## **Hydraulic Metrics Summary**

This document was prepared for use by individual technical working groups to assist in their development of interest satisfaction curves and performance indicators required in the evaluation process of Lake Ontario regulation plans, in the International Lake Ontario–St. Lawrence River Regulation Study.

It was determined that a compilation of preferred, satisfactory and critical water levels and flows for the various interest groups, through the collection of papers, previously-conducted surveys and anecdotal records, would be of use to the TWG's. This summary synthesizes these water levels and flows for both high and low supply conditions, as well as ideal or satisfactory conditions, as expressed or experienced by the various regulation agencies, stakeholders and interest groups. The nature of these flows and levels differs. Some may be preferences, which if surpassed would cause little or no hardship to any interest. Others may indicate points beyond which more serious consequences occur. Little or no supporting evidence for the severity of impact of violating these values is given in the sources used. In addition, as all of the interests have evolved over time, these values may no longer be representative.

Information sources include international and federal policy documentation, academic research and public consultation surveys. The sources referred to in the summary are specified below:

### **IJC 1956:**

Order of Approval for Regulation of Lake Ontario

### **Interest Preference Indicators:**

International St. Lawrence River Board of Control, 1997. An Updated Regulation Plan For The Lake Ontario – St. Lawrence River System. Report to the International Joint Commission, June 2, 1997.

### **WID Report:**

Great Lakes - St. Lawrence Regulation Office, Water Issues Division, Environment Canada, January 26, 2001. Critical Water Levels in the Lake Ontario and the St. Lawrence River. Report.

### **Eberhardt 1996:**

Eberhardt, A.J., March 1996. Review of a Decision Support System for Lake Ontario and the St. Lawrence River. Proceedings of the Fifth Water Resources Operations Management Workshop sponsored by ASCE, Arlington, Virginia.

**Hudon-Werick 2002:**

Hudon, C., and W. Werick. January 21, 2002. Regulation and the Environment: A General Framework. (Draft)

**PIAG Year 1 Report:**

Public Interest Advisory Group. April 2002. Year One Report

The water level and flow information has been organized by interest, beginning with a summary of general interest water levels, as indicated primarily by the “Criteria for the Regulation of Lake Ontario Outflows From the Orders of Approval for Lake Ontario Regulation of the International Joint Commission”.

Water level and flow information has also been compiled for the environment, riparian, recreational boating, commercial navigation, hydropower and domestic water supply interests.

For each interest, the levels and flows have been tabulated by geographic location and, if available, the particular time period, month or date is listed as well.

Graphs from the Interest Satisfaction Model can be found following the tables of summarized levels and flows for each interest. Two versions of the interest satisfaction graphs have been provided with the expectation that the technical working groups can delineate which graphs (or aspects of the graphs) most accurately describe the level/flow - satisfaction relationship. It is suggested that each interest compare any accompanying set of graphs to identify any incorrect or inaccurate relationships between levels/flows and interest satisfaction

| <b>Table of Contents</b> |              |
|--------------------------|--------------|
| 1. Riparian              | Page 3 - 7   |
| 2. Recreational Boating  | Page 8 - 12  |
| 3. Commercial Navigation | Page 13 - 18 |
| 4. Hydropower            | Page 19 - 23 |
| 5. Domestic Water Supply | Page 24 - 25 |
| 6. Environmental         | Page 26 - 28 |

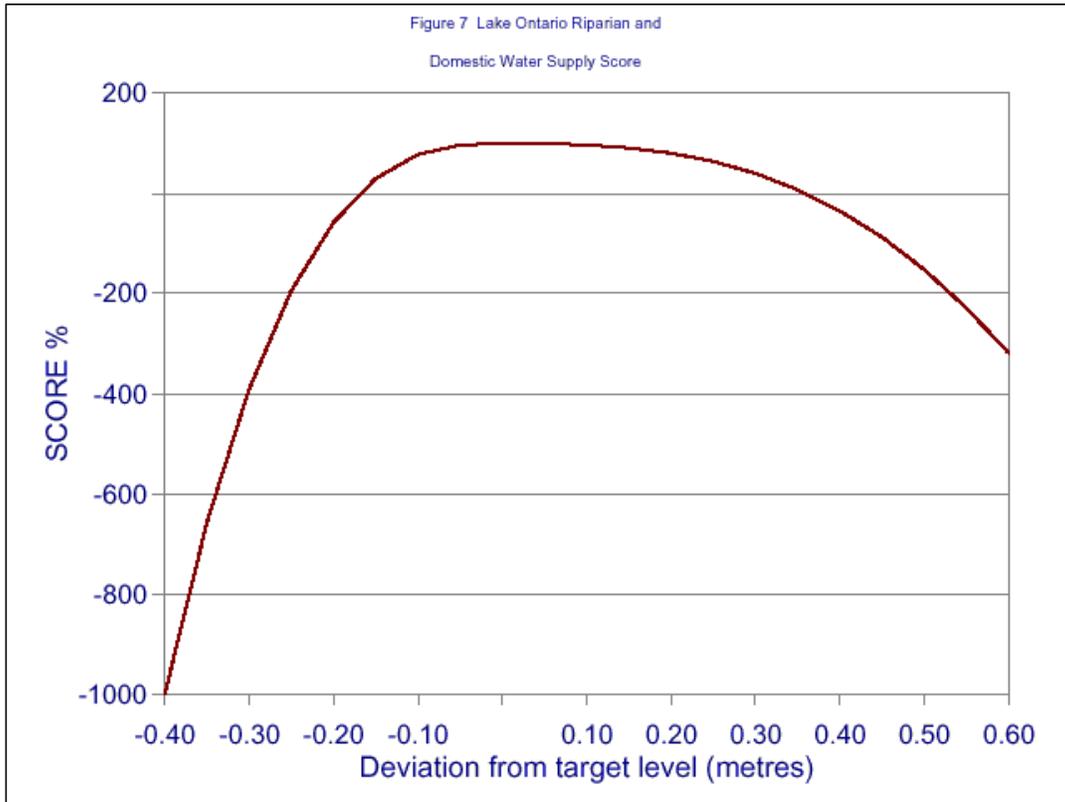
### 1. Riparian Interests

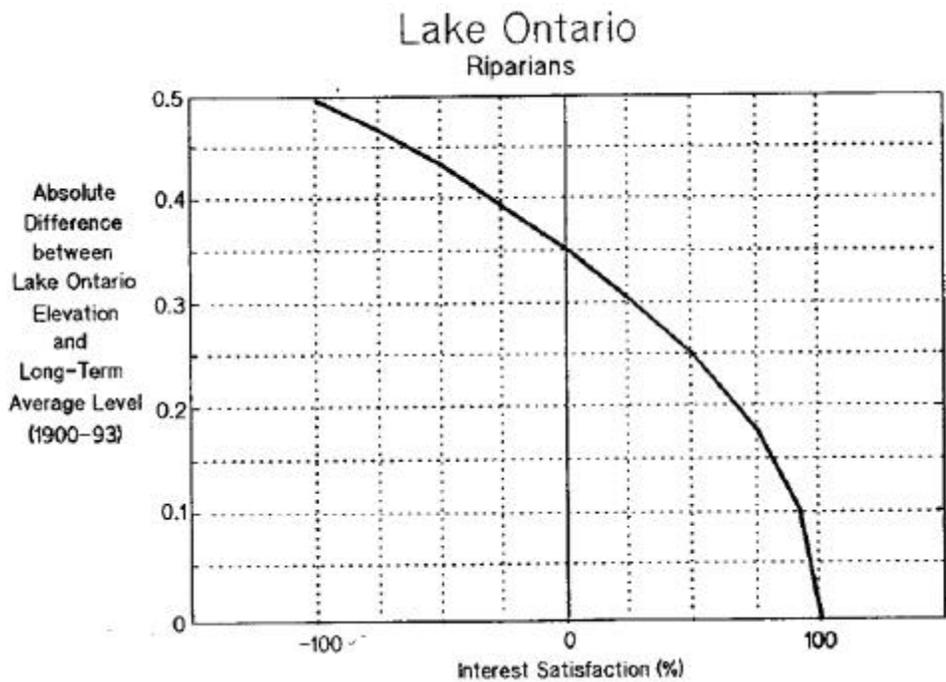
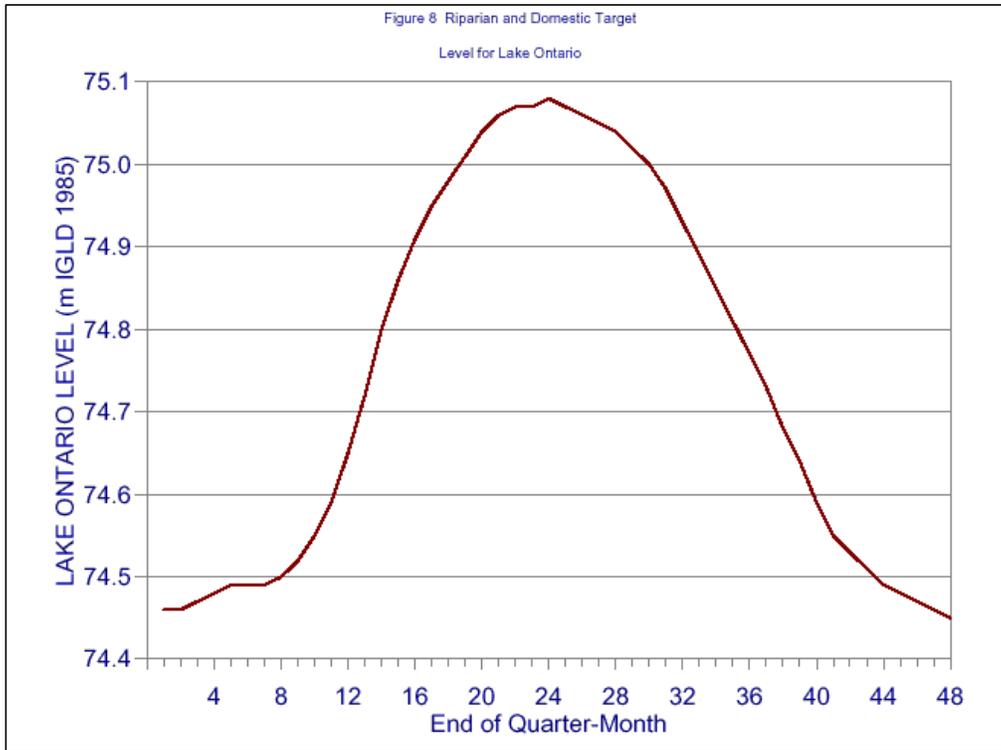
The table below is an inventory of water level/flow conditions that are specified under the criteria in the 1956 Orders of Approval, or expressed by various publications documenting the preferences/concerns of the riparian interest.

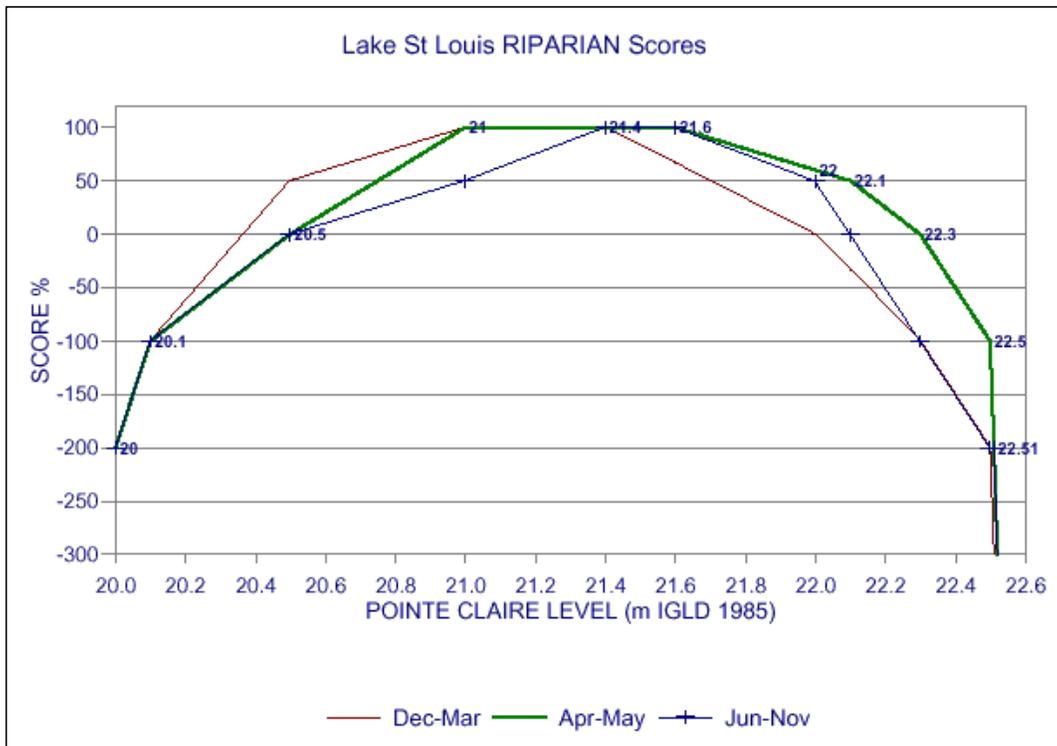
Following the table you will find five (5) **interest satisfaction curves**. Please examine these curves and update them to the best of your knowledge and information gathered to date. If necessary, please develop any additional interest satisfaction curves required to better represent the diversity of the riparian interest (different geographies, different time periods, different shoreline types etc.).

| <b>Riparian: Flood &amp; Erosion</b> |                   |  |  |
|--------------------------------------|-------------------|--|--|
| <b>Location</b>                      | <b>When?</b>      | <b>Water Level/Flow Conditions</b>   | <b>Publication Source</b>                              |
| <b>Lake Ontario</b>                  |                   | Do not increase seasonal long-term average levels  | 2.2.1.a<br>(Interest Preference Indicators, June 1997) |
|                                      |                   | Minimize the frequency of levels > 75.07 m   | 2.2.1.b<br>(Interest Preference Indicators, June 1997) |
|                                      | June - July       | Frequency of levels < 74.6 should be similar to pre-project conditions   | 2.2.1.c<br>(Interest Preference Indicators, June 1997) |
|                                      | Dec – Jan         | Frequency of levels < 74.2 should be similar to pre-project conditions   | 2.2.1.c<br>(Interest Preference Indicators, June 1997) |
|                                      |                   | Optimal level: seasonal long term (1900 - 1990)  | Eberhardt 1996   |
|                                      |                   | Sub-optimal level: 35 cm above/below average   | Eberhardt 1996   |
|                                      |                   | Critical low level: > 35cm below average   | Eberhardt 1996   |
|                                      |                   | Level shall not exceed 75.37 m (with adjusted supplies of the past)  | Criterion ‘h’<br>IJC 1956                              |
|                                      |                   | Frequency of monthly mean > 75.07 shall be less than would have occurred in past with supplies                   | Criterion ‘i’<br>IJC 1956                              |
|                                      |                   | Concern for flood/erosion damage from property owners when level is > 30 cm above seasonal average               | WID Report   |
|                                      |                   | loss of sand dunes (3 – 4 feet per year) when water levels greater than 75 m                                     | PIAG Year 1 Report                                     |
|                                      |                   | preference for levels to range between 74.93 m (245.83 ft) – 75.19 m (246.69 ft)                                 | PIAG Year 1 Report                                     |
|                                      |                   | Level should never be greater than 74.68 m (245 ft)  | PIAG Year 1 Report                                     |
|                                      | until October 1st | Maintain at 74.68 m (245 ft) until October 1st   | PIAG Year 1 Report                                     |
|                                      | March, June       | erosion occurs when level is 74.98 m (246 ft) or higher in March, or 75.29 m (247 ft) or higher in June          | PIAG Year 1 Report                                     |
| <b>St Lawrence at Cardinal</b>       |                   | Based on previous events, the maximum level that can be tolerated by a particular water-front industry is 75.1 m | WID Report   |
| <b>Lake St. Lawrence</b>             |                   | Iroquois Dam operated such that high levels are not a problem  | 2.2.2<br>(Interest Preference Indicators, June 1997)   |
|                                      |                   | Saunders Headwater gauge:  | WID Report   |

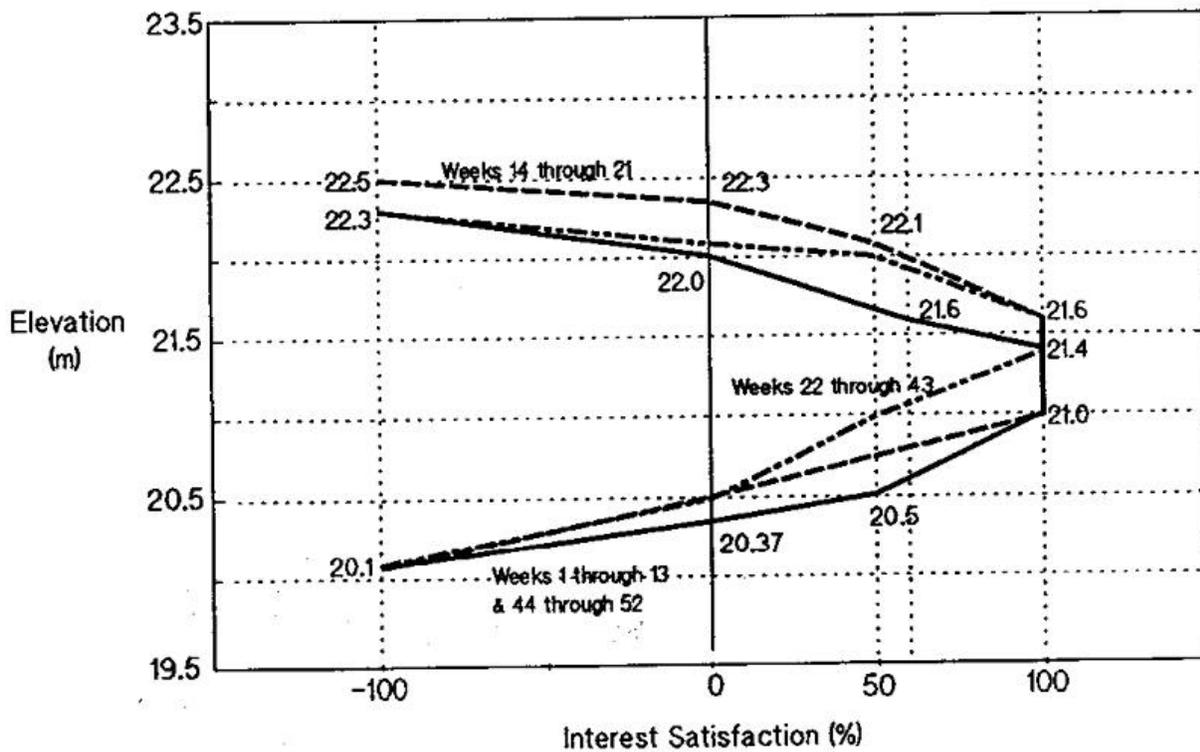
|                         |                      |  |  |
|-------------------------|----------------------|--|--|
|                         |                      | flood alert: 74.33 m<br>flood threshold: 74.48 m   |  |
|                         |                      | Ideal level is 71.63 m (235 ft)  | PIAG Year 1 Report   |
| <b>Lake St. Francis</b> |                      | According to shore property owners, the maximum level that can be tolerated at the Cornwall gauge is 47.5 m  | WID Report   |
|                         |                      | ?? According to shore property owners, the maximum tolerable level at Summerstown is 47.0 m.<br>?? Expressed concern for increased turbidity at water intakes when levels < 46.6 m   | WID Report   |
|                         |                      | concern for flooding below Cornwall at 9900 m <sup>3</sup> /s  | WID Report   |
|                         |                      | The Côteau structures regulate the Côteau Landing levels at the outlet of Lake St. Francis within a range of 46.33 m - 46.63 m to meet the needs of Beau-Cedars hydropower and Seaway installations, local domestic and environmental interests and to reduce the potential of flood and erosion..   | WID Report   |
|                         | open water season    | To reduce the adverse effects of seiche on the lake, the level is kept below 46.58 m during the open water season  | WID Report   |
|                         | open water season    | level is kept above 46.45 m by Hydro Quebec for Seaway concerns.   | WID Report   |
|                         | <b>Lac St. Louis</b> |  | Prefer to minimize the frequency of levels > 22.1 m at Pointe Claire |
|                         |                      | Optimal level: 21.0 - 21.6 m (100% satisfaction)   | Eberhardt 1996   |
|                         |                      | Critical high level: 22.5 m (-100 % satisfaction)  | Eberhardt 1996   |
|                         |                      | Critical low level: 20.1 m (-100 % satisfaction)   | Eberhardt 1996   |
|                         |                      | According to 1989 report, property damage, damage from ice, flooding and erosion begin when level > 21.6 m at Pointe Claire. Bank exposure and reduced accessibility begin when level < 21.4 m   | WID Report<br>(Dumas report, 1989)                                   |
|                         |                      | Following high water levels in spring 1993, Quebec report identified that levels higher than 22.4 m at Pointe Claire result in residential flooding.<br>Sewer flooding and subsequent pumping begins when level is 22.3 m.<br>The filtration plant at Pointe Claire required dike protection at 22.55 m.<br>Residential flooding at Dorval if level is at 22.77 m. | WID Report (Québec Ministère de la Sécurité publique)                |
|                         |                      | Pointe Claire gauge:<br>flood alert level: 22.10 m<br>flood threshold: 22.33 m   | WID Report   |
| <b>Port of Montreal</b> |                      | Prefer to minimize the frequency of levels > 8.6 m at Jetty #1   | 2.2.4.a<br>(Interest Preference Indicators, June 1997)               |
|                         |                      | In 1993 report, Montreal was not affected by high levels in April 1993 (monthly mean of 8.24 m at Jetty #1), but pumping of sewers occurred at Pointe-aux-Trembles to avoid damage during February ice-jam.  | WID Report   |
|                         |                      | Port of Montreal:<br>flood threshold for dock facilities: 8.6 m  | WID Report   |
| <b>Lac St. Pierre</b>   |                      | Prefer to minimize the frequency of levels > 6.7 m at Sorel  | 2.2.5.a<br>(Interest Preference Indicators, June 1997)               |
|                         |                      | According to riparian owners, the maximum level that can be tolerated is 6.5 m at Sorel  | WID Report   |







## Lake St. Louis Riparians



## 2. Recreational Boating Interests

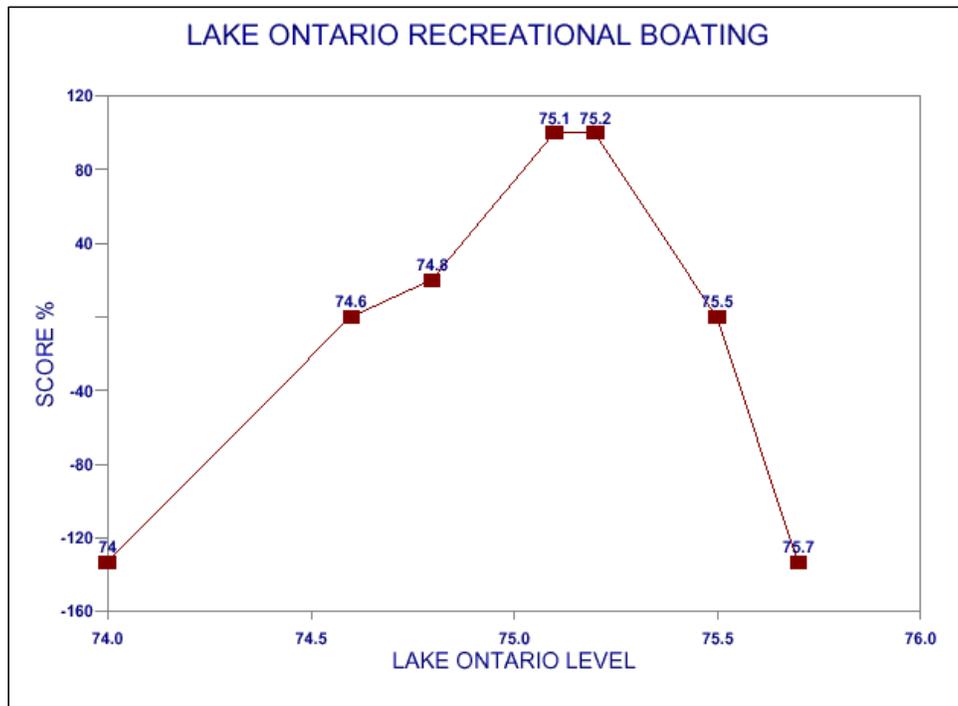
The table below is an inventory of water level/flow conditions that are specified under the criteria in the 1956 Orders of Approval, or expressed by various publications documenting the preferences/concerns of the recreational boating interest.

Following the table you will find four (4) **interest satisfaction curves**. Please examine these curves and update them to the best of your knowledge and information gathered to date. If necessary, please develop any additional interest satisfaction curves required to better represent the diversity of the recreational boating interest (different geographies, different time periods etc.).

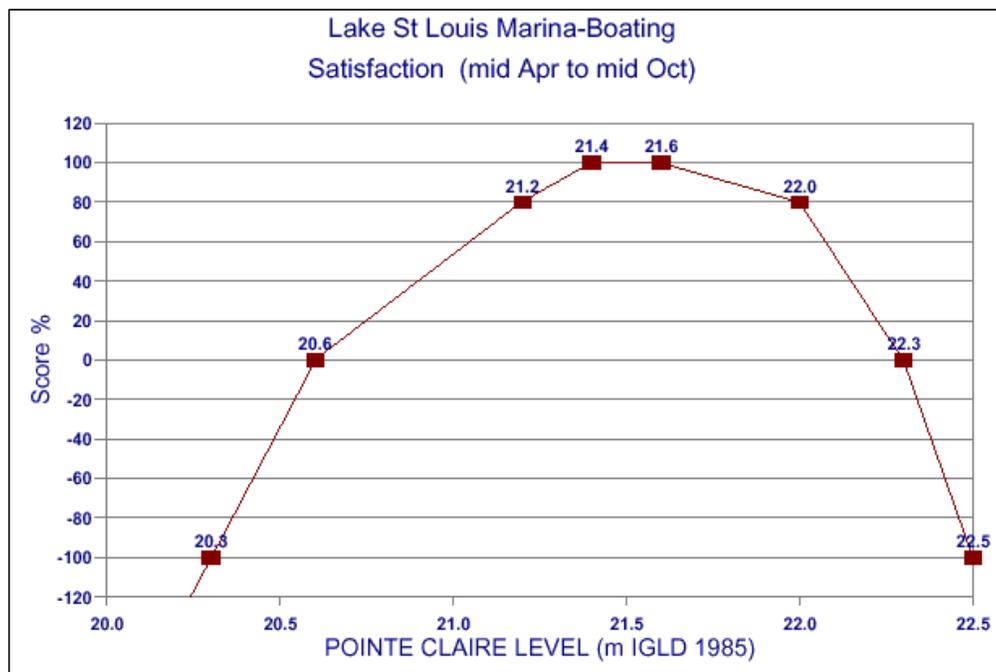
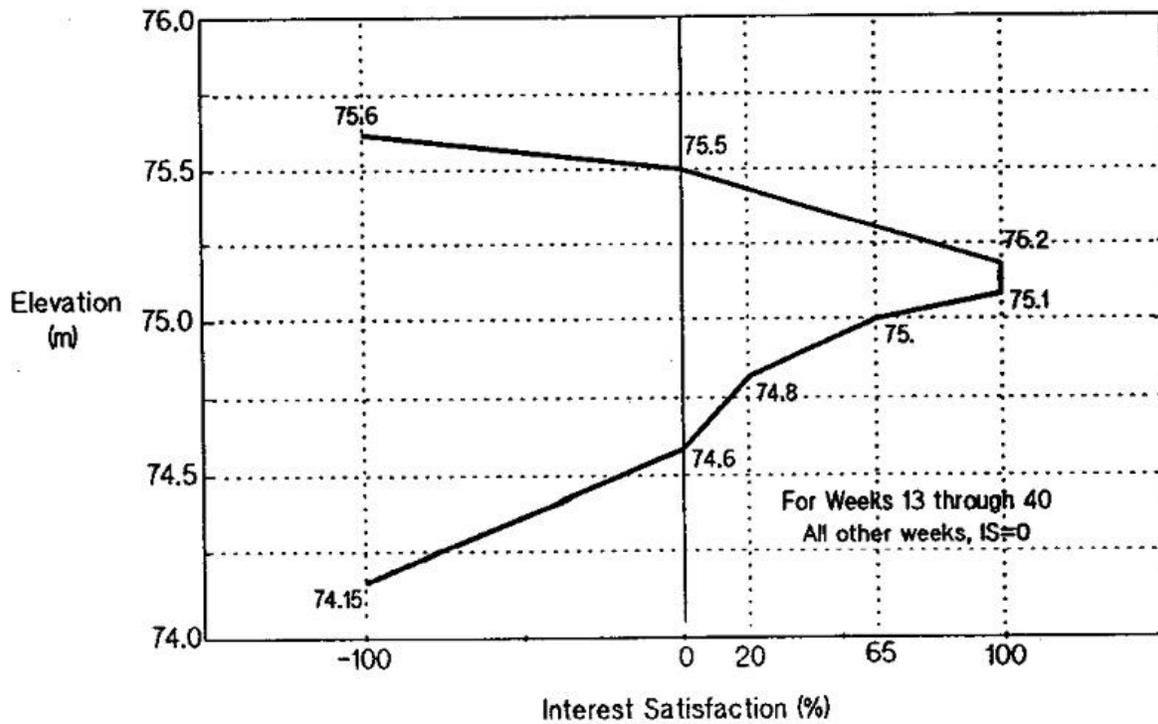
| <b>Recreational Boating</b>                                  |                                |   |  |
|--|--------------------------------|---|--|
| <b>Apply during boating season (mid-April – mid-October)</b> |                                |   |  |
| <b>Location</b>  | <b>When?</b>                   | <b>Water Level/Flow Conditions</b>  | <b>Publication Source</b>                              |
| <b>Lake Ontario</b>  |                                | Prefer to minimize the frequency of levels:<br>< 74.95 m on May 1<br>< 75.00 m from mid-May to mid-August<br>< 74.90 m on September 1<br>< 74.85 m at mid-September<br>< 74.75 m pm October 1<br>< 74.66 m at mid-October | 2.3.1.a<br>(Interest Preference Indicators, June 1997) |
|  |                                | Prefer to minimize the average rate of decline from spring peak to end of boating season.   | 2.3.1.b<br>(Interest Preference Indicators, June 1997) |
|  | April 1 – Oct 31 <sup>st</sup> | Optimal level: 75.1 – 75.2 m  | Eberhardt 1996   |
|  | April 1 – Oct 31 <sup>st</sup> | Critical low level: 74.15 m   | Eberhardt 1996   |
|  | April 1 – Oct 31 <sup>st</sup> | Critical high level: 75.68 m  | Eberhardt 1996   |
|  |                                | Levels greater than 75.6 m expect to cause inconvenience and generate complaints from boaters and marinas.  | WID Report   |
|  |                                | August 2000 mail-out survey results:<br>Critical high level: 75.6 m<br>Satisfactory level: 74.71 – 75.37 m<br>Critical low level: 74.54 m   | WID Report   |
|  | May – June                     | Erosion problems occur when level is greater than 75.07 m (246.3 ft)  | PIAG Year 1 Report                                     |
|  | Sept – October                 | no boating activity when levels lower than 74.61 m (244.8 ft)   | PIAG Year 1 Report                                     |
|  |                                | When level drops below 74.82 m (245.5 ft), dock/marina usage becomes inhibited.   | PIAG Year 1 Report                                     |
|  |                                | Preference for level of 74.77 m (245.3 ft) and 74.46 m (244.3 ft) in the winter to alleviate damage from storms   | PIAG Year 1 Report                                     |
|  |                                | Preference for 75.29 m (247 ft) during the boating season and 74.37 m (244 ft) during the winter season   | PIAG Year 1 Report                                     |
|  | May - October                  | Range should be 74.68 m (245 ft) – 75.13 m (246.5 ft)   | PIAG Year 1 Report                                     |
|  | Nov. 15 – Nov. 25              | level should be 73.76 m (242 ft) – 74.07 m (243 ft) to prevent spring erosion   | PIAG Year 1 Report                                     |

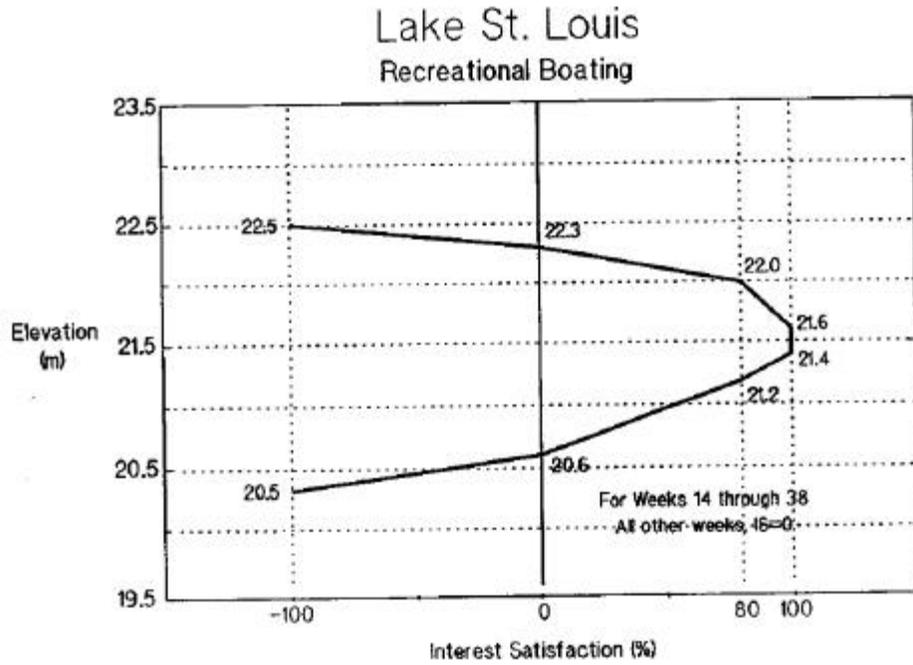
|                              |                         |  |  |
|------------------------------|-------------------------|--|--|
| <b>1000 Islands</b>          |                         | <p>August 2000 mail-out survey results:<br/> critical high level:<br/> 75.68 m at Kingston<sup>1</sup><br/> 75.55 m at Alexandria Bay<sup>2</sup><br/> 75.32 m at Prescott<sup>3</sup></p> <p>satisfactory level:<br/> 74.78 – 75.43 m at Kingston<sup>1</sup><br/> 74.76 – 75.28 m at Alexandria Bay<sup>2</sup><br/> 74.71 m – 75.02 m at Prescott<sup>3</sup></p> <p>critical low level:<br/> 74.53 m at Kingston<sup>1</sup><br/> 74.43 m at Alexandria Bay<sup>2</sup><br/> 74.41 m at Prescott<sup>3</sup></p> | WID Report   |
| <b>Lake St. Lawrence</b>     |                         | Preference for 73.4 m  | 2.3.2.a<br>(Interest Preference Indicators, June 1997) |
|                              | May – July              | Prefer to minimize the frequency of levels < 73.1 m  | 2.3.2.b<br>(Interest Preference Indicators, June 1997) |
|                              | Aug. – Sept.            | Prefer to minimize the frequency of levels < 72.9 m  | 2.3.2.b<br>(Interest Preference Indicators, June 1997) |
|                              |                         | Prefer to minimize the average rate of decline from spring peak to end of boating period   | 2.3.2.c<br>(Interest Preference Indicators, June 1997) |
| <b>Morrisburg Waddington</b> |                         | <p>August 2000 mail-out survey results:<br/> critical high level: 74.07 m<br/> satisfactory level: 73.30 - 73.91 m<br/> critical low level: 73.00 m</p>  | WID Report   |
| <b>Lac St. Francis</b>       |                         | The Côteau structures regulate the Côteau Landing levels at the outlet of Lake St. Francis within a range of 46.33 m - 46.63 m to meet the needs of Beau-Cedars hydropower and Seaway installations, local domestic and environmental interests and to reduce the potential of flood and erosion..   | WID Report   |
|                              | open water season       | To reduce the adverse effects of seiche on the lake, the level is kept below 46.58 m during the open water season  | WID Report   |
|                              | open water season       | level is kept above 46.45 m by Hydro Quebec for Seaway concerns.   | WID Report   |
| <b>Lac St. Louis</b>         |                         | Preference for 21.5 m  | 2.3.3.a<br>(Interest Preference Indicators, June 1997) |
|                              |                         | Prefer to minimize the frequency of levels < 21.2 m  | 2.3.3.b<br>(Interest Preference Indicators, June 1997) |
|                              |                         | Prefer to minimize the average rate of decline from spring peak to end of boating period   | 2.3.3.c<br>(Interest Preference Indicators, June 1997) |
|                              |                         | optimal level: 21.4 – 21.6 m (100 % satisfaction)  | Eberhardt 1996   |
|                              |                         | critical low level: 20.1 m (-100 % satisfaction)   | Eberhardt 1996   |
|                              |                         | critical high level: 22.5 m (-100 % satisfaction)  | Eberhardt 1996   |
|                              | summer and early autumn | maintain lake at 21.5 m (71 ft) with a Moses-Saunders discharge of 7,000 cms (247,100 cfs) or greater  | PIAG Year 1 Report                                     |

|                         |        |   |  |
|-------------------------|--------|---|--|
|                         | spring | levels must exceed 22.5 m (74 ft.) corresponding to a Moses-Saunders discharge of 10,500 cms (370,650 cfs)                              | PIAG Year 1 Report                                     |
|                         |        | levels greater than 21.5 m are considered to ‘improve boating conditions’   | PIAG Year 1 Report                                     |
| <b>Lac St. Pierre</b>   |        | Prefer to minimize the average rate of decline from spring peak to end of boating period  | 2.3.4.c<br>(Interest Preference Indicators, June 1997) |
|                         |        | preferred water level of 4.3 m (14 ft) that corresponds to 7,000 cms (247,100 cfs) or greater   | PIAG Year 1 Report                                     |
| <b>Montreal Harbour</b> | summer | maintain level of 6.5 m (21 ft., corresponding to a Moses-Saunders flow of 7,000 cms (247,100 cfs)                                      | PIAG Year 1 Report                                     |
|                         | spring | flood damages occur when levels are greater than 7.5 m (25 ft), corresponding to a Moses-Saunders discharge of 12,000 cms (423,600 cfs) | PIAG Year 1 Report                                     |



### Lake Ontario/ 1000 Island Recreational Boating





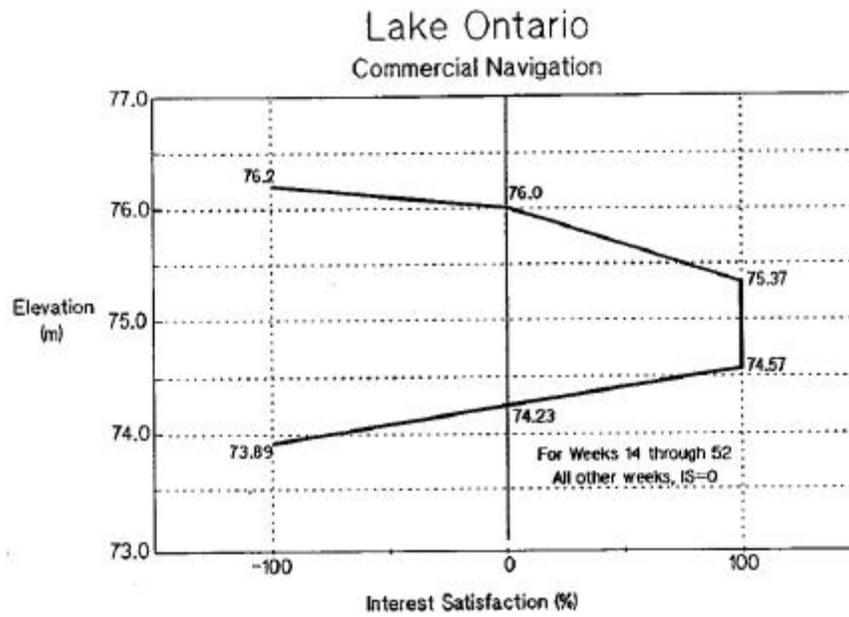
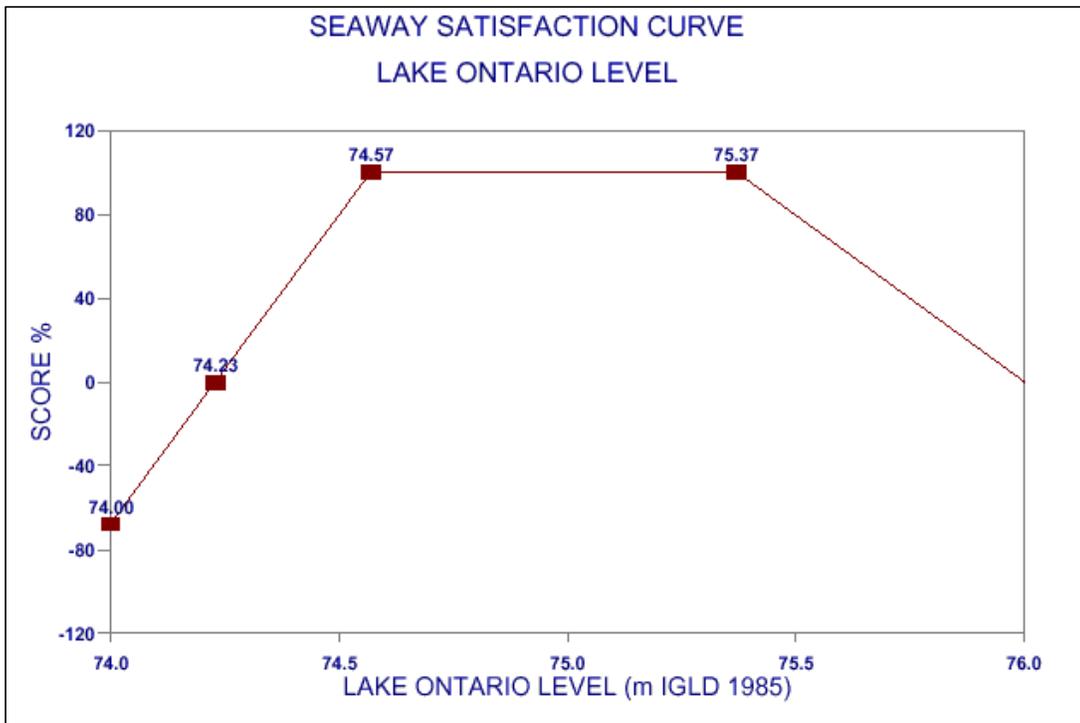
### 3. Commercial Navigation Interests

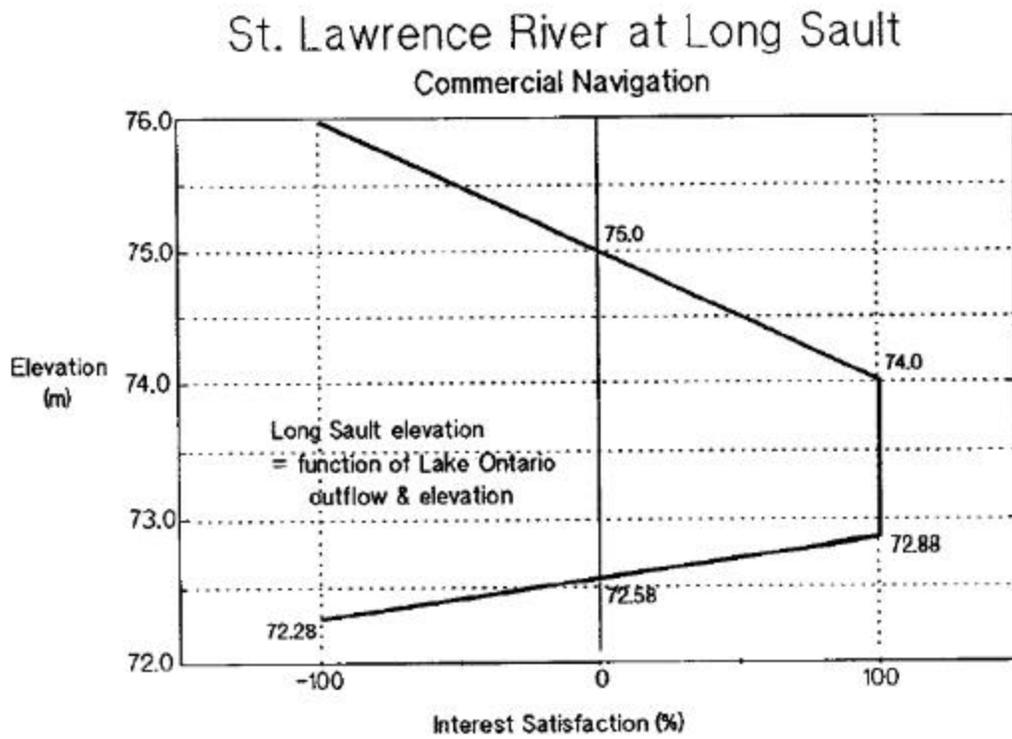
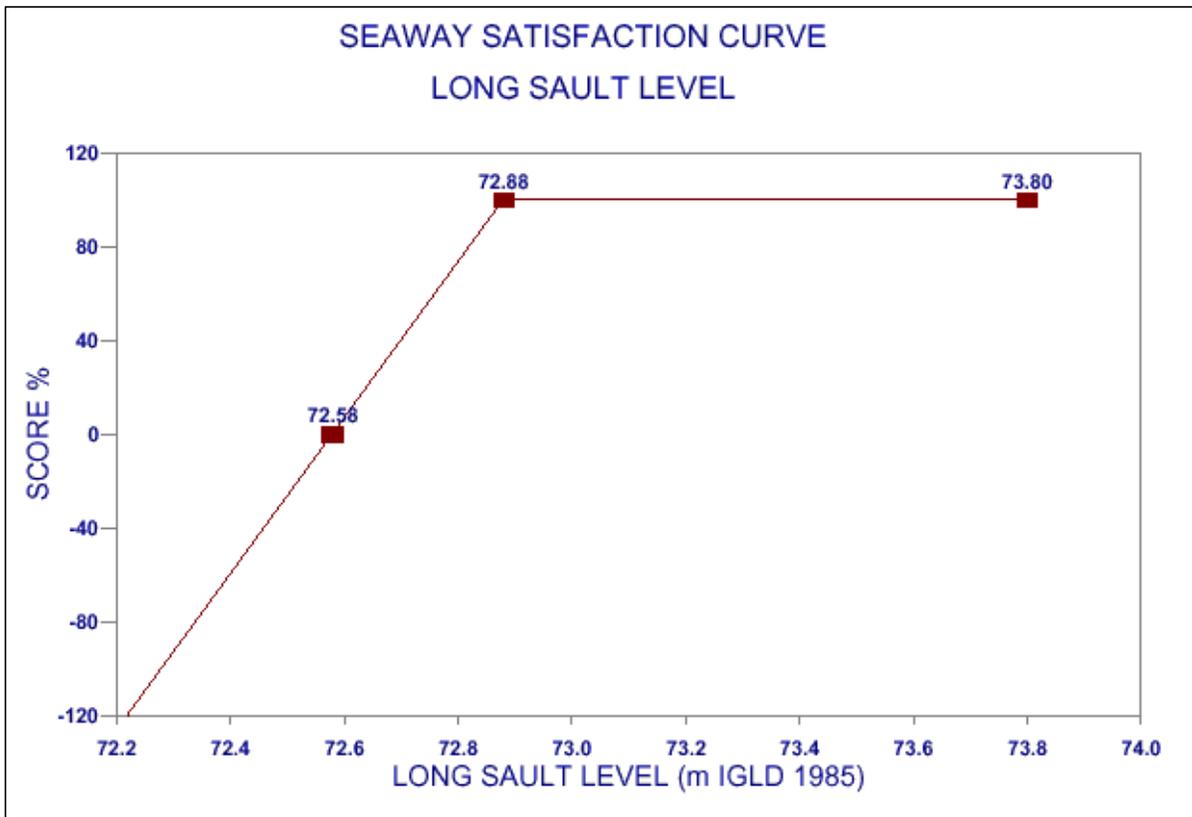
The table below is an inventory of water level/flow conditions that are specified under the criteria in the 1956 Orders of Approval, or expressed by various publications documenting the preferences/concerns of the commercial navigation interest.

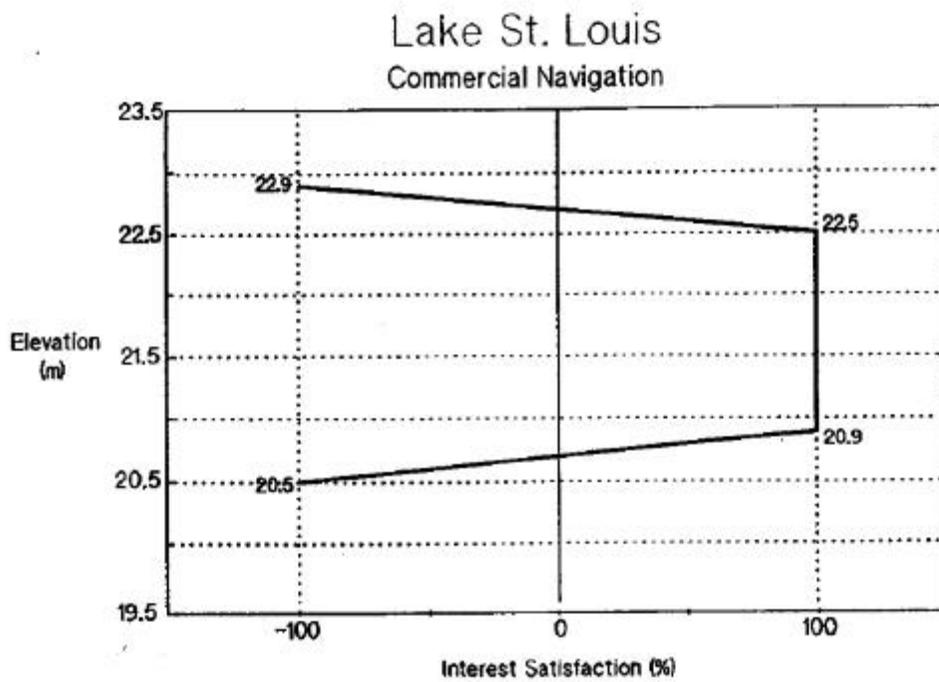
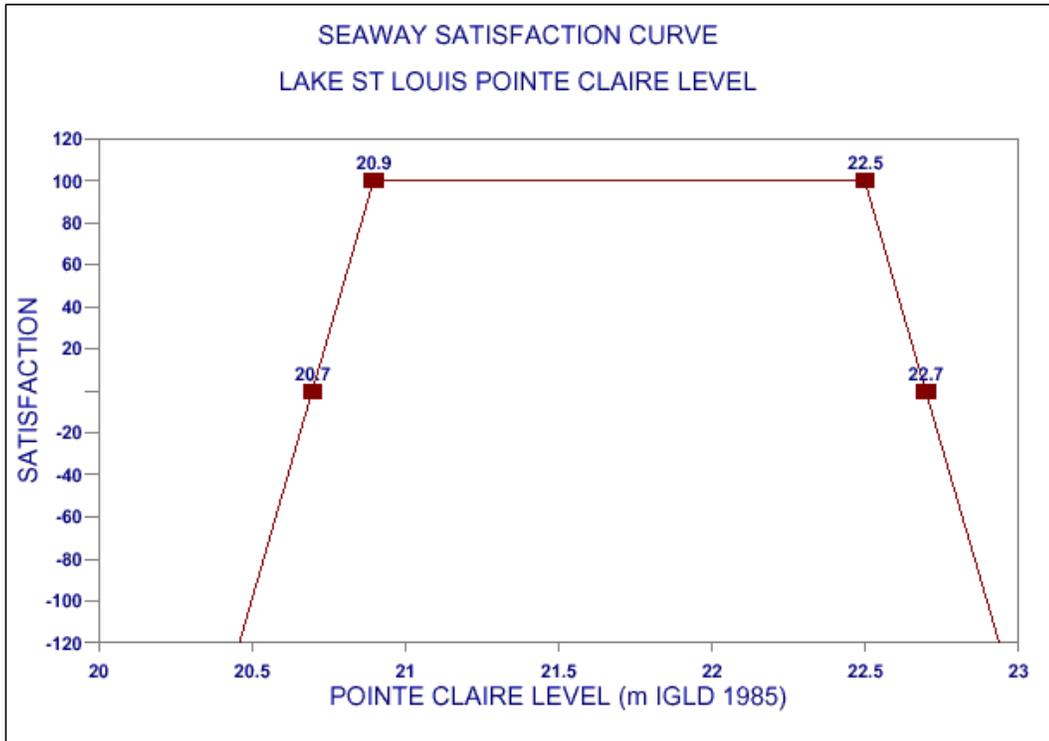
Following the table you will find eight (8) **interest satisfaction curves**. Please examine these curves and update them to the best of your knowledge and information gathered to date. If necessary, please develop any additional interest satisfaction curves required to better represent the diversity of the commercial navigation interest (different geographies, different time periods etc.).

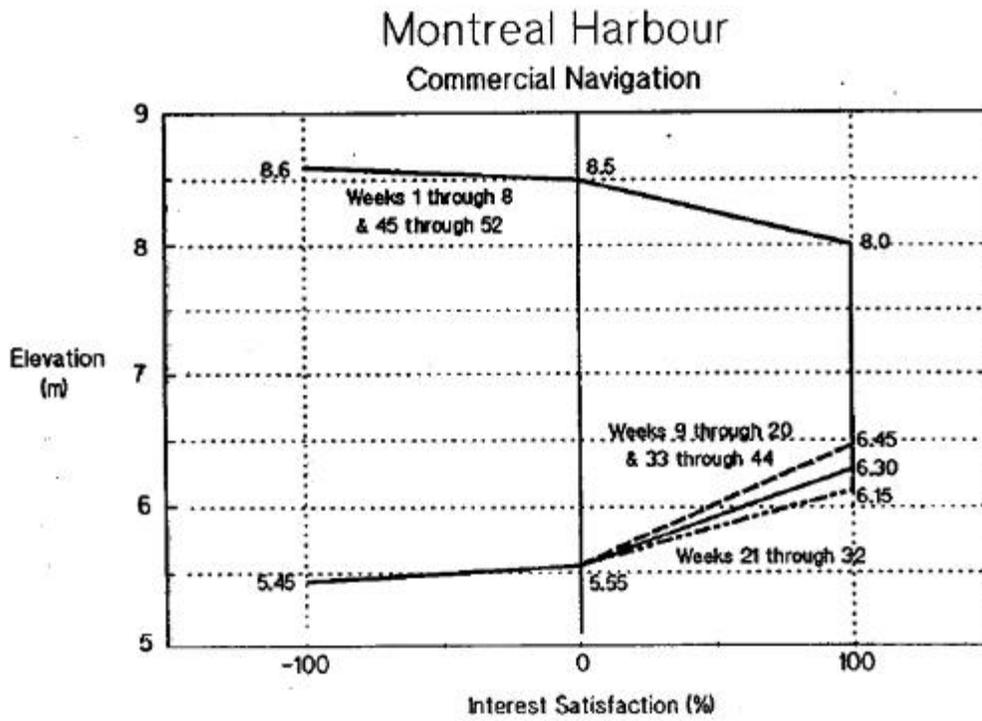
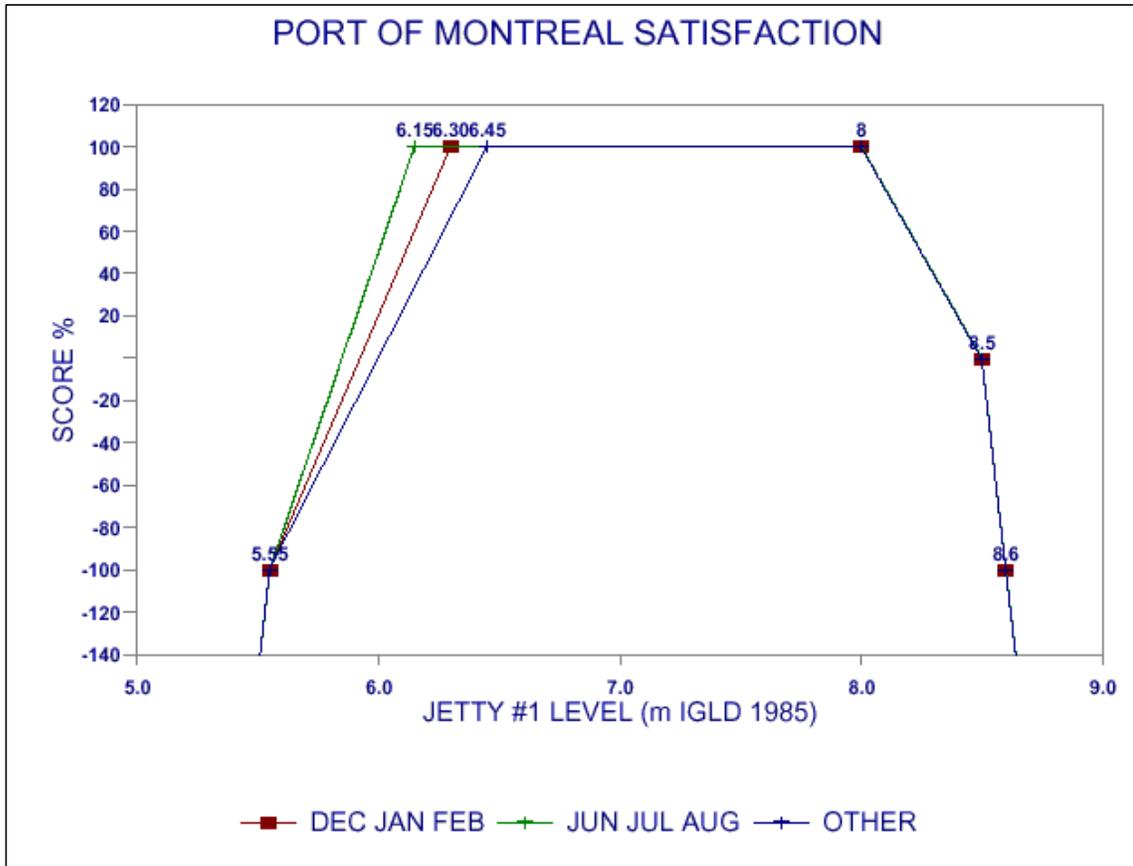
| Commercial Navigation<br>Shipping Season: LO - Lac St. Louis: beginning April - 3 <sup>rd</sup> Q December<br>Montreal - Downstream: Year Round Navigation |                  |   |  |
|--|------------------|---|--|
| Location   | When?            | Water Level/Flow Conditions   | Publication Source                                     |
| Lake Ontario   |                  | prefer to minimize the frequency of levels < 74.3 m   | 2.4.1.a<br>(Interest Preference Indicators, June 1997) |
|  | Apr. 1 – Dec. 31 | optimal level: 74.57 - 75.37 m (100 % satisfaction)   | Eberhardt 1996   |
|  |                  | critical low level: 73.89 m (-100 % satisfaction)   | Eberhardt 1996   |
|  |                  | critical high level: 76.2 m (-100 % satisfaction)   | Eberhardt 1996   |
|  | April 1          | regulated level shall not be lower than 74.15 m   | Criterion ‘j’<br>IJC 1956                              |
|  | Apr. 1 – Nov. 30 | monthly mean level shall be maintained at or above 74.15 m  | Criterion ‘j’<br>IJC 1956                              |
|  |                  | 74.2 m may be considered the critical level for Seaway navigation.                                | WID Report   |
| Intl’ section of St Lawrence River   |                  | The Seaway has considered the maximum tolerable for safe velocities to be 9900 m <sup>3</sup> /s  | WID Report   |
|  |                  | The Seaway suspended traffic in 1993 between Lake Ontario and Montreal at 10900 m <sup>3</sup> /s | WID Report   |
| St. Lawrence River   |                  | < 9630 m <sup>3</sup> /s<br>(results in velocity of 1.2 m/s and is hazardous for navigation)      | Eberhardt 1996   |
| Lake St. Lawrence  |                  | Prefer to minimize the frequency of levels < 72.7 m (at Long Sault)                               | 2.4.2.a<br>(Interest Preference Indicators, June 1997) |
|  |                  | Prefer to minimize the frequency of flows > “L” Limit   | 2.4.2.b<br>(Interest Preference Indicators, June 1997) |
|  |                  | Prevent flows > 9910 m <sup>3</sup> /s<br>(350,000 cfs)   | 2.4.2.c<br>(Interest Preference Indicators, June 1997) |
|  |                  | Prefer to minimize the frequency of levels < 73.5 m (at Iroquois Headwater)                       | 2.4.2.d<br>(Interest Preference Indicators, June 1997) |
|  |                  | optimal level: 72.78 - 74.0 m at Long Sault   | Eberhardt 1992   |

|                                  |                   |  |  |
|----------------------------------|-------------------|--|--|
|                                  |                   | (100 % satisfaction)   |  |
|                                  |                   | Minimum level for full draught vessels is 72.5 m at Long Sault Dam   | WID Report   |
| <b>Lake St. Francis</b>          |                   | At Summerstown, an alert is issued for ships with > 8m draught at 46.58 m  | WID Report   |
|                                  |                   | The Côteau structures regulate the Côteau Landing levels at the outlet of Lake St. Francis within a range of 46.33 m - 46.63 m to meet the needs of Beau-Cedars hydropower and Seaway installations, local domestic and environmental interests and to reduce the potential of flood and erosion.. | WID Report   |
|                                  | open water season | To reduce the adverse effects of seiche on the lake, the level is kept below 46.58 m during the open water season  | WID Report   |
|                                  | open water season | level is kept above 46.45 m by Hydro Quebec for Seaway concerns.   | WID Report   |
|                                  |                   | Prefer to minimize the frequency of levels < 20.7 m at Pointe Claire   | 2.4.3.a<br>(Interest Preference Indicators, June 1997) |
| <b>Lac St. Louis</b>             |                   | optimal level: 20.9 - 22.5 m<br>(100 % satisfaction)   | Eberhardt 1996   |
|                                  |                   | An alert is issued for ships with > 8 m draught at 20.68 m   | WID Report   |
|                                  |                   | Mandatory anchoring for ships with 7.9 m draught occurs when level < 20.6 m  | WID Report   |
|                                  |                   | Prefer to minimize the frequency of levels < 6.2 m   | 2.4.4.a<br>(Interest Preference Indicators, June 1997) |
| <b>Port of Montreal Jetty #1</b> |                   | Minimum level of 5.55 ?? m (chart datum?) for ships with 10.4 m draught  | WID Report   |
|                                  | year-round        | Optimal level: > 6.15 m  | WID Report   |
|                                  | dry periods       | Optimal: chart datum   | WID Report   |
|                                  |                   | short-term higher levels to accommodate large ships  | WID Reports  |
|                                  |                   | critical high level: 8.6 m   | WID Report   |









#### 4. Hydropower Interests

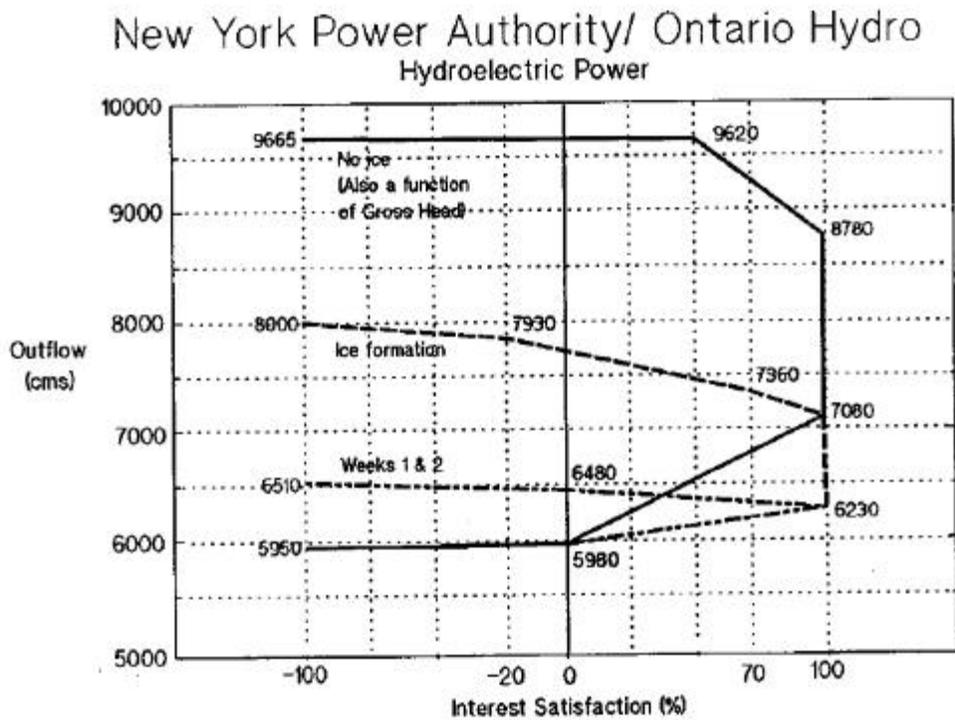
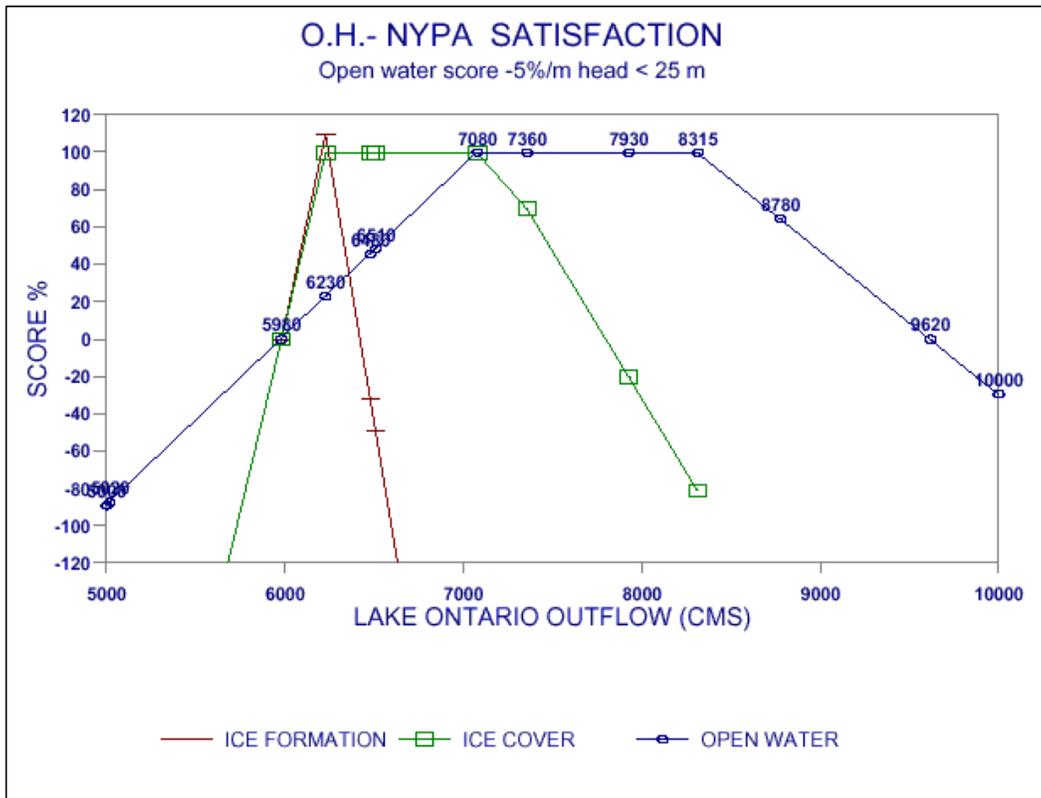
The table below is an inventory of water level/flow conditions that are specified under the criteria in the 1956 Orders of Approval, or expressed by various publications documenting the preferences/concerns of the hydropower interest.

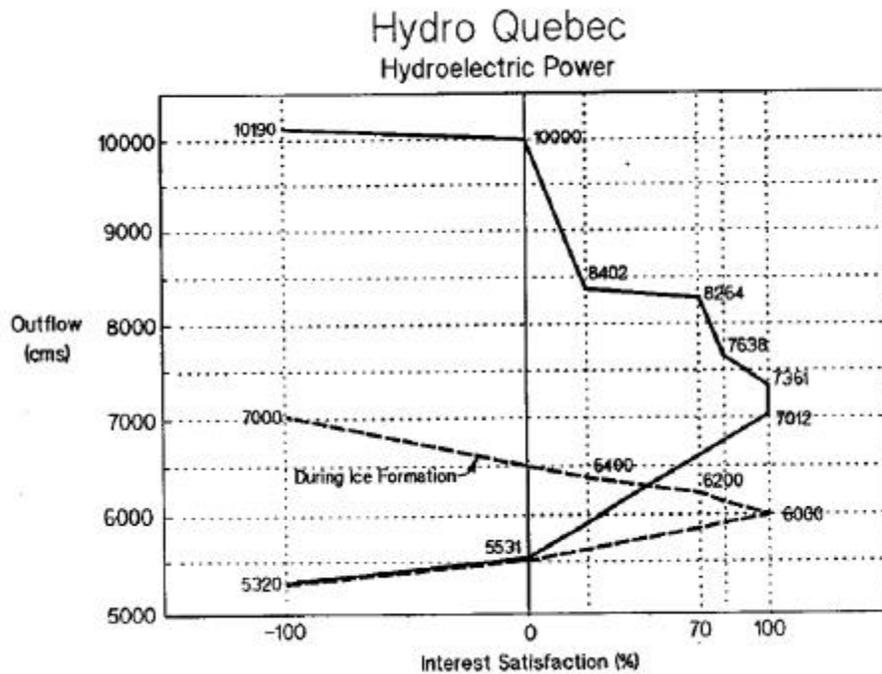
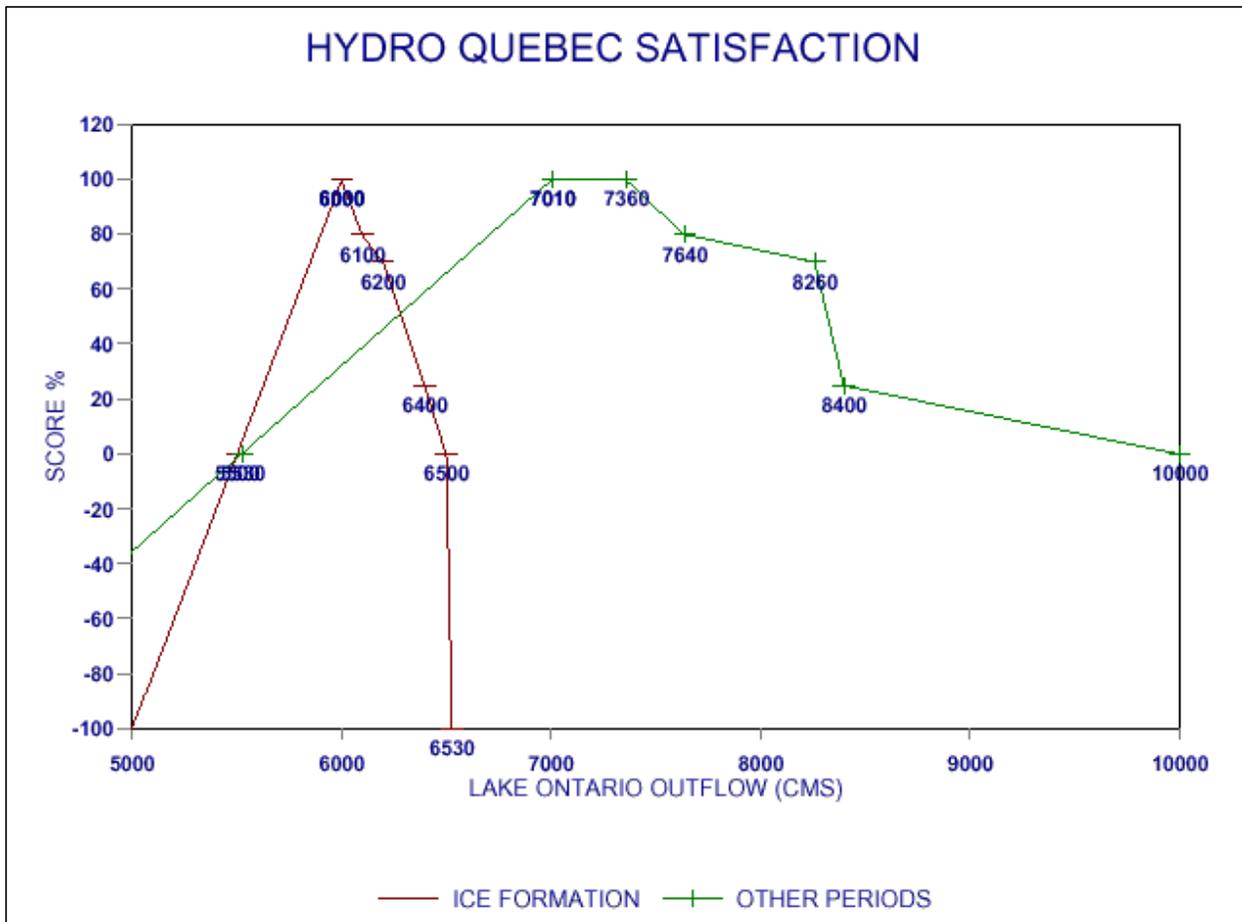
Following the table you will find four (4) **interest satisfaction curves**. Please examine these curves and update them to the best of your knowledge and information gathered to date. If necessary, please develop any additional interest satisfaction curves required to better represent the diversity of the hydropower interest (different geographies, different time periods etc.).

| <b>Hydropower</b>                            |   |  |  |
|--|---|--|--|
| <b>Location</b>                              | <b>When?</b>                                  | <b>Water Level/Flow Conditions</b>   | <b>Publication Source</b>                              |
| <b>Lake Ontario</b>                          | April 1                                       | Level shall be greater than 74.15 m  | Criterion ‘j’<br>IJC 1956                              |
|  | April 1 - Nov 30                              | Monthly mean level shall be maintained at or above 74.15 m                         | Criterion ‘j’<br>IJC 1956                              |
| <b>International section of St. Lawrence</b> |   | max mean velocity < 1.22 m/s   | Condition (i)<br>IJC 1956                              |
| <b>Ogden Island Channels</b>                 | Jan 1 for ice fm                              | max mean velocity < 0.69 m/s   | Condition (i)<br>IJC 1956                              |
| <b>Montreal Harbour</b>                      |   | optimal level: 6.15 - 8.0 m  | Eberhardt 1996   |
| <b>Lake St. Lawrence<br/>NYPA &amp; OH</b>   |   | Prefer to minimize the frequency of flows > 8800 m <sup>3</sup> /s                 | 2.5.1.a<br>(Interest Preference Indicators, June 1997) |
|  |   | Prefer to minimize the frequency of flows < 6000 m <sup>3</sup> /s                 | 2.5.1.b<br>(Interest Preference Indicators, June 1997) |
|  | with ice cover and during ice cover formation | Prefer to minimize the frequency of flows > 7400 m <sup>3</sup> /s                 | 2.5.1.c<br>(Interest Preference Indicators, June 1997) |
|  |   | Prefer to minimize the frequency of flows > 6300 m <sup>3</sup> /s                 | 2.5.1.d<br>(Interest Preference Indicators, June 1997) |
|  | high demand periods of winter & summer        | Prefer to pass relatively higher flow  | 2.5.1.e<br>(Interest Preference Indicators, June 1997) |
|  |   | Optimal flow: 7930 - 8780 m <sup>3</sup> /s at Moses-Saunders (100 % satisfaction) | Eberhardt 1996   |
|  |   | Maximum outflow: 8780 m <sup>3</sup> /s  | “L-Limit” Plan 1958-D<br>WID Report                    |

|  |  |   |  |
|--|--|---|--|
|  | Prefer to minimize the frequency of flow/level combinations that result in Long Sault levels > 73.9 m (requires operation of Iroquois Dam to lower Lake St. Lawrence levels) | 2.5.1.f<br>(Interest Preference Indicators, June 1997)  |  |
|  | Prefer to minimize the magnitude of average week to week flow changes, except for ice management   | 2.5.1.g<br>(Interest Preference Indicators, June 1997)  |  |
|  | Prefer to pass flows that maximize energy production   | 2.5.1.h<br>(Interest Preference Indicators, June 1997)  |  |
|  | Saunders' Plant: optimal flow:<br>current: 4290 m <sup>3</sup> /s<br>post-upgrade: 4500 m <sup>3</sup> /s<br>at maximum capacity: 5020 m <sup>3</sup> /s                     | WID Report  |  |
|  | Moses Plant: optimal flow: 4000 m <sup>3</sup> /s (4800 m <sup>3</sup> /s max capacity)  | WID Report  |  |
| April - December                           | Moses-Saunders Dam: optimal flow: 8290 m <sup>3</sup> /s   | WID Report  |  |
|  | Flows great than 10,000 m <sup>3</sup> /s are possible at Moses-Saunders without spillage, but are inefficient.  | WID Report  |  |
| Dec. & Jan.                                | Plan 1958D: monthly minimum flow to be no less than 5950 m <sup>3</sup> /s .   | WID Report  |  |
| <b>Lake St. Francis</b><br>Hydro<br>Quebec | Prefer to minimize the frequency of flows > 8400 m <sup>3</sup> /s   | 2.5.2.a<br>(Interest Preference Indicators, June 1997)  |  |
|  | Prefer to minimize the frequency of flows < 6000 m <sup>3</sup> /s   | 2.5.2.b<br>(Interest Preference Indicators, June 1997)  |  |
|  | during ice cover formation   | Prefer to minimize the frequency of flows > 6100 m <sup>3</sup> /s  | 2.5.2.c<br>(Interest Preference Indicators, June 1997) |
|  | high demand periods of winter & summer   | Prefer to pass relatively higher flows  | 2.5.2.d<br>(Interest Preference Indicators, June 1997) |
|  |  | Prefer to minimize the magnitude of average week to week flow changes, except for ice management                          | 2.5.2.e<br>(Interest Preference Indicators, June 1997) |
|  |  | Prefer flexibility in plan in order to vary the timing of flow reductions for ice formation and subsequent flow increases | 2.5.2.f<br>(Interest Preference Indicators, June 1997) |
|  |  | Optimal flow: 7012 - 7361 m <sup>3</sup> /s<br>(100 % satisfaction)   | Eberhardt 1996   |
|  | during ice formation   | Optimal flow: 6000 m <sup>3</sup> /s<br>(100 % satisfaction)  | Eberhardt 1996   |
|  | July 15 - April 15   | Minimum flow in the channel at Côteau: 283 m <sup>3</sup> /s  | WID Report   |
|  | April 15 – July 15   | Minimum flow in the channel at Côteau: 450 m <sup>3</sup> /s  | WID Report   |
|  |  | Capacity at Côteau: 1800 m <sup>3</sup> /s  | WID Report   |
|  |  | Optimal flow at Beauharnois Canal: 6800 - 7400 m <sup>3</sup> /s  | WID Report   |
|  | during open water period   | Maximum capacity at Beauharnois: 8200 m <sup>3</sup> /s   | WID Report   |
|  | July 15 -  | Combined optimal flow (Cedars & Beau.): 7100 m <sup>3</sup> /s  | WID Report   |

|  |  |            |
|--|--|------------|
| Apr. 15:                                       |  |            |
| Apr. 15 –<br>July 15:                          | Combined optimal flow (Cedars & Beau.): 7250 m <sup>3</sup> /s   | WID Report |
|  | maximum tolerable flow (Cedars & Beau.): 9300 m <sup>3</sup> /s<br><i>(This has been exceeded fairly often. Need to verify)</i>  | WID Report |
|  | The Côteau structures regulate the Côteau Landing levels at the outlet of Lake St. Francis within a range of 46.33 m - 46.63 m to meet the needs of Beau-Cedars hydropower and Seaway installations, local domestic and environmental interests and to reduce the potential of flood and erosion.. | WID Report |
| open water<br>season                           | To reduce the adverse effects of seiche on the lake, the level is kept below 46.58 m during the open water season  | WID Report |
| during ice<br>formation                        | Ideal flow (Beau. Canal, near Km 23): 5200 m <sup>3</sup> /s   | WID Report |
| once ice<br>formation<br>nears Km<br>6.5 - 5.0 | Previously, flow is gradually reduced to 4000 m <sup>3</sup> /s  | WID Report |
| once ice<br>formation<br>nears Km 3            | Previously, flow is gradually increased to 5500 m <sup>3</sup> /s  | WID Report |



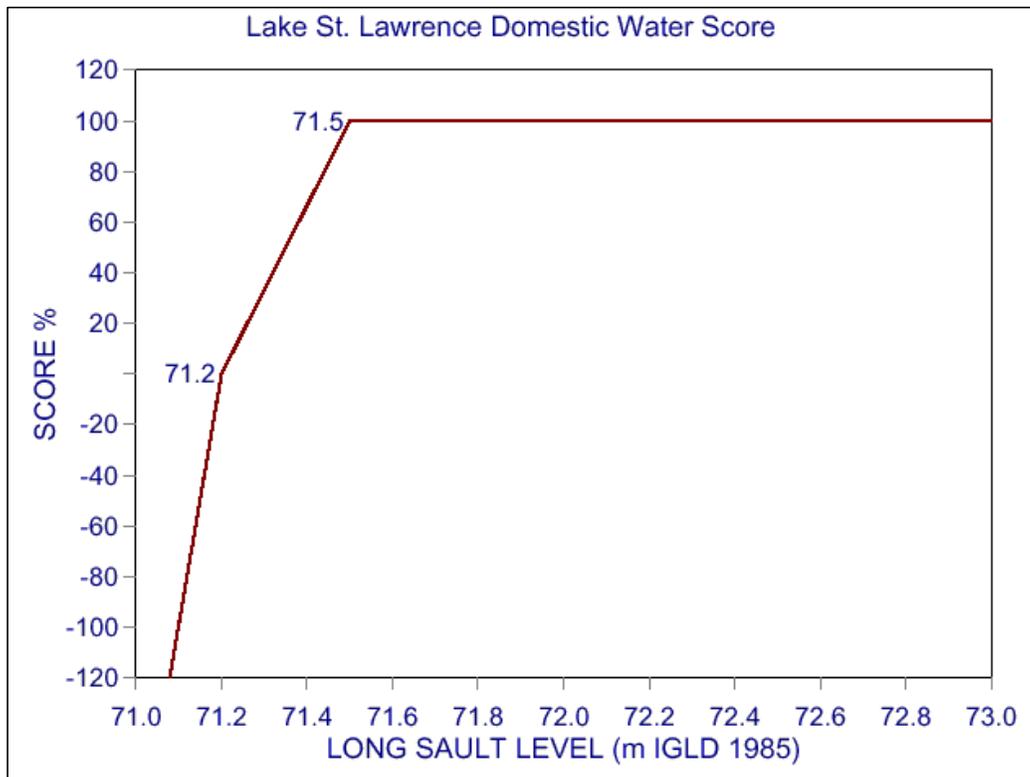


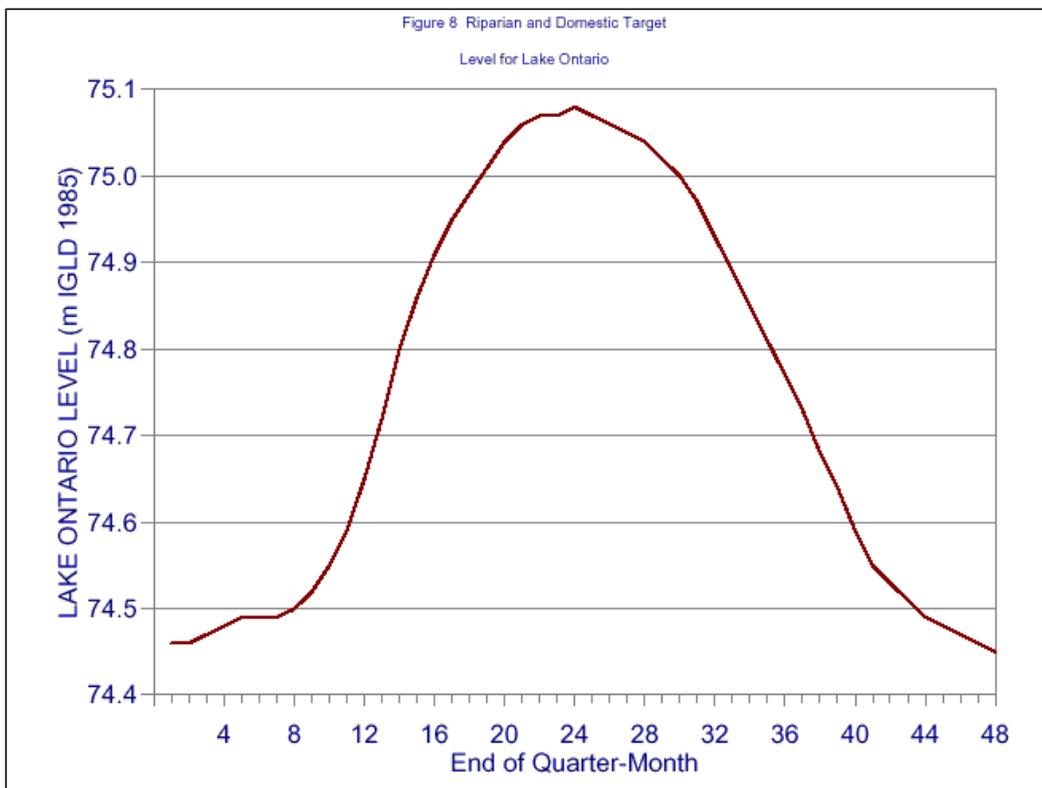
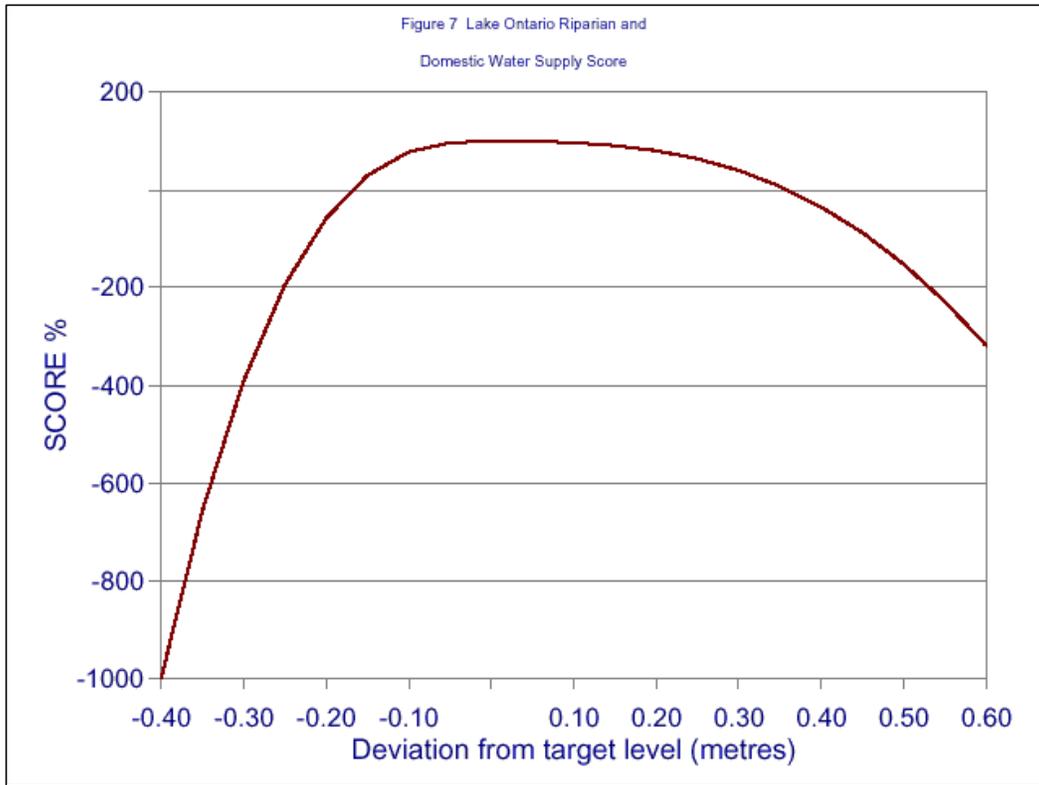
### 5. Domestic Water Supply

The table below is an inventory of water level/flow conditions that are specified under the criteria in the 1956 Orders of Approval, or expressed by various publications documenting the preferences/concerns of the domestic water supply interest.

Following the table you will find three (3) **interest satisfaction curves**. Please examine these curves and update them to the best of your knowledge and information gathered to date. If necessary, please develop any additional interest satisfaction curves required to better represent the diversity of the domestic water supply interest (different geographies, different time periods etc.).

| Domestic Water Supply |       |  |  |
|-----------------------|-------|--|--|
| Location              | When? | Water Level/Flow Conditions                            | Publication Source                                     |
| Lake Ontario          |       | minimize frequency of levels < 74.1 m                  | 2.6.1.a<br>(Interest Preference Indicators, June 1997) |
| Lake St. Lawrence     |       | minimize frequency of levels < 71.6 m at Long Sault    | 2.6.2.a<br>(Interest Preference Indicators, June 1997) |
| Lac St. Louis         |       | minimize frequency of levels < 20.4 m at Pointe Claire | 2.6.3.a<br>(Interest Preference Indicators, June 1997) |





## 6. Environmental Interests

The first table (Table A.) is an inventory of water level/flow conditions that have been expressed by various publications documenting the preferences/concerns of the environmental interests.

The second table (Table B.) is our latest summary of the performance indicators being studied by the Environment TWG as described in the Hudon/Werick report.

To date, there have been no **interest satisfaction curves** developed for the environmental interest. At this time, and to the best of your ability, please develop as many interest satisfaction curves as you feel necessary to best represent the diversity of environmental interests (different geographies, different species etc.). The “unregulated condition” scenario will be included as one of the plan alternatives.

**Table A. Preferred Water Level/Flow Conditions by the Environmental Interest**

| <b>Environment: Wetlands/Habitat</b> |  |  |  |
|--------------------------------------|--|--|--|
| <b>Location</b>                      | <b>When?</b>                                     | <b>Water Level/Flow Conditions</b>   | <b>Publication Source</b>                              |
| <b>Lake Ontario</b>                  |  | Maintain some variation in peak annual levels<br>?? peak level: 75.6 m every 10 - 20 years<br>?? peak level: 74.5 (for 1 - 2 years) between longer term highs  | 2.1.1.a<br>(Interest Preference Indicators, June 1997) |
|                                      | April<br>1 <sup>st</sup> Quarter                 | Levels should reach 75.0 m in high supply years<br>- IE. frequency of levels above 75.0 m in the first quarter of April should be similar to pre-project conditions  | 2.1.1.b<br>(Interest Preference Indicators, June 1997) |
|                                      |  | Frequency of minimum winter levels > 75.0 m should be similar to pre-project conditions  | 2.1.1.c<br>(Interest Preference Indicators, June 1997) |
|                                      |  | Range of level in 10 year period should be 2.26 m  | Eberhardt 1996   |
| <b>Lake St. Lawrence</b>             |  | Minimize weekly variation in levels  | 2.1.2.a<br>(Interest Preference Indicators, June 1997) |
|                                      |  | Maintain some variation in peak annual levels  | 2.1.2.b<br>(Interest Preference Indicators, June 1997) |
|                                      |  | The Côteau structures regulate the Côteau Landing levels at the outlet of Lake St. Francis within a range of 46.33 m - 46.63 m to meet the needs of Beau-Cedars hydropower and Seaway installations, local domestic and environmental interests and to reduce the potential of flood and erosion.. | WID Report   |
|                                      | open water season                                | To reduce the adverse effects of seiche on the lake, the level is kept below 46.58 m during the open water season  | WID Report   |
|                                      | open water season                                | level is kept above 46.45 m by Hydro Quebec for Seaway concerns.   | WID Report   |
| <b>Lac St. Louis</b>                 | early April - early May during high supply years | Preference for level of 22.0 m at Pointe Claire  | 2.1.3.a<br>(Interest Preference Indicators, June 1997) |
|                                      |  | Prefer some annual variation in level  | 2.1.3.b  |

|                       |  |   |  |
|-----------------------|--|---|--|
|                       |  |   | (Interest Preference Indicators, June 1997)            |
| <b>Lac St. Pierre</b> | early April - early May during high supply years | Preference for level of 6.79 m at Sorel | 2.1.4.a<br>(Interest Preference Indicators, June 1997) |
|                       |  | Prefer some annual variation in level   | 2.1.4.b<br>(Interest Preference Indicators, June 1997) |

**Table B. Performance Indicators being studied by the Environment TWG and their relationship to water levels/flows**

| <b>Environmental Interim Performance Indicators</b>   |                     |                                    |  |  |
|---|---------------------|------------------------------------|--|--|
| These performance indicators are work-in-progress by the Environment TWG and should be considered a first draft..<br>These will be revised as further refinements and updates are made by the Environment TWG.. |                     |                                    |  |  |
| <b>Location</b>   | <b>When?</b>        | <b>Performance Indicator</b>       | <b>How related to levels and flows?</b>  | <b>Publication Source</b>  |
| <b>St. Lawrence River</b>   | after ice formation | 1. Muskrat habitat                 | Drop in water level may cause ice to collapse, either blocking or crushing muskrat homes. Results from literature review to follow...  | Hudon - Werick 2002 (Project 1.22)   |
|   |                     | 2a. Riparian bird habitat          | Common tern nests are typically located in storm surge areas and are subjected to flooding. Results from fieldwork to follow...<br><br>Black tern nests are located on half-submerged stable surfaces, but if subjected to rapid increases in water level, may be flooded and destroyed (including offspring). Dry conditions predispose the terns to increased predation. Range of optimal levels to follow | Hudon - Werick 2002 (Project 1.16)<br><br>Hudon - Werick 2002 (Project 2.20) |
|   |                     | 2b. Palustrine bird habitat        | Water depth, duration of flooding and timing of fluctuations of the hydrologic cycle affect the wetland morphometry, which in turn, determines the vegetative composition and diversity of waterbird guilds. Projects are underway to establish the relationship between wetland attributes and waterbird species.   | Hudon - Werick 2002 (Projects 0.7, 1.15, 1.17, 1.18)                         |
|   |                     | 2c. Wildfowl and game bird habitat | Water levels affect the vegetative composition of wetland areas and area of nesting habitat.<br>Lower levels are required May 1 – July 3 for dabbling duck habitat, whereas higher levels are required in deeper marshes from early June to early September for duck rearing.  | Hudon - Werick 2002 (Projects 0.8, 1.19, 2.16, 2.17, 2.18)                   |
|   |                     |                                    | 3. Amphibian   | none so far  |

|  |   |   |   |
|--|---|---|---|
|  | and reptile habitat                     |   |   |
|  | 4a. Fish habitat                        | <p>Establish linkage between fish habitat and water level</p> <ol style="list-style-type: none"> <li>1. abundance and distribution (habitat supply maps based on water levels on Lake Ontario and St. Lawrence River – WUSD-Weighted Suitable Area Days)</li> <li>2. recruitment (deposition of eggs dependant upon water levels, reproductive success of northern pike require certain amplitude and duration of spring floods)</li> <li>3. productivity (assessment of fish annual biomass and production under various water level conditions)</li> </ol>  | <p>Hudon - Werick 2002 Projects:<br/>1.9, 1.10, 1.11, 1.12, 2.7, 2.10</p> <p>0.5, 1.20, 2.11, 2.14, 2.26, 2.8</p> <p>2.9, 2.12,</p> |
|  | 4b. Fish abundance and diversity        | Establish effects of river discharge (flow variability and discharge) on St. Lawrence River fish abundance and diversity.   | Hudon - Werick 2002 Projects 0.6, 1.14  |
|  | 5. Faunal habitat and food availability | <ol style="list-style-type: none"> <li>A. Habitat abundance, distribution and accessibility:             <ul style="list-style-type: none"> <li>?? link relationship of level to area of wetland in hydrologically active zone</li> <li>?? link relationship of level to percent of wetland area in different vegetation types</li> <li>?? link relationship of seasonal water level to surface area of wetland type</li> </ul> </li> <li>B. Habitat and species diversity             <ul style="list-style-type: none"> <li>?? identifying landscape metrics for studying wetland changes and a predictive model to relate hydrological characteristics to landscape metrics</li> <li>?? conduct literature review to determine range, ideal water depth and flood duration for native and exotic plant species in Lake Ontario shoreline wetlands</li> </ul> </li> <li>C. Habitat productivity             <ul style="list-style-type: none"> <li>?? determine relationship between average water level during the growth season and total annual biomass</li> </ul> </li> </ol> | Hudon - Werick 2002   |