

November 6, 2009

**Dr. Mark Colosimo**

Engineering Advisor, United States Section, International Joint Commission

**Dr. Paul Pilon**

Engineering Advisor, Canadian Section, International Joint Commission

Dear Drs. Colosimo and Pilon,

Subject: Response to IRG Review of “The Ecological Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Study”

***References:***

1. Peer Review of the Study Board Document. Ecological Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Levels Study (IUGLS), July 22, 2009 (Revised August 5, 2009)
2. The Ecological Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Study, July 14, 2009

This is the Board’s response to the advice and comments provided by the Independent Review Group (IRG) with respect to the ecological evaluation approach proposed for the Lake Superior regulation phase of the IUGLS. The IPG met with the Study Team at the Crowne Plaza Detroit Metro Airport Hotel, Romulus, Michigan on July 21 and 22, 2009, to discuss this and the proposed socio-economic methodology. The Board has previously responded to parallel IRG reviews of the plan formulation and evaluation strategies. It will respond separately to the review of proposed socio-economic strategy.

Respectfully submitted,

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Co-Lead, United States IUGLS Director

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## 1.1 Initial Work and Overall Study Approach

The Independent Review Group (IRG) recognized the significant data, time, and resource limitations of the proposed study and stated the following in their report, “*the proposed study relies heavily on existing data. Thus, this study will not allow a comprehensive assessment evaluation of the impacts of proposed water-level regulation plan. Nevertheless, the proposed study will help inform the decisions with respect to changes in the Lake Superior water regulation. As such, the panel feels that the proposed strategy is sufficient for informed water resources decision-making*”.

As part of their review, the IRG concurred with the overall objectives, study approach, and initial work accomplished by the Ecosystem Technical Work Group (ETWG). This work includes:

1. completion of a comprehensive literature review by Dr. Val Brady (University of Minnesota);
2. completion of an expert “white paper” that identifies major ecological systems of the Upper Great Lakes (UGL) and provides recommendations as to: potential water-level related issues or concerns, types of performance indicators and/or data that would be necessary (or available) to evaluate those indicators, responses of ecological components to changing water-level regimes, and possible project implementation strategies (Ciborowski 2009); and
3. identification of project objectives and an overall study approach.

The ETWG has adopted a study approach that is focused on assessing ecosystem vulnerabilities to changing Upper Great Lakes water level regimes. The objective of this approach is to identify water-level regimes and thresholds that minimize adverse impacts to biotic communities and ecosystem function. For the purpose of this study, water level regimes are defined as the magnitude, frequency, timing (seasonality), duration, and rate of change of water levels through time.

The ETWG has also developed a “descriptive framework of biological condition” as a way to place thresholds in an ecological and functional context. This framework is based on descriptions of progressive degradation used by U.S. EPA and various State agencies when designating aquatic life uses in aquatic systems.

The IRG recognized the need to develop and apply an integrated modelling framework tool (IERM2) to Identify and establish site-specific and regional water-level criteria or thresholds above which, or below which, harm will be done to various ecosystem components and, by extension, to the Upper Great Lakes ecosystem. This tool will assist with the Identification of vulnerabilities and potential opportunities for ecological improvement as a function of changing water-level regimes and may be used to guide adaptive management decisions as well.

The IRG did identify several areas for improvement, and those recommendations are listed below along with the ETWG response.

## 1.2 Study Design

a. *The IRG recommended that the ETWG adopt a stratified design to site selection based on physical characteristics, such as disturbance gradient, shoreline geomorphology, wetland type, and/or ecoregion.*

Response - Individual field sites have been selected based on a set of stratified criteria that include: sensitivity and responsiveness to changes in water-level regime; geographic and ecoregional representation across representative shoreline and wetland types; available historical data and imagery; ongoing research and field activity; and socio-economic interest. Individual sites are grouped by shoreline type and multiple sites will be evaluated by the same team of site coordinators to ensure consistency between lakes and regions.

b. *The IRG pointed out that additional sites may be identified by evaluating the availability of historical aerial photography and high-resolution bathymetry.*

Response – Site coordinators will be instructed to use all available existing data. Limited resources constrain the total number of sites that can be evaluated, and the ETWG believes that the updated site list shown in Table 1 will provide adequate representation and information to evaluate potential ecological impacts due to changing water-level regimes.

c. *The IRG recommended the use of any available high resolution bathymetric data in conjunction with aerial photos to derive ecological data. The IRG is not recommending the collection of new (expensive) high-resolution bathymetric data as part of this study.*

Response – The ETWG has contacted all relevant agencies who may have collected or have access to high-resolution bathymetric data in the Upper Great Lakes. This effort to identify new sources of high-resolution bathymetric data will continue, and it is hoped that site coordinators will have site-specific knowledge of local sources of high-resolution bathymetric data. The ETWG project manager has been working with the NOAA Coastal Services Center, National Ocean Service, Coastal and Geodetic Survey, and the U.S. Army Corps of Engineers to identify additional high-resolution bathymetric (LIDAR) datasets in the UGL. Currently, the Canadian Hydrographic Service is not collecting, nor does it have access to, high-resolution bathymetric (LIDAR) datasets.

d. *The IRG recognized that the greatest potential impact of water-level regulation would be on Lake Superior, and that the initial suggested ETWG study sites on Lake Superior were insufficient to detect potential impacts.*

Response - Additional sites have been added to Lake Superior to ensure that potential impacts of changing water-level regimes will be detected and evaluated. Table 1 lists the field sites by Lake. Figure 1 illustrates their geographic distribution. The number of representative sites is now balanced between Lakes.

e. *The IRG recommended that a representative wetland site be added on Lake Superior.*

Response - Per the IRG's recommendation, the Kakagagon Slough wetland complex and a tributary mouth wetland complex were added to the list of Lake Superior sites.

### 1.3 Performance Indicators and the IERM Model

The IRG comments on Performance Indicators and the IERM model will be more adequately addressed once the contracts for the Site Coordinators are finalized and the Site Coordinators are authorized to proceed with their work. Many of the site-specific IRG comments can only be addressed by the individual Scientists working those sites. The ETWG will share the IRG comments and recommendations with the Site Coordinators to ensure that specific IRG comments and recommendations are considered and implemented if appropriate.

**Table 1. Field Site List by Great Lake, Geomorphic Type, and Country**

| <b>Site List by Great Lake and Ecosystem Component</b> |                                                           |                                        |                          |
|--------------------------------------------------------|-----------------------------------------------------------|----------------------------------------|--------------------------|
| Lake                                                   | Location                                                  | Type                                   | Country                  |
| Lake Huron                                             | Eastern Georgian Bay Wetlands                             | Wetland                                | Canada                   |
|                                                        | North Channel Georgian Bay Wetlands                       | Wetland                                | Canada                   |
|                                                        | Les Cheneaux Islands                                      | Wetland                                | United States            |
|                                                        | Saginaw Bay                                               | Shallow Embayment                      | United States            |
| Lake Michigan                                          | Bays de Noc                                               | Embayment                              | United States            |
|                                                        | Eastern Shore Drowned River Mouths                        | Drowned River Mouths                   | United States            |
|                                                        | Beaver Island Archipelago                                 | Bedrock Island                         | United States            |
| Lake Superior                                          | St. Louis River Estuary                                   | Drowned River Mouth                    | United States            |
|                                                        | Chequamegon Bay – Kakagon Sloughs                         | Wetland, Shallow Embayment             | United States            |
|                                                        | Black Bay                                                 | Wetland, Shallow Embayment             | Canada                   |
|                                                        | Bedrock North Shore Stream Mouths (Duluth to Thunder Bay) | Bedrock River Mouths                   | Canada/<br>United States |
|                                                        | Apostle Islands                                           | Bedrock Islands                        | United States            |
|                                                        | Batchewana and Goulais Bays (SE Superior)                 | Wetland                                | Canada                   |
| Lake Erie                                              | Long Point                                                | Wetland/Shallow Embayment              | Canada                   |
| Connecting Channels                                    | St. Marys River                                           | Connecting Channel, Rapids, Hydropower | Canada/<br>United States |

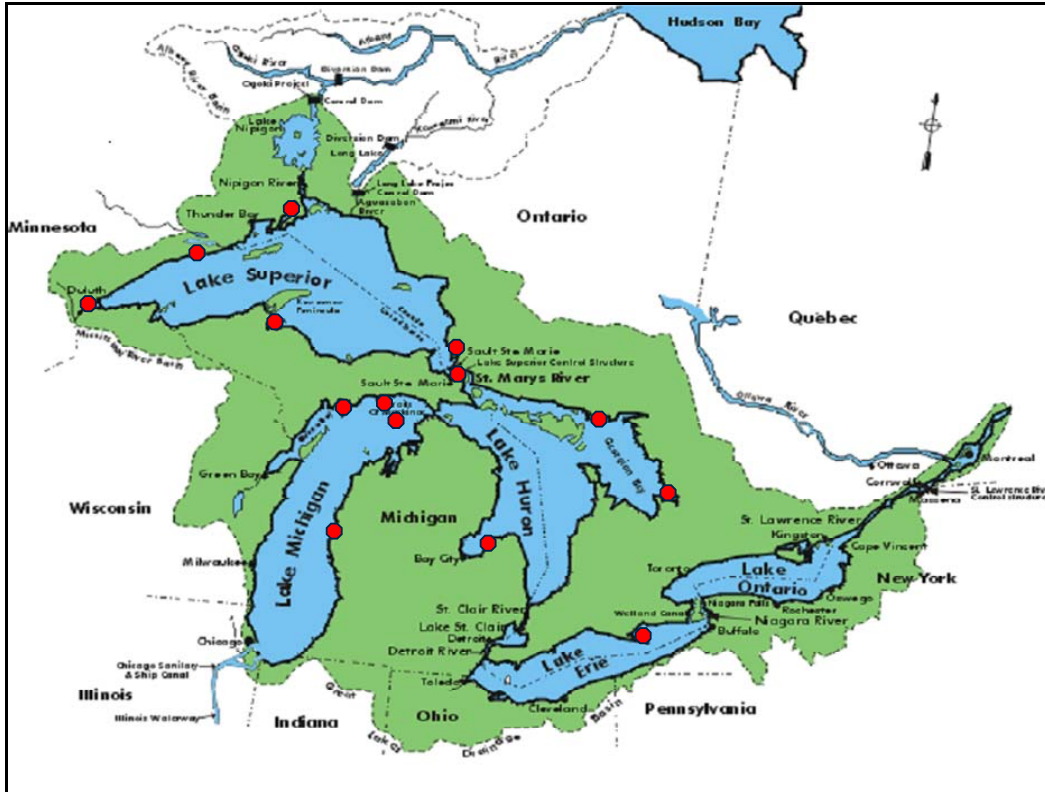


Figure 1. Study Sites

a. *The IRG recommended that the Performance Indicators (PI) be documented more thoroughly and an attempt should be made to establish consistency with PI descriptions and metrics.*

Response – In response to the Cooperative Ecosystem Studies Unit (CESU) request for proposals, groups of experts have been formed that will likely be contracted to perform the site evaluations. These groups will be working as coherent teams, which will ensure that the PI’s and the site evaluation methodologies will be consistent across Lakes and ecosystem types. The ETWG project manager will coordinate these activities to ensure that results are consistent and can be used as input into the IERM2 and shared vision models. Once under contract, a workshop is planned to facilitate the coordination and site evaluation process.

b. *The IRG recommended that the ETWG use existing data and various suitable statistical methods for threshold identification. The IRG suggested that the ETWG consider and evaluate several different statistical approaches to establish responses to lake level changes and to identify threshold responses.*

Response – As part of the IERM2 development process the modelling contractor, working in collaboration with the Site Coordinators, will evaluate multiple approaches, such as statistical, qualitative observations, best profession judgement, etc., to identify threshold responses and to quantify ecological responses to changes in water-level regime.

c. *The IRG recommended inclusion (or development) of specific indicators of vulnerability to changes in water-level regime.*

Response – As part of the IERM2 development process the modelling contractor, working in collaboration with the Site Coordinators, will develop metrics that can be used to evaluate the vulnerability of sites with specific physical characteristics to changes in water-level regime.

d. *The IRG recommended that uncertainty levels for each PI be specified. In cases where quantitative data are not available, it will be necessary to identify those PI's based on "best professional judgment" that may represent a higher level of uncertainty.*

Response – Given data, time, and resource limitations, the ETWG recognized early on that different PI's would have different levels of uncertainty. The ETWG will request that the Site Coordinators identify those PI's and metrics that have a higher degree of uncertainty and will work with the modelling contractor to ensure that those uncertainties are incorporated into IERM2 and shared vision model analyses. The ETWG recognizes the importance of providing information on uncertainty (or degree of confidence) to the Board as part of the overall decision-making process.

e. *The IRG recommended that a schematic diagram (flow chart) and a worked example of the IERM2 model be included in the updated ETWG Study Approach document to clarify exactly what the IERM2 does and what are its limitations. The IRG also recommended that existing data be used to test and validate the IERM2 model.*

Response – A meeting with the modelling contractor was held in early September. Initial information on sites and possible PI's/metrics has been provided to the modelling contractor to develop a "mock model" to illustrate IERM2 functionalities and output. Once the Site Coordinators are under contract and begin work, the list of PI's and associated metrics will be finalized and model development and validation will proceed accordingly using data and algorithms developed by the Site Coordinators.

f. *The IRG recommended adding Return Interval to the synthetic time series to account for longer-term variability.*

Response – The ETWG will discuss merits of doing this with the modelling contractor and the Hydroclimate TWG.

## **1.4 Evaluation**

a. *The IRG suggested that more weight should be given to PI responses and metrics at the extremes of water level condition (very high and very low).*

Response – The development of the IERM2 model will incorporate provisions to evaluate extreme changes in water-level regime. Data to support ecological responses to these extreme water level events may be sparse. The ETWG will rely on "best professional judgment" to evaluate the impacts of these extreme events. The IERM2 will incorporate weighting factors to evaluate sensitivity of the model to extreme events.

b. *The IRG suggested that under extreme water level regime events, the ecological response may change from linear to non-linear and may reach a “tipping point” that permanently alters the ecosystem.*

Response – Yes, it is possible that the ecological response of certain PI’s may change from linear to non-linear. The design of the IERM2 model should accommodate those types of responses and will enable the ETWG to evaluate the critical water-level regime thresholds (or triggers) that yield a significant ecological response.

## **1.5 Evaluation**

a. *The IRG suggested that sentinel (or long-term monitoring) sites be identified as an outcome of this Study.*

Response – The ETWG will discuss this and other long-term adaptive management needs with the newly formed Adaptive Management Group, recently established by the Study Board to address the adaptive management component of IUGL S.

b. *The IRG suggested an expansion of the literature search to include non-Great Lakes wetlands.*

Response – The current literature review has been completed. However, the literature review is a “living document” and will be periodically updated as the Study progresses. If time and resources permit, the ETWG has no objection to expanding the literature search to include locations and research studies outside of the basin.

c. *The IRG suggested that the ETWG could make better use of existing literature and techniques.*

Response – Yes, that is certainly possible. The ETWG will share the IRG comments and suggestions with the Site Coordinators.

d. *The IRG requested that the ETWG review the role of ice jams at tributary mouths and shore ice at sustaining shoreline ecosystems.*

Response – The implications of ice jams at tributary mouths and shoreline ice on shoreline ecosystems needs to be examined.. There may be an effect on shoreline geomorphology and erosion/sediment transport during the winter months, but the ecological impacts and relationship to changing water-level regimes is unclear.

e. *The IRG suggested that inferred climate data from sediment cores be incorporated into the current dendrochronological study to link within-lake paleo responses to infer paleoclimatic conditions.*

Response – Probable component of the Hydroclimate analyses. Recommendation will be forwarded to the Hydroclimate TWG.

f. *The IRG suggested that the IJC Study Board collaborate with other agencies to obtain high-resolution bathymetry for the Great Lakes Basin to identify vulnerable areas.*

Response – This will be pursued as part of the Study’s adaptive management strategy.