July 22, 2009
Revised August 5, 2009

Re: Peer Review of the Study Board Document, *Ecological Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Levels Study* **(IUGLS)**

The Review Team convened by the Independent Review Group (IRG) has assessed the proposed methodology presented in *Ecological Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Levels Study* developed by the Lake Superior Study Group of the IUGLS. The Review Team has participated in a thorough discussion with the Ecosystem Technical Working Group (TWG), the IUGLS Study Managers, and the International Joint Commission's (IJC) Engineering Advisors concerning the ecological evaluation methods and proposed study design.

Due to the limited opportunity to collect additional data, 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. However the panel has developed a series of recommendations to improve the reliability of the evaluations and the long-term value of the information to be acquired in the proposed investigations. Implementation of these recommendations will prove useful in to the adaptive management component of the regulation plan.

Following are the review team's comments on the proposed methodology.

1. Study Design:

        a. The IRG strongly encourages the TWG to employ a stratified design to site selection whereby physical characteristics such as disturbance gradient, shoreline geomorphology, wetland type, and/or ecoregion are used to identify unique shoreline types or units. Individual study sites should then be grouped by shoreline type. ,

        b. Site selection appears to be based on availability of ecological data as well as ancillary data (e.g., bathymetry, aerial photos, etc.), however sites with a history of aerial photographs (when combined with bathymetry data), may expand site coverage.

        c. The IRG strongly encourages the use of any available high resolution bathymetry in conjunction with aerial photos to derive ecological data (e.g., vegetation zonation) to the extent feasible. Due to the great expense and time requirements, the IRG is not recommending the collection of new bathymetry within the IUGLS. However such data will be of great value to the long term management of the system, particularly under changing conditions, thus recommendation 4.f. below seeks to encourage acquisition of new bathymetry basin-wide.

d. The greatest impact of the Lake Superior Regulation Plan will be to Lake Superior water levels. The IRG feels the number of sites on L.S. is not sufficient to detect potential impacts. The IRG recommends changes in representation across Lakes, e.g., currently insufficient number and distribution of sites on Lake Superior vs. Huron and Michigan. The review team does not feel that sites on L. Erie will yield valued scientific information, given limitations of resources and time.

e. The IRG recommends the TWG attempt to include a representative wetland complex on Lake Superior, for example, Kakagagon Slough, along with a barrier beach wetland (whose water levels are controlled by a bar at the mouth of a tributary).

2. Performance Indicators (PI) and the IERM Model:

a. PIs need more thorough documentation; TWG should attempt to establish consistency with respect to descriptions and metrics (e.g., note ecosystem type where each would be used; units of measure)

b. What methods will be used to identify threshold responses? What other statistical analyses will be used to establish responses to lake level changes? Recommend using existing data to test suitability of various statistical methods for threshold identification.

c. Recommend inclusion of specific indicators of vulnerability to water level change, e.g., based on geomorphology, bathymetry, position in the landscape and basin, slope, parent material, presence of sills and benches, etc. This may inform the site selection process and the adaptive management effort.

d. Recommend specifying uncertainty levels for each PI. In the absence of quantitative data for PIs, use best professional judgment, but distinguish those from PIs with higher confidence. The uncertainty analysis should include tests of different response relationships, e.g, linear, nonlinear, and thresholds.

e. The IRG recommends updating the strategy report to include a schematic diagram and a worked example of the IERM. Recommend that test runs be undertaken with existing data to test the model.

f. Consider adding Return Interval to hydrologic responses to account for longer term variability.

3. Evaluation

a. The proposed methods focus on an overall score for water level responses across an extended simulation period; the panel feels that more weight should be given to PI responses at the extremes of water level conditions (very high and very low).

b. Consider potential for alternative response trajectories under extreme conditions. That is, under dramatically changed climate, the response relationships may change from a linear response to a threshold response or the system may experience a tipping point under extreme conditions as compared to less extreme conditions.

4. Additional Suggestions/Recommendations:
   a. As an outcome of this study, identify sentinel sites for long term investigation as related to adaptive management
   b. Explore literature beyond investigations of Great Lakes wetlands, (for example, Peace-Athabasca Delta)
   c. Make better use of existing literature and techniques, for example TWG could explore use of causal analysis pathways (as per EPA methods)
   d. What is the role of ice jams at tributary mouths and shore ice in sustaining shoreline ecosystems? Is this a significant issue that should be considered?
   e. Add a paleobiology component (e.g., based on sediment cores, pollen or diatoms) to the current dendrochronological study to link within-lake paleo-responses to climatic conditions
   f. Study Board should seek to collaborate with other agencies to acquire high resolution bathymetry for the Great Lakes Basin as a whole to identify vulnerable areas.

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