



September 12, 2008

**Dr. Paul Pilon**

Engineering Adviser, Canadian Section, International Joint Commission

**Dr. Mark Colosimo**

Engineering Adviser, United States Section, International Joint Commission

Dear Drs. Pilon and Colosimo,

At the outset we would like to apologize for this delay in responding. Thank-you for forwarding the Independent Review Group's (IRG) assessment of the Hydroclimatic Technical Work Group (HC TWG) Hydrology and Climate Modelling Strategy for the International Upper Great Lakes Study (IUGLS) conducted June 26, 2008 in Reston, Virginia USA. The Study Board is very appreciative of the IRG's timely response given the importance of the Hydrology and Climate Modelling component to the overall Study, as are we pleased with the review process as a whole and with the exchange and advice we received from each of the reviewers. We feel the exercise was a very productive and has added substantially to the overall quality of the Study.

The Study Board is also satisfied with the Independent Review Group (IRG)'s overall conclusions regarding the Hydrology and Climate Modelling component, namely, that the proposed methodology is generally appropriate to the accomplishment of the outlined tasks; that the study has clearly stated objectives and that the investigation employs generally appropriate and widely accepted databases and modelling approaches.

The Study Board would like to thank the IRG for the advice they provided on a number of issues that they felt required additional focus and will take the opportunity to respond here to the seven issues which were identified as required or recommended to be addressed:

- 1) ***Design of Integrated Framework (required):*** The Study Board concurs with the IRG assessment, and will develop a comprehensive flow diagram which more clearly outlines the processes required to complete the project. We appreciate the effort the IRG expended in developing a flow diagram for us to consider.
- 2) ***Validation of Water Balance Terms (required):*** The Study Board agrees that in addition to the focus on Net Basin Supply (NBS), greater attention should be given to both: (1) precision of estimates of components of the water balance; and (2) agreement of various NBS model estimates with their associated lake levels.

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The study team has met and discussed the best approach to address this issue. We expect that as we refine our uncertainty analysis, the validation exercise will be clarified.

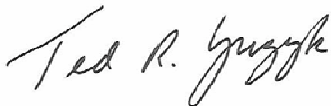
- 3) ***Consideration of Winter Ice Regimes (required):*** The Study Board agrees that some analysis needs to be undertaken of winter ice regimes, considering both 1) lake ice cover and 2) effects of connecting channel ice on conveyance. To address the first issue, provisions are underway to examine and consider a modification of the lake ice analyses developed by Ray Assel - Principal Investigator (PI), Great Lakes Environmental Research Laboratory, NOAA, now retired. This will be explored further over the coming months. Secondly, a hydraulic analysis of the effect of connecting channel ice on conveyance is underway.
- 4) ***Inclusion of Additional Observational Data (required/recommended):***
  - *Comparisons of evaporation estimates based on modelling work with insitu pan evaporation records. (required):* The literature on the utility of pan-evaporation to infer large lake evaporation is quite clear in that the thermal retention of large lakes versus that of small pans makes this inappropriate. In consequence, the Study Board does not feel it is feasible to draw any conclusions from pan data. We will ensure that our synthesis report comprehensively reviews the literature on this topic and that expert conclusions regarding the usefulness of pan-derived data for large lake evaporation inferences are clearly articulated. While there is some utility in the use of pan measurements for potential ET estimates, PET estimates are not required for this study.
  - *Paleo-data synthesis from literature. (required):* The Study Board agrees with the potential usefulness for paleo-data and is currently undertaking a literature review to ensure that we understand the paleo-climatic context of the Great Lakes basin.
  - *Existing data could be critically reviewed to determine if atmospheric water recycling is a significant factor in the water balance. (recommended):* Although highly desirable, the Study Board feels that this will only be possible using the modelling study and examining an atmospheric water balance from the Regional Climate Model. The PI responsible for this aspect of the project has been tasked to examine the atmospheric water balance from the model to address this issue.
  - *Other examples of readily available data that could be reviewed. (recommended):* The Study Board acknowledges the conventional value of ancillary energy balance data, however, the utility of these data (radiation, pressure, etc.) in the context of water balance estimations is quite limited. It should be noted that these data are *indirectly* included in our analysis since the models often make direct use of these ancillary data for their water balance estimates.
  - *The IUGLS has recently installed eddy covariance instrumentation and the results of this monitoring must be incorporated into the study as expeditiously as possible. (required):* The Study Board certainly agrees

with this requirement and every effort will be made to characterize lake evaporation using all available model estimates and observations.

- 5) ***Estimation of Ungauged Watershed Inflows (required)***: The Study Board agrees and has asked one of the PIs to develop a commensurate proposal to ensure that ungauged inflows are being captured. The current established method will be compared to a more rigorous geo-statistical estimation method that has been previously tested in other regions. This method will also be compared to an existing operational product being developed by the USGS.
- 6) ***Analysis of Atmospheric Drivers (recommended)***: The Study Board agrees that there is undoubtedly value in determining synoptic factors that may influence water balance components and that these drivers are accounted for in the climate models used for this study. While there have been initial attempts to examine this issue more directly, funding limitations require that we focus attention on other more important topics.
- 7) ***Future Projections of Climate (required)***: The Study Board agrees with the IRG recommendations and will use transient scenarios versus steady-state solutions for future climate change projections. The Study Board will direct the HC TWG to work closely with the Plan Evaluation Group to appropriately select climate change projections based on metrics relevant to Great Lakes hydrology and operations.
- 8) ***Uncertainty (required)***: The Study Board recognizes the importance of addressing issues related to uncertainties in each component of the scientific process. We agree with the IRG that there is a requirement to develop a framework for the systematic assessment of uncertainty for all the components. An expert workshop on uncertainties was held in August, 2008 and the results of this workshop are now being considered for inclusion in the study. A more comprehensive strategy for managing uncertainties in data, interpretative techniques and modeling is being developed at the time of this response.

We would like to thank the IRG for another productive interchange at the ASCE Headquarters in Reston. The IRG's comments, dialogue and recommendations will assist us greatly in ensuring we achieve our scientific objectives in this plan of study.

Sincerely,



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**Ted R. Yuzyk**  
Canadian Co-Chair  
IUGLS Study Board



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