

May 5, 2009

Re: Peer Review of the Plan Evaluation Group's Document, *The Formulation and 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 Formulation and Evaluation of Lake Superior Regulation Plans for the International Upper Great Lakes Levels Study* proposal developed by the Plan Evaluation Group (PEG) of the IUGLS. The Review Team has participated in a thorough discussion with the PEG, the IUGLS Study Managers, and the International Joint Commission's (IJC) Engineering Advisor for Canada concerning the proposal.

The PEG has been asked to respond to the IJC's Directive to "review the operation of structures controlling Lake Superior outflow in relation to impacts of such operations on water levels and flows, and consequently affected interests assess the need for changes in the Orders or regulation plan to meet the contemporary and emerging needs, interests, and preferences for managing the system in a sustainable manner, including climate change scenarios; and evaluate any options identified to improve the operating rules and criteria governing Lake Superior Outflow regulation".

The overall approach of the PEG's plan formulation and evaluation methodology is one of shared vision planning. This includes:

1. Assessing the physical, economic, environmental, and social dimensions and impacts of current and alternative regulation plans on the affected water-using and water-dependent sectors
2. Determining public needs and preferences through a robust public involvement program
3. Plan Formulation: creating regulation plans that address public needs, and minimize adverse impacts of changing environmental conditions.
4. Evaluation: defining performance indicators, decision criteria for plan ranking and decision making,
5. Adaptive Management: a complementary plan that "relies on a continuing accumulation of knowledge and information, through a monitoring and evaluation system, which is used to improve the suite of management decisions." This approach allows the IJC and other management agencies to adjust incrementally to the uncertainty associated with climate change and emerging trends in other social and economic factors that are associated with the use and management of Great Lakes resources, as they become evident.

Formulation and evaluation of Lake Superior regulation plans is a challenging task in that the effects of regulation are relatively small in comparison to the natural variations in lake levels. The IRG's review team has assessed the proposed methodologies and considered the needs related to public understanding of study findings. The shared vision process proposed by the PEG shows high promise and appears to incorporate sound

principles of planning, evaluation and decision-making. However, the review team found that:

- A number of the proposed methods are not described with enough detail to enable the review team to be able to fully evaluate the recommended approach without reviewing cited references.
- The proposed methods may not always be appropriate to the task, for example reliance on net basin supply forecasts.

Based largely on the technical discussions, the review team makes the following observations and recommendations:

A. With regard to Plan Formulation:

The proposed approach to plan formulation involves multiple investigators developing a variety of what appear to be a series of closely related plans. Given that there will be adjustments made to fine tune each plan, would it be more effective to start with fewer candidate plans?

1. **Legal Review.** The water use priorities identified in Article VIII of the *Boundary Waters Treaty* apply to the upper Great Lakes. It would be useful to prepare a legal review that would consider how these priorities interact with other water uses on the Great Lakes, particularly environmental uses that have emerged since treaty formulation and which are generally supported by the public. Such a review should consider other treaty clauses, e.g. Article 4.
2. **Perfect Forecast.** Forecasting of Net Basin supply (NBS) or its components is perceived to be a viable approach to improved outflow management. We recommend that the PEG employ scenarios using perfect forecasts (as in LOSL, 2006) of various time horizons to determine the degree to which forecasts benefit the regulation plans. These perfect forecasts would cover all seasonal inflows to the upper Great Lakes.
3. **Scenarios.** Figure 20 (page 46) illustrates an interest satisfaction curve. Although a lake level duration curve is not presented in the same figure, it is likely that satisfaction is highest when lake levels are perceived as normal. What is the current status of drought and high water contingency plans in the upper Great Lakes?

The study may wish to consider a scenario-driven analysis in which specified extreme event scenarios are used in the analysis. This would include the impact of future economic growth scenarios for the basin, and implications for water uses.

Economic growth scenarios should include an envelope of scenarios as they affect water use in the basin: (1) a baseline business as usual forecast of the Midwest economy and (2) an accelerated growth forecast based on the Midwest and

Chicago Region as the hub within the network of world transportation/logistics and associated manufacturing and service industries. Both impacts on groundwater, tributary streams, and lake withdrawals and their interrelationships would need to be considered. Navigation uses may substantially grow under an accelerated growth forecast but may be constrained under a warmer and drier climate scenario.

Navigation should include not only ship-oriented transport but also lake and tributary barge transportation. Navigation in both contexts is important as an economic driver of the region, but also from an environmental standpoint, by diverting traffic from less economically and environmentally-efficient rail and especially truck transportation.

For all scenarios, the implications for energy use and conservation, especially fossil fuel based technologies, need to be documented, given the policy priority for energy conservation (greenhouse gases) and energy independence.

4. **Climate Change.** Climate change scenarios should take into account landscape changes. For example, would a warmer and drier climate lead to increased water demands for irrigation. Given that this is one of the Treaty priorities, what effect would this have on other uses and on lake levels? Would other climate scenarios lead to increased sediment or nutrient loads?

The envelope of economic growth scenarios should be superimposed or integrated within climate change scenarios that encompass the range of climatic possibilities. The purpose is to conduct a “stress test” for the environment and the economy, as it would affect the range of impacts upon the basin’s water resources. This will identify the range of levels that goes beyond the historical norms, and the potential impacts of these changes.

B. With regard to Plan Evaluation:

1. **Stochastic Analysis.** Long-term continuous simulation is proposed in the plan evaluation strategy to address the long response times and “memory” inherent in the Great Lakes hydraulic system. However, nearly all legitimate operating strategies perform reasonably well in maintaining lake levels within the acceptable range nearly all the time. Experience has shown that plans that ameliorate extreme high (or low) levels will increase the risk of extreme lows (or highs). It may be more efficient to focus on the plan evaluation on a dozen or so stochastic sequences that represent critical dry and wet scenarios. In general, such an analysis will provide the same information as one utilizing the full 50,000 sequence database. The plan evaluation should include an assessment of system memory. Specifically, how long can the impact of a regulatory action be detected in the system?

2. **Integrated Ecological Response Model.** Development of the IERM is a key task, but there is insufficient detail concerning the approach that would be taken. The review team would like to review the specific proposal for this model particularly the performance indicators, the extent to which they mask or reveal key data, the assumptions that go into the model and their support within current scientific knowledge, and the relative weight given to particular variables in the model. The list of performance indicators provided in the methodology, identified as preliminary, is generic and insufficiently defined. It also would be informative to know what alternative approaches were considered and why they might have been dismissed.
3. **Environmental Data.** The review team recognizes that cost constraints preclude the collection of new environmental data. Therefore we feel that there needs to be a significant and serious synthesis and integration of studies already available. If nothing else, available annual research reviews should be consulted. These could include studies by Environment Canada, the U.S. EPA or Army Corps of Engineers, studies done by academic scientists working on the Great Lakes, and major review that appear in such sources as *The Annual Review of Energy and Environment* or *Annual Review of Ecology and Systematics*.
4. **Sampling Criteria.** The study proposes a sampling approach to considering many items such as wetlands and recreational boating because there are insufficient study resources to do a comprehensive review. The review team looks forward to reviewing the site selection criteria when they become available.
5. **Adaptive Management.** The proposed adaptive management protocol is insufficiently described for the review team to evaluate without going to cited references. It appears to be a passive or social process rather than an active technical one. The PEG should clarify the specific tasks that will be undertaken including how “uncertainty” and “risk” will be defined and assessed, and how the approach will reduce uncertainty, and hence risk in future decision-making, by reducing data gaps in models.

For example, does the approach deal systematically with the following: (1) What are the most important facts that we know that help to answer the question? (2) What are the most important information gaps and priorities to address the question? What is the value of waiting for more information in making decisions, in terms of the economic, social, and environmental benefits of making a better decision and perhaps avoiding irreversible change if we act today? What do we do while waiting – research, preparing contingency and prevention plans? Can we identify management solutions that are flexible in response to new information? Information can play a number of important functions in decision-making, including the evaluation of benefits in reducing risks, or the conversion of situations involving uncertainty to a situation in which risks can be quantified. Is it possible to develop early warning, or leading indicators for the economy,

environment, and society that alert the planning process to impending change and the need for management action?

Item 4 on page 31 refers to continued “resource production.” Does this refer to continued operation while additional data are being acquired, or to production of commercially-harvested resources such as fish, in contrast to sustainable use of the Great Lakes in terms of what have come to be called “ecosystem services?”

6. **Sites and Species of Interest.** It was not evident to the review team that the plan formulation recognizes sufficiently the differences among the lakes in terms of the “quality” of the environmental resource. Lakes Erie and St. Clair have been far more altered and disturbed than Lake Superior, and parts of Lake Michigan have seen moderate to severe disturbance while other parts, e.g., the Door County peninsula in Wisconsin and the George Peninsula in Ontario, show far less disturbance.

Lake Superior is the least disturbed of all the lakes, contains a far more diverse set of wetland habitats, likely contains more rare and uncommon species, or “species of concern”, and more generally reflects how all the lakes looked at the time the Treaty was signed than the other lakes. It is the only lake that has not been extensively-invaded by the invasive cattail, *Typha x glauca*. The shores of the Door County Peninsula and the George Peninsula also contain highly diverse wetland habitats likely to contain many unusual species.

7. **Shared Vision Planning.** It appears that many stakeholders are not cognizant of the physical realities and limitations associated with management of Great Lakes water levels. These misconceptions persist despite the various outreach efforts of the IJC and others. Does this situation preclude the use of SVP? How will the study board address this issue? The IRG suggests the PEG attempt to document the level of misunderstanding as part of this task.

References

Lake Ontario □ St. Lawrence River (LOSL) Study Board, 2006. *Options for Managing Lake Ontario and St. Lawrence River Water Levels and Flows*. St. Lawrence River Study Board to the International Joint Commission. March 2006.

Eric D. Loucks, Ph.D., P.E.
US Co-Chair, IRG

Robert A. Halliday, P.Eng.
Canada Co-Chair, IRG

Barbara L. Bedford, Ph.D.

R. Derek Bjonback, Ph.D., MBA