

Exhibit A
International Upper Great Lakes Study – Sub-Product Reviews, Synthesis Product Reviews, and Draft Final Study Report Reviews Template

Peer Review of Manuscripts

This manuscript has been submitted for independent peer review to the Co-Chairs of the Independent Peer Review Group (IRG) as identified in the Independent Review Plan (IRP) of the International Upper Great Lakes Study (IUGLS).

The evaluation and acceptance of the technical report (documentation) will include, as part of the review criteria, how effectively the goals of the work have been accomplished within the limits as described in the “background and context statement in Article 9.3.1.2.

Manuscripts shall be evaluated on the extent to which the authors’ efforts have been covered/documented and the extent to which the reviewers can answer the review questions:

- Are the methods employed by the authors sufficient to answer the questions;
- are they being used correctly;
- are the analyses and tests appropriate for the problem at hand; and
- are the derived conclusions supportable by the model and analyses?
- Are there any other comparable methods or approaches that may/ought to be considered, which would provide more insight for the specific task under review?

Checklist for the Reviewer

Your review is:

- To provide the authors with directions as to how they could improve their analysis and technical report. Please provide clear instructions and comment objectively, remembering the efforts that they have made to prepare the manuscripts. On a separate sheet, you may provide comments for the editor that you feel are necessary. These separate comments will not be provided to the authors.

Some additional points are:

- Please document statements adequately so that authors may fully understand your concerns. You may do this using additional sheets cross-referencing your additional comments to the specific questions below.
- Some of the questions follow a scale of 1 through 5, with 1 be the highest rank (yes -- always or excellent) and 5 being the lowest (no -- never or very poor). Please encircle your responses.

Manuscript: Formulation and Evaluation of New Control Structures in the Great Lakes System

Author(s): Dr. Bryan Tolson, Saman Razavi and Masoud Asadzadeh

Name of Reviewer: Dr. Abbas Seifi

1. Are the objectives of the work clearly stated? ①2 3 4 5
2. Are the methods employed valid, appropriate and sufficient to address the questions, hypotheses or the problem? 1②3 4 5
3. Are the observations, conclusions and recommendations supported by the material presented in the manuscript (e.g., data, model and analyses)? 1②3 4 5
4. Are the assumptions used valid and are the mathematics presented correct? ①2 3 4 5
5. Is the manuscript well organized, material precise and to the point, and clearly written using correct grammar and syntax? ①2 3 4 5
6. Are all of the figures and tables useful, clear, and necessary? ①2 3 4 5
7. What is the quality of the overall work? 1②3 4 5

Recommendation (please circle your response)

A - acceptable

①B - acceptable with suggestions for revision

C - acceptable if adequately revised

D - unacceptable

If you have selected **C**, do you wish to receive the revised manuscript for further review?

yes no

Rating (Circle the rating you would like to give this manuscript. Unacceptable work should be given a score of 40 or less.)

100 **①90** 80 70 60 50 40 30 20 10 0

Comments (limit responses to one paragraph for each question; reference pages, charts, and data. Please distinguish if responses are of major or minor concerns.)

A. What is the best/most unique part of the analysis?

The main strength of their method is the development of three simulation models used to assess the multi-lake system performance under various regulating rule curves. Extensive simulation analysis and detailed formulations of rule curves for each lake are the best part of this work. Another advantage of their method is due to directly optimizing rule curve coefficients by which they avoid inferring rule curves from a previously found optimal sequence of releases using regression analysis. Furthermore, the method includes sufficient details about the system constraints and flow information to produce practically useful and viable results.

B. What is the most critical aspect of the study/analysis? Why?

The optimization method uses only 8 scenarios of 70 years from 50,000 available scenarios. It is also not clear how they incorporate those 8 scenarios during the course of optimization. They could use all available scenarios to produce a robust baseline for target releases using a stochastic programming or robust optimization method. Such methods would consider both probability of occurrence and magnitude of extreme flows among all 50000 scenarios and, as a result, would produce more reliable baseline solution.

C. Which aspect of the analysis/modeling is weakest? Why? How can it be improved?

The method failed to generate a trade-off solution between 29.6 and 8.5 billion clusters of solutions. It would be desirable to find a solution that significantly improves the frequency based objective at some reasonable more cost. The 8.5 billion UW plan is the best solution found here but still not satisfactory in terms of greatly improving the operation over the base case. We would expect much improvement over the base case and almost similar (1%) solution is not good enough since the base case itself is far from ideal and questionable.

D. Are there any other suggestions that are related to how this analysis may be used more effectively or the results explicated in a more understandable manner?

There is a major question on UW plan and that is: when it is actually violating the base case in any of the lakes or points, how much is the average magnitude of the flow that is violating the extremes? These magnitudes should have been considered in the objective function using a Conditional Value at Risk (CVaR) measure of risk which is popular in Finance.

The objective function is connected to decision variables X through Y which is an embedded function defined by UW plan based on simulation. That is why the model becomes an embedded-simulation optimization model. The convergence of solution method for such model is seriously questionable and has to be taken care of by means of a mechanism to ensure convergence. This is lacking and could be the main reason for the algorithm to take so much time and also fail to converge to better expected results.

Please indicate any confidential comments to the Co-Chair(s) of the Independent Peer Review Group in the space below. Comments for transmission to the author(s) should be on a separate sheet attached.

Signature: A. Seifi

Date: August 31, 2011.

Comments for Transmission to Authors

It would be useful to have both general comments and specific comments for major and minor revision. Please use additional sheets should they be required.

Further comments for transmission to the authors:

- 1) This study focuses on developing multi-lake regulation strategies to mitigate extreme climates, or more specifically, extreme water supply scenarios.

They did not specifically test extreme climates. The extremes are lost among 50000 scenarios and the deviations averaged over all 50000 scenarios could be misleading.

- 2) The comparison with the base case could also be a problem since the base case itself violates the extremes (bounds) frequently.

They use monthly flow information and monthly average lake levels but the target releases found are not monthly. Rather, they have found release targets for only two regulation seasons as mentioned in Section 2.4.2. The results given in Table A4-1 may not be helpful for guiding the actual monthly operation.

- 3) Overall, the objective function is constructed to try to identify a plan that improves upon the base case regulation performance (reduced frequency of going beyond extremes) at every evaluation location for every NBS scenario considered. Thus, a multi NBS scenario formulation was developed to optimize the rule curve parameters over multiple NBS scenarios with significantly different behaviors simultaneously. The resulting rule curves would be expected to be robust and more reliable when facing unpredictable future climate conditions.

This method does not necessarily create a robust baseline since the probability of occurrence is not considered explicitly in the optimization process. Therefore, the solution found may damage regular operation for the sake of improbable scenarios. An alternative approach would be an advance method to create robust baseline for operating the system using the key idea of uncertainty margin budgeting.

- 4) The single objective function to optimize the rule curve parameters for any single NBS scenario.

This formulation causes difficulties for the optimizer as it involves binary variables that may not get binary values during the course of optimization but that is not the case here since they used a genetic algorithm. I think they made the problem unconstrained (except for bounds) because they wanted to use Genetic algorithm which has difficulty with constrained problems.

- 5) The authors claim that: initial results showed that pattern search could not noticeably enhance the quality of DDS solutions suggesting that the solutions found with DDS were all very close to local minima.

It is not known how good the found solution is in comparison with other possibly optimal solution since nothing is reported on the convergence of optimization method and the solution found is only compared with the base case which is itself questionable.

- 6) Validation performance of UW plan and Base Case over the full 50,000 year.

There is a major question on UW plan and that is: when it is actually violating the base case in any of the lakes or points, how much is the average magnitude of the flow that is violating the extremes? These magnitudes should have been considered in the objective function.

- 7) There are two distinct clusters of solutions on the tradeoff separated by a very large difference in regulation costs (a difference of approximately \$20 billion). It is not currently clear why there is such a distinct difference in cost or whether this difference actually exists in the true set of tradeoff solutions (remember, PA-DDS is heuristic and can only be expected to approximate the true tradeoff like all other applicable multi-objective optimization algorithms).

This shows that two sets of single objective optimal solutions have been found and a trade-off solution between the two clusters have not been established.

The method failed to generate a trade-off solution between 29.6 and 8.5 billion. It would be desired to find a solution that significantly improves the frequency based objective at some reasonable more cost. The 8.5 billion dollar solution is the best solution found here but still not satisfactory in terms of greatly improving the operation over the base case. We would expect much improvement over the base case and almost similar (1%) solution is not good enough.

- 8) The comparison of the various solutions in Table 7 and Table 8 (and Table 4) highlights that a variety of reasonable quality solutions (multi-lake regulation plans) exist for a range of estimated costs.

This is exactly what is missing in the report. We do not see a variety of tradeoff solutions between the two clusters of (single objective) solutions found therein.

