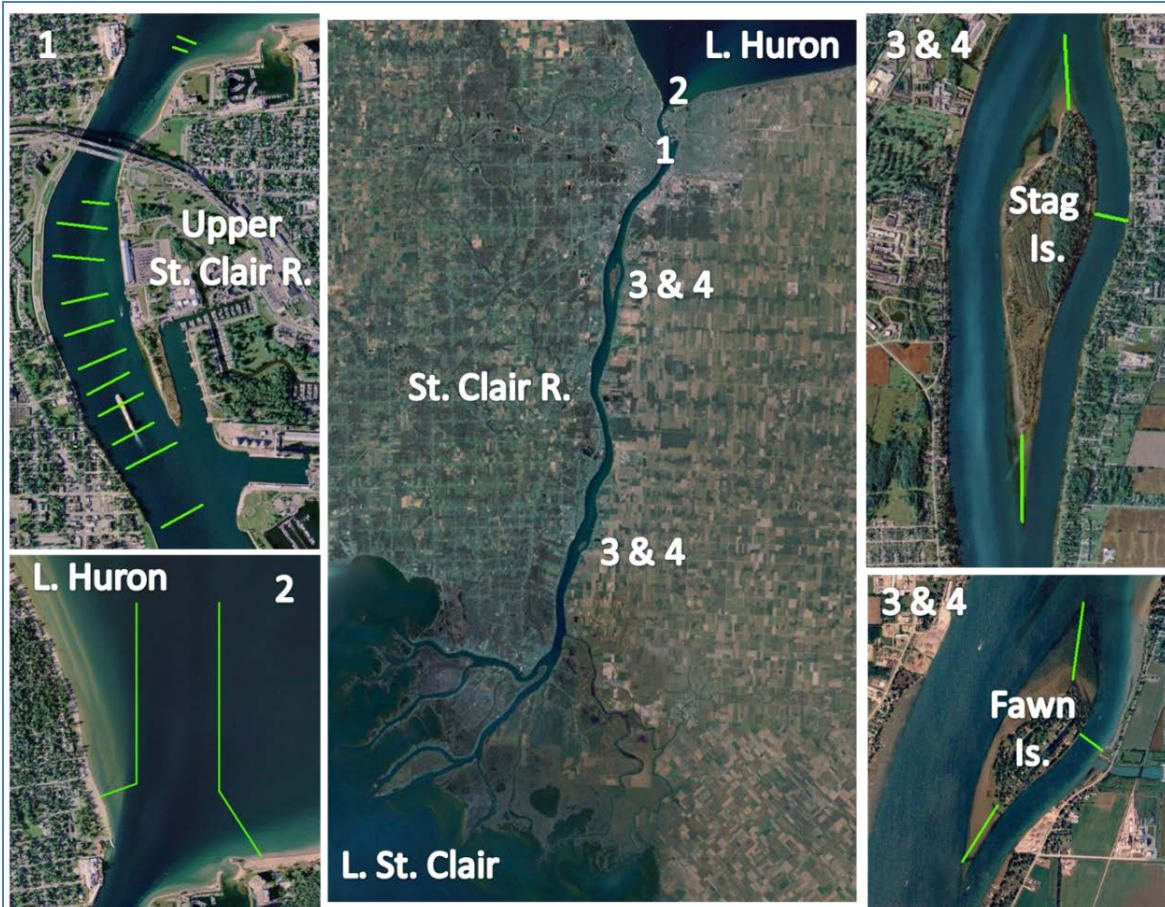




**Ninth Semi-Annual Progress Report  
of the  
International Upper Great Lakes Study  
to the  
International Joint Commission**



*Restoration structures in the St. Clair River and their locations that were studied.*

**covering activities from  
October 1, 2010 through March 31, 2011**

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## INTERNATIONAL UPPER GREAT LAKES STUDY BOARD

Commissioners:

The International Upper Great Lakes Study Board submits herein its ninth Semi-annual Progress Report, covering activities from October 1, 2010 through March 31, 2011.

### 1. SUMMARY

During this period, the emphasis has been on the finalization of performance indicators and coping zones for each of the technical work groups for inclusion into the Shared Vision Model (SVM) framework for plan formulation and evaluation. The Board has begun to participate in decision exercises to prepare for its selection of an alternative regulation plan for Lake Superior later this year. Refinements of the hydrological scenarios have also taken place for testing of alternative plans. Substantial progress has been made addressing the issue of restoring upper Great Lakes water levels, examining options for compensating for the historical accumulation of lake level changes due to epochs of dredging and other human and natural (includes change in conveyance since 1962) changes to the inherent hydraulic balance of the Great Lakes. This was a major and unanticipated effort that had been added, by the IJC, to the responsibilities of the IUGLS Team in this period. Workshops have been conducted to address this topic, and a report is being prepared for the IJC, along with a comprehensive public involvement strategy in conjunction with the Public Interest Advisory Group (PIAG).

The following are highlights of activities over the last six months, with more details provided under Section 2:

- All performance indicators and coping zones have been provided to the Plan Formulation and Evaluation Group (PFEG) who is working with other Technical Working Group (TWG) leads to select final values.
- The Shared Vision Model is nearing completion and an initial version of “the Board Room” within the SVM has been developed for active use by the Board for plan comparisons.
- Two workshops were held, one regarding institutional aspects of adaptive management and another on the ecological impacts of structures to restore Upper Great Lakes water levels. Three “white papers” were presented and reviewed at the workshops. In March, the report “Evaluation of Potential Ecological Impacts Resulting from Lake Michigan-Huron Water Level Restoration and the Placement of Structures in the St. Clair River” was provided summarizing the outcome of the second workshop.
- Investigations have been performed regarding lake level restoration options including structural alternatives placed in the St. Clair River, along with their costs and both

upstream and downstream hydrological, ecological and economic impacts at an exploratory level. A strategy for communicating findings to the public has also been drafted in conjunction with PIAG.

- Four phase 2 study technical reports have been submitted for independent peer review, according to schedule.
- The drafting of the Final Study Report has begun, and Mr. Thomas Shillington has been retained as technical editor.
- Dr. Syed Moin was selected as Acting Canadian Co-Director with the temporary assignment of Mr. Ted Yuzyk as Acting Secretary to the Canadian Section of the IJC. Ms. Wendy Leger was selected as Acting Canadian Co-Manager while Dr. Moin fulfilled this assignment.

## **2. STUDY TEAM AND BOARD ACTIVITIES**

### **2.1 LAKE SUPERIOR REGULATION TASK TEAM**

During the reporting period, all technical work groups have completed their work in developing performance indicators (PI) and coping zones, although refinements continue. The Plan Formulation and Evaluation and Adaptive Management Groups have worked closely together to incorporate the PIs into the latest version of the SVM and to determine how the resulting alternative plans may be modified to address uncertain hydrological futures.

The Plan Formulation and Evaluation Group has conducted evaluation exercises with the Study Board. This effort will help prepare the Board for the decisions that they will have to make in choosing an alternative plan that best addresses the management principles and guidelines developed for their evaluation.

#### **2.1.1 Performance Indicator TWGs**

##### **Coastal Zone TWG**

The Coastal Zone TWG has continued efforts related to evaluating the sensitivity of flooding, low water, erosion, and shore protection impacts expected from alternative Lake Superior regulation plans. Coldwater Consulting Ltd. has been undertaking evaluation of the shore protection structure activities. They have used detailed information at select study sites to develop a model for assessing potential structural failures. The Structures Analysis Tool (SAT) calculates various metrics related to structural failure and estimates overall sensitivity of various categories of shoreline protection structures to different lake levels

and wave regimes on Lakes Superior, Michigan, and Huron based on a general assessment of the percent of shoreline protected. While the SAT was designed to compare Lake Superior regulation plan options, it should also be applicable to other water level issues including potential water level restoration options on Lakes Michigan and Huron.

Geomorphic Solutions Ltd. completed their sensitivity analysis for water level impacts on erosion rates for stable dynamic beach shorelines and cohesive shorelines. For a study of stable dynamic beach shorelines, three test sites were selected and dune cutback was modelled for extreme storm conditions under various water level scenarios. The intent was to look at the potential landward extent of dune cutback under various conditions, alternative plans and future climate change scenarios. While higher water levels are expected to lead to increased dune cutback, differences between regulation plans are small compared to the range of water levels tested, and little difference in impact is expected between alternative plans. In addition, site specific conditions including the amount of sand available within the dune and the shape of the nearshore bathymetry were important factors influencing the extent of dune cutback. For cohesive shorelines, a shoreline retreat model was developed and calibrated at three study sites. The operational model is being used to test additional water level scenarios. Preliminary testing indicates that recession rates at the test sites can be strongly influenced by water supply sequences but that Lake Superior regulation has only a limited impact. The test sites provide a useful indication of the general sensitivity of cohesive shorelines within the upper Great Lakes Study area.

Since the previous semi-annual report (October, 2010), the Coastal Zone TWG's activities have focused on establishing a strategy for considering the potential impacts of water level restoration as part of adaptive management. It is anticipated that work over the next few months will consider flooding and low water sensitivities at study sites on Lakes Superior, Michigan-Huron and St. Clair. The methodologies could then be expanded to additional locations as part of a future adaptive management program. In addition, a peer review package was submitted regarding the low water methodologies utilized by the TWG. The peer review is not of a final model, *per se*, but instead reviews the cumulative information generated by the TWG activities in support of considering the applicability of a low water impact evaluation strategy and suitable methodology.

In addition to the detailed modelling work, preliminary coping zones were developed for the adaptive management component of the Study. This included undertaking a survey of shoreline management approaches by state and provincial agencies.

### **Commercial Navigation TWG**

The primary performance indicator for commercial navigation is transportation costs, and the model for determining the impacts on transportation costs associated with alternative regulation plans has been developed. The output from this model has been integrated into the Shared Vision Model (SVM) developed by the Plan Evaluation and Formulation TWG.

Final validation of this integration is underway. The SVM is being used to provide a series of sensitivity analyses focusing on critical factors (shipping levels, vessel operations, etc.) that could affect the magnitude of the impact on transportation costs associated with any modifications to the current regulation plan.

Preliminary results of the analyses completed to date were recently presented to U.S. and Canadian shipping interests at the annual Lake Carriers Association vessel captains meeting. Coordination will continue with commercial navigation interests to ensure the models are accurately capturing actual shipping practices.

The final contextual narrative report for the TWG was completed and has been posted on the SharePoint site.

A draft report of coping zones for commercial navigation has been delivered for use in the adaptive management component of the overall study, including a qualitative assessment of how various factors (duration, frequency, seasonality, rate of change, etc.) could influence the ability to cope with future climate change.

## **Ecosystems TWG**

The Ecosystems TWG has developed and implemented an innovative approach that is focused on assessing ecosystem vulnerabilities in response to potential changes in Upper Great Lakes water level regimes. The objective of this approach is to identify water level ranges, thresholds, and coping zones that support diverse biotic communities and ecosystem functions in the upper Great Lakes, while minimizing adverse water-level regime impacts to ecological communities and functions.

### *PI Evaluations*

PI evaluations have now been completed for all sites by the TWG site coordinators. TWG site coordinators completed field data collection and all site coordinators have provided initial draft water level response curves and threshold analyses to the modelling contractors (LimnoTech). During the fall, the modelling contractors continued to work with the site coordinators to further develop and refine the algorithms and inputs necessary to complete the Integrated Ecological Response Model (IERM2). Based on these evaluations, high and low water thresholds and coping zones have been identified and incorporated into the IERM2 model. The IERM2 model will be used by the PFE TWG and Study Board to evaluate the response of PIs, thresholds, and coping zones for individual water regulation plans for different net basin supplies.

### *IERM2 Coping Zone Calculator*

The modelling contractors have developed a spreadsheet-based “Coping Zone Calculator” that duplicates the results of the stand-alone IERM2 model. The Coping Zone Calculator is

designed to be incorporated directly into the Excel spreadsheet-based SVM, which will be used to calculate and compare benefits and impacts associated with proposed Lake Superior water level regulation plans. In other words, the environmental responses will be embedded directly into the plan evaluation software that will be used to evaluate proposed Lake Superior water level regulation plans, and their downstream impacts on the lower lakes.

### *IERM2 Validation and Testing*

In late January, the TWG co-chairs, Ecosystems Project Manager, and the modelling contractors held a conference call with the Study Managers and Plan Formulation and Evaluation Group leads to discuss overall progress of the Ecosystems TWG and share preliminary results from the IERM2 model and Coping Zone calculator. During the conference call, suggestions were made by the Study Managers and PFE TWG leads to further improve and refine the model. These suggestions helped clarify the presentation of model results that will further assist the Study Board and the IJC decision-making process.

On January 31, 2011, an IERM2 model webinar was held to review results from the IERM2 model and Coping Zone Calculator. This webinar was held primarily to receive feedback from the Site Coordinators to determine whether or not the model responses were representative of the ecological responses anticipated by the Site Coordinators. Where inconsistencies were noted, the modelling contractor followed-up and worked closely with the Site Coordinators to make final adjustments to the model based on their recommendations.

### *PI Fact Sheets*

In conjunction with IERM2 model development, each of the Site Coordinators has developed a set of PI Fact Sheets that clearly describe (and justify) site-specific PIs and associated hydrological attributes used to generate the water level response curves, thresholds, and coping zones. All of the PI Fact sheets have been updated to reflect the new thresholds and coping zones, and these will be made available to the Study Board and will be posted on the IUGLS SharePoint site to assist with evaluation of alternative regulation plans.

### *St. Clair River Ecosystem Workshop*

In response to a request made by the IJC to the IUGLS Study Board to explore possible ways to restore Lake Michigan-Huron water levels by placing structures in the St. Clair River, the Ecosystem TWG was asked to host a workshop and produce a white paper describing potential local environmental issues and concerns related to the placement of structures within the St. Clair River. In January, the TWG produced a draft white paper and on February 3, 2011, a St. Clair River Ecosystem workshop was held in Windsor, Ontario.

Workshop materials will be integrated with the draft white paper to produce a report summarizing local environmental effects on the St. Clair River resulting from these actions.

A total of 31 attendees participated on-site with another 7 attendees participating by webinar or conference call. Participants included the Study Managers, members of the PFE TWG, agency representatives supporting the Study, NGOs, First Nations, and scientists and resource managers who actively work on the St. Clair River. Important fish spawning habitat, the presence of Species-at-Risk (SAR) and their habitats, contaminated sediments, and a complex and lengthy regulatory process were all perceived to be important environmental issues that would have to be addressed before a water level restoration project could be implemented.

### *St. Marys River*

U.S. EPA has funded a Great Lakes Restoration Initiative (GLRI) proposal to evaluate how flows could be manipulated at the St. Marys River controlling works and hydropower facilities to enhance the effectiveness of the Great Lakes Fisheries Commission (GLFC) sea lamprey control program. This work would be done in collaboration with the International Lake Superior Board of Control, Ecosystems, Hydropower TWGs and PFEG and the GLFC (Dr. Mike Siefkes). A draft work plan was submitted to the TWG by the GLFC contractors and shared with the members of the PFEG, International Lake Superior Board of Control, and representatives from the hydropower producers at the Sault Ste. Marie (Cloverland, Brookfield, and the USACE).

A conference call was held on February 18, 2011 to explore the feasibility of activities proposed for this upcoming spring and summer. The response to the proposed plan was generally positive, and it was determined that the hydropower producers could accommodate most of the requested flow adjustments over the requested time period (mid-May through July). However, flow deviations from Plan 77A may be required, and the GLFC, Ecosystems TWG, and Board of Control are currently working to develop appropriate requests to be discussed and presented at the March 23, 2011 Board of Control meeting in Niagara Falls, New York. Further coordination will be required, and discussions are continuing between parties to establish communication and coordination protocols to facilitate this work.

### *Other*

The IERM2 model was submitted for an independent peer review on March 4, 2011. Material submitted by the Ecosystem TWG and modelling contractors included a summary description and products derived from the IERM2 model and Coping Zone Calculator, as well as, PI fact sheets upon which the IERM2 model algorithms are based.

A summary description of the work and anticipated products from several ongoing projects in the St. Marys River were submitted for independent peer review on March 21, 2011.

These projects include the GLRI sea lamprey project, an environmental assessment of minimum and maximum flows at the Rapids, an environmental assessment of ramping rates at the compensating works, and a summary description of the St. Marys River PIs, water level response curves, thresholds, and coping zones.

During this time period, the TWG co-chairs, members, and liaisons attended or participated in multiple Study Board, PFE, Adaptive Management and Information Management TWG, PIAG, and Study Team strategy meetings.

### **Recreational Boating, Cruise Ship and Tourism TWG**

The TWG's contextual narrative has been completed and reviews are continuing through the Study Board hierarchy. An economic analysis of the impacts of water levels to recreational boating on the Great Lakes has been developed and submitted to the Study Board Managers for the Peer Review Group. The Study Managers, along with the economic advisor, provided comments for finalizing the document. Final adjustments to the economic analysis document are in progress. The Independent Peer Review Group is conducting a review of the analysis.

### **Municipal, Industrial and Domestic Water Uses TWG**

During the reporting period, the TWG completed the development of its performance indicators: the number of facilities, intakes and outfalls that are impacted at different elevations; the population served by municipal systems that were impacted at different elevations; and the cost of impacts at different elevations. This last PI is still being vetted with the Plan Formulation and Evaluation Group. Fact sheets have been developed for these PIs.

The work by Environmental Consulting & Technology, Inc. (ECT) and Veritas Economic Consulting was completed. This effort identified and characterized potential problems of municipal, manufacturing and electricity sector water users associated with fluctuations in water levels on the upper Great Lakes. The study indicates that facilities are able to adapt within a broad range of lake levels, i.e., over the historical record. The study also confirms that there are substantial differences among the selected facilities in their ability to cope with changes in water levels. Some facilities have intakes more than 4.5 metres below the historic low levels while others are closer to the record lows. In terms of high lake levels, more facilities could be impacted and need mitigation actions at flood levels; these costs of mitigation would be less than for the low lake level impacts. Coping zones were developed with the data from the report.

### **Hydropower TWG**

### *Peaking and Ponding*

Data analysis, completed in September 2010, of eighteen events in 2008 and 2009 show that the maximum effects of peaking and ponding operations occurred at the U.S. Slip gauge at Sault Ste. Marie downstream of the hydropower plants. The effects diminished downstream and were almost not noticeable at Rock Cut and De Tour, which are located near the mouth of the St. Marys River and Lake Huron. Backwater effects generated by water level variations in Lake Huron – the result of meteorological processes – are frequent and mask the effects of peaking and ponding operations on the lower reach of the St. Marys River.

### *Coping Zones*

The TWG has compiled coping zones for the plants in the Great Lakes – St. Lawrence River System. The completed tasks include a discussion of the institutional arrangements governing hydropower operations, review of IJC Board reports on past operations, and consultation with the hydropower plant operators. The coping zones delineate water levels, flows and other physical factors that affect plant operations.

In July 2010, a questionnaire was sent to the operators of fifteen hydropower plants requesting information that would assist investigators in defining coping zones. The generating capacities of these plants range from about 6 MW (megawatts) total for the three generating units by the Welland Canal to almost 3,000 MW for the Moses-Niagara plant and its pump-generating station.

By late October 2010, most the plants had provided feedback to the questionnaires. A report “Coping Zones of Hydropower Operations In the Great Lakes – St. Lawrence River System, February 2011” has been prepared. The information is used to refine the spreadsheets initiated last fall that capture plant parameters defining coping zones.

The most important parameter for a plant is the amount of water available for hydropower generation, and lack of water can seriously affect energy generation and revenue. In addition, some plants have minimum flows for meeting energy contracts, e.g., NYPA’s plants in the Niagara and St. Lawrence Rivers, operating navigation locks, e.g., U.S. Government Plant at Sault Ste. Marie, preventing freeze-up in the power canal, e.g., all three plants at Sault Ste. Marie, and heating building and preventing freezing of equipment, e.g., at the U.S. Government Plant. Poor ice covers and ice jams can be problematic for the plants in the Great Lakes connecting channels especially those in the St. Lawrence River. High and low water levels in the headpond and tailrace of some plants can lead to flooding of the plant, vortices and cavitation damage to equipment and loss of power generation.

High lake levels and outflows, while increasing generation, can be problematic and undesirable as they can lead to water spilled, less efficient use of the diverted water, and

increased the risk to the structural integrity of hydropower infrastructure. Low lake levels and outflows reduce hydropower generation and may lead to an inability to meet energy contracts (e.g., Moses-Niagara), shutting down of units and staff reductions.

The coping zone study also examined the operations of the regulatory structures at Lake Superior and Lake Ontario for the purposes of meeting the objectives and requirements of the Niagara River Treaty. With proper maintenance, these structures can be expected to continue to function under the historical range of water supplies. However, a detailed structural analysis would be needed to assess the ability of the St. Marys River Compensating Works to withstand hydroclimatic regimes more severe than those of the past. The IJC's 1986 Great Lakes Water Levels Task Force concluded that, while the different structures at Sault Ste. Marie can accommodate a water level of about 184.0 m (IGLD 1985) on Lake Superior, no further raising of the Lake Superior water level (e.g., to alleviate downstream high water levels) is possible without proper structural stability analyses of the existing compensating and regulation structures.

#### *Electricity Price Forecasts for Upper Great Lakes Hydropower Generation and Peer Review*

In October 2010, Synapse Energy Economics, Inc. conducted short-term (2 years) and long-term (30 years) forecasts of electricity prices for the Upper Great Lakes hydropower generation. Synapse submitted its report on January 19, 2011. The Synapse investigators examined the past five years of energy generating data for the hydropower plants starting in 2005 on the St. Marys River, the Niagara River and those at DeCew Falls by the Welland Canal. They also reviewed how peak and off-peak prices have varied, impact of natural gas prices (these being the factor affecting wholesale electricity prices during peak load periods), and both recent usage and forecasts of energy consumptions.

According to the Synapse report, the largest uncertainty affecting future electricity prices is regulation of greenhouse gas emissions (GHG) and the imposition of prices on emissions of carbon dioxide (CO<sub>2</sub>), the predominant GHG emitted by the electric sector. A price on carbon could significantly increase the cost of coal and natural gas generation and affect wholesale electricity prices. It is unknown at this time what path such regulations might take. Thus, Synapse investigators presented two electricity price forecasts: one with and one without CO<sub>2</sub> costs. In the absence of CO<sub>2</sub> costs, electricity prices increase by about 40% over the 2011 to 2040 period (an average growth rate of 1.2%). If CO<sub>2</sub> costs are included, real prices more than double with an increase of 135% over the same period (an average growth rate of 3.2%). The Synapse electricity price study will be used along with other information to rank alternative regulation plans for Lake Superior.

On January 20, 2011, the Synapse report was forwarded to the IJC's Engineering Advisors for independent peer review along with an accompanying contextual narrative.

## 2.1.2 Integration Technical Work Groups

### Plan Formulation and Evaluation TWG

The focus of the TWG during this period has been in integrating the key performance indicators into the SVM, continuing the development of alternative Lake Superior regulation plans, providing continued decision support for the Study Board, technical support for the St. Clair River restoration evaluation elements of adaptive management, analysis of ice constraints on the maximum water releases at Sault Ste Marie, continuation of support for the IERM2, as well as continuing work with the Hydroclimate TWG to assure the Board will have the necessary information to select regulation plans.

#### *Shared Vision Model*

The SVM is the key tool being developed for use in the Study to evaluate the effects of alternative Lake Superior regulation plans, different hydrologic sequences and St. Clair River restoration options on different interests in the upper Great Lakes system. The SVM is an Excel workbook that integrates the key performance indicators developed by the six Performance Indicator TWGs (Figure 1). As much of the performance indicator information was delivered from the TWGs in the fall of 2010, substantial work was done to incorporate these PIs into the SVM. Work during this period included expanding and refining the hydropower pricing options, including peaking and ponding in the hydropower analysis; debugging the navigation PI and using it to analyze which routes and water levels are critical; integration of marina slip depth and boat launch PIs; and incorporating both the shore protection damage cost PI and the draft IERM2 into the SVM. PFE TWG members have been testing the performance indicators as coded in the SVM through their use in evaluating regulation plans. Further verification of the metrics as coded in the SVM is ongoing with the TWGs to obtain their stamps of approval. Iterative feedback between the plan formulators and the SVM developer is occurring to improve the usefulness and make sure the evaluation information the SVM presents is easily understood and interpreted.

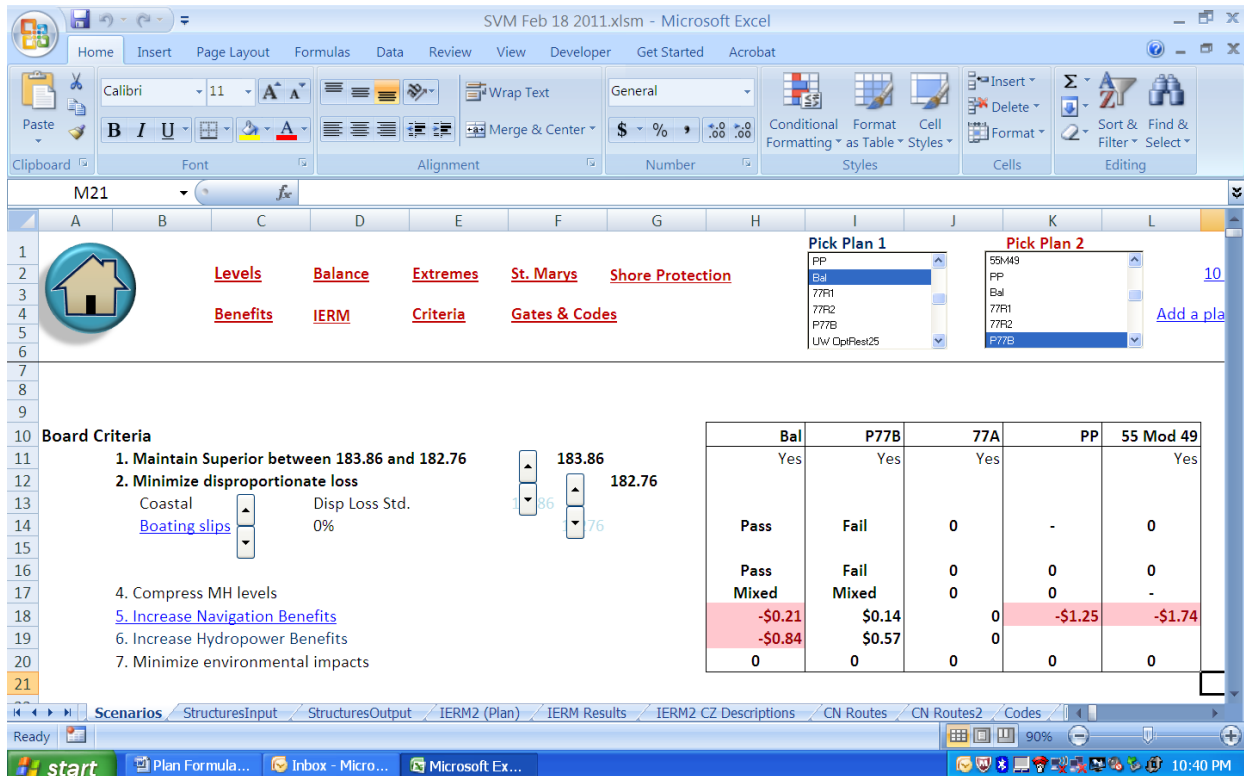


Figure 1. The Criteria Summary Page from the Feb 18 Draft SVM

### Decision Support for the Study Board

At the Board's February 22-24, 2011 meeting, the TWG presented an overview of the SVM and demonstrated its use in evaluating several preliminary Lake Superior regulation plans as well as the effects of a St Clair River conveyance restoration scenario. The TWG reviewed the six draft objectives and criteria to assess regulation plans and worked with the Board at this meeting to better define its decision process, including how uncertainties in performance indicators could be considered in the Board's decision. At this meeting, the TWG also reviewed with the Board the multiple scenarios of net basin supplies prepared by the Hydroclimate TWG that are available for use in the development and evaluation of regulation plans. The TWG presented a summary of the SVM and plans to the PIAG on February 24<sup>th</sup>.

The TWG drafted a discussion paper that explored the key issues raised by the Board in the existing IJC orders of approval for Lake Superior regulation and the Boundary Waters Treaty that required clarification and interpretation by the Commission's legal advisors. The legal advisors explained their interpretation of the issues identified in the discussion paper at a meeting with the Study Board and PFE TWG leads on February 2<sup>nd</sup>.

### *Regulation Plan Development*

The PFEG held a plan formulation meeting in Burlington on October 14-15, 2010 at which formulators exchanged ideas on how to improve their regulation plans and reviewed the status of the SVM and its use in plan development. The TWG held a week-long plan formulation workshop in Montreal on January 10-14, 2011. This workshop included briefings from consultants to the Hydroclimate TWG on the stochastic contemporary climate and climate change net basin supplies datasets they had developed, the seasonal net basin supply forecasting methodologies that had been developed and their potential for use in regulation plans. A draft consultant's report on the analysis of ice constraints on the maximum water releases at Sault Ste. Marie was presented and discussed. Analyses of the commercial navigation transportation cost model and the hydropower evaluation section of the SVM were presented to provide insights to regulation plan improvement. It appears that the depths at commercial docks on the lakes tend to govern ship loading more frequently than do the depths available in the connecting channels. The group discussed several key factors including the sensitivity of plan evaluation results to the volatility of future electricity prices, the relative importance of peaking and ponding in the evaluation of monthly release policies and the uncertainty in Niagara power estimates and their use in evaluation. Several different simulation and optimization approaches to plan development were shared.

### *Support for other TWGs*

In addition to the meetings described above, the PFEG participated in working meetings and teleconferences with the Municipal and Industrial Water Use and the Coastal Zone TWGs to finalize their PIs, the Hydropower TWG to assist in their hydropower pricing study, the Ecosystem TWG to refine the IERM2, the Commercial Navigation TWG to verify its model, the Adaptive Management and the Information Management Groups.

PFEG co-leads participated in the Institutional Analysis Workshop organized by the Adaptive Management Group in Windsor on February 1-2, 2011.

In addition, the PFEG provided support to the Study Team in its development and evaluation options of restoring water levels in Lake Michigan-Huron. At the Restoration Ecosystem Workshop on February 3, 2011 the group presented the effects on lake levels and preliminary impacts on interests of two variants of the 10 cm restoration as demonstrated in the SVM.

### *Coordination with Hydroclimate TWG*

The PFEG also participated in a Hydroclimate Work Group meeting in Burlington on December 7, 2010 to exchange information on the progress of hydroclimatic products and progress in regulation plan development. At the PFEG workshop in Montreal on January 10-14, 2011, PFEG worked with members of the Hydroclimate Work Group to receive and

better understand the stochastic, climate change and paleo-climate scenarios and hydrologic forecast tools developed by the Hydroclimate Work Group for use in Lake Superior regulation plan development and evaluation.

## **Hydroclimate TWG**

The Hydroclimate TWG has made significant progress in completing a number of studies vital for the evaluation and testing of regulation plans and to support development of adaptive management strategies.

Of primary importance, was the development of critical supply sequences representing a wide range of plausible future water supply scenarios. The supply sequences, developed to date, include: historic supplies from 1900-2008; stochastically generated contemporary supplies (Figure 2); stochastic supplies transformed by climate change; GCM/RCM climate change sequences for different emission scenarios; and paleo-sequences derived from tree-ring data of the past 1,000 years. These sequences will be used to evaluate the robustness of various regulation plans being developed by the Plan Formulation and Evaluation TWG and to explore the plausibility of rare events.

In addition, work continued on the quantification of uncertainty in hydroclimatic components, improvement of evaporation estimates, estimating ungauged inflows, and the development of a number of forecasting methodologies for enhancing Lake Superior regulation.

During a December 2010 workshop on “Uncertainty in Upper Great Lakes Water Budgets”, investigators presented their findings to assist in preparation of a draft business case and action plan for upper Great Lakes water budget uncertainty goals. Preliminary findings in monitoring and modelling of evaporation and precipitation, estimation of ungauged inflows, and forecasting were presented. Dr. Taha Ouarda and his group at INRS, Québec City presented the methodology and software tools for producing surface runoff estimates from ungauged watersheds. These tools will ultimately be shared among operational staff at the various Canadian and US agencies.

At a recent meeting of the PFEG, held in January 2011, members of the Hydroclimate Work Group discussed their findings in order to precisely identify the needs of the PFEG. Hydroclimate members also participated in the Institutional Workshop in Windsor, Ontario that addressed institutional/governance challenges and opportunities associated with implementation of the new Lake Superior regulation plan.

The Hydroclimate TWG has started to prepare the final text for the Phase II report and will prepare a narrative on climate and climate change for the Study Board.

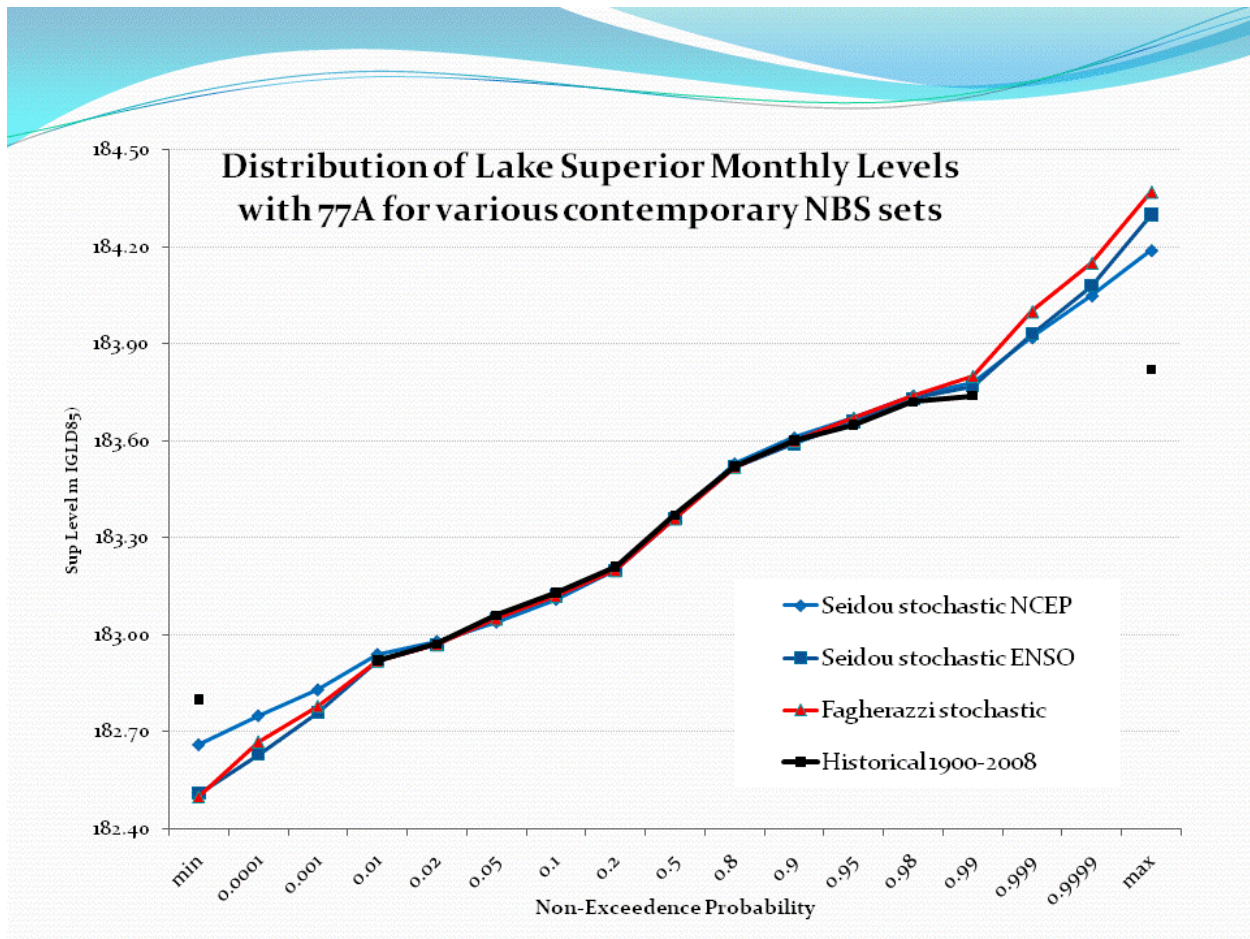


Figure 2. Stochastically Generated Contemporary Supplies  
(Illustrative figure provided courtesy of Fay and Fan)

### Adaptive Management Group

The Adaptive Management Group (AMG) continues to work towards the development of recommendations to the Study Board for proposing a long-term, post Study Adaptive Management (AM) program to support the Lake Superior Regulation Plan and beyond.

As noted in earlier summaries, the AMG is taking the approach of assessing vulnerabilities of the various interests to changing water levels known as coping zones. All of the Performance Indicator TWGs have provided working level coping zones to the AMG. The TWG is now in the process of working with these coping zones and a wide range of historical, stochastic, climate change and paleo water supply scenarios provided through the Hydroclimate Work Group to assess plausible risks. Specifically, Dr. Casey Brown from the University of Massachusetts-Amherst has begun to analyze how common these conditions are in all the various water supplies provided. He is developing risk evaluation matrices that will help determine problematic high risk, plausible conditions. Preliminary results are expected by the end of March 2011. These will be shared with the AMG and with agency representatives who have agreed to work with the Study.

As part of the AM plan for Lake Superior regulation, the group assisted with a workshop of hydroclimate experts in December 2010 to discuss the implication of uncertainties in the Great Lakes water budget and how they can be addressed through improved monitoring and modelling. A follow-up workshop with senior officials of responsible hydroclimate monitoring programs is being planned to present a business case and seek buy-in for a program designed to reduce these uncertainties.

### *Institutional Analysis Workshop*

Recognizing the limitation of Superior regulation for addressing risks associated with extreme water levels and climate change, the AMG continues its work in examining two other types of actions at an exploratory level – multi-lake regulation and non-regulation actions. Dr. Bryan Tolson from the University of Waterloo is in the process of developing an optimization approach for multi-lake regulation. As a start, he will use the objective of keeping lakes within the historical range and will provide results by mid-April 2011 for peer review by the end of April. Mr. Jacob Bruxer from Environment Canada has produced a review of past studies on single and multi-lake regulation proposals/ideas/concepts and compensation in the Great Lakes-St. Lawrence River system and will draw upon this in exploring possible structural alternatives. Mr. Douglas Brown has completed two institutional analysis white papers. The first related to the implementation of adaptive management in a revised Superior regulation plan and the second related to new structures or compensation works in the system in the future. These papers were reviewed at an experts workshop on Feb 1-2, 2011 in Windsor. A key finding from the first paper was that flexibility would be needed in the Order of Approval to allow for adjusting the regulation plan to address future conditions. A key finding of the second white paper was that new structures would take 20-30 years to be implemented due to necessary appropriations, approvals, design/engineering and construction requirements, e.g., international approval, environmental and other regulatory approvals, further feasibility studies and engineering design and construction.

Dr. Michael Donahue of URS Corporation, working with Baird and Associates, has completed an institutional/governance analysis of non-regulation actions. This included a literature review and assessment of institutional barriers, an inventory of current and prospective adaptive response actions, and opportunities for the development of a long-term adaptive management process for non-regulation actions. Key findings from this paper concluded that adaptation to fluctuating water levels has historically been “ad hoc” and “piecemeal”; has been driven by crises conditions and seasonal water levels changes; that the legal, regulatory and programmatic “infrastructure” varies considerably among jurisdictions; and that an Adaptive Management Process is needed at the bi-national level.

Per AMG direction, the non-regulation white paper focused on the development of an adaptive management process concerning on targetting floodplain management, shore protection permitting, dredging and low water land management. The TWG is working with responsible agencies in these areas such as the Great Lake states and the Ontario

Conservation Authorities to determine what they need to help them to better manage risks. Some areas that are being explored include providing necessary hydroclimate information out to the responsible agencies through a central, bi-national organization, receiving information back in terms of the state of shoreline vulnerabilities, the effectiveness of what is being implemented and data gaps for properly assessing and addressing risk. The third area being explored is whether it would be possible to have a bi-national, coordinated effort for Great Lakes shoreline management.

#### *Outreach Activities Beyond AM*

The TWG is working with its membership to reach out to agencies and organizations with responsibility and authority for non-regulation actions, such as Ontario Conservation Authorities, FEMA, etc.. On Oct 8, 2010 the TWG co-leads presented their adaptive management concepts to the Great Lakes Commission. As a follow-up each state has recently identified a representative to work with the TWG in developing a post Study AM strategy. Presentations were also made to the Great Lakes Bi-national Executive Committee and the Canada/Ontario Agreement Management Committee to see if there are opportunities for overlapping efforts under the new Great Lakes Water Quality Agreement. On February 11, 2011, the TWG held a webinar with the Great Lakes Conservation Authorities who agreed to follow-up with comments on a number of specific questions and identify the level to which they are willing to engage with this AM process. The TWG intends to meet with fishery managers at the Council of Lake Committees meeting in April 2011, and the Great Lakes mayors as part of the Great Lakes Cities Initiative meetings in June 2011. Circles of Influence workshops are also planned for May and June 2011 in Duluth, Chicago, and in the Lake St. Clair and Southern Georgian Bay areas.

#### *Data Ring Project*

A contract was awarded in March 2011 to CDM and Baird and Associates to integrate existing geospatial datasets at four selected sites and use the data and the methods to estimate the impacts of flooding and low water at these sites along the Great Lakes shoreline: Duluth (Lake Superior) for flooding and low water; Chicago (Lake Michigan) for flooding only; Southern Georgian Bay (Collingwood/Wasaga Beach - Lake Huron) for flooding and low water; and Wayne and MaComb Counties (Lake St. Clair) for flooding and low water. The sites are among those identified in Figure 3.

The contractors will use the experience gained to identify datasets required to undertake similar analyses on other areas of the Great Lakes and to support part of the adaptive management of the Great Lakes that will occur after the Study has been completed

The contractors will work with several TWGs, principally the Coastal Zone, Ecosystems, Adaptive Management, Information Management and Plan Formulation and Evaluation.

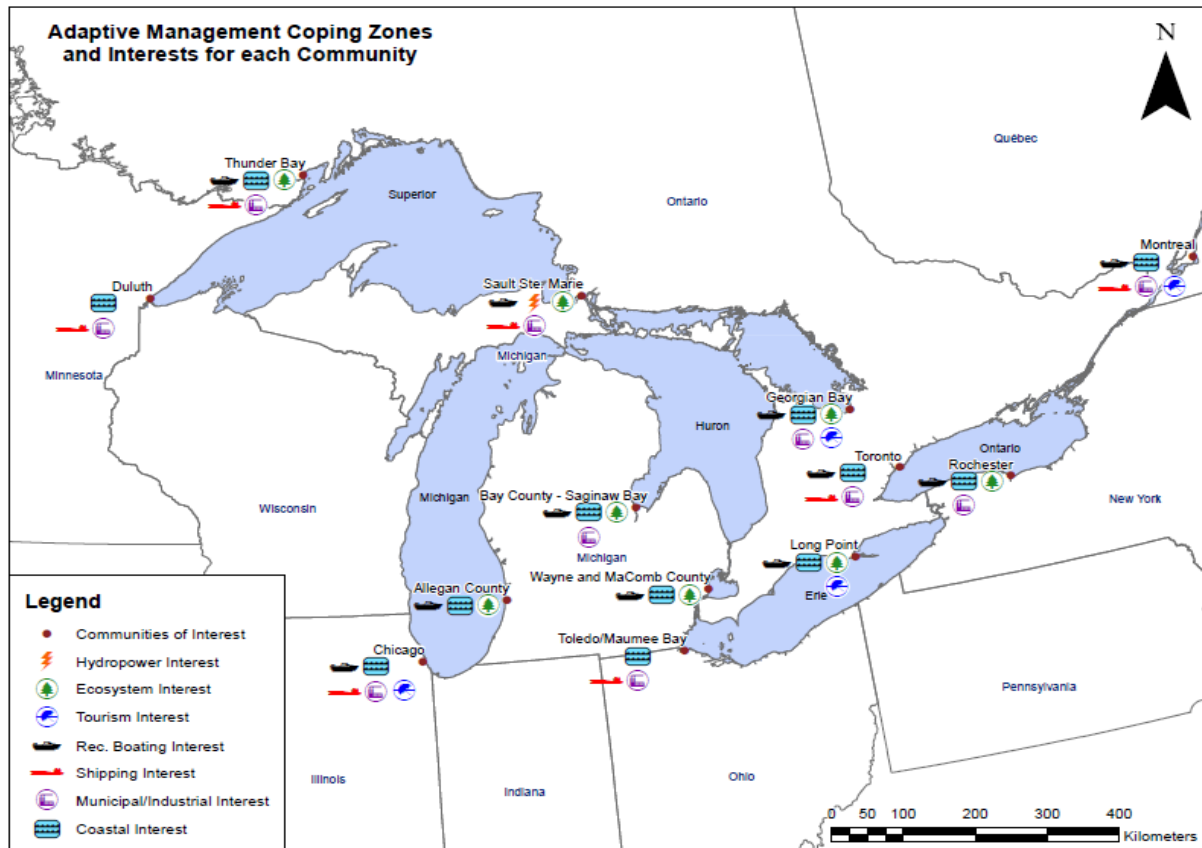


Figure 3. Adaptive Management Study Areas

### *Restoration of Upper Great Lake Levels*

Following guidance from the IJC on the scope of the restoration analysis, the Study developed a strategy to address the key components of this project. In addition to the guidance, the IJC decided that it would be beneficial to undertake an Independent Peer Review the restoration analysis report. The Study expanded its original scope of work to address these additional requirements. The key elements of the restoration analysis are captured in the schematic diagram (Figure 4) that shows the interdependencies necessary for rounded enquiries. The strategy required the Study to either re-design ongoing projects or initiate investigations to address one of the components.

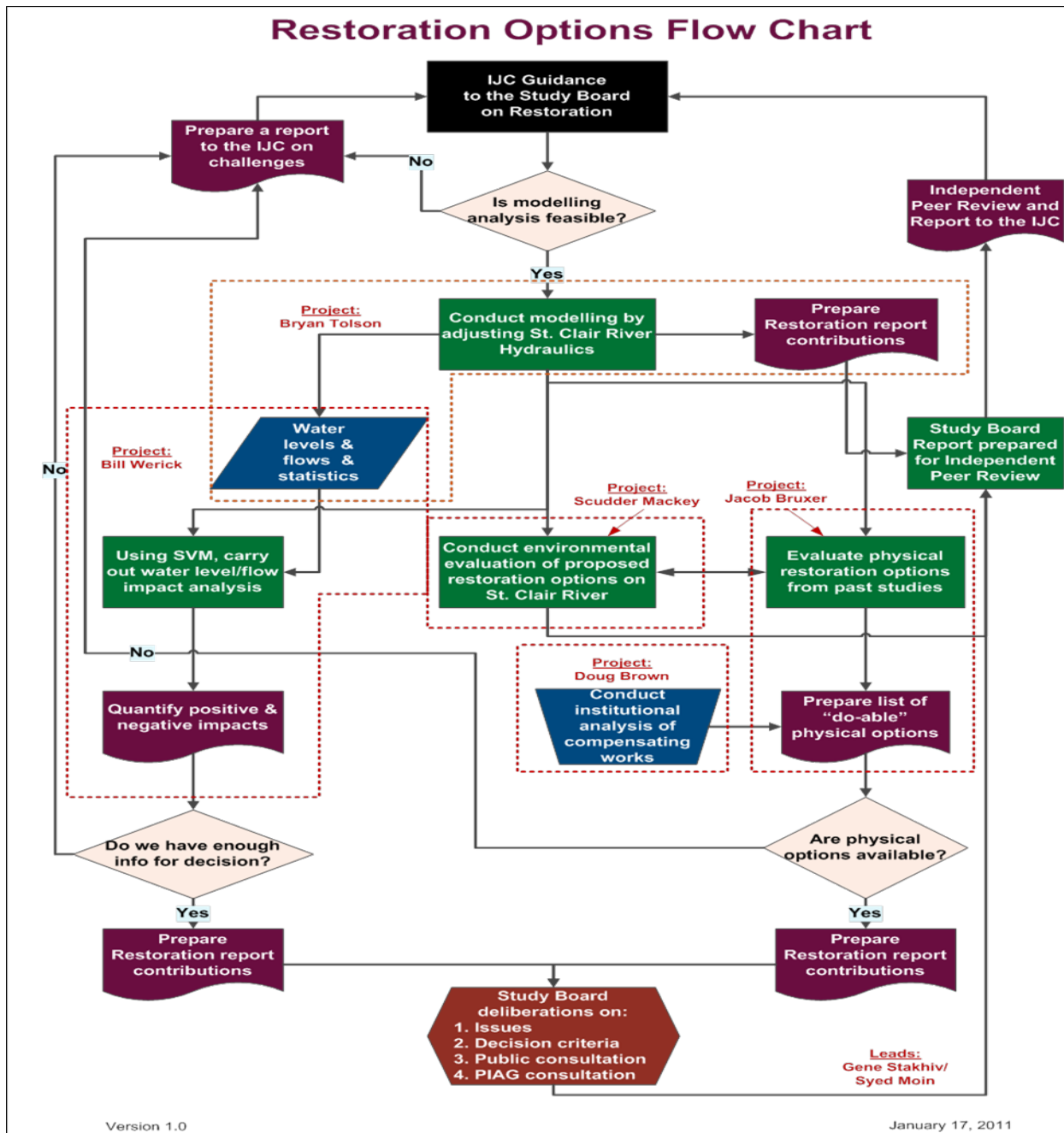


Figure 4. Restoration Analyses Schematic

The key components of the strategy are:

- A. Conduct system modelling by adjusting St. Clair River hydraulics to simulate the physical effects of water level restoration options on Lake Michigan-Huron, and effects downstream through Lake Erie;

- B. Using the Shared Vision Modelling tools, carry out upstream and downstream water level/flow impact analysis on the six economic/environmental sectors, to the extent possible;
- C. Evaluate candidate physical structures that have been recommended and previously studied for restoration options from the past studies, including an update of their respective cost estimates;
- D. Conduct an exploratory environmental reconnaissance of proposed restoration options, focusing on the St. Clair River; and,
- E. Conduct an institutional analysis for compensating works.

The key elements of the analysis are now complete. Efforts are now being made to develop and finalize the report and make it available for peer review. Figure 5 shows the activities and timeline of their completion.

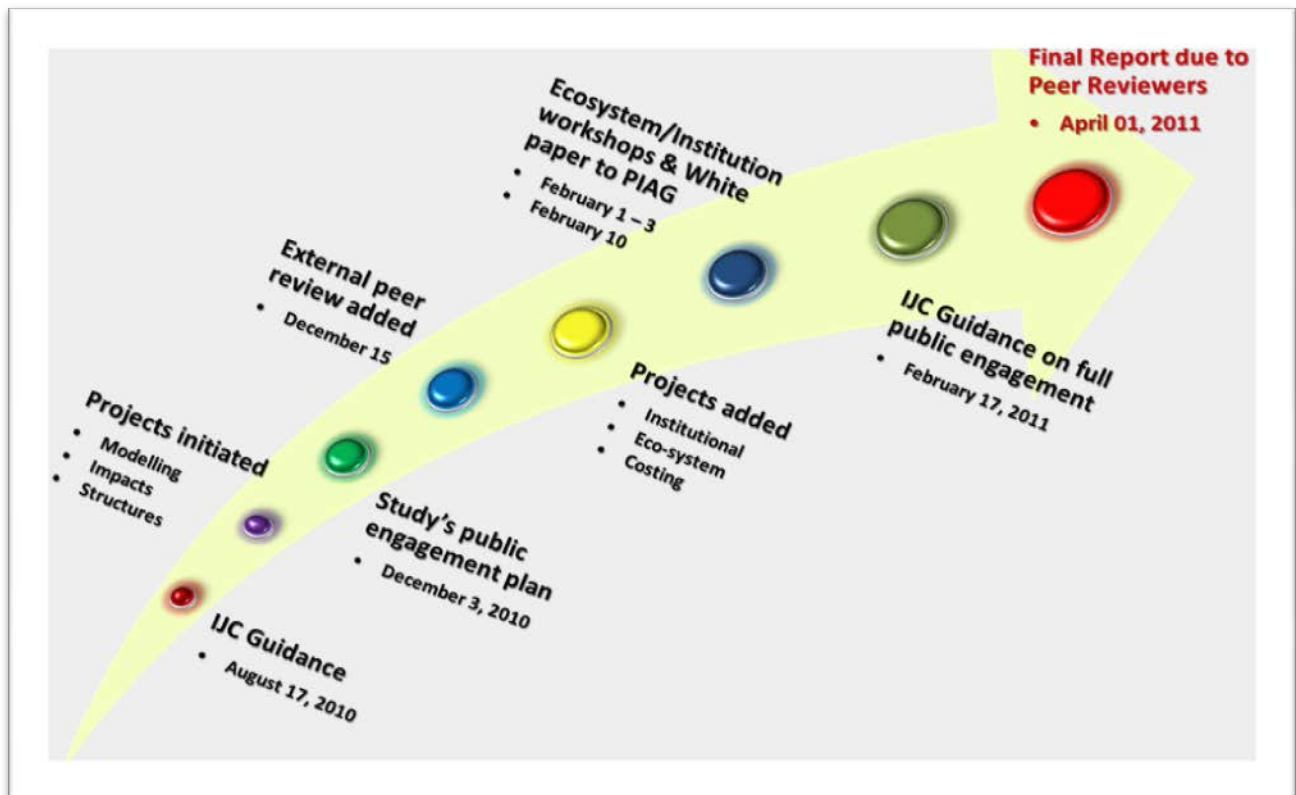


Figure 5. Timeline of Activities of the Restoration Analyses

### Information Management Group (IMG)

The IMG has held regular bi-weekly meetings via teleconference since October 2010 to develop a work plan and the appropriate governance needed to create the information

management policy statement approved by the Study Board. In parallel, the TWG has also worked to resolve the most urgent Study information / data management needs.

The IUGLS SharePoint site has been restructured and two training webinars were held for the Study teams and TWG members to help them learn to use the new structure to manage their documents. The problems with access to the SharePoint site experienced by Study participants from Environment Canada were resolved after some extensive trouble shooting efforts by members of the IM TWG and IJC staff. At the present time, all study participants can obtain a username/password and access the site. Study participants must now populate the SharePoint site so that Study materials that support the final conclusions are preserved.

The Great Lakes Observation System (GLOS) agreed to provide support for a metadata capture and management solution for study participants. This solution will include the use of the *GeoNetwork* software tool that has been customized to support the IUGLS metadata template. It is anticipated that the tool will be available before April 2011 so Study participants can use this tool to create the required metadata. The TWG also developed a metadata profile and resulting template for use by the Study participants to document Study information and data assets. An effort was made to find a controlled vocabulary that could be used as a keyword list for metadata creation, but none of the existing vocabularies reviewed fit well with the topics covered by the Study.

A draft IM plan for the Study is currently being circulated to IM TWG members for review. The goal of this plan is to provide an overall work plan in order to measure progress more readily. An Information Management Policy Framework document is also being drafted for review by IM TWG members. Both documents will be submitted to the Study Board for review and approval later this spring.

A challenge for the Study continues to be the identification of all key information assets and the data stewards that will support the management of these assets during and after the Study. After potential data stewards are identified, it will be necessary for the IJC to engage in licensing agreements with those organizations to clarify responsibilities, secure the needed long-term access and ensure archiving of the data / information. It will also be necessary for the IJC to identify a post Study data steward lead that will maintain communication with select Study information / data stewards. This role will be one of great importance for the Adaptive Management TWG. The current information / data steward lead during the Study is the Canadian Study Manager.

### **2.1.3 Legal Advice**

Dialogue has continued between the Study Team and the IJC Legal Advisors regarding the definition of “pre-project” conditions and the practical details for ensuring compliance with Treaty and Orders of Approval. The legal advisors attended the institutional workshop sponsored by the AMG and Ecosystem TWG and provided input on legal aspects of the placement of connecting channel structures for levels restoration.

## 2.2 Independent Peer Review

Table 1 reflects a revised list the Study Board has provided to the Independent Peer Review group with a series of sub-products being available for review in an orderly manner. The table identifies those sub-products that have been submitted since the last semi-annual report. The Study Team is awaiting comments from the reviewers.

No.	Sub-Product Review	TWG/Lead	Available
1	Economic analysis of Coastal Processes – Low Water Impacts	Mike Shantz/Eric Tauriainen	Jan. 10, 2011*
2	Hydropower Pricing	Peter Yee/Steven Rose	Jan. 20, 2011*
3	Recreational Boating Impact Analysis	Glenn Warren/Bill Boik	Feb. 01, 2011*
4	Integrated Ecosystem Response Model IERM2 (Model only)	Joe Depinto/Scudder Mackey	Mar. 04, 2011*
5	St. Marys River for ecological restoration project, PI defined	Scudder Mackey	Mar.21, 2011
6	Hydroclimate – Climate Change (GCM/RCM)	Murray McKay/Brent Lofgren	Apr. 01, 2011
7	Restoration Analysis	Study Team	Apr. 01, 2011
8	Adaptive Management – Multi-lake regulation /optimization)	Bryan Tolson	Apr. 15, 2011
9	Hydroclimate – Stochastic	Al Pietroniro/Debbie Lee	Apr. 21, 2011

Table 1. List of Sub-Products for Independent Peer Review  
 \* submitted for Independent Peer Review

### 2.3 PUBLIC INTEREST ADVISORY GROUP (PIAG)

Since the last progress report, PIAG met on October 27, 2010, in Thunder Bay, Ontario, and met via teleconference on December 3, 2010. Most notably, PIAG met jointly with the Study Board for the first time on February 24, 2011, in Windsor, Ontario to receive extensive briefings on key Study activities. Following the joint session, PIAG convened the next day to discuss and approve outreach efforts regarding the report on restoration scenarios and regarding the status report on all Phase 2 activities, scheduled to begin in June and during July-August, 2011, respectively.

PIAG members participated in a St. Clair River Ecosystem Workshop with consultant Scudder Mackey on restoration options held February 3, 2011, in Windsor. PIAG members continued to attend various TWG and Task Team meetings and reported to their colleagues regarding key messages.

The Commission was notified of the resignation of US PIAG members Kate Bartter and Jeff Vito. An existing PIAG member, Mr. Frank Ettawageshik has agreed to maintain contacts with both First Nations and Native Americans.



Photo 1. Joint Meeting of the Study Board and PIAG, February 24, 2011  
*Communications and Outreach*

During the period, new media and outreach adviser Jeff Kart has been working with IJC communications adviser John Nevin to create new content for the website. That content, involving reports about Study research and interviews with researchers and PIAG representatives, is being posted on the site and distributed via social networks including Facebook and Twitter. A newsletter compiling the key posts was distributed via e-mail.

A goal is to make the public and interest groups aware of the Study's progress and prepare for public engagement efforts in the spring and summer. In particular, efforts are focused on sustaining a regular increase in people who follow Study progress both on Facebook and Twitter. The PIAG Facebook page has more than 700 followers, up by several hundred since October. In addition, the IUGLS webpage navigation was improved to allow for easier access to documents and a new Facebook box was added, providing both official news related to the Study, as well as, clearly identified reports from outside agencies and media on general Great Lakes issues.

## **2.4 STUDY MANAGEMENT**

### **2.4.1 Meetings**

The various groups associated with the Study have met throughout the last reporting period. Appendix 1 shows the groups, activities, dates and locations of these meetings. Meetings planned for April through September 2011 are shown in Appendix 2.

### **2.4.2 Budget/ Expenditures**

Tables 2 & 3 below show approved, committed and spent amounts in the U.S. and Canada from October 1, 2010 through March 15, 2011. Please note the expenditures for the US side reflect the mid-year status, while those in Canada, the expenses represent the fiscal year-end status. The US side expenditures are expected to be committed for Study management and as activities are identified.

Table 2 – U.S. (in \$1000US)

Activity	Budget <sup>1</sup>	Spent <sup>2</sup>	Committed <sup>3</sup>	Difference <sup>4</sup>
Study Board and Management	330.1	243.4	247.3	82.9
St. Clair Task Team & Hydroclimate TWG	238.0	88.0	88.0	150.0
Lake Superior Regulation Task Team	360.8	161.6	360.8	0.0
Public Interest Advisory Group & Communications	129.0	35.5	35.5	93.5
Information Management	19.9	10.8	19.9	0.0
Plan Formulation /Evaluation & Adaptive Management TWG	188.2	133.4	151.1	37.1
Peer Review Group	0.0	0.0	0.0	0.0
<b>Grand Total Budget</b>	<b>1266.1</b>	<b>672.7</b>	<b>902.6</b>	<b>363.5</b>

Notes:

1. Study Board budget
2. Funds spent to date
3. Funds committed through contracts or MOUs
4. Difference between budget and committed/ spent to date

Table 3 - Canadian Funding (in \$1000Cdn)

Activity	Budget <sup>1</sup>	Spent <sup>2</sup>	Committed <sup>3</sup>	Difference <sup>4</sup>
Study Board and Management	406.5	336.1	21.4	49.1
St. Clair Task Team & Hydroclimate TWG	400.0	392.8	30.2	(23.0)
Lake Superior Regulation Task Team	914.0	674.1	342.6	(102.7)
Public Interest Advisory Group & Communications	30.0	18.4	0.0	11.6
Information Management	53.0	76.0	10.0	(33.0)
Plan Formulation /Evaluation & Adaptive Management TWG	522.0	345.6	135.5	40.8
Peer Review Group	30.0	0.0	29.6	0.4
<b>Grand Total Budget</b>	<b>2355.5</b>	<b>1842.9</b>	<b>569.3</b>	<b>-56.7</b>

Notes:

1. Study Board budget
2. Funds spent to date
3. Funds committed through contracts or MOUs
4. Difference between budget and committed/ spent to date

Respectfully submitted,



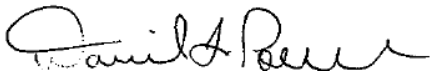
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GENE STAKHIV  
U.S. Co-Director




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SYED MOIN  
Acting Canadian Co-Director



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DAVID POWERS



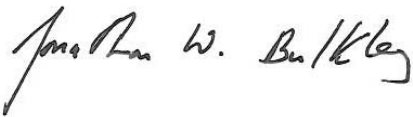
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JIM BRUCE




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JAMES BREDIN



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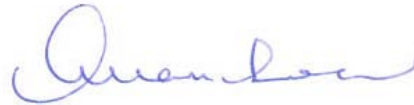
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JONATHAN BULKLEY



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JON GEE



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JOHN BOLAND

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ALLAN CHOW



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TONY EBERHARDT  
U.S. Study Manager

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WENDY LEGER  
Acting Canadian Study Manager

**Appendix 1 – Meetings Held Related to the Study**

	Oct 10	Nov 10	Dec 10	Jan 11	Feb 11	Mar 11
Study Board	IJC Hearing Ottawa (20)	Windsor (Nov. 29- Dec. 2)			Windsor (22-24)	
TWGs	PFEG Burlington (14-15)	PFEG/ AMG “Skunk Works” Workshop Burlington (2-4)	FIRM Workshop Burlington (8-10)	PFEG/ Forecasting Workshop Montréal (10-14)  PFEG/ AMG Strategy Workshop Burlington (25-27)	AMG Institutional Workshop Windsor (1-2)  St. Clair River Ecosystem Workshop (3)  M&I Meeting with Chicago Water Authority (9)	PFEG/ AMG Strategy Workshop Burlington (8-9)  Coastal (29-31)
PIAG	Thunder Bay (27-28)				Windsor (24-25)	
Other			Regional Hydrology Training Burlington (8)			

## Appendix 2 – Planned Meetings Related to the Study

	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sep 11
Study Board	Wash., DC (11-12)  IJC Hearing Wash., DC (13)		Niagara Falls, Ontario (7-9)			Chicago (19-22)
TWGs		PFEG/ AMG Strategy Workshop Burlington (10-11)  Hydroclimate Work Group Ottawa (18-19)				
PIAG	Wash., DC (13-14)			TBC		
Public Mtgs.				TBC	TBC	
Other			IAGLR <sup>1</sup> 54 <sup>th</sup> Conference Duluth (May 30- June 3)  64 <sup>th</sup> CWRA <sup>2</sup> Conference St. John's, NF (June 27-30)	CZ <sup>3</sup> 11 Conference Chicago (17-21)		

<sup>1</sup> International Association of Great Lakes Research

<sup>2</sup> Canadian Water Resources Association

<sup>3</sup> Coastal Zone 2011