

Great Lakes-St. Lawrence River  
Adaptive Management Committee

# GLAM

Annual  
Work  
Plan

Fiscal Year

2017

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Annual Work Plan towards building a long-term vision and adaptive management strategy for the on-going review and evaluation of the regulation plans.

Covering  
October 1, 2016 to September  
30, 2017

October 7<sup>th</sup>, 2016

## WORK PLAN

<b>Project Name:</b>	Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee Annual Work Plan for 2017		
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## Overview

**Purpose** This work plan provides a statement of how and when objectives of the GLAM Committee are to be achieved over the coming year, by showing the major products and activities required for the scope of the plan. This work plan includes the priority activities to be carried out by the GLAM Committee in the period covering October 1, 2016 through September 30, 2017 toward building a long-term vision and work plan for the on-going review and evaluation of the regulation plans.

**Contents** *The Work Plan covers the following topics.*

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*The following quality criteria have been observed in developing this work plan:*

- The work plan is achievable;
- Estimates are based in consultation with the resources who will do the work;
- Team leads agree that their part of the plan is achievable;
- It is planned to an appropriate level of detail (not too much or little);
- The work plan incorporates lessons from previous IJC studies and lessons learned from GLAM’s first year;
- The plan covers management and control activities (such as quality and communication) as well as the activities to create the products necessary to meet the IJC Directive;
- The plan supports GLAM project management strategies including the Communication, Outreach and Engagement Strategy.

## **Introduction**

On January 16, 2015 the International Joint Commission (IJC) issued a Directive establishing the Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee which report to the three Great Lakes-St. Lawrence River Boards of Control (Superior, Niagara and St. Lawrence (Boards)). The GLAM Committee is to carry out the required monitoring, modelling and assessment related to on-going evaluation of the regulation plans and address other questions that may arise due to changing conditions, in consultation with the Boards.

## **Purpose and Objectives**

The general purpose behind adaptive management (AM) is to establish a structured, iterative process of robust evaluation in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring and feedback to the decision-making framework based on knowledge gained. In this context and as outlined in the January 2015 GLAM Directive, the overall objective of the GLAM Committee is to provide information to the Boards and advise them and the IJC regarding the effects that the control structures approved in the Commission's Orders of Approval and Directives have on levels and flows in boundary waters and the impacts the regulation plans have on the affected interests. This includes the on-going review and evaluation of regulation plans related to:

- a) the effectiveness of the existing regulation plans in managing water levels and flows in the Lake Ontario-St. Lawrence River system and the outflows of Lake Superior in the past and into the future;
- b) examining how the system may be changing over time and whether any modifications to the regulation plan(s) may be warranted to address what is learned over time including emerging issues and/or to address changing conditions; and
- c) any other questions requested by the Boards and/or IJC that may affect the Boards' water management decisions over the long-term.

The Directive to the GLAM Committee is to design a work plan that assists the Boards by addressing these questions:

1. How well are the impacts of levels and flows represented by current data and models used in the evaluation of the management of levels and flows?
2. Will future water supplies be different from those used to test the current management of levels and flows?
3. How are other physical, chemical, biological, and/or socio-economic conditions of the system changing over time?
4. How can the management of levels and flows benefit other physical, chemical, biological and/or socio-economic conditions?

The 2017 GLAM work plan builds on initial planning and discussions held by the committee in the 2016 fiscal year to develop a framework that guides future GLAM Committee regulation plan evaluation; clarifies products and annual priorities and identifies roles, responsibilities and annual resource requirements.

### Scope and Timeline

This is the second work plan prepared by the GLAM Committee and it builds on work initiated in the 2016 work plan and is nested within the context of a broader 3-5 year mid-term strategy document developed as part of Year 1 activities. The 3-5 year mid-term strategy document provides an overview of a three tiered framework and the organizational structure for how GLAM will achieve the on-going review of the regulation plans. It provides the broader context and the annual work plans provide the details of what will be carried out in a specific year towards meeting the broader objectives of the 3-5 year mid-term strategy. The annual work plan coincides with the U.S. fiscal year and this 2017 plan covers October 1, 2016 through September 30, 2017. The 2017 work plan includes a mixture of carry over items from the 2016 work plan as well as new and emerging activities that fit within the context of the 3-5 year mid-term strategy.

### Preliminary Strategic Framework for Regulation Plan Review

As part of the implementation of the 2016 work plan, the GLAM Committee has been developing a 3-5 year mid-term strategy to help guide both short and long-term committee requirements as outlined in the 2015 directive surrounding the review and evaluation of the existing regulation plans. The proposed framework is a tiered approach. A detailed description of the tiers can be found in the 3-5 year mid-term strategy document. Figure 1 illustrates the connections between the tiers and their descriptions are provided below:

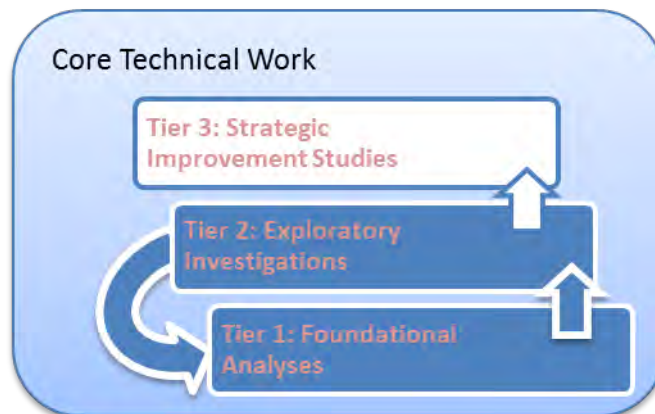


Figure 1: Proposed tier framework for the GLAM Committee

**The three tiers include:**

**Tier 1: Foundational Analyses:** An annual review of foundational requirements for the on-going review of the regulation plans and an assessment of priorities for the coming year.

**Tier 2: Exploratory Investigations:** Targeted studies for investigating specific aspects of a regulation plan and for improving the performance indicators, tools, and processes to support the Strategic Improvement Studies and feedback into the Foundational Analysis.

**Tier 3: Strategic Improvement Studies:** Comprehensive assessment of the relative performance of a set of alternative regulation strategies to achieve improved outcomes.

Each tier requires stakeholder outreach and engagement to ensure products are accessible, transparent and trusted. Therefore, the 2017 work plan includes activities and products required to support the three tiered plan review and evaluation process along with activities and products to ensure effective administration of the adaptive management process including continued development of long-term operating procedures along with outreach and engagement.

## GLAM Organization, Roles, and Responsibilities

The 3-5 year mid-term strategy document outlines the GLAM organization, roles and responsibilities of three integrated working groups to deliver on the activities required to meet the directive, and their specific activities within the three tiers. They include the following:

1. **Hydroclimate Working Group** – Focusses on understanding and reducing uncertainty in the primary “driver,” that being the dynamics of the hydroclimate system, the impacts on water supplies and other secondary factors (i.e., winds, waves, etc.), and the resulting water level and flow response.
2. **Stakeholder Assessment Working Group** – Made up of three sub-groups covering i) operational interests (commercial navigation, hydropower and municipal and industrial water uses); ii) Non-operational economic interests (coastal and recreational boating) and iii) Non-operational environmental. These sub-groups work to ensure outcomes of water level and flow scenarios on the various interests can be measured and assessed.
3. **Plan Review and Evaluation Working Group:** This group will augment, enhance, update and run the models and tools used in reviewing and evaluating regulation plan performance. This group integrates all of the data and science to allow the assessment of regulation plan performance. Collectively, this WG supports the activities needed to understand whether the management of levels and flows can benefit other physical, chemical, biological, and/or socio-economic conditions.
4. **Decision Support:** This is not a separate working group, but is a role carried out by the GLAM Committee members and IJC advisors to work with the Boards to articulate regulation plan

objectives and decision criteria for determining when and how a decision should be made by the Boards to recommend a change to the regulation plan to the IJC.

The GLAM Committee as a whole provides oversight to the working groups as well as guidance and support related to cross-cutting issues including providing strategic direction, liaising with the Boards and the IJC to understand the implication of GLAM products and findings, liaising related to Great Lakes Water Quality Agreement (GLWQA) activities, supporting external communications with key stakeholders through outreach and engagement, managing information, and ensuring quality control. Figure 2 illustrates the proposed structure as outlined in the 3-5 year mid-term strategy (note: the mid-term strategy is still under review).

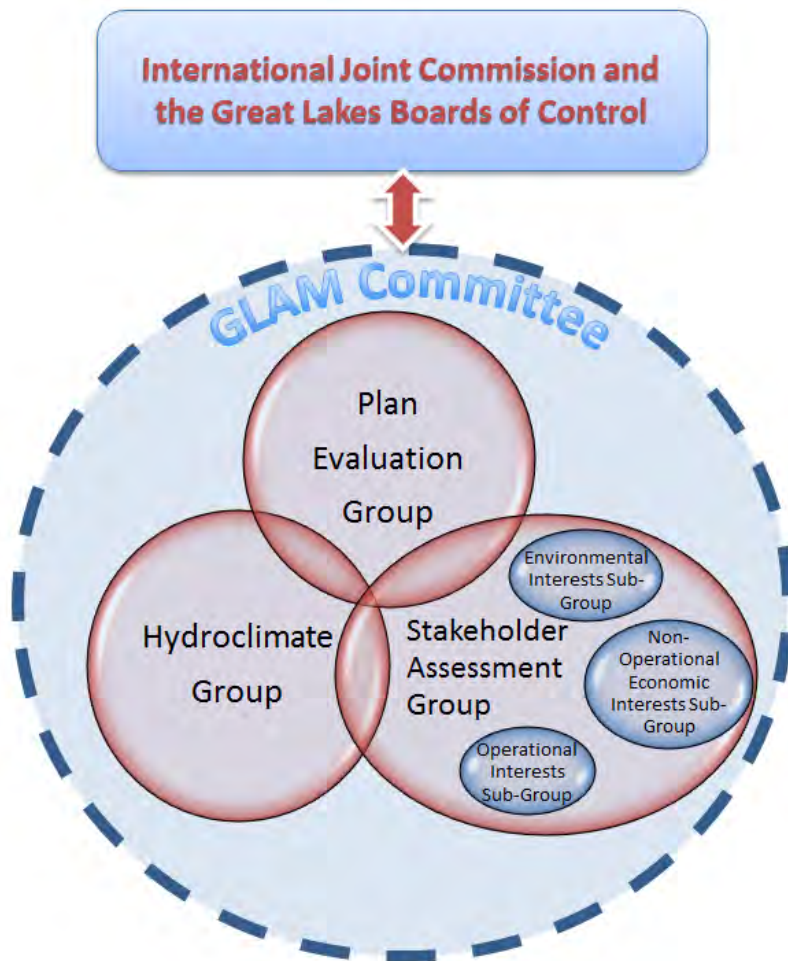


Figure 2: Proposed GLAM organizational and reporting structure

## Fiscal Year 2017 Work Plan - Product Descriptions, Timelines and Resources

The adaptive management process is an on-going effort that recognizes the dynamics of the system and while this work plan is based in the context of a long-term initiative and the 15 year reporting period, it represents a summary of priority adaptive management products and tasks to be undertaken or initiated within the period covering October 1, 2016 through September 30, 2017. The tasks and products are a mixture of carry over items from the 2016 work plan as well as new and emerging activities. The committee is using successes and challenges learned through the implementation of its year 1 work plan to guide activities within this work plan.

The Work Plan is divided into two sections. **Section A** identifies work projects to be undertaken by the proposed working groups in support of plan review and evaluation. The individual tasks are organized based on the tier and the working group. **Section B** outlines GLAM oversight and administrative activities needed to manage the GLAM Committee and support all work projects and long-term efficiencies.

Specific tasks identified in the work plan represent activities the GLAM Committee has identified as priorities and which the GLAM Committee believe can be resourced with available staff given current expectations for the coming year. Table 1 summarizes current expectations regarding identified resources available to the GLAM Committee in FY 2017. In addition, agencies are providing in-kind staff contributions. These in-kind staff contributions have been divided amongst all of the identified tasks.

Agency	\$US	\$CDN
IJC support (includes proposals submitted under International Watersheds Initiative (IWI) ***)	\$187K	\$206K
<b>Total:</b>	<b>\$187K</b>	<b>\$206K</b>

Table 1: Summary of currently identified resources (\$) for GLAM activities in FY 2017 (\*\* does not include small amount of carry-over from FY16 wetlands project)

\*\*\* Resources identified as under the IWI are based on proposals that have been approved by the IJC. However, formal arrangements are required for individual projects before the funds can be allocated. If formal arrangements cannot be made, the funding would not occur.

The work plan also includes a short list of additional items that are beyond the current capacity of the GLAM Committee given current resources and expected in-kind contributions. The Committee may look for alternative support such as additional submissions under the International Watershed Initiative (IWI) or through additional agency support to complete these tasks.



## Section A – Plan Review and Evaluation

### Tier 1: Foundational Analyses

The primary tier 1 objectives for the FY2017 work plan are to establish the appropriate processes and activities within each working group to perform annual, routine foundational analyses and to conduct initial sample analyses as outlined in the processes. The first portion of the fiscal year will be used for the planning component and the latter half for the implementation. Details are provided in the following task descriptions:

#### Hydroclimate Working Group

##### **FY17-1.1: Establish and test processes for performing annual, routine foundational analyses required for hydroclimate assessments.**

The priority for the Hydroclimate Working Group is to define annual requirements for a tier 1 foundational analysis. The focus for the driver (water levels and flows) is on an annual assessment of all hydraulic and hydrologic factors that support plan reviews including water levels, flows, water supplies as well as ice conditions, wind, waves and storms, tributary flows, conveyance (e.g. weed factors) etc. and on identifying any observed trends or unique extreme events that may require further study. Details of the processes will be defined by the Hydroclimate Working Group in consultation with the other Working Groups and the GLAM Committee. Components of this annual analysis may include:

- Working with Coordinating Committee and Board Regulation Representatives to report on observed hydrologic and hydraulic conditions for the year and to maintain a database of hydraulic and hydrologic data required for plan review and evaluation including:
  - Provide continual assessments and updates to the historical hydraulic and hydrologic datasets, including water levels, flows, net basin supplies (NBS), ice, winds, waves, water temperatures and any others identified as being necessary for GLAM to perform ongoing reviews and evaluations of regulation plan performance;
  - An annual assessment/update of the occurrence of extreme events, ice conditions, and wave data and their relation to water levels;
  - An annual assessment/update of the hydraulic and hydrologic assumptions and relationships used in the existing plan evaluations tools to simulate water levels and flows in the connecting channels and the St. Lawrence River, including conveyance, ice/weed factors, water level/flow relationships, tributary flows, etc.);
  - Assessing observed water levels and flows under the current regulation plan and current NBS conditions (i.e. what happened this year?).
- Update the statistical analyses of water levels and flows on a regular (annual?) basis.
- Conducting annual surveillance to identify/highlight any important research, news, or other updates related to physical changes to the system including trends that could influence the management of levels and flows.

- Working with the Stakeholder Assessment Working Groups to identify other key hydroclimate parameters required in calculating performance indicator algorithm(e.g. water temperature for fish PI)
- Regularly update St. Lawrence River and connecting channel rating curves based on updated H&H data

The Working Group will require approximately the first half of the FY to establish the draft processes. The remainder of the FY will focus on testing the implementation of the defined processes and summarizing the results and lessons learned to support subsequent annual reviews.

**Products:**

- Summary document outlining processes for tier 1 annual hydroclimate foundational analyses.
- Brief year-end report outlining results for tier 1 hydroclimate analysis activities and implications for future processes.
- A list of potential priorities for FY2018.

**Stakeholder Assessment Working Group****FY17-1.2: Establish and test processes for performing routine assessments required for understanding baseline conditions and benefits and impacts of observed water levels and flows.**

The priority for the Stakeholder Assessment Working Group is to define annual requirements for tier 1 foundational analyses. The assessment of outcomes focusses on the current conditions and on benefits, impacts and risks for the various interest categories of observed water levels and flows. Details of the processes will be defined by the Stakeholder Assessment Working Group and its sub-groups in consultation with the other Working Groups and the GLAM Committee. Components of this annual analysis may include:

- Identifying and documenting on an annual basis any observed, reported and anecdotal evidence of benefits and impacts of water levels and flow that raised with Boards, in media and through stakeholder engagement;
- Engaging with stakeholders to continually assess the state of their interest and whether the effects of water levels and flows are being accurately and appropriately captured and on how this could be improved;
- Conducting annual surveillance on things that might affect the sensitivity of interests to water levels and flows, and identifying priorities for further study;
- Incorporating any monitoring data gathered over the year or recent past into evaluation models;
- Assessment of resource requirements to carry out tier 1 and tier 2 tasks;
- Assessment of on-going Information Management requirements;

- Assessing all foundational information for each interest category, including baseline, surveillance, engagement, etc., to identify any updates that may be necessary and bring these to the attention of GLAM as potential priorities under tier 2.

The Working Group will require approximately the first half of the FY to establish the draft processes. The remainder of the FY will focus on testing the implementation of the defined processes and summarizing the results and lessons learned to support subsequent annual reviews.

**Products:**

- Summary document outlining processes for tier 1 annual performance indicator foundational analyses.
- Brief year-end report outlining results for tier 1 performance indicator analysis activities and implications for future processes.
- A list of potential priorities for FY2018.

**Plan Review and Evaluation Working Group**

**FY17-1.3: Establish and test processes for performing annual, routine foundational analyses required for ongoing evaluations of existing regulation plan performance.**

The priority for the Plan Review and Evaluation Working Group is to define annual requirements for tier 1 foundational analyses. The analysis will utilize existing models and evaluation tools to assess the performance of the current regulation plans under existing conditions over the recent past. Details of the processes will be defined by the Plan Review and Evaluation Working Group in consultation with the other Working Groups and the GLAM Committee. Components of the regular, routine, foundational analyses required for on-going review of current regulation plan under existing conditions may include:

- Working closely with Hydroclimate and Stakeholder Working Groups to ensure continual alignment of their work with GLAM’s requirements related to plan review and evaluation, and integrate any new tools, findings, data or other information generated by these groups into the ongoing plan review and evaluation process;
- Running existing models and tools, adapted to the task if required, with current and updated performance indicators to assess impacts/benefits under current regulation plans during recent years in terms of both “absolute” outcomes and relative performance compared to measured baselines;
- Comparing results generated from observed water levels and flows (i.e. the existing regulation plans with actual Board deviations) against results simulated with:
  - the existing regulation plans with deviations to assess accuracy of simulated results;;
  - the existing regulation plans without deviations to assess the effect of deviations on outcomes;

- the proposed or previous alternative regulation plans, i.e., Plan 1977-A for Lake Superior as the recently replaced plan and Plan 2014 on Lake Ontario as the current recommended plan of the IJC.
- Reviewing simulation results compared to any related data and information from Stakeholder Working Groups to assess where the existing performance indicators are not capturing outcomes effectively and identify potential priority studies under tier 2 that may improve performance.

The Working Group will require approximately the first half of the FY to establish the draft processes. The remainder of the FY will focus on testing the implementation of the defined processes and summarizing the results and lessons learned to support subsequent annual reviews.

**Products:**

- Summary document outlining processes for tier 1 annual plan review and evaluation foundational analyses.
- Brief year-end report outlining results for tier 1 plan review and evaluation analysis activities and implications for future processes.
- List of potential priorities for FY2018.

## Tier 2: Exploratory Investigations

Tier 2 work plan tasks defined for the FY2017 focus on reducing uncertainty in estimates of Net Basin Supplies across the Great Lakes, improving specific hydroclimate and performance indicator simulation tools, undertaking field data collection to gather baseline data and to validate existing models, and evaluating specific aspects of regulation plan performance along the St. Marys River. Some of these tasks carry over from the FY2016 work plan while others are new projects. Details are provided in the following task descriptions:

### Hydroclimate Working Group

#### **FY17-2.1: Extended CaPA and GEM hindcasts of water supply components in the Great Lakes Basin and Canada-US transboundary watersheds (IWI)**

The Canadian Precipitation Analysis (CaPA) is an operational near real-time gridded precipitation product from Environment Canada available since April 2011 for North America. CaPA has generated a lot of enthusiasm in the Great Lakes area, due to its unique capability of capturing some of the precipitation features that are specific to the Great Lakes, in particular organized shallow convection events which are responsible for lake-effect snowfall. Indeed, because it uses a background field from the Global Environmental Multiscale Model (GEM) atmospheric model, it can represent the effects that the lakes have on the precipitation patterns, something that is very difficult to catch with the existing precipitation gauging network, as it is entirely land-based.

The International Upper Great Lakes Study (IUGLS) demonstrated that GEM and CaPA can be used together to obtain skilful component net basin supplies on a monthly time scale for the Great Lakes.

A limitation of CaPA has always been the short period for which it is available operationally, making it challenging to compute meaningful anomalies, which are helpful when it comes to explaining changes in Great Lakes water levels. A 15-km retrospective analysis was produced as part of the IUGLS which goes back to June 2004. At the time, the cost of running GEM further back in time was deemed prohibitive. Furthermore, some required datasets were not available at ECCC. During FY 2015-2016, a proof of concept was performed that proved that it is now possible to extend CaPA and GEM hindcasts back in time for 30 years: the datasets have been acquired, and the computing time has been reduced considerably. An implementation strategy was proposed by which the hindcast could be generated in parallel for six 5-year periods. The runs could then be completed in a few months if a sufficient number of CPUs are dedicated to the project (on the order of a few thousand CPUs). Because ECCC will receive a new supercomputer before the end of FY 2016-2017, the most efficient solution seems to be to wait for that computer to be fully operational before starting the production of the 30-year hindcast. Under the current project, is the committee proposes to refine the methodology over a 2-year evaluation period and then generate the hindcast products for one 5-year period.

This IWI approved project directly supports GLAM Committee efforts to improve measurement and understanding of the individual components of the water supply and reduce uncertainty in hydrological conditions which could lead to better forecasting and improvements to regulation rules.

At the request of the IJC, the project methodology will also be applied outside the Great Lakes basin in other transboundary watersheds along the Canadian-U.S. border.

**Products:**

- Detailed analysis of the quality of the hindcast over a two year period;
- Gridded GEM and CaPA data for a 5-year period;
- Report summarizing project methods and results.

**FY17-2.2: Development of a statistical model to close the water balance of the Great Lakes (IWI)**

This IWI endorsed project is intended to develop a new historical record of monthly runoff, over-lake evaporation, over-lake precipitation, and connecting channel flows for each of the Great Lakes using a novel statistical model that (through an explicit acknowledgment of bias and uncertainty) reconciles discrepancies between model- and measurement-based estimates of each component while closing the Great Lakes water balance. The proposed project will help understand key uncertainties in model- and measurement-based estimates of each water supply component. Outcomes from this project will improve the underlying understanding of how each Net Basin Supplies (NBS) component contributes to observed water levels. In turn, the project will provide important direction to support more focused

research on factors that drive the observed contributions. The work will help the GLAM Committee to define better ways to use water supply information and model output (including climate change models) in the testing of existing and alternative water management scenarios throughout the Great Lakes Basin.

This project is expected to result in the first comprehensive water budget estimates for the Great Lakes that systematically close the entire water balance while addressing both measurement bias and uncertainty. Perhaps more importantly, in addition to leading to a novel set of new estimates, this project will lead to a modeling framework that is designed to incorporate qualitative perceptions of measurement uncertainties that can be incorporated, through a process of Bayesian updating, into the final estimates. Furthermore, the newly-developed water budget estimates are expected to provide a much more robust basis (relative to previous estimates) for decision making not only because they include an expression of uncertainty (a gap in decision making that has been evident for decades) but also because they provide a full explanation for changes in water levels from month-to-month. Similar modelling approaches have not been systematically applied to the Great Lakes over any historical period.

The project will help in resolving the regional water budget across monthly and inter-annual time scales and represents an important stepping stone towards addressing a long-standing need in the Great Lakes for clear and defensible differentiation between hydrological, climatological, geological, and anthropogenic drivers behind seasonal and long-term changes in Great Lakes water.

**Products:**

- Monthly time-series data set of runoff, over-lake evaporation, over-lake precipitation, and connecting channel flow component supplies for each lake back to approximately 1950.
- Summary report outlining project process, description of statistical model, stakeholder input, results and implications, and possible future application.

**Stakeholder Assessment Working Group****FY17-2.3: Evaluate Meadow Marsh Algorithm.**

This is the continuation of a task that was initiated during GLAM's FY2016 work plan (Task FY16-1.2) using a combination of in-kind agency resources and funding from the US Section of the IJC under the IWI. The wetlands meadow marsh performance indicator has been a critical component of the evaluation of water level regulation plan options for the Lake Ontario-St. Lawrence River system and it is important to validate and improve the modelling approach.

This task is to compare the types of plants growing in Lake Ontario wetlands to the types predicted by the Integrated Ecological Response Model (IERM) used in the LOSLR study and determine whether the IERM predictions are validated by the data. The validation will have three parts:

1. Using the algorithm embedded in the IERM and actual 1945-2014 Lake Ontario levels, calculate a time series of annual elevations labeled A, B, C, D, E, F and G. These lettered elevations are defined by previous Lake Ontario levels. For example, in any year, “B” is the elevation that has not been flooded in the last ten years, “flooded” meaning under still water for 2-3 quarter-months. The letter elevations in turn can be used with area-elevation curves to predict the areas covered with upland, meadow marsh, emergent and submerged vegetation each year. For example, the bottom of the predominantly meadow marsh area is elevation “C”.
2. Use the monitored plant data to determine the “actual” areas of upland, meadow marsh, emergent and submerged vegetation each year, and then
3. Compare the two and judge whether the algorithm should be corrected based on the evidence provided by the new plant data.

An initial workshop was held in March 2016 to outline potential methods for synthesizing existing field data and comparison to the wetland model output. Following up on the workshop, agency staff have been working on updating the wetlands model and preparing it for use with the data synthesis. As part of the FY2017 task, the project team will work to integrate the synthesized wetlands data and compare the model output with the field data. After the monitoring data is processed and work is done to compare the model and field results, a second experts workshop may be held to present and review the findings. The objective is to have a project summary report completed by the end of December 2016.

**Products:**

- An excel based modelling tool that incorporates recent observed wetland monitoring data and allows for assessment under actual water level conditions compared to expected performance indicator results from existing planning models used in LOSLR.
- Transfer of expertise on the evaluation tools from contractors to government agencies.

**FY17-2.4: Monitoring Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – site surveys (IWI)**

Monitoring how coastal wetland habitats change with respect to elevation is important for teasing apart the influence of water-level management and other factors that play a role in habitat change, such as invasive species, alterations to adjacent upland areas, or other changes in hydrologic inputs. Monitoring wetland-elevation dynamics allows for improved models of how wetlands respond to water-level management by better refining the amount of delay in vegetation response and the magnitude of effect of flooding or dewatering events. This project will provide greater understanding of the relationship among elevation, vegetation, and time and higher precision.

This IWI supported project will result in detailed vegetation community information referenced to elevation in sixteen Lake Ontario and St. Lawrence River coastal wetlands on the US side, complementing previous efforts in Canada (e.g. GLAM Task FY16-1.1). The proposed work conforms to related work in Ontario wetlands and will allow the development of a lakewide, binational assessment of wetland status. These data can be used to support adaptive management of lake level dynamics and

can integrate into wetland vegetation community modelling (i.e., refine Integrated Ecological Response Model (IERM) inputs and validate outputs) that was developed for the IJC's Lake Ontario and the St. Lawrence River Study (LOSLR).

**Products:**

- Summary report outlining field sampling methods, sites and results for wetland site survey analysis.

**FY17-2.5: Monitoring of Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – Imagery (IWI)**

The goals of this IWI project are to acquire high-resolution aerial imagery in maximum-vegetation condition (August-September 2017) for sixteen Lake Ontario and St. Lawrence River coastal wetlands, use GIS to map the vegetation types within these wetlands, and then assess similarities and differences in wetland extent from equivalent mapping products from 2012 and 2014. This work will complement the planned collection of coastal wetland aerial imagery on the Ontario side to allow the development of a lakewide, binational assessment of the current status of Lake Ontario and St. Lawrence River coastal wetlands. These data can be used to support adaptive management of lake level dynamics and integrate into wetland vegetation community modelling of the meadow marsh extent indicator for the Lake Ontario – St. Lawrence River (LOSLR) area. The LOSLR study identified the meadow marsh performance indicator as one of the primary metrics for assessing the environment. Therefore, monitoring this indicator is an important part of water-level adaptive management. Monitoring change in the *extent* of coastal wetland habitats is important for understanding the magnitude of change occurring on the landscape and how this change may be linked to lake-level regulation. Tracking changes spatially also helps us understand how local forces (such as wave action, sedimentation, or invasive species expansion) may be influencing the changes detected.

**Products:**

- Summary report outlining field sampling methods, sites and results for wetland imagery analysis.

**FY17-2.6: Lower St. Lawrence River IERM2D code update (IWI).**

The environmental performance indicators (PI) for the Lower St. Lawrence River (IERM2D) are a critical component of the evaluation of water level regulation plans for the Lake Ontario-St. Lawrence River system and are important to maintain in an adaptive management perspective. These PIs were created, programmed and used during the Lake Ontario – St. Lawrence River (LOSLR) Study (2000-2005) and have been used many times since then for new plan assessment and other applications in the river. These 40 PIs represent 14 different components of the ecosystem; they are used to quantify the effect of discharge/level modifications for several floral and faunal resources.



The Hydrology and Ecohydraulic Section of ECCC was the principal investigator (with several partners responsible for the field work) in charge of the creation, validation and the maintenance of these Lower St. Lawrence River PIs. However, the coding version in which they were created (vb.Net 2008) is no longer supported. Consequently, these Performance Indicators are rapidly becoming obsolete and it is necessary to update them. The Hydrology and Ecohydraulic Section of Environment Canada has been moving to PYTHON over the last 5 years and one of the benefits of this is that PYTHON can be executed on both Windows and Linux operating systems, commercially available machines as well as on CMC machines (Canadian Meteorological Center).

The Hydrology and Ecohydraulic Section of ECCC will update the Lower St. Lawrence PIs including:

- Re-designing oriented-object applications for each existing PI.
- Recoding the 40 PI's from vb.net to *PYTHON*, including quality verification (i.e. results obtained should be the same as they were before recoding).
- Recoding the applications that are associated with the data entry necessary to run the models (water level/discharge transformation, spatial and temporal data preparation, etc.).

The target language is *PYTHON 2.7* which is stable and very well documented. *PYTHON 2.7* is consistent with the operational requirements for CMC supercomputers and will be supported in the near future.

Furthermore, integration of new discharge/water-level time series (new regulation plans), coordination of the different calculation steps, spatial verification, and results management are presently time consuming for staff. Implementing this program will result in significant process optimization, and reduce the time required to run the system.

Consequently, the application created by this project will aim to optimize:

- Improving the integration of new time series:
  - Integrate time series into IERM2D system internal format
  - Verify (time shift, realistic water levels) and compare time series to existing ones.
- Coordinating the calculation sequence of all the models allowing the creation of spatially explicit results for verification and distribution.
- Storing final results in a format consistent with adaptive management modelling needs (spatially distributed results, verification of results, reality check, etc.).

The final product should be a nearly “automated system” that regroups: 1) the integration of new time series, 2) PI calculations and 3) production of final results. The system will significantly minimize the time required to evaluate new regulation plans or field observations for model validation and assessment. Updates will also ensure that the existing PIs are compatible with current programming languages that are supported into the future. In addition, the work will be coordinated with members of the GLAM Committee to ensure consistency in model output to allow comparison with other Lake Ontario performance indicators.

This major update will be done by the staff of Hydrology and Ecohydraulic Section (ECCC) and external contractors. The Canadian Section of the IJC is providing funding under the IWI to support this project.

**Products:**

- An updated Lower St. Lawrence River IERM2D model.

**FY17-2.7: FEPS model - update based on shore protection information (PI verification)**

This task builds on work initiated as part of GLAMs FY2016 work plan (Task FY162.3) where site specific shore protection height information for a number of structures on the US shoreline of Lake Ontario was entered into the Flood and Erosion Prediction System (FEPS) database. Shoreline protection maintenance on Lake Ontario is the coastal performance indicator within FEPS that was found to be most sensitive to the differences among candidate regulation plans during the LOSLR Study. Elevations of existing shore protection structures are estimated within the FEPS database, as are the design characteristics of replacement structures when existing shore protection fails within the model. Sensitivity analysis of the shore protection results suggests that shore protection failure is sensitive to the design water level elevation used within the model and that verification of design water levels for existing and replacement shore protection would provide additional confidence of assumptions used within the model. Following the LOSLR Study, the NY State DEC and the USACE conducted on-the-ground surveys of a number of locations along the south shore of Lake Ontario to gather shore protection types, quality and height of structures to compare to key assumptions in the FEPS database. The data was delivered to the USACE during GLAM's FY2016 Report and the data was then quality checked and formatted to be included into the FEPS database. In addition, staff from USACE worked to become more familiar with the model and USACE and ECCC staff conducted a number of sensitivity tests to verify model assumptions based on actual measured data. A preliminary summary of the comparisons has been developed and will now be reviewed within GLAM. The review and any associated updates to the work will continue until approximately December 2016 to ensure time for interested GLAM members and associates to provide feedback on the draft results.

**Products:**

- Summary report outlining comparison of FEPS model results using the baseline model assumption and site specific structure information (field surveys).

**FY17-2.8: Detailed scoping of requirements to develop an ecohydraulics model of the St. Marys River and prototype application to the St. Marys Rapids area (IWI).**

This IWI endorsed project will involve developing a detailed scope of work for an integrated ecosystem response model with simulated two-dimensional hydraulics (IERM2D) applied to the St. Marys River, and an initial prototype application of this model to the St. Marys Rapids area, calibrated/validated for a limited number of hydrologic scenarios. The project will include identifying critical objectives for the model and appropriate performance indicators (e.g., desirable spawning habitat for Lake Sturgeon, and

sport fish/salmonids; sea lamprey spawning rates); collection and documentation of all currently available data and models that could be used in support of this work; identifying gaps in this information and potential strategies and/or projects that may be required to fill these additional data needs and requirements; and development of a prototype version of the model from this available information for the St. Marys Rapids area. This prototype, will be based on an existing 2D hydrodynamic model currently in development by USACE-Detroit, which will have the potential to be extended to the full St. Marys River and a larger range of water supply scenarios (both observed and predicted).

**Products:**

- Scoping requirements for an IERM2D model for St. Marys Rapids.
- Prototype IERM2D model for the St. Marys Rapids illustrating potential application and associated documentation.

**FY17-2.9: Baseline Common Reed (Phragmites) work on Lake Ontario (IWI).**

Common reed is an exotic, invasive, perennial grass that grows up to five metres tall. This Eurasian species has invaded wetland habitats across eastern North America and is also common in roadside ditches. Common reed is a serious threat to biodiversity as it outcompetes native plants and affords relatively poor wildlife habitat. Once introduced into an area, it generally becomes well-established and is extremely difficult to control or eradicate. Although there is no detailed fine-scale vegetation mapping across Lake Ontario coastal wetlands, there is consensus among coastal wetland practitioners that common reed is far less extensive in Lake Ontario than in lakes Erie and Huron. It is unknown whether Lake Ontario water-level regulation has helped resist the establishment of common reed or natural proliferation has simply not occurred. Absence of natural proliferation seems curious because it is thought that common reed was introduced on the eastern seaboard and spread westward. There is speculation that the establishment of vast cattail stands across Lake Ontario following regulation may have precluded the establishment of common reed as the two taxa share a similar hydrologic niche. This study will collect data to provide insights regarding common reed colonization and extent in selected wetlands across Lake Ontario.

This IWI backed study will consider two main categories of Lake Ontario coastal wetlands 1. Wetland influenced directly by water-level regulation (i.e., permanent surface-water connection with the lake) and 2. Wetlands not directly influenced by water-level regulation (i.e., wetlands on the coast without a permanent surface-water connection with the lake; e.g., permanent or dynamic barrier beaches, diked wetlands). The extent of common reed will be mapped in selected wetlands within each category. The intent is to generate a baseline understanding of Common Reed extent in specific Lake Ontario wetlands to support assessment of potential changes in the future.

**Products:**

- GIS delineations of Common Reed extent within select Lake Ontario coastal wetlands on the Canadian shoreline.
- A final project report summarizing methods and key results.

**FY17-2.10: Develop Performance Indicator prioritization process to guide future PI update efforts.**

Moving forward, GLAM will continue to be faced with the need to prioritize performance indicator work balancing multiple geographic and interest group needs within the resource limitations of the committee. This task is intended to further outline a strategy for integrating available information and identifying priorities regarding updates to existing performance indicators and the development of new ones. Development of this process will require discussion and feedback between the Stakeholder Assessment Working Group, the Plan Review and Evaluation Working Group, and the broader GLAM Committee. Development of this process will be initiated early in 2017 and will be completed in time to guide development of the 2018 work plan.

**Products:**

- Strategy (process) and criteria for prioritizing future performance indicator work.

**Plan Review and Evaluation Working Group****FY17-2.11: Programming support for update to Coordinated Great Lakes Regulation and Routing Model.**

The overall objective of this IWI supported project is to develop a new, authoritative, coordinated numerical modelling framework that will allow efficient and accurate simulations of water levels and connecting channel flows in the Great Lakes system given user-specified net basin supply scenarios and alternative flow regulation strategies. A related and important secondary objective of this work is to ensure the new model is well-documented and easily accessible, and that it can be readily employed for a wide variety of operational and research purposes, and by a wide variety of potential users, including government agencies, academic researchers, private sector consultants, etc.

The new regulation and routing model would replace the current Coordinated Great Lakes Regulation and Routing Model (CGLRRM), which has been employed since the 1990s, but which is poorly documented and becoming increasingly outdated and difficult to use. At its 95th meeting on 20-21 November 2013, the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data agreed to establish an ad-hoc regulation and routing model (RRM) subcommittee that would be responsible for developing an updated and improved hydrologic routing and regulation model for the Great Lakes-St. Lawrence River system. The need for a replacement had been identified by the Coordinating Committee in response to several issues identified with the current model including the complicated nature of the model framework which makes it inaccessible to many potential users, lack of flexibility for testing alternative regulation scenarios or alterations in hydraulic properties of the connecting channels, and technical concerns related to outdated Lake Ontario regulation code, unrealistic assumptions (e.g. steady state conditions for an entire simulation period), and inflexible data handling and simulation time step. The RRM subcommittee includes a number of staff who are directly

involved with the Great Lakes- St. Lawrence Adaptive Management (GLAM) Committee and the Great Lakes Boards of Control.

The primary goal of this project is to develop a flexible, efficient, and relatively simplified numerical modeling framework to be used to simulate Great Lakes water levels and flows under alternative regulation strategies and future water supply scenarios. The new model will be developed to meet the needs of a variety of users. For example, it will be used by GLAM members to simulate Great Lakes water levels and flows under alternative regulation strategies and future water supply scenarios and changing climate conditions and evaluate their impacts, all of which are key provisions of GLAM's Directive from the IJC. The new model will also be used to meet the provisions in the Orders of Approval for both the Lake Superior Board of Control, which operationally runs Plan 2012 using the current CGLRRM model, and the St. Lawrence River Board of Control, which operationally runs Plan 1958-D using alternative tools developed by the agencies (primarily USACE and ECCC), and by both these Boards and the agencies (again primarily USACE and ECCC) to forecast water levels and flows under various water supply scenarios. The framework will be fully documented in a technical design and user manual for the RRM subcommittee, GLAM, the Boards of Control. Furthermore, academic and other researchers will be able to access the new model and its documentation, and use it for their own research initiatives and/or those in support of GLAM, the Great Lakes Boards, and relevant government agencies.

**Products:**

- Model code.
- Final summary report including executive summary and lessons learned.

**FY17-2.12: St. Marys River – Review impacts of reductions in maximum side channel capacity (formerly FY16-4.1.1).**

Plan 2012 was developed and tested during the IUGLS, assuming a maximum side channel capacity of 2320 m<sup>3</sup>/s, and this assumption has carried through to the operational implementation of Plan 2012 as well. However, this constant value is based on a number of assumptions that are essentially representative of a specific set of near "ideal" conditions, and often these conditions do not exist. In particular, these assumptions do not reflect actual operational conditions in two important ways:

- i. Hydropower outages

The maximum side-channel capacity of 2320 m<sup>3</sup>/s is based on the assumption that all three of the hydropower plants are running all generating units at full capacity, but the reality is that most years there are a number of scheduled and unscheduled outages at the hydropower plants that result in unit outages and a reduction in the maximum capacity of the plants.

- ii. Variations in hydrologic conditions

Even when all hydropower generating units are available and running, the flow capacity of these units varies as a result of variations in hydrologic conditions, most notably changes in water levels and ice conditions. There is also a specific concern that because side-channel capacity is often limited in winter that the maximum winter flow of 2410 m<sup>3</sup>/s prescribed by Plan 2012 is unattainable (under the normal one-half gate equivalent winter setting), and this may have consequences in terms of high water levels during the following spring and summer.

This task was initiated in GLAMs FY2016 work plan (Task FY16-4.1.1) using in-kind contributions from partner agencies. Work on this project will continue into FY2017 with the priority to investigate the impacts of hydrologic conditions on maximum hydropower plant capacity and develop mathematical relationships that relate the two, which can then be incorporated into evaluation and operational models/tools. It will also be used to review the impacts of reduced side-channel capacity in winter, notably the potential for higher Lake Superior levels in spring/summer than were estimated during IUGLS plan formulation and evaluation, and how to address this issue. Finally, this task will include a study of the impacts of large and fluctuating flows in the St. Marys River due to varying maximum side-channel capacity, and develop and evaluate methods to address these impacts. This analysis should consider the positive and negative impacts on stakeholder groups. Recommendations should include rules, limits, and/or guidelines that the Board could follow in addressing these issues, including the potential use of deviations from Plan 2012 or permanent changes to Plan 2012 itself. Staff of the Lake Superior Board at ECCC and USACE have begun to investigate the relationships between hydropower capacity and hydrologic conditions using limited data when the plants were running at full capacity recently. This analysis would benefit from additional data (both from the past or available in the near future) and from involvement of the hydropower operators themselves. This task will continue be conducted with GLAM Committee staff at ECCC and USACE through the Board regulation representative offices.

Through the work done so far, the project team has noted that there are few performance indicators or evaluation tools that focus on the St. Marys Rapids area. This has been identified as a potential gap for completing this task (FY17-2.12) and the following one (FY17-2.13), and development of these has been identified as a priority item required to support future plan evaluations. To this end, the USACE Detroit District continued to refine its new hydraulic model of the St. Marys Rapids during the past several months, and this will be critical to assess the impacts of water levels and flows under various side channel capacity and Compensating Works gate setting scenarios. In addition, these hydraulic modelling efforts may be used in the development of an ecohydraulic model in the St. Marys River (Task FY17-2.8). The proposed ecohydraulic model would be similar to a past 2-Dimensional Integrated Ecological Response Model (IERM2D) prepared for the lower St. Lawrence River.

**Products:**

- Report on varying hydropower plant capacity due to hydrologic conditions.
- Evaluation and initial report on impacts and potential strategies to address reductions in hydropower capacity.

**FY17-2.13: St. Marys River – Review multiple partially open gate settings at the Compensating Works (formerly FY16-4.1.2).**

As a result of the recent rise in upper Great Lakes water levels, regulated outflows from Lake Superior through the St. Marys River have also increased, and this has required the gate setting of the Compensating Works at the head of the St. Marys Rapids to be increased above the minimum one-half gate equivalent. A number of concerns have been raised in using fully open gates including the impacts of higher flows and levels on the St. Marys Rapids fishery and recreational anglers, potential flooding of Whitefish Island, the risk of ice damage to the Compensating Works and structures in the lower St. Marys River, the impacts of “spilled” water on hydropower production, and impacts to commercial navigation due to reduced levels in the lower St. Marys River if gate settings were reduced. Since May 2014 the Lake Superior Board began employing multiple partially open gates in lieu of fully open gates in order to provide a number of potential benefits in the St. Marys Rapids. One issue with this new approach is that the existing hydraulic relationships and the flow measurements used to verify the relationships are applicable to flow through fully open gates at the Compensating Works only, and cannot be applied to partially open gate settings. Flows through the partially open gates have been calculated using standard, textbook gated flow equations. Flows through the Compensating Works constitute a significant component of the overall flow through the St. Marys River, particularly during periods of high flows when they make up a greater proportion of the total. Therefore, understanding the relationships between water levels and flows through partially open gates is critical to the operation of the Compensating Works and to the determination and regulation of the total outflow from Lake Superior.

This task was initiated in GLAMs FY2016 work plan (Task FY16-4.1.1) using in-kind contributions from partner agencies. Work on this project will continue into FY2017 with GLAM Committee and support staff working with stakeholders, including ecosystem/fisheries scientists, recreational anglers, First Nations/Whitefish Island and hydropower operators, to develop a better understanding of the advantages and disadvantages of partially open gate settings. If necessary, any issues may be addressed through modifications to the Coordinated Great Lakes Regulation and Routing Model (CGLRRM), Plan 2012 and/or the operational guidelines for Lake Superior regulation. The Lake Superior Board staff working with the GLAM Committee will use recently collected St. Marys Rapids flow measurements at partially open gate settings, to continue to develop and verify partially open gated flow equations. These equations will need to be incorporated into the CGLRRM to be used operationally by the Board for Lake Superior regulation and by GLAM for the ongoing evaluation of regulation plans. This task will continue to be conducted with GLAM Committee staff at ECCC and USACE through the Board regulation representative offices.

**Products:**

- Initial report on benefits/disadvantages to stakeholders of partially open gate settings.
- Initial joint report with Lake Superior Board on partially open gate setting flow relationships for operational implementation and incorporation into CGLRRM.

### Tier 3: Strategic Improvement Studies

The GLAM Committee does not currently expect to undertake any tier 3 type analyses in FY2017.

## Section B – GLAM Oversight and Administration

### **FY17-3.1: GLAM Committee Coordination, Management, and Reporting**

This is an on-going task that includes the coordination, management operation and oversight of GLAM Committee activities and working groups. It includes primarily the work of the co-chairs, secretaries and their staff who help support the operation of the GLAM Committee. This activity is supported primarily through USACE and ECCC with some operation and maintenance funds provided by IJC-Ottawa.

There are two specific products for this task. The first is that each year the GLAM Committee will prepare an annual work plan for submission to the Boards outlining the activities to be carried out and products to be delivered in support of the adaptive management process. The work plan will identify the priority work items, the project leads, timeline, any external costs, GLAM Committee contributions and product deliverables. This will be submitted to the Boards in advance of their fall semi-annual meeting and presented to the Boards at their fall meeting. The Boards will present the work plan to the IJC during the Semi-Annual IJC Board Appearances. The Boards may request the GLAM Committee co-chairs to present the work plan on their behalf to the IJC.

The second product, as per the IJC Directive, will be for the GLAM Committee to prepare semi-annual progress reports outlining the status of the GLAM Committee in meeting the commitments of its annual work plan. These progress reports will be prepared by the GLAM Committee secretaries and co-chairs and presented to the Boards at their March and September meetings in advance of the IJC Semi-Annual Meetings. The Boards will report on progress to the IJC or may ask the GLAM Committee co-chairs to present on their behalf.

**Product:**

- Annual work plan for FY 2018 for submission to the Boards.
- Semi-annual progress reports for submission to the Boards in March 2017 and September 2017.

### **FY17-3.2: Monitoring of the work plan delivery**

The GLAM Committee secretaries in conjunction with the GLAM Co-chairs will track work plan progress. This will include working with task leads to establish task descriptions and timelines along with performance tracking. This is an ongoing committee requirement and contributes to semi-annual progress reporting.



**Product:**

- Task descriptions and periodic updates on progress that contribute to semi-annual reporting.

**FY17-3.3: Finalize mid-term strategy**

During GLAM’s FY2016 work plan, Task FY16-5.3 included the development of a 3-5 year mid-term strategy for the committee. The 3-5 year mid-term strategy allows the GLAM to consider what can be done within a 3-5 year time horizon and the stages required to support the 15 year plan evaluation as outlined in the Directive. The 3-5 year outlook of a 3-5 year mid-term strategy considers important stages of the adaptive management process and provides a broader planning horizon over which to consider the arc of the adaptive management process.

The committee has prepared a draft plan and submitted it to the Boards for their review. In the early part of FY2017 (e.g. October to December 2016), the GLAM Committee will be working with the Boards to review the 3-5 year mid-term strategy and seek feedback. The GLAM Committee will use the feedback from the Boards to finalize the initial version of the 3-5 year mid-term strategy. The intent is to have the final version completed by January 2017.

**Product:**

- A finalized 3-5 year mid-term strategy that incorporates Board input.

**FY17-3.4: Prepare first GLAM triennial progress report**

The first Triennial Report of the IJC on the progress of the Great Lakes Water Quality Agreement is due in January 2017. As per the GLAM Committee’s Directive from the IJC, the GLAM Committee shall report to the IJC on a similar schedule. GLAM initiated the preparation of a draft outline for its triennial progress report as part of the FY2016 work plan. In FY2017, the GLAM Committee will prepare its first triennial progress report. The intent is to have the progress report finalized by January 2017.

**Product:**

- Finalized GLAM Triennial Progress Report for January 2017.

**FY17-3.5: Business analysis of future GLAM information management needs**

The GLAM Committee has already leveraged available IJC support to establish a high level website along with making use of Sharepoint and File Transfer Protocol (FTP) resources to communicate internally and manage products and information. As GLAM moves forward, there will be greater requirements to manage larger datasets and models in addition to the files and documents already managed through existing IM/IT infrastructure. Further direction is needed to identify appropriate approaches for handling future IM requirements. The GLAM Committee is proposing that a small team be put together that includes IJC IM/IT staff, GLAM Committee members, and potentially an external contractor or

partner agency IM expert to do a business analysis of GLAM IM needs and consider potential options (including a review of external IM efforts that could be leveraged) that will support GLAM in the future.

A portion of this work may be a possible candidate for funding through the IWI process as it promotes broader information management needs regarding transboundary water management. The resources available to pursue this task are still being negotiated and progress will likely vary based on the resources that can be allocated to it.

**Product:**

- Business analysis of GLAM IM/IT opportunities and needs within the context of available IJC IM/IT resources and capacities.

**FY17-3.6: Maintain engagement with Great Lakes Water Quality Agreement activities**

The IJC Directive to the GLAM Committee specifically highlights the importance of ensuring coordination and liaison between the Great Lakes Control Boards and the Boards created by the Great Lakes Water Quality Agreement (GLWQA) – the Great Lakes Water Quality Board (WQB) and Science Advisory Board (SAB). To better link water levels and flows regulation with water quality considerations, the GLAM Committee is requested to engage in outreach activities with the WQB and SAB. The GLAM Committee co-chairs are participating in joint meetings of the WQB and SAB.

Additionally, the GLAM Committee has started the process of drafting a strategy to engage with specific Annex committees of the GLWQA. In order to facilitate interaction and collaboration between the GLWQA and the GLAM Committee, the GLAM committee will employ its existing members who also currently have roles within the GLWQA Annex subcommittees. These members and their connection to the Annexes can be found in the following table.

	Annex	GLAM member	IJC Observer
1	Areas of Concern		Child
2	Lakewide Management	Zelazny, Christie, Luckey (L. Ont)	Child
3	Chemicals of Mutual Concern		Boehme
4	Nutrients	Luckey, Zelazny	Bejankiwar
5	Discharges from Vessels		Burrows
6	Aquatic Invasive Species	Christie, Hamilton	Wang
7	Habitat and Species	Christie	Wilson
8	Groundwater		Arvai

9	Climate Change	Leger, Caldwell	Boehme
10	Science	Christie	Wang

GLAM Committee members will first work within their Annex subcommittees to introduce the work of the GLAM Committee and discuss potential areas for collaboration within the context of the Annexes with a focus on Annexes 2 , 4, 6, 7, 9 and 10 (see list above). Where the Annexes are receptive, GLAM Committee members will offer to present the adaptive management framework established by the GLAM Committee designed for on-going review of the regulation plans and ideas for collaboration with the Annex. The GLAM Committee will then discuss and document the potential applications of their process to the subcommittee’s objectives established under the GLWQA.

Upon successful discussions with the Annex subcommittees, the GLAM Committee will seek a spot on the June 2017 GLEC agenda to present their findings and provide useful insight as to how a binational adaptive management process is being applied from a water quantity perspective and potential areas for sharing information and lessons learned related to water quality and the principles of adaptive management outlined in the 2012 GLWQA. The desired outcome of the GLAM Committee’s presentation to the GLEC is to introduce the work of the GLAM Committee and make GLEC aware of collaborative efforts being forged within the Annex sub-committees to share research, information and experiences across the water quantity and water quality boards/committees as well as to share concepts and lessons learned related to implementing a binational adaptive management approach.

**Product:**

- Ongoing GLAM co-chair participation in meetings of the IJC’s WQB and SAB.
- Interaction with GLWQA annexes to further potential common objectives.
- Potential update as part of June 2017 GLEC agenda to introduce GLAM and illustrate common interests between the GLAM and the Annexes.

**FY17-3.7: Develop and initiate an engagement plan for advisory networks**

In the future, it will be important to engage partner agency representatives, key stakeholders, and academic advisory groups. The GLAM Committee initiated discussions on how to engage these external groups as part FY2016 work plan activities (Task 6.2). There will be a range of engagement requirements by each of the individual GLAM working groups and the committee as a whole will need to provide some oversight as to how to make these engagement processes work in keeping with the GLAM Communication, Outreach, and Engagement strategy and requirements of the various Boards and the IJC. The strategy will build upon the Communications, Outreach and Engagement Strategy by providing details of how and when the GLAM Committee should/could engage with each network and what mechanisms it will use to reach out to the various representatives and how they will be engaged. The GLAM Committee will seek Board input on the proposal and/or approval from the Boards as appropriate.

**Product:**

- Proposed engagement strategy of GLAM advisory networks.

**Work Plan Table**

<b>SECTION A: Plan Review and Evaluation</b>				
<b>Tier 1: Foundational Analyses</b>				
Hydroclimate Working Group				
<b>Task</b>	<b>Task Title</b>	<b>Proposed Products</b>	<b>Resources</b>	<b>Estimated Delivery</b>
FY17-1.1	Establish and test processes for performing annual, routine foundational analyses required for hydroclimate assessments	1) Summary document outlining processes for tier 1 annual hydroclimate foundational analyses. 2) Brief year-end report outlining results for tier 1 hydroclimate analysis activities and implications for future processes. 3) A list of potential priorities for FY2018	In-kind	Sept-17
Stakeholder Assessment Working Group				
FY17-1.2	Establish and test processes for performing routine assessments required for understanding baseline conditions and benefits of observed water levels and flows	1) Summary document outlining processes for tier 1 annual performance indicator foundational analyses. 2) Brief year-end report outlining results for tier 1 performance indicator analysis activities and implications for future processes. 3) A list of potential priorities for FY2018	In-kind	Sept-17
Plan Review and Evaluation Working Group				
FY17-1.3	Establish and test processes for performing annual, routine foundational analyses required for ongoing evaluations of existing regulation plan performance	1) Summary document outlining processes for tier 1 annual plan review and evaluation foundational analyses. 2) Brief year-end report outlining results for tier 1 plan review and evaluation analysis activities and implications for future processes. 3) A list of potential priorities for FY2018	In-kind	Sept-17

<b>SECTION A: Plan Review and Evaluation</b>				
<b>Tier 2: Exploratory Investigations</b>				
Hydroclimate Working Group				
<b>Task</b>	<b>Task Title</b>	<b>Proposed Products</b>	<b>Resources</b>	<b>Estimated Delivery</b>
FY17-2.1	Extended CaPA and GEM hindcasts of water supply components in the Great Lakes basin and Canada-US transboundary watersheds	1)Detailed analysis of the quality of the hindcast over a two year period; 2)Gridded GEM and CaPA data for a 5-year period; 3)Report summarizing project methods and results.	IWI	Mar-17
FY17-2.2	Development of a statistical model to close the water balance of the Great Lakes	1) Monthly time-series data set of runoff, over-lake evaporation, over-lake precipitation, and connecting channel flow component supplies for each lake back to approximately 1950. 2) Summary report outlining project process, description of statistical model, stakeholder input, results and implications, and possible future application.	IWI	Sept-17
Stakeholder Assessment Working Group				
FY17-2.3	Evaluate Meadow Marsh Algorithm	1) An excel based modelling tool that incorporates recent observed wetland monitoring data and allows for an assessment under actual water level conditions compared to expected performance indicator results from existing planning models used in LOSLR. 2) Transfer of expertise on the evaluation tools from contractors to government agencies.	In-kind and IWI	Dec-16
FY17-2.4	Monitoring of Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – site surveys	1)Summary report outlining field sampling methods, sites and results for wetland site survey analysis	IWI	Oct-17
FY17-2.5	Monitoring of Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – Imagery	1)Summary report outlining field sampling methods, sites and results for wetland imagery analysis.	IWI	Oct-17
FY17-2.6	Lower St. Lawrence River IERM code update	1)An updated Lower St. Lawrence River IERM2D model.	IWI	Mar-17
FY17-2.7	FEPS model - update based on shore protection information (PI verification)	1)Summary report outlining comparison of FEPS model results using the baseline model assumption and the site specific structure information (field surveys).	In-Kind	Dec-16

**GLAM Committee Annual Work Plan for 2017**

Created/updated 02/12/16

<b>Task</b>	<b>Task Title</b>	<b>Proposed Products</b>	<b>Resources</b>	<b>Estimated Delivery</b>
FY17-2.8	Detailed scoping of requirements for developing an ecohydraulics model of the St. Marys River and prototype application to the St. Marys Rapids area	1) Scoping requirements for an IERM2D model for St. Marys Rapids. 2) Prototype IERM2D model for the St. Marys Rapids illustrating potential application and associated documentation.	In-kind and IWI	July-17
FY17-2.9	Baseline Common Reed (Phragmites) work on Lake Ontario (CWS)	1)GIS delineations of Common Reed extent within select Lake Ontario coastal wetlands on the Canadian shoreline. 2)A final project report summarizing methods and key results.	IWI	Mar-17
FY17-2.10	Develop PI prioritization process to guide future performance indicator update efforts (integrated outcomes of Tier 1 testing)	1)Strategy (process) and criteria for prioritizing future performance indicator work.	In-Kind	June-17
<b>Plan Review and Evaluation Working Group</b>				
FY17-2.11	Routing model update	1)Model code. 2)Final summary report including executive summary and lessons learned.	IWI	Mar-17
FY17-2.12	St. Marys River – Review impacts of reductions in maximum side channel capacity	1)Report on varying hydropower plant capacity due to hydrologic conditions. 2)Evaluation and initial report on impacts and potential strategies to address reductions in hydropower capacity.	In-kind	Mar-17
FY17-2.13	St. Marys River – Review multiple partially open gate settings at the Compensating Works	1)Initial report on benefits/disadvantages to stakeholders of partially open gate settings. 2)Initial joint report with Superior Board on partially open gate setting flow relationships for operational implementation and incorporation into CGLRRM.	In-kind	Mar-17
<b>SECTION B: GLAM Oversight and Administration</b>				
FY17-3.1	GLAM Committee Coordination, Management, and Reporting	1)Annual work plan for FY 2018 for submission to the Boards. 2)semi-annual progress reports for submission to the Boards in March 2017 and September 2017.	In-kind	Sept-17
FY17-3.2	Monitoring of Work Plan Delivery	1)task descriptions and periodic updates on progress that contribute to semi-annual reporting.	In-kind	Sept-17

**GLAM Committee Annual Work Plan for 2017**

Created/updated 02/12/16

<b>Task</b>	<b>Task Title</b>	<b>Proposed Products</b>	<b>Resources</b>	<b>Estimated Delivery</b>
FY17-3.3	Finalize mid-term strategic plan	1)A finalized mid-term strategic plan that incorporates Board input.	In-kind	Jan-17
FY17-3.4	Prepare first GLAM triennial progress report	1)Finalized GLAM Triennial Progress Report for January 2017.	In-kind	Jan-17
FY17-3.5	Business analysis of future GLAM information management needs	1)Business analysis of GLAM IM/IT opportunities and needs within the context of available IJC IM/IT resources and capacity.	In-kind	Sept-17
FY17-3.6	Maintain engagement with GLWQA activities	1)Ongoing GLAM co-chair participation in meetings of the IJC’s WQB and SAB. 2)Interaction with GLWQA annexes to further potential common objectives. 3)Potential update as part of June 2017 GLEC agenda to introduce GLAM and illustrate common interests between the GLAM and the Annexes.	In-kind	Sept-17
FY17-3.7	Develop and initiate an engagement plan for advisory networks	1)Proposed engagement strategy of GLAM advisory networks.	In-kind	June-17

The work plan outlined above represents an ambitious set of products for the FY 2017. The work plan items are but a few of the key priorities chosen from an extended list by the GLAM Committee. A few additional items are identified below. Along with a number of the projects identified in the work plan, the items listed may be considered as candidates for possible submission to the IJC under IWI either in the Fall 2016 or Spring 2017 sessions to acquire additional resources. The estimated resource requirements for these projects are currently being assessed and the decision on whether to submit will depend on the GLAM’s ability to add on these extra tasks without sacrificing other FY 2017 work plan commitments.

**POSSIBLE IWI SUBMISSIONS (See Appendix for Full Description)**

<b>Task</b>	<b>Proposed Task</b>	<b>Proposed Products</b>	<b>Estimated Delivery</b>
<b>Hydroclimate Working Group</b>			
FY17-A1	Process existing over-lake evaporation data for select monitoring sites	<ul style="list-style-type: none"> <li>- Data processing QA/QC tools for evaporation station monitoring</li> <li>- Develop buoy and ship-borne platform correction tools for evaporation monitoring</li> <li>- Apply developed tools to most recent monitoring data, as a test, and produce an initial manuscript draft</li> </ul>	TBD
<b>Stakeholder Assessment Working Group</b>			
FY17-A2	Initiate development of combined LOSLR and IUGLS commercial navigation models	<ul style="list-style-type: none"> <li>- Scoping and design requirements for the development of a combined LOSLR and IUGLS commercial navigation performance indicator model</li> </ul>	TBD



## Work Plan Prerequisites and External Dependencies

Prerequisites required to ensure the success of this work plan include the on-going annual support of the agencies represented on the GLAM Committee along with additional staff support as identified by those agencies. It also assumes that funding from the IJC to support a number of IWI-endorsed projects will be forthcoming and that a base level of funding from the IJC will also be made available. The priorities set within this work plan assumed the current regulation plans including Lake Superior Plan 2012 and Plan 1958 DD regulating the outflows of Lake Ontario remained in place. Should the IJC’s recommended Plan 2014 be implemented within the fiscal year, this could have implications for the work priorities established. The work plan might also be affected by water level conditions should any of the lakes move into extreme conditions within the year, and this could alter the prioritization and/or addition of new tasks.

As this is an on-going effort, the priorities set and commitments made are estimates based on what the committee understands to be the resources available. The expertise available through the partner agencies is still being evaluated relative to the priorities identified. There may in fact be a need to readjust proposed products depending on the expertise required and available to complete the task. These assessments will occur throughout the year as the work plan progresses. Should the GLAM Committee determine that they are not able to deliver on any of the products identified, they will notify the Boards through the Board secretaries.

## Revision History

**Date of next revision:**

<b>Revision Date</b>	<b>Previous Revision Date</b>	<b>Summary of Changes</b>	<b>Changes Marked</b>
Sept 23/16	Sept 8/16	Updated tier 1 tasks to reflect GLAM discussion at Quebec City meeting on September 13 and 14, 2016	Yes
Oct 7/16	Sept 23/16	Addressed remaining comments identified by committee and board members	No

## APPENDIX – Additional Work Items Considered

The following tasks have been identified as priorities, but are beyond the resources currently available. These items are currently viewed as possible candidates to submit for IJC funding under the IWI. These are presented by category and not in order of priority.

### **FY17-A1. Process existing over-lake evaporation data for select monitoring sites**

Over-lake evaporation is a critical component required to accurately estimate Net Basin Supplies in the Great Lakes, yet there are few sources of measured evaporation for the over-lake areas. During IUGLS, a few over-lake eddy covariance evaporation monitoring stations were established to measure over-lake evaporation. Many of these stations have remained operational since the end of IUGLS through research grants and other means. Processing of the data and appropriate QA/QC activities remain a challenge and have resulted in a delay in finalizing annual evaporation estimates. As well, new buoy and ship-borne installations are being tested which require additional QA/QC procedures. This project would focus on developing and testing more refined QA/QC tools and procedures to improve the efficiency of moving the raw monitoring data to a final reporting product.

#### **Products:**

- Data processing QA/QC tools for evaporation station monitoring
- Develop buoy and ship-borne platform correction tools for evaporation monitoring
- Apply developed tools to most recent monitoring data, as a test, and produce an initial manuscript draft

### **FY17-A2. Initiate development of combined LOSLR and IUGLS commercial navigation models**

Commercial navigation models were developed for both the LOSLR Study and IUGLS to assess potential impacts to commercial navigation outcomes under changing climate and water level management scenarios. The two studies occurred independently and the associated models were developed using differing techniques. Moving forward, there is a need to update some of the model assumptions and consider the option of developing an integrated commercial navigation model that includes both Lake Ontario and the St. Lawrence River system along with the upper Great Lakes. This task would initiate some of the thinking around the opportunities and issues that require consideration in developing such a model.

#### **Products:**

- Scoping and design requirements for the development of a combined LOSLR and IUGLS commercial navigation performance indicator model