
Great Lakes-St. Lawrence River Adaptive Management Committee (GLAM)

4th Semi-Annual Progress Report to the Great Lakes Boards and the
International Joint Commission
Covering the period September 1, 2017 to February 28, 2018

April 9, 2018



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Cover photo: Top Left - Evaporation over Hamilton Harbour (Lake Ontario) in December 2017 (photo: Sean Mclean, Environment and Climate Change Canada). Middle Right – Flooded shrub vegetation during Lake Ontario wetland field monitoring, September 2017 (photo: Canadian Wildlife Service, Environment and Climate Change Canada). Bottom – Marina in Gananoque on May 7, 2017 (left) and November 22, 2017 (right) (photo: David Fay, International Joint Commission)

GLAM Committee Membership

Blue text identifies other International Joint Commission Board and Committee affiliations

United States	Canada
<p>Arun Heer, Co-Chair U.S. Army Corps of Engineers – Great Lakes and Ohio River Division U.S. Secretary, International Lake Ontario – St. Lawrence River Board, International Lake Superior Board of Control</p>	<p>Wendy Leger, Co-Chair Environment and Climate Change Canada</p>
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NOTE: The Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee was established by the International Joint Commission (IJC) and is comprised of an equal number of members from the United States and Canada. Members of the Committee serve at the pleasure of the IJC and are expected to be full participants in all activities of the Committee. As with all IJC Boards and Committees, the GLAM Committee members serve in their personal and professional capacity, not as a representative of their agencies or employers.

Executive Summary

The International Joint Commission (IJC) established the Great Lakes – St. Lawrence Adaptive Management (GLAM) Committee through an IJC directive on January 16, 2015, to provide monitoring and evaluation of regulation plans in support of the three Great Lakes-St. Lawrence River Water Management Boards (Boards). This report is the fourth semi-annual report to the IJC and the Boards.

The committee's annual work plans cover the period of October 1 through to September 31st of each year. As a result, the September 1, 2017 through February 28, 2018 reporting period for this semi-annual focuses on activities initiated to support the 2018 work plan with some highlights covering 2017 work plan items wrapped up in September 2017. Both the 2017 and 2018 work plans have a similar structure and were prepared to align with the GLAM Committee's preliminary strategic framework which separates activities into two broad categories. The Plan Review and Evaluation category represents the primary hydroclimate, impact assessment, and plan review functions of the committee while the Oversight and Administration category covers the overarching functions required to keep the committee on track.

Over the reporting period, the GLAM Committee has been particularly focused on preparing an annual report covering 2017. This annual summary is considered a baseline activity intended to document annual highlights from each year as they relate water level regulation within the Great Lakes – St. Lawrence River basin. This includes a summary of water level and outflow management from Lake Superior under Plan 2012 and from Lake Ontario under Plan 2014. It also includes a summary of hydroclimate conditions, and water level impacts observed throughout the year as well as preliminary plan review testing to better understand the role of water level regulation in the observed outcomes. Given the exceptional water level conditions in Lake Ontario and the St. Lawrence River in 2017, this first annual report has been particularly challenging and resource intensive for the Committee. It is expected that the baseline annual report development will become more routine in future years. In addition to the annual report development, the GLAM Committee has continued to support a number of targeted studies to validate and improve performance indicators used to compare regulation strategies and continue developing the basic hydroclimate information needed to test the robustness of regulation plan options. Many of these activities are interim steps that represent critical pieces of long-term efforts to meet the GLAM Directive.

The GLAM Committee continues to rely heavily on in-kind agency contributions to support its ongoing activities and has also benefited greatly from direct support through the International Watersheds Initiative (IWI) for a number of targeted, binational projects identified in its work plans. Despite these resources, the committee has been challenged over the reporting period to adequately meet all its objectives. Many committee members and technical support staff also play operational roles with the various Great Lakes boards and with above average water levels throughout the system, their attention has necessarily been on operational

requirements. Every effort is being made to meet all obligations given existing resource limitations.

1.0 Introduction

A directive signed January 16, 2015 by the International Joint Commission (IJC) established the Great Lakes – St. Lawrence Adaptive Management (GLAM) Committee to undertake monitoring and assessment of Lake Superior, and Lake Ontario-St. Lawrence River Boards’ regulation plans and Niagara River Board activities, as well as coordinate with the Water Quality and Science Advisory Boards on issues of common interest. The GLAM Committee (committee) is comprised of a Canadian and U.S. co-chair, as well as members from government agencies, the Great Lakes Water Management Boards (Boards), and technical experts. The committee is supported on an on-going basis by an appointed Canadian and U.S. secretary.

The overall objective of the GLAM Committee is to provide information to the Boards and the IJC while advising them on the effects that the control structures approved in the IJC’s Orders of Approval and directives have on levels and flows in boundary waters. GLAM also captures the benefits and impacts that the regulation plans have on the affected interests and communicates this to the Boards and the IJC. This includes the on-going review and evaluation of regulation plans related to:

- a) the effectiveness of the existing regulation plans;
- b) examining how the system may be changing over time and whether any modifications to the regulation plan(s) may be warranted; 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 GLAM Committee was initiated to establish a structured, iterative process of robust evaluation in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring and feedback to the decision-making framework based on knowledge gained.

This fourth semi-annual report will highlight GLAM Committee progress and accomplishments for the reporting period of September 1, 2017 to February 28, 2018.

2.0 Work Plan Progress

The GLAM Committee’s annual work plans cover the October 1 to September 30 time period, consistent with the U.S. fiscal year. This semi-annual report includes a few items from the Fiscal Year 2017 (FY17) work plan (starting October 1, 2016) as well as activities carried-over or initiated under the Fiscal Year 2018 (FY18) work plan starting October 1, 2017. The GLAM Committee’s FY18 work plan was approved by the Boards and further endorsed by the IJC in October 2017.

The core technical work within the Plan Review and Evaluation Section is organized using a three-tiered framework including:

Tier 1 baseline foundational analyses;

Tier 2 exploratory investigations; and
Tier 3 strategic improvement studies.

Only tier 1 and 2 activities are included in the FY17 and FY18 work plans. The second section of the work plans deal with overarching oversight and administration components.

GLAM Committee activities are supported in large part by in-kind agency contributions as well as project specific support through the International Watersheds Initiative (IWI). Through these resources, considerable progress was made during the reporting period towards completing tasks from the FY17 work plan and initiating tasks from the FY18 work plan. Highlights of progress are discussed below and task-specific details of FY18 work plan items and select FY17 items provided in *Appendix A*.

2.1 Plan review and evaluation

The technical work of the GLAM Committee covered in the FY17 and FY18 work plans is separated into tier 1 and tier 2 activities. Tier 1 activities are focused on the development of an annual report framework to summarize critical hydroclimate, impact assessment, and plan review observations gleaned from observed yearly conditions throughout the system. Tier 2 activities are considered targeted studies to support long-term efforts to develop and maintain tools and capacity to review and evaluate existing regulation plans and potentially test alternatives. These activities are led by separate hydroclimate, impact assessment, and plan review working groups and progress on specific tasks is outlined in the following sub-sections.

2.1.1 Tier 1 Activities

As outlined in the FY18 work plan, the primary tier 1 objective is to undertake an annual review of 2017 conditions related to regulation plan operations and performance for reporting to the Boards and the IJC. This review includes a hydroclimate component, impact assessment component, and plan review component. Such reviews are expected to be undertaken annually, although particular priority and added emphasis is being assigned to the current review due to the extreme conditions observed in 2017 in the Lake Ontario – St. Lawrence River system.

The primary product from the Tier 1 analysis will be a draft GLAM Committee Annual Report for calendar year 2017 on what occurred over the past year and lessons learned. A preliminary draft of the Tier 1 analysis for the Lake Ontario – St. Lawrence system is being prepared with input from the Hydroclimate, Impact Assessment, and Plan Review Working Groups and will be provided to the International Superior Board and the International Lake Ontario – St. Lawrence River Board ahead of their March meetings. The draft is considered preliminary, with the final version expected for September 2018. As this is the first attempt at an annual report, the committee will discuss the process with the Boards at their March meetings, seek concurrence on overall direction, and allow opportunity for feedback from the Boards. Not all pieces of the

annual report will be available for the first draft, but the document will illustrate the overall direction of the committee.

To date, efforts have been made related to the Hydroclimate, Impact Assessment, and Plan Review sections. The Hydroclimate team has been focusing on 2017 conditions in the Lake Ontario and the St. Lawrence River basin as well as some information for the upper Great Lakes. There has been considerable coordination with the regulation representative offices in Cornwall, Buffalo, and Detroit, as well as with hydroclimate experts associated with the Coordinating Committee on Great Lakes Basic Hydrologic and Hydraulic Data. These coordination efforts are ongoing and will supplement the preliminary draft materials ahead of finalization in September 2018.

The Impact Assessment activities have been quite varied, relying on a series of ongoing activities including a review of media reports and direct discussions with key stakeholders. For some impact categories, key stakeholders are well represented through the operations activities of the boards and the initial draft material is considered a good representation of 2017 impacts and outcomes. In other cases, the stakeholder communities are much more varied and it is more challenging to represent the range of outcomes experienced. It was recognized going into the annual report development that the GLAM Committee would be relying on information gathered by external agencies in many cases. Work on the annual report throughout the reporting period has illustrated the challenges of relying on this external information. In a number of cases, the agencies or groups responsible for the information have not yet released summaries for public use leaving some gaps in the draft materials being prepared by the committee. It is hoped that some of these gaps can still be filled by the final September version of the document, in part by targeted projects being initiated by the GLAM Committee through Tier 2 activities discussed later in this update.

Finally, the Plan Review Working Group has made good progress on their Tier 1 reporting. Their efforts include sensitivity analysis to better understand and differentiate between the many factors that led to 2017 high levels. Such an analysis will allow the committee to further evaluate and study contributing factors, including how they compare to historical values used in plan development, whether the system is changing, and whether there is a need to adapt to these changes. Preliminary simulations have been undertaken as examples for the boards to illustrate the types of testing that is expected to occur over the coming months in support of the for the final Annual Report, both for Lake Ontario – St. Lawrence River and for Lake Superior outflows. However, the Plan Review Working Group has been challenged by the fact that many of the members and technical support staff also provide direct operational support to the boards. Given active winter operation conditions throughout the system, attention has rightfully been on immediate operational requirements as opposed to longer-term GLAM components. Despite these challenges, preliminary material will be available for board review and discussion at their March 2018 meetings.

2.1.2 Tier 2 hydroclimate activities

The FY18 work plan includes two Tier 2 hydroclimate tasks, both of which were supported through the IWI. Both projects support the GLAM Committee's longer-term requirement in the Directive to consider whether future water supplies will be different from those used to test the current management of water levels and flows.

The first project is led by Dr. Fortin of Environment and Climate Change Canada and continues a multi-year effort to improve understanding of water supply components and particularly over-lake precipitation in transboundary watersheds including the Great Lakes basin. During the reporting period, Dr. Fortin and his team continued their efforts to evaluate an initial 5-year hindcast dataset for water balance components in the Great Lakes and prepare documentation to allow a full simulation of the 30 year hindcast dataset using existing Environment and Climate Change Canada supercomputer resources later in 2018. This long-term project is an important activity supporting improved hydroclimate science in the Great Lakes Basin as better estimates of historical net basin supplies will allow a better understanding of variability and improve the GLAM Committee's ability to test regulation plan robustness.

A related, but distinct, component of the IWI project is further development of precipitation anomaly datasets for the Great Lakes basin based on Canadian Precipitation Analysis (CaPA) and US National Weather Service Multi Precipitation Estimates (MPE) products which include overlake precipitation. Progress on this aspect of the project has been limited during the reporting period due to ongoing US contracting procedures that must be finalized prior to that part of the work being initiated.

The second Tier 2 hydroclimate work plan item was the finalization of a project led by Dr. Gronewold from the Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration. Dr. Gronewold and his team developed a statistical water balance model for the Great Lakes basin which allows a better understanding of uncertainty in various water balance components which extends datasets back to 1950. A project report was prepared and a presentation given to a number of GLAM Committee members and members of the Coordinating Committee on Hydrologic and Hydraulic Data on December 8th, 2017. Final versions of the reports and materials will be available by the end of March, 2018. Efforts are underway to work with the experimental model products and test how they can be operationalized and ultimately wrapped into annual reporting of the GLAM Committee.

2.1.3 Tier 2 impact assessment activities

The impact assessment activities focus on ensuring that the outcomes of water level and flow scenarios affecting the various interests are measurable and assessable. More specifically, they support the GLAM Committee in understanding how accurately the impacts on these groups are represented by current data and models used in evaluating the management of levels and flows and whether conditions of the system are changing over time. Given the extreme water

levels in 2017, particularly in the Lake Ontario – St. Lawrence River system, the Impact Assessment Working Group has continued or initiated a number of targeted efforts to improve impact understanding.

The Impact Assessment Working Group undertakes monthly coordination conference calls to discuss progress and re-prioritize efforts as necessary. While the focus has largely been on preparing material for the Tier 1 annual report, a number of stand-alone projects are also underway that will either directly support the finalization of the Annual Report in September or provide information related to long-term GLAM efforts to review regulation plan performance. The Tier 2 impact assessment tasks were separated into Lake Ontario – St. Lawrence River ecosystem, Lake Ontario – St. Lawrence River socio-economic, and upper Great Lakes activities.

Lake Ontario – St. Lawrence River Ecosystem Activities:

The Lake Ontario – St. Lawrence River ecosystem activities focus on various efforts to monitor wetland conditions on Lake Ontario and the upper St. Lawrence River and identify ways to validate existing models. A number of monitoring efforts initiated in the FY17 work plan continued during the reporting period including three separate IWI supported projects. Field monitoring of wetland plant vegetation was undertaken at sites on the Canadian and U.S. shoreline of Lake Ontario in late summer 2017, a critically important activity given high water levels in 2017. The monitoring data was being processed during the reporting period with individual project reports expected by the end of March, 2018. A further IWI project involved collection and interpretation of orthophotos for select US sites to identify vegetation extent within select wetlands and support change detection. That project complements a similar work plan item being led by the Ontario Ministry of Natural Resources and Forestry for imagery analysis at wetland sites on the Canadian shoreline. The Ontario Ministry of Natural Resources and Forestry project is still ongoing. The GLAM Committee also initiated an IWI supported project to develop a state of science assessment of remote sensing technologies to support wetland monitoring, particularly related to the meadow marsh community. The project was a recommendation emerging from a wetlands experts workshop hosted in April 2017. A contractor has been hired and will be developing a draft report by late March at which time further input will be sought from external experts before a revised document is prepared for the GLAM Committee in May 2018. All these wetland monitoring items will support further validation of the wetland performance indicator from the LOSLRS, which has been put on hold until the 2017 monitoring data is available in April 2018.

The FY18 work plan includes a number of Tier 2 socio-economic impact assessment tasks for the Lake Ontario – St. Lawrence River System. All the tasks support the gathering of information to assess impacts as they related to existing performance indicators. Two projects in particular were emphasized over the reporting period. The first project involved the development of a questionnaire for shoreline property owners within the Province of Ontario. The project was led by staff at Conservation Ontario who helped develop and then host the online, self-reporting questionnaire as well as promote the survey through their networks. Conservation Ontario completed their contract requirements at the end of February, 2018 with a summary report

provided to the IJC. In total, Conservation Ontario reports 472 total questionnaire responses of which 241 were completed (i.e. made it to the end of the questionnaire) and an additional 56 partially completed (i.e. completed some part of the questionnaire) for the shoreline within the Province of Ontario. GLAM will be reviewing the information and integrating preliminary pieces into its 2017 annual report. While not a part of the original contract, GLAM Committee staff worked with Conservation Ontario to modify the survey slightly and make it available to all shoreline property owners including those in New York and Quebec. The GLAM Committee worked with IJC Communications staff to promote the survey in these areas. The data for these areas has been submitted to the IJC and the GLAM Committee is currently working out the details of how this data will be analyzed for later inclusion into the annual report.

GLAM technical sub-group members have also been working on reviewing aerial and oblique imagery acquired during high water conditions in 2017. Figure 1 shows an example from the Oshawa, Ontario area on June 8th, 2017 where bluff erosion and damage to a shoreline trail is visible. Preliminary results are included in the draft annual report and further verification and review will occur prior to the September submission of the final report.



Figure 1: Example of shoreline erosion and impacts to trail in Ajax Ontario (Photo Source: Transport Canada National Aerial Surveillance Program, June 8th, 2017)

The GLAM Committee was also conditionally approved for three socio-economic impact tasks through the IWI process as of January 11, 2018. Since that time, efforts have been underway to respond to conditions and develop more details scopes to initial the projects. These projects related to a review of shore protection structures that had previously been surveyed to determine how they responded to record high water levels in 2017 as well as gathering information related to marina and recreational boating impacts and municipal water supply impacts in 2017.

For Lake Superior, the FY18 work plan includes four Tier 2 impact assessment tasks. A project proposal was submitted to the IWI to support further data collection that will support improvements to the IERM2D model that was recently developed for the St. Marys Rapids. The proposal was conditionally approved in January 11, 2018 and staff from USACE Detroit are working on responding to identified conditions. The other three tasks all relate to furthering the understanding of ecosystem and flood vulnerability in the St. Marys Rapids area. These tasks are targeted for completion in September 2018.

2.1.4 Tier 2 plan review working group

The Plan Review group has been leading a number of simulations related to Lake Ontario – St. Lawrence River and Lake Superior outflow management that will be integrated into the 2017 annual report. These efforts, along with operational activities in support of the Boards, have been the priority for members of the Plan Review working group. The FY18 work plan included two specific tasks related to the management of Lake Superior outflows including a look at gate settings and reductions in maximum side channel capacity. While these are still important, they have not been a priority over the reporting period due to the continued requirement for Board support. Some related information will be included in the draft 2017 annual report but a more fulsome assessment will not occur until there are further improvements to St. Marys River performance indicators. For Lake Ontario and the St. Lawrence River the focus of the Plan Review group was in supporting tier 1 annual plan reviews including an intensive week-by-week (and at times, day-by-day) review of hydrologic conditions and potential outflow strategies, and then simulation of variations in these factors. This review will feed into longer-term assessments and should help highlight some areas for further consideration and testing in terms of on-going plan evaluation.

2.2 Oversight and administration

Activities within the Oversight and Administration category include the overarching functions required to keep the committee on track. This includes ongoing secretariat functions and reporting, communications and engagement, and information management. The GLAM Committee has started holding regular monthly conference calls to update members and discuss relevant items. This has been particularly important during the reporting period given the focus on developing the draft annual report for 2017, the first such report prepared by the committee. Committee members have been involved in many aspects of the report development, including ongoing discussion about how the upper Great Lakes and Lake Ontario – St. Lawrence River components will be coordinated. The committee also held a face-to-face technical meeting on February 7 and 8, 2018 in Burlington, Ontario. The primary focus of the meeting was discussion on the draft annual report with a secondary focus on engagement activities.

In recent months, the committee has been further focusing efforts related to engagement activities, particularly the concept of Circles of Influence. The committee has been developing a

scoping document to better define how a Circles of Influence approach could support its work and mandate in the context of the broader communications and engagement strategy. The proposal will be discussed with the boards at the upcoming March meetings and pending approval, will guide engagement efforts related to the draft annual report over the late spring and summer months.

In addition to the development of a Circles of Influence strategy, committee co-chairs and secretaries continue to participate as part of the International Lake Ontario – St. Lawrence River Board’s communications committee. This has proved valuable in ensuring coordination on items of common interest. For example, the Canadian co-chair and secretary and regulation representatives for the International Lake Ontario – St. Lawrence River Board have given a number of invited presentations during the reporting period related to high water level conditions in 2017. The GLAM Committee has taken those opportunities to promote the work of the committee by including a number of slides discussing the committee, its objectives, and how we are looking for information related to water level impacts to improve existing models. Presentations were given at a variety of events and locations (Table 1, with GLAM member/participants highlighted). In all cases, board and/or GLAM representatives were invited to participate. Finally, the GLAM committee co-chairs continue to stay connected with both the Water Quality Board and the Science Advisory Board through IJC sponsored co-chair meetings.

Date	Event	Participants
September 21, 2017	Ontario Provincial Flood Forecasting and Warning Committee	<u>Mike Shantz</u> , <i>Genevieve Bechard</i> , <u>Jacob Bruxer</u>
October 4, 2017	St. Lawrence River Institute of Environmental Sciences	<u>Rob Caldwell</u>
October 17, 2017	Recreational Boating Advisory Council – Bolton	<u>Wendy Leger</u> , <i>Gail Faveri</i>
October 18, 2017	Emergency Managers – Belleville, ON	<u>Wendy Leger</u> , <i>Gail Faveri</i>
November 2, 2017	Hamilton Conservation Authority – Hamilton ON	<i>Gail Faveri</i> , <u>Mike Shantz</u>
November 6, 2017	Cataraqui Region Conservation Authority – Flooding Preparation and Response Workshop – Lansdowne, ON	<u>Jacob Bruxer</u> , <u>Rob Caldwell</u>
November 6, 2017	Brighton Town Council Meeting (Public Meeting) – Brighton, ON	<u>Wendy Leger</u> , <u>Jacob Bruxer</u> , <u>Rob Caldwell</u>
November 16, 2017	Gibraltar Point / Toronto Islands Flooding public meeting – Toronto, ON	<u>Mike Shantz</u> , <u>Wendy Leger</u>
November 22, 2017	Quinte West Public Meeting – Trenton, ON	<u>Wendy Leger</u> , <u>Jacob Bruxer</u> , <u>Rob Caldwell</u>
November 30, 2017	Picton Town Council – Picton, ON	<u>Jacob Bruxer</u> , <u>Rob Caldwell</u>
January 8, 2018	Oakville City Staff – Oakville, ON	<u>Wendy Leger</u> , <i>Gail Faveri</i>
February 21, 2018	Bowmanville Public Meeting, Bowmanville, ON	<u>Jacob Bruxer</u> , <u>Wendy Leger</u>

Table 1: GLAM participation in Board presentations related to Lake Ontario - St. Lawrence River high water levels (GLAM members/representatives are underlined, board members/representatives italicized, and members/representatives of both are underlined and italicized)

3.0 Upcoming International Watersheds Initiative projects

As in previous years, the GLAM Committee’s FY18 work plan was developed relying primarily on available agency in-kind staff contributions at the time the work plan was developed. However, given the significant water levels observed in 2017, a number of additional tasks were identified in the work plan as ones that could not be completed with in-kind resources but were considered critical to the work of the committee. The committee submitted five proposals through the fall IWI process and received conditional approval for four of the projects in January 11, 2018. These projects included support for a review of Lake Ontario shore protection structures that had previously been surveyed prior to 2017 high water conditions, further data collection in the St. Marys River to support refinement of ecological models developed in 2017, and two related projects looking at collecting impact information from marina and yacht club owners as well as municipal water supply operators. Committee members continue efforts to respond to IJC conditions and develop more details projects scopes to support contracting efforts.

In addition to the recent IWI proposals, a number of previously approved IWI projects remain ongoing. Two US monitoring efforts for Lake Ontario wetlands are nearing completion, with deliverables expected in the coming months. Two US hydroclimate projects are also being undertaken. The first project related to developing a statistical model to help close the water balance of the Great Lakes was completed in December 2017 and a related project to update the Coordinated Great Lakes Regulation and Routing model is ongoing. A combined Canadian/US hydroclimate project to develop an updated hindcast of water balance components is being pursued and Canadian products for this year are expected by March 31, 2017. Funding for the US portion of that project is still being arranged through the US Section of the IJC. Finally, a contract has been initiated to develop a state of science assessment related to remote sensing to support wetland monitoring with the final product expected by the committee in May 2018. Table 2 identifies all current IWI projects including ones that are active, ones that were completed during the reporting period, and ones that have been conditionally approved.

IWI Project Code	Source	Project Title	Project Status
AM-04-2015	US	Closing the water balance of the Great Lakes: developing a new historical record of reconciling bias and uncertainty	Agreement in place. Final project materials delivered in December 2018
AM-05-2015	US	Programming support for update of Coordinated Great Lakes Regulation and Routing Model	Agreement in place. Will conclude as part of FY18 work plan.
AM-06-2015	US	Monitoring of Lake Ontario - St. Lawrence River coastal wetland habitat in support of adaptive management (US	Agreement in place. Will conclude as part of FY18 work plan.

		shoreline)	
AM-07-2015	US	Monitoring the extent of wetland types in the Lake Ontario - St. Lawrence River coastal system in support of adaptive management (US shoreline)	Agreement in place. Will conclude as part of FY18 work plan.
AM-01-2017	CAN/ US	Extended hindcast of Water Supply Components over Canada/U.S. Transboundary Watersheds based on the CaPA, CaLDAS and GEM systems and coordination with NWS Multi-Precipitation Estimates (MPE)	Agreement partially in place. Continue to pursue finalization of U.S. component.
AM-02-2017	CAN	Monitoring of Lake Ontario coastal wetland habitat in support of adaptive management	Complete
AM-03-2017	CAN	State of Science Assessment of Remote Sensing for Great Lakes Coastal Wetlands	Agreement in place. Work is ongoing and expected to be completed in May.
AM-04-2017	CAN	Survey of Impacts of High Water Levels in 2017 on Lake Ontario – St. Lawrence River Municipal and Industrial Water Uses	Conditionally approved as of January 11, 2018
AM-06-2017	CAN	Survey of Impacts of High Water Levels in 2017 on Lake Ontario – St. Lawrence River Marinas and Yacht Clubs	Conditionally approved as of January 11, 2018
AM-07-2017	US	Shore Protection Structure Condition Assessment Following 2017 High Water Levels on Lake Ontario	Conditionally approved as of January 11, 2018
AM-08-2017	US	Substrate Classification of St Mary’s River to Support Future Ecosystem Modeling	Conditionally approved as of January 11, 2018

Table 2: Summary of IWI projects related to GLAM activities

4.0 Funding and Resourcing

The GLAM Committee continues to appreciate the funding contributions of the IJC through the IWI program to support specific work plan tasks. These resources leverage considerable in-kind contributions from supporting agencies, including those represented through members of the GLAM Committee as identified on page 3 of this report and allow the committee to pursue a wide range of initiatives to help deliver on its directive.

The committee makes every effort to design its annual work plans based on the resource availability expected for that year recognizing that the in-kind nature of the resource commitments can limit delivery of specific items if resources need to be directed to other priorities. Many committee members and technical support staff play important operational roles with the various Great Lakes boards and with above average water levels throughout the

system, they're attention has necessarily been on operational requirements. Every effort is being made to meet all obligations given existing resources, however, the committee has been challenged over the reporting period to adequately meet all its objectives given operational board requirements. Given the necessary overlap between board operations and GLAM committee support, these resourcing challenges are expected to continue during periods of extreme water levels. Likewise, the GLAM Committee has been challenged to meet all of the data gathering requirements of an extreme water level year. The GLAM Committee will continue to discuss these issues with the Boards and IJC in an effort to consider long-term strategies for dealing with the added resource pressures and requirements of extreme event years.

The GLAM Committee will continue to rely heavily on in-kind support from contributing agencies as well as resource contributions from the IJC to successfully implement adaptive management approaches in the ongoing review of existing water level regulation plans through the Great Lakes water regulation Boards.

Respectfully Submitted,

Mr. Arun Heer
GLAM Committee U.S. co-chair

Ms. Wendy Leger
GLAM Committee Canadian co-chair

Appendix A: Summary of FY18 Work Plan Progress

SECTION A: Plan Review and Evaluation		
Tier 1: Foundational Analyses		
Hydroclimate Working Group		
Task	Task Title	Status
FY18-1.1	Test established processes for performing annual, routine foundational analyses required for hydroclimate assessments	The Hydroclimate Working Group has been focused on developing material for the 2017 annual report, coordinating with external resources including those of the Coordinating Committee on Great Lakes Hydrologic and Hydraulic Data where appropriate.
Impact Assessment Working Group		
FY18-1.2	Test established processes for performing routine assessments required for understanding baseline conditions and benefits of observed water levels and flows	The Impact Assessment Working Group has been focused on preparing material for the 2017 annual report as it relates to Hydropower, Municipal and Industrial Water Uses, Commercial Navigation, Coastal Property Owner, Recreational Boating and Tourism, and Ecosystem. This includes acquiring available information from external sources as well as summarizing preliminary results from GLAM activities including the review of air photos and other resources.
Plan Review and Evaluation Working Group		
FY18-1.3	Test established processes for performing annual, routine foundational analyses required for ongoing evaluations of existing regulation plan performance	The Plan Review Working Group has been undertaking preliminary simulations for the 2017 annual report related to Lake Ontario – St. Lawrence River and Lake Superior outflows.

SECTION A: Plan Review and Evaluation		
Tier 2: Exploratory Investigations		
Hydroclimate Working Group		
Task	Task Title	Status
FY18-2.1	Extended hindcast of Water Supply Components over Canada/U.S. Transboundary Watersheds based on the CaPA, CaLDAS and GEM systems and coordination with NWS Multi-Precipitation Estimates (MPE)	A five-year sample dataset has been produced and the daily precipitation analyses are available on the web at this address: http://collaboration.cmc.ec.gc.ca/science/outgoing/capa.grib/hindcast/capa_hindcast_rdrs_v1/ The hourly data for all meteorological variables required to operate a land-surface scheme have been converted to NetCDF and transferred to a FloodNet server. The data will be used for the GRIP-E project that is now starting. The methodology and dataset have been presented at the Coordinating Committee and at the American Geophysical Union Fall Meeting. A draft of the science paper to be submitted later this Spring, which will serve as the project's final report, will be available by the end of March.
FY18-2.2	Development of a statistical model to close the water balance of the Great Lakes	The project scope was completed in December 2017 with an updated project report as well as a presentation (webinar) for GLAM Committee members and interested members of the Coordinating Committee on Great Lakes Basic Hydrologic and Hydraulic Data. The preliminary model is now being tested for integration with regular activities of the Coordinating Committee on Great Lakes Basic Hydrologic and Hydraulic Data and will be considered by GLAM in its broader hydroclimate efforts.
Impact Assessment Working Group – Lake Ontario and St. Lawrence River (ecosystem)		
FY18-2.3	Evaluate Meadow Marsh Algorithm	The project team reviewed the feedback provided by an external expert related to the April 2017 workshop and summary report. It was agreed that the 2017 monitoring results, expected in April 2018, would be critical to follow up on the peer review and so the efforts has been limited in recent months while the 2017 monitoring data is processed.
FY18-2.4	Monitoring of Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – site surveys	The contract for this project was established by the IJC in winter 2017. The field sampling was completed for 16 sites in September 2017 and the data processing has been taking place since then, with results expected in the coming months.
FY18-2.5	Monitoring of Lake Ontario – St. Lawrence River coastal wetland habitat in New York State – Imagery	The contract for this project was established by the IJC in winter 2017. The imagery was collected at 16 sites and the interpretation and delineation of vegetation communities has been occurring over recent months.
FY18-2.6	Monitoring of Lake Ontario Coastal Wetlands on the Canadian Shoreline (IWI)	Staff from the Canadian Wildlife Service undertook sampling at 16 sites in September of 2017. The data was subsequently processed with the deliverables expected in March 2018.
FY18-2.7	State of Science Assessment of Remote Sensing for Great Lakes Coastal Wetlands	An external contractor in collaboration with staff of Environment and Climate Change Canada's Geomatics Research Section have initiated the development of the state of science report in winter of 2018. They have been doing background resources and connecting with other researchers to identify methods and tools that will help GLAM improve its long-term wetland monitoring strategies.

Task	Task Title	Status
FY18-2.8	Wetland monitoring and ecosystem indicator development (muskrat and Northern Pike)	Waiting on update from project lead (this is a NYDEC project that also contributes to GLAM priorities).
FY18-2.9	Wetland imagery interpretation	This is a multi-year Ontario Ministry of Natural Resources and Forestry Project initiated in 2016 to test the suitability of remote sensing imagery and methods to track vegetation zone extent in Lake Ontario and upper St. Lawrence coastal wetlands. High resolution (8cm) leaf-on orthoimagery was collected in year 1 of the project for coastal wetland areas. A classification scheme has been developed in year 2 (17/18) to create a detailed spatial inventory of current wetland vegetation that can be used for monitoring purposes (12 classes). To date about half of the imagery capture area has been delineated, using both colour infrared and “true colour” for interpretation at a large scale. Features are delineated at a scale of about 1:5000 and a minimum mapping unit of 0.125 ha. Next steps are to complete the mapping and classification, generate a DEM for the wetland areas from imagery derivative products, and to acquire and test RADARSAT 2 imagery on several wetland areas as a preliminary assessment of additional remote sensing options to track change.
Impact Assessment Working Group – Lake Ontario and St. Lawrence River (socio-economic)		
FY18-2.10	Revisit shore protection that was surveyed by either NYDEC (2011) or USACE (2015) to assess response to high water conditions	The IWI project was conditionally approved as of January 11 th , 2018. Based on feedback from the IWI review team, GLAM Committee members have been undertaking a pre-screening effort to prioritize previously surveyed sites. A detail scope of work is also being developed with the hope of initiating contracting efforts in the coming months, pending availability of US funds.
FY18-2.11	Implementation of Shoreline Damage Survey for the Canadian Shoreline of Lake Ontario and the Upper St. Lawrence River	Conservation Ontario work with GLAM Committee members to develop the questionnaire and then posted it online and undertook promotional efforts. The survey closed December 31 st for shoreline property owners in Ontario and the contract deliverables were provided to the IJC at the end of February 2018. The GLAM Committee will be integrating a few components into the draft annual report for March 2018 and may include additional items as part of revisions to the report when further time is available to review the results.
FY18-2.12	Oblique Imagery of Lake Ontario and St. Lawrence River Shoreline	Staff from Environment and Climate Change Canada have initiated a review of shoreline conditions in Niagara, Northumberland, and Prince Edward County. As well, they have coordinated with staff at the IJC to review a small section of the lower St. Lawrence River while staff from the U.S. Army Corps of Engineers in Buffalo have been working on a related effort for Wayne County. Preliminary results are expected in the March 2018 draft annual report, followed by further QA/QC efforts ahead of the final September version.
FY18-2.13	Survey and review of operational impacts on marinas due to 2017 water levels	The IWI project was conditionally approved as of January 11 th , 2018. GLAM Committee members are developing a response to the IJC conditions and will follow up with the development of a detailed scope of work.
FY18-2.14	Survey and review of operational impacts on M&I	The IWI project was conditionally approved as of January 11 th , 2018. GLAM Committee members are developing a response to the IJC conditions and will follow up with the development of a detailed scope of

	infrastructure due to 2017 water levels	work.
Task	Task Title	Status
Impact Assessment Working Group – Upper Great Lakes		
FY18-2.15	St. Marys River IERM Rapids Data	Data to be collected during 2018 field season.
FY18-2.16	St. Marys River IERM Calibration	The IWI project was conditionally approved as of January 11 th , 2018. GLAM Committee members are developing a response to the IJC conditions and will follow up with the development of a detailed scope of work.
FY18-2.17	Assimilate St. Marys River IERM into SVM	April plan evaluation team meeting scheduled to discuss potential modifications to SVM or creation of new tool for evaluating short term regulation impacts. Path forward from this meeting will determine how IERM could be assimilated into new or modified tool.
FY18-2.18	Development of initial flooding performance indicator for the St. Marys River	Will be discussed in April planning meeting discussed in 2.17.
Plan Review Working Group		
FY18-2.19	Routing model update	NOAA GLERL continues programming model data handler as part of IWI project. Development of lake routing and regulation scheduled to begin in May.
FY18-2.20	St. Marys River – Review impacts of reductions in maximum side channel capacity	Simulations have been undertaken to support annual report preparation but more detailed assessments will be put off until further performance indicator development has occurred.
FY18-2.21	St. Marys River – Review multiple partially open gate settings at the Compensating Works	Simulations have been undertaken to support annual report preparation but more detailed assessments will be put off until further performance indicator development has occurred.

SECTION B: GLAM Oversight and Administration		
Task	Task Title	Status
FY18-3.1	GLAM Committee Coordination, Management, and Reporting	The FY18 and fall semi-annual update were approved by the IJC in October, 2017 following submission to the Boards. The committee's first Triennial report was finalized and posted to the GLAM website.
FY18-3.2	Monitoring of Work Plan Delivery	Monitoring of work plan delivery was undertaken to support annual report development and semi-annual reporting.

FY18-3.3	GLAM Information Management Needs including file sharing and data/model management strategies.	At the committee's February 7-8 meeting, information management needs were discussed and the IJC advisors agreed to follow up with IJC information management experts. They've asked the GLAM Committee secretaries to further define information management requirements and will subsequently schedule a discussion on possible IJC support.
FY17-3.4	Maintain engagement with GLWQA activities	The Canadian and U.S. co-chairs remain connected with the IJCs Water Quality Board and Science Advisory Board and update them on GLAM work plans and any connections.
FY17-3.5	Develop and initiate an engagement plan for advisory networks	The GLAM co-chairs and secretaries continued to participate on the Communications Committee of the International Lake Ontario – St. Lawrence River Board. As well, efforts were made to develop a Circles of Influence Strategy that will be presented to the Boards at their March meeting. In coordination with the secretaries and regulation representatives of the International Lake Ontario – St. Lawrence River Board, GLAM members participated in a number of public meetings related to 2017 high water levels in an effort to promote the work of the committee.