Short-Term and Long-Term Strategy

For Evaluating and Improving the Rules for Managing Releases from Lakes Ontario and Superior

September 1, 2020

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Great Lakes – St. Lawrence River Adaptive Management Committee

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Great Lakes - St. Lawrence River Adaptive Management Short and Long-Term Strategy

Executive Summary

The International Joint Commission (IJC) issued updated Supplementary Orders of Approval for the structures used to regulate releases on Lake Superior in 2014 (Plan 2012) and Lake Ontario in 2016 (Plan 2014). Both orders require the IJC to conduct a review of the results of regulation under each order within 15 years of issuance. The IJC created the Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee to fulfill this obligation.

This paper describes a flexible strategy developed by the GLAM Committee for the on-going evaluation and improvement of the regulation plans through the use of adaptive management. Adaptive management is a structured, iterative cycle for improving actions through long-term monitoring, modelling, and assessment. The GLAM Committee is responsible for implementing many components of the adaptive management cycle, including providing scientifically sound data, knowledge, and technologically advanced tools for supporting management decisions. Based on the information and tools provided by the GLAM Committee, the International Lake Ontario-St. Lawrence River Board and the International Lake Superior Board of Control may recommend to the IJC that revisions to the regulation plans be made. The IJC, with public input and government concurrence, will decide whether to modify the regulation plans.

With the goal of further moderating flooding that occurred because of record water supplies to the Lake Ontario-St. Lawrence River system in 2017 and 2019, the IJC has asked the GLAM Committee to review Plan 2014 sooner than the 15 years specified in the Order. Phase 1 of this expedited review is an 18-24 month effort officially launched by the IJC in February 2020 that focuses on assessing flow releases under Board deviation authority. Evaluations will be made of deviations from four specific flow release limits that apply during or near extreme conditions:

- Deviating from the limits set to balance upstream and downstream flooding impacts (F-limit)
- Exceeding the regulation limits for safe navigation velocities and minimum levels to allow for increased outflows to lower Lake Ontario during extremes (L-Limit)
- Departing from the limits for setting flows for establishing and maintaining a stable ice cover, as well as the minimum level of Lake St. Lawrence outside the navigation season, to allow for higher flows to reduce Lake Ontario levels during extremes (I-Limit)

- Examining changes to the seasonal (H14) triggers that indicate when the Board has deviation authority to allow the Board to act sooner with the goal of reducing impacts (more Phase 2)

Phase 1 includes establishment of a Public Advisory Group to help the GLAM Committee seek potential improvements to regulation by contributing knowledge about local water level impacts and input on the assessment methods used in the review.

Phase 2 of the expedited review includes a three-year expedited review of Plan 2014 rules and operations. Phase 2 will provide a comprehensive assessment of Plan 2014 under many possible water supply and level extremes, both high and low, to determine the risks and implications to all interests of changes to plan rules and limits. The GLAM Committee will work with the Board to identify decision criteria for assessing whether changes to the regulation plans are warranted. The Board's recommendations will be sent to the IJC for consideration.

Longer term, the GLAM Committee will continue, over the next 10 to 12 years, to work at reviewing Plans 2012 and 2014 under a full range of conditions and multiple objectives. This on-going effort will incorporate new and evolving science, continuous monitoring, and any other physical, economic, environmental or social changes that might influence regulation decisions.

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Background: Origin and Purpose of the GLAM Committee

The International Joint Commission (IJC) was created by the Boundary Waters Treaty of 1909 between Canada and the United States, which share the Great Lakes. The IJC is responsible for the regulation of outflows from Lake Superior and Lake Ontario. The IJC issued updated Supplementary Orders of Approval for the structures used to regulate releases from those two lakes--Lake Superior in 2014 (Plan 2012) and Lake Ontario in 2016 (Plan 2014).

The revised Orders stipulate that releases from Lake Ontario and Lake Superior be made according to the rules governing releases, better known as regulation plans, approved by the IJC and consistent with criteria contained in the Orders. Both Orders require the IJC to conduct a review of the results of regulation under each Order within 15 years of it being issued (2029 for Plan 2012 and 2031 for Plan 2014) and report its findings to Canada and the United States. The IJC created the Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee in early 2015 to fulfill this obligation[1].

Adaptive Management and Regulation Plan Assessment

Adaptive Management is a process for continual learning and improvement

Adaptive management allows decisions to be reviewed, adjusted and revised as new information and knowledge becomes available and/or as conditions change (IUGLS, 2012). This thoughtful, deliberative assessment is informed by long-term monitoring and modelling. It is an especially effective strategy for making informed decisions about managing natural resources that are affected by unpredictable factors such as weather. This structured, repetitive cycle for improving actions is

[1] A partial structure also exists above Niagara Falls on the Niagara River, known as the Chippawa-Grass Island Pool (CGIP) Control Structure. This structure does not regulate the outflows of Lake Erie and therefore while the GLAM Committee does also report to the International Niagara River Board of Control, because this Board does not regulate outflows from Lake Erie, it is not included in this strategy.

necessary to ensure outflow from Lake Ontario and Lake Superior meet established goals of the regulation plans.

The regulation plans for Lake Ontario- St. Lawrence River outflows (Plan 2014) and Lake Superior outflows (Plan 2012) were each selected based on evaluations using simulations of their potential benefits and impacts relative to the regulation plans that were previously in place. Adaptive management compares actual, observed outcomes to expected results to improve and re-calibrate predictive impact models and reduce uncertainties. The improved simulation models can then be used to assess the on-going performance of the regulation plans and formulate and evaluate proposed improvements.

Figure 1 depicts the adaptive management cycle and highlights the importance of collaboration and institutional arrangements for linking the science and evaluations to the decision makers.

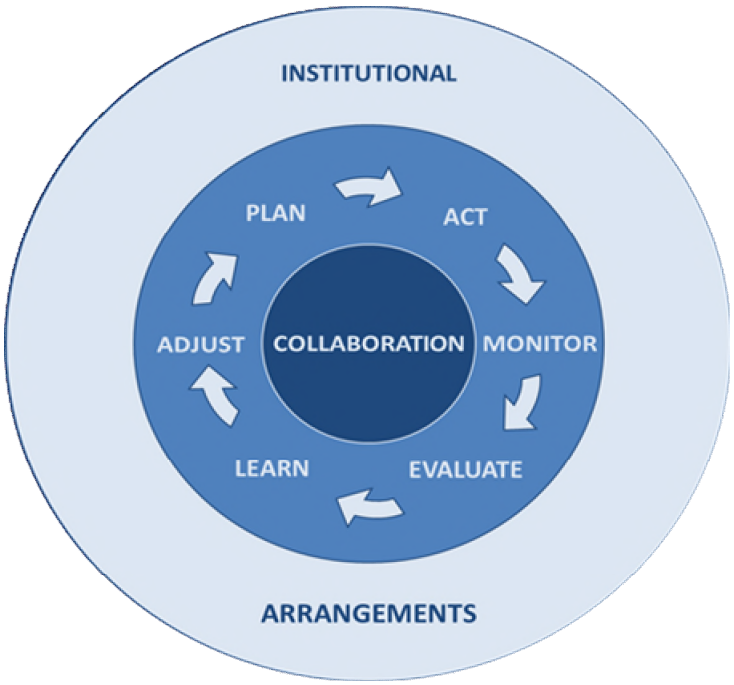

Figure 1 Adaptive management function diagram (IJC, 2008)

The GLAM Committee's Role

Ultimately, the GLAM Committee provides the science and information necessary to assist those who are making the decision on whether to make changes to the regulation plan.

The GLAM Committee is responsible for fulfilling a significant portion of the adaptive management cycle, but not all of it. The GLAM Committee must rely on collaboration with others. Because the GLAM Committee is not a decision-making body, it must work with the decision-makers—the IJC and its International Lake Ontario-St. Lawrence River Board and International Lake Superior Board of Control--in reviewing and evaluating the regulation plans. Ultimately, the GLAM Committee provides the science and information necessary to assist those who are making the decision on whether to make changes to the regulation plan.

For its part, the GLAM Committee is responsible for providing scientifically sound data, knowledge, and technologically advanced tools for making management decisions. Based on this information, the Boards may recommend revisions to water flow/level regulation plans to adapt to new or evolving ecological, socio-economic and climate-induced changes within the system over time. In effect, the GLAM Committee is responsible for ensuring the "Monitor", "Evaluate" and "Learn" components shown in Figure 1 are implemented and that options for the "Adjust" component are provided to the Boards to consider. Based on this information, the Boards may recommend to the IJC that revisions to the regulation plans be made. The IJC, with public input and government concurrence, will decide whether to modify the regulation plans. It is important to recognize that adaptive management must be collaborative and that it relies on many organizations, levels of government and the public to complete the cycle.

Adaptive Management Strategy: Overview

To undertake its portion of the adaptive management cycle, the GLAM Committee reviews the six components of the analyses used in the design and selection of Plans 2012 and 2014 that make up the adaptive management framework (see Figure 2):

1. Understand and Assess Future Hydrologic Conditions – what range of hydroclimate conditions needs to be considered to best test regulation plans?

2. **Calculate Water Levels and Flows** – accurately model water levels and flows through the simulation of how water travels through the system and how regulation rules, water supplies and weather conditions (e.g. ice factors) impact water levels and flows.
3. **Impact Assessment and Predictive Models** – improve and reduce uncertainties inherent in the models that relate water levels and flows produced by regulation plans to socio-economic and environmental impacts (using performance indicators). Determine whether monitoring shows a need to redesign the models of performance and select which of these performance indicators should be used in an update of the integrated modelling framework (Shared Vision Model).
4. **Plan Formulation and Evaluation** – test changes to both the deterministic rules of Plan 2012 and Plan 2014 and protocols for deviations from these rules, simulate the performance of the revisions, integrate results and compare them to what is done now.
5. **Decision Support** – visualize and present an array of performance evaluation data to assist the Board in understanding and weighing tradeoffs and support its efforts to make recommendations for possible changes to the plans or deviation strategies.
6. **Cross-cutting Items** - These include project management and all aspects that help support and build trust in the simulations, including stakeholder involvement, peer review, information management, partner collaboration, and succession planning.

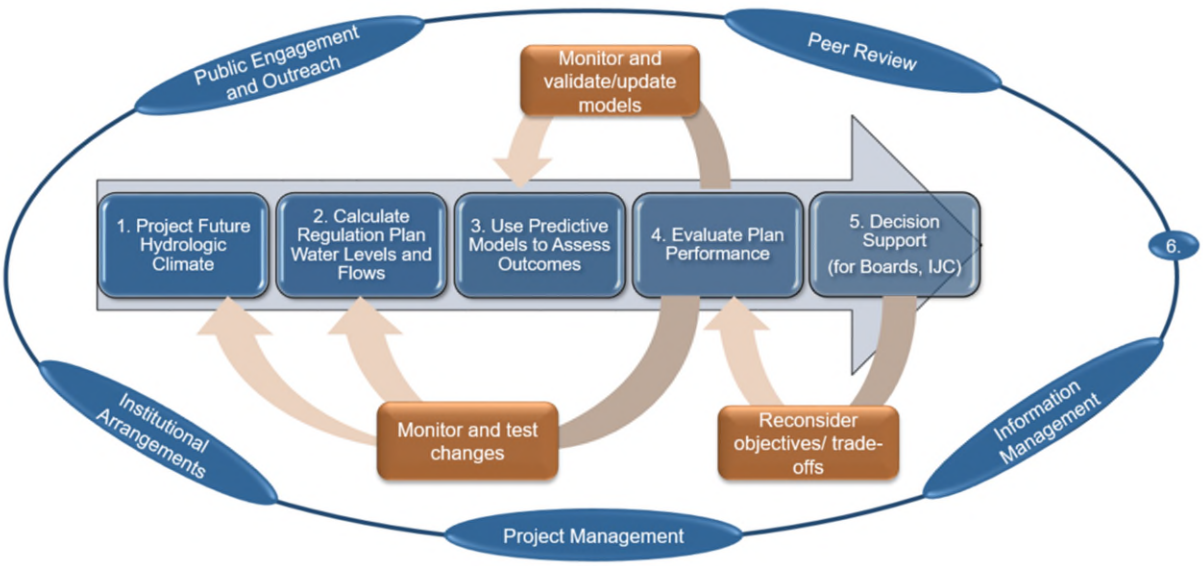

Figure 2: General overview of plan evaluation under an adaptive management approach (Adaptive Management Framework)

Adaptive Management Strategy: Recent Actions

The GLAM Committee has already made progress in some aspects of these six components, many of which are discussed in the 2018 GLAM Report: Summary of 2017 Great Lakes Basin Conditions and Water Level Impact to Support On-going Regulation Plan Evaluation

- **Component one:** the GLAM Committee reviewed recent climate trends and projections to summarize emerging findings and conducted an analysis to help reduce uncertainty in Great Lakes net basin supply data that could influence future regulation plan evaluations.
- **Component two:** the GLAM Committee identified a lack of flexibility in the assumptions in Lake Superior regulation Plan 2012 regarding side-channel flow capacity and developed a method to adjust for varying side-channel capacity that the Board implements as an authorized deviation from the plan. The Committee has also been working to update the plan simulation models based on the most recent deviation strategies used by the Boards.
- **Component three:** significant work has been done to monitor and interpret data related to Lake Ontario wetland vegetation and shore protection cost performance indicators. Data and information have also been gathered about impacts experienced during the recent flooding conditions in 2017 and 2019 to shore property, recreational boating facilities, municipal and industrial water intakes and outfalls, commercial navigation, and hydropower.
- **Component four:** the GLAM Committee undertook an immediate review of the performance of Plans 2012 and 2014 based on levels and flows in 2017 (but without impact assessments).
- **Component five:** the GLAM Committee collected the data and models used in the previous International Lake Ontario St. Lawrence River Study and the International Upper Great Lakes Study to support the calculation of water levels and flows and the impacts related to each. Based on that information, a mid-term strategy was developed that laid the conceptual groundwork and was reported on in the first Triennial Progress Report to the IJC. Most importantly, after record-high Lake Ontario water supplies and levels in 2017, the GLAM Committee analyzed what had happened in the 2018 GLAM report, touching on each of the six components to some degree. Perhaps the most important conclusion from that analysis is that in extreme water supply years such as 2017, even the most promising plan modifications will not reduce high water levels much. Additionally, modifications that would reduce high levels and related damages to one interest or at one location tended to result in offsetting increases in levels and damages elsewhere or to other interests.
- **Component six:** the GLAM Committee has developed a communications plan and made its work plans, progress and special reports, and fact sheets publicly available. In support of the GLAM communication plan, the IJC has established an 18-member Public Advisory Group covering the

interests and regions affected by water levels and flows on Lake Ontario and the St. Lawrence River to support the work of the GLAM Committee, encourage two-way communication, and guide a longer-term public engagement effort. The GLAM Committee has also met with various experts and organizations to help with the review of existing performance indicators and examine methods for validating, updating or modifying existing evaluation tools. Finally, the GLAM Committee has been working with the IJC to formulate an information management process that will assist the Committee in managing the data, information and tools.

Short-term Strategy: Expedited Review of Plan 2014

- The IJC has asked the GLAM Committee to conduct a review of Plan 2014 sooner than the required 15 years
- The goal of this expedited review is to further moderate flooding, upstream and downstream
- A two-phase approach has been developed and incorporated into the adaptive management strategy

Based on the Orders, the GLAM Committee Directive specifies that the first full review of the Orders and associated regulation plans be completed no later than 15 years following the effective dates of the Orders. The IJC has asked that the review of Plan 2014 be completed sooner. This expedited review of Plan 2014 is an example of adaptive management in action.

Since the implementation of Plan 2014 in January 2017, Lake Ontario and the St. Lawrence River (LOSLR) have experienced extraordinary conditions and record water levels two out of four years. While recognizing that record supplies to the system in 2017 and again in 2019 caused the flooding, and no regulation plan can eliminate coastal impacts under such extreme water supply conditions, the IJC has directed the GLAM Committee to outline priority activities that could be done to support an **expedited review** of Plan 2014 with the goal of further moderating flooding.

In response, the GLAM Committee has incorporated this request into the adaptive management strategy by developing a two-phase approach to the expedited review. The first phase is focused on the near-term, providing information to help the Board with deviation decisions in anticipation that the water levels on the Great Lakes could remain high for some time. Phase 2 will build on this effort and look at how the plan addresses extreme highs and lows under many different scenarios

and over the longer-term. During this phase, the GLAM Committee also will assess whether adjustments to the plan could be made to further mitigate the impacts of extreme conditions, not just for the current conditions, but overall.

An overview of the phases for the Plan 2014 expedited review, integrated where appropriate with the on-going longer-term review for Plan 2012 and Plan 2014, is provided below (Figure 3). Priority is given to information that supports Board decisions to deal with continuing high levels. For all phases, the ability of the GLAM Committee to undertake the required activities in any given year will depend on the availability of resources in that year and on the on-going collaboration of partner agencies and organizations who contribute to the GLAM Committee.

The strategy assumes that adequate financial and human resources will be available and that partner agencies and organizations will be willing and able to work with and contribute to GLAM Committee efforts. As of February 3, 2020, the IJC has confirmed in a letter to the GLAM Committee that funding is available to support Phase 1 priorities. Funding still needs to be confirmed for Phase 2 of the expedited review. Without additional resources to support Phase 2 tasks, a number of those tasks would need to be deferred and the timing and extent of the main tasks in the overall strategy adjusted.

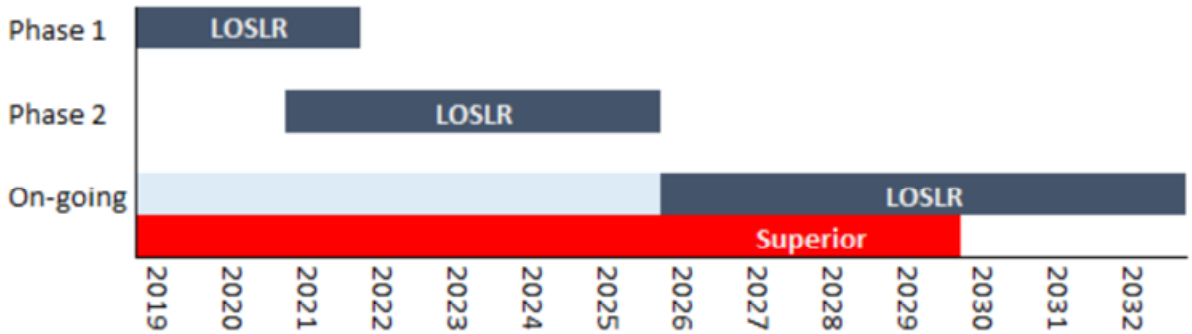

Figure 3- Timeline of Adaptive management of Lake Ontario-St. Lawrence River (LOSLR) and Lake Superior outflow regulation

Short-Term Strategy: Plan 2014 Expedited Review, Phase 1

An 18-24 month LOSLR-specific effort, starting in October 2019, is focused on **assessing flow releases under Board deviation authority,** recognizing current conditions, high lake levels, and high inflows in the foreseeable future. This effort will primarily support the International Lake Ontario-St.

Lawrence River Board (ILOSLRB or Board) in deciding how best to deviate from Plan 2014 to moderate high levels, especially when operating under criterion H14 of the 2016 Orders.

The initial review will prioritize analysis of the impacts and limits on releases that could be made in the next several months to years, or until record high water inflows from Lake Erie have come down. Because water supplies have been so high since Plan 2014 was implemented in January 2017, it is estimated that releases have been essentially the same as they would have been under the old plan more than 80% of the time, with releases determined either by maximum outflow limits or Board deviations from the plan rules.

While the goal of the expedited review is to look for ways of moderating flooding both upstream and downstream of the project, it must be recognized that no regulation plan will eliminate shoreline impacts under extreme water supply conditions. As such, a secondary objective of the expedited review is to improve the understanding, documentation and presentation of how the plan and the Board has or could respond to extremes, the limits of lake outflow regulation, and the change in the balances of impacts and tradeoffs inherent with any modification to the regulation plan.

The initial review will prioritize analysis of the impacts and limits on releases that could be made in the next several months to years, or until record high water inflows from Lake Erie have come down.

The Expedited Review will prioritize shoreline issues, while considering the range of affected interests (i.e., shoreline communities, commercial navigation; municipal and industrial water uses; recreation and tourism; hydropower; and ecosystems). The primary focus of Phase 1 is on supporting the Board with information to make deviation decisions when Lake Ontario levels are very high and the Board is authorized to operate consistent with criterion H14 of the Orders. This authority occurs when levels are above levels that trigger criterion H14 or when the IJC grants the Board special authority. Four specific release modifications will be evaluated:

- Deviating from the limits set to balance upstream and downstream flooding impacts (F-limit)
- Exceeding the regulation limits for safe navigation velocities to allow for increased outflows to lower Lake Ontario during extremes (L-Limit)

- Departing from the limits for setting flows for establishing and maintaining a stable ice cover, as well as the minimum level of Lake St. Lawrence outside the navigation season, to allow for higher flow to reduce Lake Ontario levels during extremes (I-Limit)
- Examining changes to the seasonal (H14) triggers that indicate when the Board has deviation authority to allow the Board to act sooner with the goal of reducing impacts (more Phase 2)

Phase 1 of the expedited review will take three approaches to addressing the above release modifications:

1. **Retrospective**: Could the Board have deviated any differently in 2017 through May 2020 to achieve different results along the Lake Ontario-St. Lawrence River system?
2. **Near-term decisions**: What, if any, are the best deviation strategies (if necessary) over the coming months in consideration of existing levels and hydrologic uncertainty?
3. **Scenario Testing (including worst case)**: What if conditions are the same or worse in 2021, 2022 or 2023? How should the Board assess this risk and prepare?

The GLAM will work with the Board to help them better understand and weigh the impacts, risks and uncertainties of alternative deviation decisions based on the information gathered, assessed and integrated and through scenario testing.

Establishing a Public Advisory Group

Phase 1 includes the establishment of a Public Advisory Group to help the GLAM Committee improve its support to Board regulation decisions by contributing knowledge about local water level impacts and input on the assessment methods used in the review. Public Advisory Group members will also help foster a two-way dialogue between the GLAM Committee and affected interests and advise on the development of a longer-term engagement strategy.

The most important result from Phase 1 may be better documentation, understanding and communication of the factors considered by the Board in making deviation decisions and impacts of those decisions. The GLAM Committee will work within its established Communication Plan to help facilitate communication and seek broad public comment on Phase 1 of the expedited review in cooperation with the Board.

Short-Term Strategy: Plan 2014 Expedited Review, Phase 2

Phase 2 will comprehensively assess Plan 2014 under many water supply and level extremes, emphasizing ways to reduce coastal impacts upstream and downstream.

Phase 2 includes a three-year expedited review of Plan 2014 rules and operations. This includes the plan's rule curves, internal forecasts, flow limits, triggers and assumptions and is focused on addressing extreme conditions. Some aspects of this work have already been started, but the bulk of this work would start in 2021 following Phase 1 and is expected to be carried out over a 3 year time horizon, dependent on available resources. The scale of the second phase might vary, but is expected to focus on analyzing what can be done to address coastal issues in consideration of impacts to all interests. This phase is expected to cost $4 million per country over 3 years.

Phase 2 will provide a comprehensive assessment of Plan 2014 under many possible water supply and level extremes, both high and low, to determine the risks and implications to all interests of changes to plan rules and limits, the criterion H14 triggers, and Board deviations decisions over the longer term (beyond the current/near term conditions). This phase will focus on changes that could be made to the plan to try to address extremes and provide a robust assessment of how effective modifications might be under a range of future conditions and how balances and tradeoffs of potential changes might play out over the longer term.

Through this second Phase, the GLAM Committee will work closely with the Board, third-party experts, and the Public Advisory Group to review and update agreed upon performance indicators. Results will be integrated using evaluation tools, such as an updated shared vision model, to assess the performance of the various modifications to Plan 2014 under a full range of plausible conditions.

The IJC's Supplementary Orders of Approval contain objectives to benefit each of the interests affected by regulation. The regulation plan and other operational procedures attempt to balance these objectives in a manner that is acceptable to the Governments of Canada and the United States. Using data and evaluation, Phase 2 will help identify whether changes to regulation of Lake Ontario outflows could improve the outcomes for one or more interests without impacting other interests, as well as better informing how balance is evaluated and risks and tradeoffs are assessed. The GLAM Committee will work with the Board to identify decision criteria for assessing whether

changes to the regulation plans are warranted. The Board will send any recommendations it makes to the IJC, which will consult with the public and, consistent with its rules of procedure, ensure that all affected interests have convenient opportunity to be heard before communicating with the two governments on any changes that require their concurrence.

The impetus for Phase 2 of the expedited review is reviewing the rules of Plan 2014 in consideration of the high levels of 2017 and 2019, with an emphasis on reducing coastal impacts upstream and downstream during extremely high-water conditions. The potential to reduce impacts during extremely low water conditions will also be reviewed.

Long-Term Strategy: On-going Review of Lake Superior and Lake Ontario-St Lawrence River Regulation Plans

The full analysis will build on what GLAM has completed so far. It will include everything completed in Phases 1 and 2 of the Plan 2014 expedited review and also look at broader plan performance when supplies are less extreme but when releases can still influence future high and low water risks.

The full 15-year review of Lake Superior and Lake Ontario regulation plans, covering a full range of conditions and multiple objectives, is consistent with the time horizon within the IJC Orders that will run from now through 2029 for Lake Superior and 2031 for Lake Ontario. The full analysis will build on what GLAM has completed so far. It will include everything completed in Phases 1 and 2 of the Plan 2014 expedited review and also look at broader plan performance when supplies are less extreme but when releases can still influence future high and low water risks. These less extreme hydrological conditions are much more common, and they have a strong influence on trade-offs embedded in the plan evaluations and require a full assessment of economic and environmental plan performance over the longer term.

This on-going effort will incorporate new and evolving science, continuous monitoring, and any other physical, economic, environmental or social changes that might influence regulation decisions. This more complete review of both the Lake Superior and Lake Ontario plans would cost an additional ~$6.5 million per country (in addition to Phase 1 and 2 costs) and will be done over the full 15 year period (beginning in 2015 for Plan 2012 and in 2017 for Plan 2014). The longer-term analysis has

the advantage of more careful pacing and the inclusion of important monitoring data acquired during and after the expedited review.

The Lake Superior review and each phase of the Lake Ontario review require components of the adaptive management framework to be completed. Some items will support the Lake Superior regulation review, some all three phases of the LOSLR review, while others are specific to a single phase. Some aspects of the Lake Superior and upper lakes work, such as the hydroclimate analysis and flow modeling, are also required for the Lake Ontario review. It is possible that, should Phase 2 of the expedited review of Plan 2014 lead to a change to the regulation plan, the timeline for the 15 year on-going review of the regulation of Lake Ontario outflows may be reset based on the date of the implementation of a revised plan.

Preliminary Costing Tables for Phased Approach

Initial costing of the Phase 1 LOSLR portion of the proposed adaptive management strategy has been developed and is outlined in Table 1 below. Note that these estimates and activities may be refined slightly through the implementation process. Table 1 below also shows the estimates for the Phase 2 components and the estimated new funds per country required to complete this phase. The ON-GOING columns Table 1 identifies the key components and cost estimates per year per country that would be required for the on-going Lake Superior and longer-term LOSLR components. Note that the last two years have reduced amounts as the Plan 2012 review is due for completion in 2029. Table 2 shows the estimated costs per fiscal year for each phase.

While these costing estimates provide a good sense of what the effort will cost, they are subject to change as the effort progresses and priorities are clarified. The strategy is meant to be an evolving document. Greater details of costs and priorities are included in the annual GLAM Committee work plans which are available on the GLAM Committee website at https://ijc.org/en/glam.

Table 1: COST ESTIMATES BY COMPONENT (NEW FUNDS) – ALL PHASES / ALL YEARS

***NOTE: Phase 1 funding was confirmed by the IJC in a February 3, 2020 letter to the GLAM Committee*

Cost Estimates by Component - All Phases / All Years	PHASE 1** Near-Term Plan Review Board Deviations (18 Months)		PHASE 2 Expedited Plan Review Under Extremes (3 Years)		ON-GOING Plan Review (12 Years)		TOTAL - ALL PHASES	
COMPONENT 1 - UNDERSTAND AND ASSESS FUTURE HYDROLOGIC CONDITIONS	US ($K US)	Canada ($K CDN)	US ($K US)	Canada ($K CDN)	US ($K US)	Canada ($K CDN)	US ($K US)	Canada ($K CDN)
1.1 Understanding Water Supplies	0	0	0	0	475	475	475	475
1.2 Projecting Future Water Supplies	20	15	265	265	475	475	760	755
1.3 Improving Forecasts	0	0	0	225	475	200	475	425
SUB-TOTAL 1 - Understand and assess future hydrologic conditions	**20**	**15**	**265**	**490**	**1425**	**1150**	**1710**	**1655**
COMPONENT 2 - CALCULATING LEVELS AND FLOWS								
2.1 Update and incorporate new routing models	0	0	25	175	120	120	145	295
2.2 Updating regulation plan simulation models	30	20	0	0	120	120	150	140
SUB-TOTAL 2 - Calculating Levels and Flows	**30**	**20**	**25**	**175**	**240**	**240**	**295**	**435**
COMPONENT 3 - IMPACT ASSESSMENT AND PREDICTIVE MODELS								
3.1 Performance Indicators	730	820	2135	2395	1825	1825	4690	5040
3.2 Integrated Performance Indicator Modelling / Verification	200	100	75	25	675	675	950	800
SUB-TOTAL -3 Impact Assessment and Predictive Models	**930**	**920**	**2210**	**2420**	**2500**	**2500**	**5640**	**5840**
COMPONENT 4 - PLAN FORMULATION AND EVALUATION								
4.1 Plan Formulation	100	100	285	270	730	730	1115	1100
4.2 Plan Evaluation and Visualization of Results	20	20	75	0	75	0	170	20

SUB-TOTAL 4 - Plan Formulation and Evaluation	**120**	**120**	**360**	**270**	**805**	**730**	**1285**	**1120**
COMPONENT 5 - DECISION SUPPORT								
5.1 Decision Support	0	25	100	75	275	200	375	300
5.2 Practice Decisions	0	0	25	25	275	200	300	225
SUB-TOTAL 5 - Decision Support	**0**	**25**	**125**	**100**	**550**	**400**	**675**	**525**
COMPONENT 6 - CROSS CUTTING ITEMS - PROJECT CONTROLS								
6.1 Project Management	50	50	150	150	550	550	750	750
6.2 Communications and Engagement	200	200	275	275	460	660	935	1135
6.3 Peer Review	100	100	140	45	200	200	440	345
6.4 Information Management	50	50	340	265	400	400	790	715
SUB-TOTAL 6 - Cross cutting items - Project Controls	**400**	**400**	**905**	**735**	**1610**	**1810**	**2915**	**2945**
Less reduction in on-going requirement for upper lakes portion in last two years of strategy					**-520**	**-520**	**-520**	**-520**
TOTALS	**1500**	**1500**	**3890**	**4190**	**6610**	**6310**	**12000**	**12000**

Table 2: COST ESTIMATES BY YEAR - NEW FUNDS (EQUAL FOR EACH COUNTRY) $K

***NOTE: Phase 1 funding has been confirmed by the IJC in a February 3, 2020 letter to the GLAM Committee*

	FY20		FY21		FY22		FY23		FY24 Through FY29 (**Per Year**)		FY30 and FY31 (**Per Year**)		**TOTAL**	
	US	CAN	US	CAN	US	CAN	US	CAN	US	CAN	US	CAN	US	CAN
PHASE 1**	1000	1000	500	500									**1500**	**1500**
PHASE 2 (3 YR)			1315	1535	1430	1680	1145	975					**3890**	**4190**
ON-GOING			350	250	350	250	350	250	760	760	500	500	**6610**	**6310**
TOTAL	**1000**	**1000**	**2165**	**2285**	**1780**	**1930**	**1495**	**1225**	**760**	**760**	**500**	**500**	**12000**	**12000**

Summary

The GLAM Short and Long-Term strategy provides a flexible approach for both the on-going and expedited evaluation and improvement of the regulation plans through the use of adaptive management. Phase 1 of the expedited review is focused on assessing flow releases under board deviation authority and has received $1.5 M from each Canada and the U.S.. This phase is scheduled to present information and tools by the end of September 2021 for assisting the Board with deviation decision. Phase 2 of the expedited review is scheduled to begin in 2021, pending funding, and build on Phase 1 efforts to provide a robust assessment of possible modifications to Plan 2014 under a range of future conditions and extremes (both high and low) and how balances and tradeoffs of potential changes might play out over the longer term.

While the goal of the expedited review is to look for ways of moderating flooding both upstream and downstream of the project, it must be recognized that no regulation plan will eliminate impacts under extreme water supply conditions. As such, a secondary objective of the expedited review is to improve the understanding, documentation and presentation of how the plan and the Board has or could respond to extremes, the limits of lake outflow regulation, and the change in the balances of impacts and tradeoffs inherent with any modification to the regulation plan.

The on-going plan review covering both Plan 2012 and Plan 2014 provides a full analysis building on everything completed in the Plan 2014 expedited review. It also looks at broader plan performance under more common hydrological conditions when releases can still influence future high and low water risks and have a strong influence on trade-offs embedded in the plan evaluations requiring a full assessment of economic and environmental plan performance over the longer term. The on-going review relies on the on-going commitment of agencies and requires a level of base funding to successfully proceed.