N O T I C E T O
CLOCA BOARD OF DIRECTORS

Please find enclosed the Agenda and supporting documents for the **CLOCA Board of Directors'** meeting on **Tuesday, October 20, 2020, 5:00 p.m**. This meeting will be a Virtual Meeting.

The list below outlines upcoming meetings and events for your information.

UPCOMING MEETINGS & EVENTS

DATE	TIME	EVENT	LOCATION
Tuesday, October 20/20	5:00 p.m.	CLOCA Board of Director's Meeting	Virtual Meeting Due to COVID-19
Tuesday, November 17/20	5:00 p.m.	CLOCA Board of Director's Meeting	TBD
Tuesday, December 15/20 *(Tentative)*	5:00 p.m.	CLOCA Board of Director's Meeting	TBD

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CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

A G E N D A

AUTHORITY MEETING

Tuesday, October 20, 2020 - 5:00 P.M.

MEETING LOCATION: VIRTUAL MEETING
(ACCESS DETAILS TO BE PROVIDED)

CIRCULATION LIST

Authority Members:	Bob Chapman, Chair	***Authority Staff:***	C. Darling Chief Administrative Officer
	Ron Hooper, Vice Chair		B. Boardman, Executive/Accounting Administrator
	Dave Barton		R. Catulli, Director, Corporate Services
	Janice Jones		J. Davidson, Director, Watershed Planning & Natural Heritage
	Chris Leahy		L. Hastings, Marketing & Communications Coordinator
	Sterling Lee		D. Hope, Land Management & Operations Supervisor
	Tito-Dante Marimpietri		C. Jones, Director, Planning & Regulation
	Ian McDougall		P. Lowe, Director, Community Engagement
	Don Mitchell		P. Sisson, Director, Engineering & Field Operations
	Rhonda Mulcahy		L. Vaja, Executive Assistant/Health & Safety Administrator/Recording Secretary
	John Neal		R. Wilmot, GIS Systems Supervisor
	Brian Nicholson		
	David Pickles		
	Elizabeth Roy		
	Corinna Traill		

AGENDA ITEM: **SUPPORTING DOCUMENTS**

1. CHAIR'S WELCOME

Central Lake Ontario Conservation is situated on treaty land that is steeped in rich Indigenous history and is the present-day home to many First Nations, Metis and Inuit People. Today we acknowledge that we are gathering on the traditional territories of the Mississaugas of Scugog Island First Nation.

2. DECLARATIONS of interest by members on any matters herein contained

3. ADOPTION OF MINUTES of September 15, 2020 pg. **1**

4. DELEGATIONS – *None*

5. PRESENTATIONS

(1) Jennifer Court, Executive Director – Green Infrastructure Ontario Coalition
Re: GIO Updates & Economic Impact Assessment Report

6. CORRESPONDENCE

(1) Copy of a letter from Conservation Ontario to Ministers Yurek & Yakabuski pg. **4**
Re: Conservation Authorities Act (CAA) Review: Enforcement Provisions

RECOMMENDATION:
THAT the above correspondence item be received for information

7. DIRECTOR, PLANNING & REGULATION

(1) Staff Report #5704-20 pg. **6**
Re: Permits Issued for Development, Interference with Wetlands and Alteration to Shorelines and Watercourses – September 1 to 30, 2020

Cont'd

SUPPORTING DOCUMENTS

8. DIRECTOR, ENGINEERING & FIELD OPERATIONS

(1) Staff Report #5703-20 pg. **8**
Re: Technical Guidelines for Stormwater Management Submissions

(2) Staff Report #5705-20 pg. **74**
Re: Corbett Creek Floodplain Mapping Update (TMIG2020)

(3) Staff Report #5707-20 pg. **78**
Re: Summer/Fall 2020 – Conservation Areas Update

9. DIRECTOR, WATERSHED PLANNING & NATURAL HERITAGE- *None*

10. DIRECTOR, COMMUNITY ENGAGEMENT - *None*

11. DIRECTOR, CORPORATE SERVICES - *None*

12. CHIEF ADMINISTRATIVE OFFICER

(1) Staff Report #5706-20 pg. **82**
Re: Draft Strategic Plan 2021-2025 *(Staff Presentation)*

13. CONFIDENTIAL MATTERS – *None*

14. NEW AND UNFINISHED BUSINESS pg. **86**

15. ADJOURNMENT

A G E N D A

SUPPORTING DOCUMENTS

MEETING OF: Authority

DATE: Tuesday, October 20, 2020

TIME: 5:00 p.m.

LOCATION: Virtual Meeting

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

M I N U T E S N O. 4

AUTHORITY MEETING

Tuesday, September 15, 2020 - 5:00 P.M.

MEETING LOCATION: VIRTUAL MEETING THROUGH ZOOM

Present Members:	Bob Chapman, Chair	**Staff:**	C. Darling Chief Administrative Officer
	Ron Hooper, Vice Chair		B. Boardman, Executive/Accounting Administrator
	Dave Barton		J. Davidson, Director, Watershed Planning & Natural Heritage
	Janice Jones		L. Hastings, Marketing & Communications Coordinator
	Chris Leahy		D. Hope, Land Management & Operations Supervisor
	Sterling Lee		C. Jones, Director, Planning & Regulation
	Tito-Dante Marimpietri		P. Lowe, Director, Community Engagement
	Ian McDougall		P. Sisson, Director, Engineering & Field Operations
	Don Mitchell		L. Vaja, Executive Assistant/Health & Safety Administrator/Recording Secretary
	Rhonda Mulcahy		R. Wilmot, GIS Systems Supervisor
	John Neal		
	David Pickles		
	Elizabeth Roy		
	Corinna Traill		
Absent:	Brian Nicholson	**Others:**	

The Chair called the meeting to order at 5:01 p.m.

R. Hooper joined the meeting at 5:03pm
Tito-Dante Marimpietri joined the meeting at 5:03pm

DECLARATIONS of interest by members on any matters herein contained - *None*

ADOPTION OF MINUTES

Res. #52 Moved by E. Roy
Seconded by J. Neal

THAT the Authority minutes of June 16, 2020 be adopted as circulated.
CARRIED

DELEGATIONS - *None*

PRESENTATIONS - *None*

CORRESPONDENCE

(1) Letter from Mr. Provenzano (Agenda pg.11)
Re: Formal Complaint against CLOCA

(2) Letter from the Integrity Commissioners (Agenda pg. 15)
Re: Response to complaint from Mr. Provenzano

(3) Letter from Ministry of Natural Resources to Conservation Ontario (Agenda pg. 16)
Re: Client Service and Streamlining Initiative

Res. #53 Moved by I. McDougall
Seconded by R. Mulcahy
THAT the above correspondence be received for information.
CARRIED

Cont'd

DRAFT

DIRECTOR, DEVELOPMENT REVIEW & REGULATION

(1) Staff Report #5699-20 (Agenda pg. 17)
Re: Permits Issued for Development, Interference with Wetlands and Alteration to Shorelines and Watercourses – June 1 to August 31, 2020

Res. #54 Moved by R. Hooper
Seconded by S. Lee

THAT Staff Report #5699-20 be received for information.
CARRIED

DIRECTOR, WATERSHED PLANNING & NATURAL HERITAGE

(1) Staff Report #5700-20 (Agenda pg. 21)
Re: Highlighting CLOCA Science: Collaboration, Research, Results

Res. #55 Moved by J. Neal
Seconded by R. Hooper

THAT Staff Report 5700-20 be received.
CARRIED

L. Hastings joined the meeting at 5:06pm

DIRECTOR, COMMUNITY ENGAGEMENT

(1) Staff Report #5701-20 (Agenda pg. 23)
Re: September 2020 Education Program Update

Res. #56 Moved by D. Pickles
Seconded by R. Mulcahy

THAT staff Report #5701-20 be received for information.
THAT new and modified program for the 2020/2021 school year and fees be approved.
THAT staff continue to explore new education models for existing facilities
CARRIED

DIRECTOR, CORPORATE SERVICES - *None*

CHIEF ADMINISTRATIVE OFFICER

(1) Staff Report #5702-20 (Agenda pg. 31)
Re: Conservation Authority Representative on the International Joint Commission Public Advisory Group (PAG)

Res. #57 Moved by C. Traill
Seconded by J. Neal

THAT staff Report #5702-20 be Tabled.
CARRIED

NEW AND UNFINISHED BUSINESS

ADJOURNMENT

Res. #58 Moved by S. Lee
Seconded by C. Leahy

THAT the meeting adjourn.
CARRIED

Cont'd

DRAFT

The meeting adjourned at 5:11 p.m.

_____ _____

BOB CHAPMAN, CHAIR CHRIS DARLING, CHIEF ADMINISTRATIVE OFFICER

DRAFT

October 1, 2020

The Honourable Jeff Yurek
Minister of Environment, Conservation and Parks (MECP)
777 Bay Street, 5th Floor
Toronto, ON, M7A 2J3

The Honourable John Yakabuski
Minister of Natural Resources and Forestry
99 Wellesley Street West, 6th Floor
Toronto, Ontario, M7A 1W3

Sent Via Email

Re: Conservation Authorities Act (CAA) Review: Enforcement Provisions

Dear Minister Yurek and Minister Yakabuski,

On behalf of our member conservation authorities, I am writing in follow-up to the September 28th Conservation Ontario (CO) Council meeting. Minister Yurek, thank you once again for providing some opening remarks and answering a couple of questions. It was very much appreciated.

We look forward to reviewing the outcomes of the stakeholder engagement sessions and the public survey further to which you are considering regulatory and legislative amendments. In follow-up discussion with our members at Council it was noted that these consultations included a focus on our Section 28 regulatory responsibilities; responsibility for which resides with Minister Yakabuski. It is our understanding that your ministries are working together to consider regulatory and legislative amendments. Therefore I am writing to let you both know that Council identified that a positive outcome of your review would be enactment of Part VII Enforcement and Offences clauses in the CAA.

To ensure compliance with the Section 28 regulations, conservation authorities (CAs) require the basic tools that are routinely provided to other agencies, including municipal by-law officers (e.g. stop work orders). In recent reports by both the Auditor General and the Special Advisor on Flooding, it has been recognized that the CAs lack basic tools to ensure compliance with the Act and regulation which are recognized as critical components of Ontario's approach to

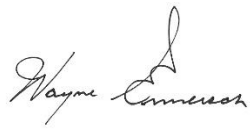
reducing risks posed by flooding and other natural hazards and strengthening Ontario's resiliency to extreme weather events.

During the Pandemic, many CAs have experienced an increase in illegal activities on CA-owned lands and in CA regulated areas. In the case of some Section 28 infractions, extensive remediation costs and damages to neighbouring properties could have been avoided if tools such as enhanced powers of inspection and stop (work) orders were available to CA officers. Instead, CAs must rely on their municipal partners to assist with stop orders under municipal by-laws or the Building Code, when appropriate. This puts undue stress on municipalities to provide services to the CAs and results in duplication of effort. For egregious offences, a CA's only recourse is to proceed through the court system, resulting in significant legal costs to the CA and to the accused. These unnecessary costs to CA and municipal budgets, as well as to the taxpayers/property owners for damages that could have been avoided cannot continue.

When a Provincial response to the engagement sessions comes out, it would be very favourably received to see that it addresses the shortfall in our enforcement capabilities and includes enactment of Part VII Enforcement and Offences clauses in the *Conservation Authorities Act.*

Thank you for your consideration in support of our efforts to cost effectively deliver on the natural hazards mandatory program. We look forward to continuing to work together in this regard and as always CO staff are available at your convenience.

Sincerely,



Wayne Emmerson
Chair, Conservation Ontario

c.c.
Graydon Smith, President, Association of Municipalities of Ontario
CAOs, All Conservation Authorities

REPORT

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: October 20, 2020

FILE: RPRG3974

S.R.: 5704-20

APPROVED BY C.A.O.

TO: Chair and Members, CLOCA Board of Directors

FROM: Chris Jones, Director, Planning & Regulation

SUBJECT: **Permits Issued for Development, Interference with Wetlands and Alteration to Shorelines and Watercourses – September 1 to 30, 2020**

Attached are Development, Interference with Wetlands and Alterations to Shorelines and Watercourses applications, pursuant to Ontario Regulation 42/06, as approved by staff and presented for the members' information.

RECOMMENDATION:
THAT Staff Report #5704-20 be received for information.

CJ/bb
Attach

s:\reports\2020\sr5704_20.docx

Permits To Be Ratified for 9/1/2020 to 9/30/2020

Row #	Municipality	Owner / Applicant	Street / Lot / Con	Permit No.	Description
1	CLARINGTON DARLINGTON	TRANS NORTHERN PIPELINES INC./VERTEX	LOT 02/CON 02	C20-041-FW	DEVELOPMENT ACTIVITIES ASSOCIATED WITH EXCAVATION AND PIPELINE REPAIR
2	CLARINGTON DARLINGTON	NATURAL BOUND POOLS	19 LIVING CT/LOT 28/CON 02	C20-177-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH INSTALLING AN IN-GROUND SWIMMING POOL
3	CLARINGTON DARLINGTON	PROPERTY OWNER	2 SUNNY RIDGE TRAIL/LOT 20/CON 07	C20-179-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH THE CONSTRUCTION OF AN ADDITION OF 2 BEDROOMS ONTO AN EXISTING DWELLING
4	CLARINGTON DARLINGTON	PROPERTY OWNER	7237 LIBERTY ST. N./LOT 08/CON 07	C20-182-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH THE DEMOLITION OF AN EXISTING SINGLE FAMILY DWELLING AND THE CONSTRUCTION OF A NEW SINGLE FAMILY DWELLING, IN-GROUND POOL, SEPTIC SYSTEM, DETACHED GARAGE AND ASSOCIATED LOT GRADING
5	CLARINGTON DARLINGTON	1361189 ONTARIO LIMITED/D.G. BIDDLE & ASSOCIATES LTD.	SE CORNER OF NASH RD & COURTICE RD/LOT 28/CON 02	C20-195-G	DEVELOPMENT ACTIVITIES ASSOCIATED WITH EXCAVATION AND REMOVAL OF ACCUMULATED SEDIMENT FROM STORMWATER MANAGEMENT POND
6	OSHAWA	PROPERTY OWNER	441 STONE ST./LOT 11/BFC	O20-081-GFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
7	OSHAWA	PROPERTY OWNER	433 STONE ST./LOT 10/BFC	O20-083-GFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
8	OSHAWA	PROPERTY OWNER	437 STONE ST./LOT 11/BFC	O20-103-GBHFS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
9	OSHAWA	2285136 ONTARIO LIMITED/MMM GROUP LIMITED	LANDS SOUTH OF WINCHESTER RD., EAST AND WEST OF SIMCOE ST. N./LOT 11/CON 05	O20-165-GH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH ROUGH GRADING, CUT AND FILL WITHIN SUBJECT LANDS
10	OSHAWA	PROPERTY OWNER	493 STONE ST./LOT 11/BFC	O20-171-GBFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
11	OSHAWA	1569 SIMCOE STREET NORTH/PODIUM DEVELOPMENTS	1569 SIMCOE ST. N./LOT 10/CON 04	O20-184-GBFA	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF 13 TOWNHOUSE BLOCKS (125 TOWNHOUSES), GRADING, SITE RETAINING WALLS AND LANDSCAPING
12	OSHAWA	PROPERTY OWNER	499 STONE ST./LOT 11/BFC	O20-187-GBFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
13	OSHAWA	PROPERTY OWNER	644 ROSELAWN AVE/LOT 17/CON 05	O20-188-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH REPAIRING EXISTING SEPTIC BED WHICH IS CLOGGED WITH TREE ROOTS
14	OSHAWA	PROPERTY OWNER	485 STONE ST./LOT 11/BFC	O20-190-GBFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
15	OSHAWA	ENBRIDGE GAS INC	LOT 11/CON 05	O20-191-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH GAS PIPELINE INSTALLATION
16	OSHAWA	PROPERTY OWNER	489 STONE ST./LOT 11/BFC	O20-193-GBFHS	DEVELOPMENT ACTIVITIES ASSOCIATED WITH CONSTRUCTION OF EROSION CONTROL WORKS AT LAKE ONTARIO SHORELINE
17	OSHAWA	PROPERTY OWNER	798 BESSBOROUGH DR./LOT 12/CON 03	O20-196-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH THE CONSTRUCTION/INSTALLATION OF AN INGROUND CONCRETE SPA
18	WHITBY	TUNNEY PLANNING INC	901 HOPKINS ST./LOT 22/CON 01	W20-065-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH ROUGH GRADING FOR AN INDUSTRIAL SUBDIVISION
19	WHITBY	PROPERTY OWNER	8 LYNDE CT./LOT 29/CON 02	W20-172-GFBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH REPLACING EXISTING DECK
20	WHITBY	PROPERTY OWNER	112 CRYSTAL BEACH BLVD./LOT 20/BFC	W20-178-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH REPLACING EXISTING DECKS AND EXTENDING THEM
21	WHITBY	HAW LIMITED PARTNERSHIP	540 TAUNTON RD. W. /LOT 31/CON 04	W20-180-GHAW	STAGE ONE DEVELOPMENT ACTIVITIES ASSOCIATED WITH POND DECOMMISSIONING AND CHANNEL RESTORATION WORKS; SITE GRADING TO FACILIATATE DRAW DOWN OF LYNDE CREEK TRIBUTARY A
22	WHITBY	PROPERTY OWNER	28 NIGHTINGALE CRES./LOT 19/CON 06	W20-198-GBH	DEVELOPMENT ACTIVITIES ASSOCIATED WITH THE CONSTRUCTION / INSTALLATION OF AN INGROUND FIBREGLASS POOL WITH POOL CABANA

REPORT

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: October 20, 2020

FILE: PSSG251

S.R.: 5703-20

APPROVED BY C.A.O.

MEMO TO: Chair and Members, CLOCA Board of Directors

FROM: R. Perry Sisson, Director, Engineering and Field Operations
Lucy Benham, Senior Water Resources Engineer

SUBJECT: **CLOCA's Technical Guidelines for Stormwater Management Submissions**

Urban development applications are commonly supported by stormwater management submissions consisting of drainage system details for:

- minor (storm sewer) flow,
- major overland drainage conveyance,
- control of peak discharge to protect against surcharging infrastructure, or causing flooding,
- stormwater quality treatment,
- control against stream erosion,
- protection/maintenance of groundwater conditions, and recharge/discharge to ecologically significant features
- stream erosion restoration or alteration,
- floodplain/natural hazard assessment and management,
- sediment control during construction.

Stormwater Management Guidelines inform development proponents of watershed specific conditions and requirements and will assist with complete Stormwater Management Report submissions. Submissions that are incomplete or lacking in supporting information are difficult to review and consume significantly more staff time than complete submissions, and lead to delays of the development review process.

CLOCA first released Guidelines for Stormwater Management Submissions in 2007, and the Guidelines have been used extensively and effectively. Over the past 13 years, there have been several advances in stormwater management, and an emphasis on Low Impact Development techniques to retain rainfall on site and reduce reliance on "end-of-pipe" technology. As a result, CLOCA staff have updated our Stormwater Management Guidelines to provide:

- Modern requirements for Low Impact Development (LID)
- Enhanced erosion and sediment control requirements based on a risk approach
- Detailed Natural Hazard requirements based on current policies
- Concise design requirements for stormwater management systems including LID features, Stormwater ponds, oil/grit separators, etc.
- List of studies to be submitted during various planning stages including required study contents
- More detailed requirements for floodplain mapping submissions.

The Guidelines are compatible with, and provide reference to, provincial and municipal standards and requirements commonly used in the industry. During the update, the new draft guidelines were circulated for comment to local development consultants, local and regional municipalities, and neighbouring Conservation Authorities. Comments received have been addressed and summarized in the document.

Cont'd

The Guidelines will be formatted and made publicly available on the CLOCA website.

RECOMMENDATIONS:

THAT Staff Report 5703-20 be received for information; and,
THAT the Technical Guidelines for Stormwater Management Submissions (CLOCA 2020) be endorsed and accepted for implementation of development review.

Attach.

RPS/LB/bb

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Technical Guidelines for Stormwater Management Submissions

Central Lake Ontario Conservation

Version: October 2020

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1.0 Introduction

There are numerous pressures on our watersheds including climate change, population growth, land use changes, and aging infrastructure. As a result, challenges in stormwater management are growing. Effective management of stormwater is essential to improving resilience to climate change, preventing increased flood risks, detrimental stream erosion, and deterioration of groundwater resources as well as protecting water quality. It is key to maintaining the health of our streams, lakes, and aquatic life.

Traditional stormwater management, which focuses on using grey infrastructure to move water away from developed areas, is unsustainable in today's environmental, social and economic climate.
Sustainable development is vital to reducing the environmental, social, and economic effects of urban development and climate change. Sustainable stormwater management includes systemically valuing, protecting, and expanding our natural assets such as wetlands and forests. Wetlands are critically important for reducing flood impacts, absorbing pollutants, and protecting our shorelines. Sustainable stormwater management also includes implementation of green infrastructure and low impact development, which have been recognized as the most cost effective, environmentally sound, hydrologically appropriate, and resilient approaches to managing stormwater by more closely mimicking the natural hydrologic cycle. CLOCA is committed to protecting, preserving, and enhancing our watersheds through championing these sustainable technologies as well as responsible environmental planning. Our goal is to protect and restore our stream's ecosystems ensuring we have "healthy watersheds for today and tomorrow".

The main purpose of this document is to provide practitioners with CLOCA's stormwater management criteria and submission requirements for sustainable development; and to streamline the submission and review process. Up-to-date standards established by individual municipalities, or within watershed/ subwatershed studies have priority over CLOCA Submission Guidelines contained in this document.

Technical reports are to be prepared in such a manner that the entire work can be recreated by any qualified person without the need to refer to any other material. Any qualified person must be able to recognize and understand all the methods, approaches, basic data, and rationale used in the calculations. Further, reports are to integrate and provide conclusions and recommendations in concert with aligned technical analysis for a site or area, for example the applicable Watershed Plan, an Environmental Impact Study or Hydrogeological Assessment Report.

Apart from copy written or proprietary models, equations should be given for all provided calculations. Model input and output files are to be provided in paper and digital form. All formulas and values used by the program must be clearly identified on the hard copy. Calculations are to be provided in hard copy.

CLOCA must be circulated a complete set of drawings outlining all the proposed works. Final engineering reports and drawings must be signed and sealed by a Professional Engineer registered with the Professional Engineers of Ontario. A complete Stormwater Management Report will include, at a minimum, all items listed in the Submission checklist. The Submission Checklist is included in Appendix A. Should the submission not contain all the required items CLOCA reserves the right to return the submission until all items are present.

2.0 Stormwater Management Requirements

CLOCA's requirements for all stormwater management submissions are outlined in the following sections, which include a description of CLOCA SWM criteria, guidance on approved methods and techniques, a summary of key hydrologic parameters, modelling and mapping requirements and a summary of submission requirements.

All submissions shall identify, meet the requirements of, and be consistent with the most current version of the following documents:

- Applicable Watershed Management Plans and Watershed Studies. The Watershed Criteria including a listing of the Management Plans and Studies is shown in Appendix B.
- Approved SWM Report
- Stormwater Management Planning and Design Manual, MOE (March 2003)
- Low Impact Development Stormwater Management Planning and Design Guide, CVC/TRCA (2010)
- Low Impact Development SWM Planning and Design Guide (LID SWM Guide) [https://wiki.sustainabletechnologies.ca]
- Hydrogeological Assessment Submissions - Conservation Authority Guidelines to Support Development Applications (June 2013)
- Erosion and Sediment Control Guideline for Urban Construction (2019)
- All applicable provincial and municipal documents including the Provincial Policy Statement, Provincial Land Use Plans and Regional and Local Official Plans

Any deviations from these policies, guidelines and/or standards must be discussed with CLOCA prior to submitting an application. SWM requirements must be addressed using a hierarchy of SWM practices or "treatment train" approach that starts with lot level controls, followed by conveyance controls and then end-of-pipe SWM facilities. Examples of these controls are listed in **Table 2-1** below.

Table 2-1 SWM Practices to meet "Treatment Train" Approach

Lot Level Controls	Conveyance Controls	End-of-pipe Stormwater Management
• Rooftop detention • Parking lot storage through catch basin restrictors or orifices in the storm sewer • Reduced % grade of lot • Discharging roof leaders to pervious surfaces • Soak away pits* • Scarified subsoil, amended topsoil and extra topsoil depth on yards ** • Porous pavement * • Rain Gardens * • Water reuse systems (cisterns, rain barrels, etc.*)	• Grassed swales • Pervious pipe systems * • Pervious catch –basins* • Bioretention swales • Filtration systems • Infiltration systems * • Filter strips • Buffer strips	• Infiltration and biofiltration basins* • Infiltration trenches* • Manufactured treatment devices (i.e. oil/grit separators or filters) • Sand filters • Stormwater management facilities (dry ponds, wet ponds, wetland ponds, hybrid ponds) • Filtration devices • Adsorptive materials • Underground Storage

* LIDs accepted as being able to meet design criteria associated with water quality, erosion control or water balance.
** These measures are recommended on all sites to reduce post-development runoff volume, however a water quality, erosion control or water balance credit will not be given for these measures on residential lots because there is no certainty that these areas will not be altered over time with homeowner projects such as patios, sheds, and pools.

2.1 Stream Erosion / Volume Control

The stream erosion / volume control requirements for private and public sector development applications is provided in Table 2-2 below.

Table 2-2 Stream Erosion/Volume Control Requirements

Criteria	**Runoff from a 25mm rainfall event must be captured, retained, or detained from all new and/or fully reconstructed impervious surfaces.** The criteria must be addressed using a hierarchy of SWM practices (see Section 2.0 above) as prioritized below.
Priority 1 Retention of the full volume of runoff from a 25mm event on site through infiltration, evapotranspiration, reuse, bio-retention, etc.	
Priority 2 If any of the factors listed below preclude full retention of the runoff from a 25mm rainfall event, then volume reduction shall be provided to the maximum extent practical with a minimum of 5mm. Following reduction of runoff to the maximum extent possible, the remaining runoff volume from the 25mm event should be detained on site and slowly released to the creek or storm sewer over 24 to 48 hours. Factors to be considered: • Shallow bedrock • High groundwater • Zoning, setbacks, or other land use requirements • Property or infrastructure restrictions • Poor soils (low infiltration rates, highly compacted, contaminated) • Highly vulnerable aquifer	

The selection and design process must be documented and justified per the site-specific conditions and environmental objectives to the satisfaction of CLOCA. Consideration must be given to relocating elements to meet the volume reduction criteria.

The recommendations of hydro geotechnical reports, environmental impact studies and watershed studies need to be considered as part of any design and may override the requirements listed in this section.

A Stream Erosion Control Study may be required:

- As part of a Master Drainage Plan for a Secondary Planning or Part II Plan Area, or similar study
- For sites located upstream of a known erosion area
- For sites tributary to small first and second order headwater streams
- When the downstream creek flows through established urban areas and the site is greater than 1% of the catchment area
- When flow diversions are proposed

CLOCA must be consulted about the need for an Erosion Study. Stream Erosion Control Studies should include the following:

- Determination of the stream reach that could be impacted
- Characterization of the existing channel and determination of the most sensitive reaches.
- Establishment of erosion thresholds based upon field measurements.
- Model of existing conditions, and proposed conditions with / without SWM controls.
- Comparison of the erosion potential for each scenario.
- Proposed release rates and storage, such that the existing conditions are not exceeded.
- Depending on site-specific conditions, a frequency – duration - exceedance analysis may be required using a continuous simulation to compare pre-development and post-development conditions.

2.2 Quality Control

Best management practices (BMPs) must be applied to all development to provide water quality treatment as per the Ministry of the Environment's (MOE) "Stormwater Management Planning and Design Manual" (March 2003). The level of treatment required for each watershed within CLOCA is stated in Appendix B. It is recognized that providing stormwater quality treatment to the Ministry of the Environment, Conservation and Parks' criteria may be difficult for sites with less than 0.25ha of impervious area. For these small sites, a "best efforts" approach will be accepted.

Thermal quality control is vitally important for the health of receiving systems and to mitigate anticipated climate change effects. Stormwater management measures must be provided to prevent discharge of warm urban drainage.

The quality control criteria should be addressed through the use of a hierarchy of SWM practices as prioritized in Table 2-3 below.

A separate maintenance manual must be provided and approved, to highlight standard operating conditions and maintenance schedule and guide the site owner through recommended maintenance requirements for all aspects of the stormwater management system.

Table 2-3 Prioritized Quality Control Measures

Priority 1 Low Impact Development Measures LIDs are generally the most effective means of providing water quality protection since they prevent pollutants from entering the drainage system and provide for flow retention at source. LID practices used to address the stream erosion / volume control requirements (Section 2.1) can also assist in addressing the quality control criteria. ⇩
Priority 2 Stormwater Management Facilities (Wet ponds, wetlands, hybrid ponds) ⇩
Priority 3 Manufactured Treatment Devices (MTDs) Generally, MTDs will not provide effective removal of nutrients, but may be used as a pre-treatment system, or as a component of the water quality control system for small projects or infill development. MTDs may be used to achieve enhanced quality control provided they are sized in accordance with the recommendations set out by both the MOE Manual and Manufacturer. Such systems should be used with the incorporation of other quality control measures, such as naturalized buffers, grassed swales, etc.

2.3 Quantity Control

The Stormwater Management Quantity Control requirements for private and public sector development applications are provided in Table 2-4 below. CLOCA will not accept any quantity control volume reductions for Low Impact Development techniques.

Table 2-4 Quantity Control Requirements

Requirements	Description
Maintain watershed boundaries	Every effort must be made to maintain existing watershed boundaries and drainage patterns. As a rule, significant changes in drainage boundaries are not permitted. Pre-consultation is mandatory for any proposed change in drainage boundaries.
Post-to-pre Controls	Unless specified otherwise by the municipality, subwatershed study, or fluvial geomorphic analysis, post development peak flow rates must not exceed corresponding pre-development rates for the 1:2 year through 1:100 year design storm events.
Overcontrol	If there is a known deficiency in the downstream conveyance system, additional quantity control may be required (i.e. private property, undersized pipes).
No Downstream Impacts	Due to the nature of the hydrologic responses of creeks and timing of peak flows there are occasions where quantity control may not be required. This is often the case downstream of major flow restrictions such as at railway or highway stream crossings. However, where no Master Drainage Plan exists, CLOCA's policy is to require control of post-development flows to pre-development levels unless it can be demonstrated through the use of modelling that the additional flow will not cause detrimental effects downstream (i.e. flood elevation increases or erosion impacts).

2.4 Water Balance / Groundwater

In some areas significant amounts of precipitation are naturally infiltrated into the ground. These High Volume Recharge Areas (HVRA's) are important to replenish and maintain groundwater aquifers. Additionally, infiltration of precipitation in some areas supports environmentally sensitive features including wetlands and watercourses through infiltration, interflow, and groundwater discharge. These areas are referred to as Ecologically Significant Groundwater Recharge Areas (ESGRA's). Areas identified as HVRA or ESGRA require special measures to ensure the balance between surface water and groundwater is maintained. A study titled Water Budget Study of the Watersheds in the CLOCA Area was prepared for CLOCA, by EarthFx Inc., in 2008. This study examined the relationship between surface water and groundwater through the preparation and execution of a surface water and groundwater numerical model. The simulated result of the study delineated areas having 15% more than the average recharge for CLOCA's entire jurisdiction. Mapping for the identified HVRA and ESGRA areas can be found online in CLOCA's open data portal.

- Open Data Portal: http://open-data.cloca.com/
- HVRA Areas: http://open-data.cloca.com/datasets/high-volume-recharge-areas-1
- ESGRA Areas: http://open-data.cloca.com/datasets/ecologically-significant-groundwater-recharge-areas.

Should a proposed development site contain any area identified as a HVRA or ESGRA, as per the mapping, a water budget will be required as a component of the stormwater management submission.

A water balance assessment should be completed as per the MOE's "Stormwater Management Planning and Design Manual" (March 2003). It is recommended that HVRA and/or ESGRA mapping be used as a planning tool for test pits and borehole locations associated with conductivity testing. Every attempt should be made to match post development infiltration volumes to pre-development levels on an annual basis. Infiltration targets may be achieved through the incorporation of a variety of best management practices including: reduced lot grading, roof leaders discharging to ponding areas or soak away pits, infiltration trenches, grassed swales/enhanced grassed swales, and pervious pipe and catch basin systems.

Although, maintained or increased infiltration may appear desirable, rising water levels can be damaging to existing and future structures if not anticipated. Over saturation of subsurface materials near valley slopes can also cause slope instability if not foreseen. Should geotechnical borehole data and/or in-situ test results suggest potential groundwater upwelling or mounding beneath infiltration galleries or perforated pipes above normal fluctuation level in the vicinity of existing or proposed structures or valley slopes, prediction and/or estimates of potential post-development changes using available technologies such as USGS developed spreadsheet calculation of the Hantush equation has to be performed

Refer to Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (June 2013) for specific water balance and hydrogeological assessment requirements.

2.5 Erosion and Sediment Control

Development and implementation of an erosion and sediment control (ESC) plan including design and installation of erosion and sediment control practices, regular inspections and maintenance is required for all sites with the intent of protecting the natural environment during construction.

Submitted Erosion and sediment control plans should be developed in accordance with The Erosion and Sediment Control Guidelines for Urban Construction, 2019. (All products specified in this document may be an approved equivalent).

Sites greater than 10 ha and with any portion of the site located within a Regulated Area must complete a Risk Assessment. The Risk Assessment shall consider the site's erosion potential based on soil type and site topography at a minimum in accordance with the Erosion and Sediment Control Guidelines for Urban Construction (2019). If the Risk Assessment indicates any areas of the site are at medium to high risk, enhanced best management practices will be required for the area. These will include (if applicable):

- Retention of vegetative cover to extent possible
- Immediate stabilization
- Diversion of flows around the area
- Double row silt fence barriers, especially for areas adjacent to natural features
- Additional stormwater detention areas such as sediment traps and ponds

CLOCA's general requirements for all erosion and sediment control plans are as follows:

- ESC plans must use a multi-barrier approach to providing erosion ***and*** sediment control for the site.
- ESC plans must consider erosion prevention first by minimizing the extent and duration of disturbance, phasing development where possible, and stabilizing any areas left inactive for 30 days or longer. Stabilization techniques must consider the time of year and recommend alternative practices for non-growing season stabilization.
- Runoff should be diverted around problem areas, slope lengths and gradients should be minimized, and concentrated flows should be avoided where possible.
- Separate ESC plans should be provided for each phase of construction:
    - Topsoil stripping, grading, and re-stabilization
    - Site servicing
    - Building construction.
- Interceptor swales or channels must be immediately stabilized.
- During construction, the use of catchbasin insert bags with lifting tabs is required in catchbasins for sediment control (such as silt sacks).
- Topsoil stockpile locations, height and volume must be indicated on the ESC Plans. Stockpiles should be located away from watercourses, drainage features, preserved trees, and top of steep slopes. Topsoil stockpiles should be stabilized immediately. Sediment controls should be installed around all stockpiles and temporary drainage directed around them.
- Temporary ESC ponds must be supported with storage volume and orifice calculations. They should include an emergency overflow weir and flow dispersion measures as well as erosion control at the outlet. Pond banks are to be immediately stabilized. Pond decommissioning details are to be included on the plans.

- ESC Plans must identify appropriate inspection and maintenance practices. Inspections must occur weekly and after individual rainfall or snowmelt events. Inspections must be routinely recorded. Repairs and maintenance and/or replacement of ineffective practices are to be completed in a timely manner. In general, BMPs requiring maintenance should be repaired / cleaned within 48 hours of notification or sooner if an imminent risk of adverse impact is evident. CLOCA must be notified of any risk of impact if there is a breach in sediment controls. CLOCA should also be consulted for changes to ESC plans.
- ESC Plans must identify appropriate pollution prevention management measures to address proper storage, collection, and disposal of hazardous materials, and fueling and maintenance areas. A safe designated location for concrete washout should be identified onsite.
- Dewatering notes and details must be identified on the ESC drawings if applicable.

Erosion and Sediment Control Requirements for LIDs

Low Impact Development (LID) measures are particularly vulnerable to impacts from construction such as clogging, erosion, subgrade compaction and contamination with construction runoff. As such, the following measures should be implemented for all proposed LIDs, as applicable:

- LID areas must be properly identified on ESC plans.
- Areas designated for LID installations should be sectioned off early in the construction process by fencing, flags, stakes, tree markings or other suitable method.
- Perimeter controls may be required to protect LIDs such as filter socks, sand or pea gravel bags, natural fibre logs and wattles, or sediment fence.
- Construction vehicles should avoid driving over LID areas.
- If possible, LIDs are to be kept offline during construction. This may require the installation and maintenance of an impermeable physical barrier at the inlet.
- Soils below LIDs which have been compacted during excavation must be broken up by scarifying the subgrade soil to promote infiltration.
- LID protection measures must be inspected weekly and after individual rainfall or snowmelt events. The ESC measures are to be maintained from the start of construction until construction is complete, the contributing drainage area is stabilized, and construction vehicle mud tracking has ceased.

2.6 Minor-Major System Conveyance

The SWM report should include the design for the minor and major systems. All minor system and major overland flow routes are to be secured by an appropriate easement as per municipal requirements.

In the case of discharge to privately owned land (where there is no sufficient outlet), the proponent may be required to obtain a legal right of discharge registered on title.

Locations of overland flow outlets and minor system/foundation drain outlets to stream valleys must be verified in the field.

Minor System

The minor system conveys the frequent runoff events up to the design frequency of the system (typically 1 in 5 year design storm [see municipal standards]) while the major system conveys the runoff from infrequent storm events (typically 1 in 100 year design storm) that exceed the minor system capacity. The minor system includes the lot drainage components i.e. lot grades, ditches, swales, street gutters, catch basins and the storm sewer system.

Major System

The major system may include overland flow routes, roadways, artificial channels, streams, and valleys. The major and minor systems are to be designed to safely convey stormwater flows to a sufficient outlet, without negative impacts on adjacent properties. A sufficient outlet typically constitutes a permanently flowing watercourse or lake. A public right of way may also provide sufficient outlet.

3.0 Natural Hazards Requirements

In accordance with the Provincial Policy Statement (2020), development shall be directed away from areas of natural or human-made hazards where there is an unacceptable risk to public health or safety or of property damage, and not create new or aggravate existing hazards.

Natural hazard areas include lands prone to flooding and erosion, and hazardous lands adjacent to shorelines. Mapping for areas of interest regulated under the Conservation Authorities Act, including Ontario Regulation 42/06 and any successor regulation, can be found online (http://open-data.cloca.com/datasets/cloca-regulated-area). The regulated area includes flooding and erosion hazards associated with riverine systems and the Lake Ontario shoreline, along with wetlands and areas of interference around the wetlands. Hazard limits including setbacks must be delineated in accordance with the most rigorous applicable standard as may be required under the Planning Act, including municipal Official Plans or CLOCA's Policy and Procedural Document. Technical requirements for Natural Hazard considerations are given in Table 3-1 below. Applicable Natural Hazard Guidelines / References are provided in the footnotes below the table.

Table 3-1 Natural Hazard Requirements

Flooding Hazards	The Provincial Policy Statement (2020) states: *3.1.2 d) Development and site alteration shall not be permitted within a floodway regardless of whether the area of inundation contains high points of land not subject to flooding.* In accordance with the Provincial Policy Statement (2020), CLOCA will not support lot creation within the floodplain. All development must be located outside the regulatory flood limit, with structure openings located a minimum of 0.3 meters above the flood level. CLOCA does not support cut and fill operations within the floodplain. In the rare instances where this approach is unavoidable and deemed necessary through rigorous consultation with the Authority the requirements outlined in Section 6.5 must be adhered to.
Erosion Hazards	Development is prohibited within the erosion hazard of a river or stream valley. Details on defining the erosion hazard limit for confined and unconfined river or stream systems are provided below.
	Confined Systems
	A **Confined River and Stream Valley** is one in which the physical presence of a valley corridor containing a river or stream channel, which may or may not contain flowing water, is visibly discernible (i.e. valley walls are clearly definable) from the surrounding landscape by either field investigations, aerial photography and/or map interpretation. The location of the river or stream channel may be located at the base of the valley slope, in close proximity to the toe of the valley slope (i.e. within 15 metres), or removed from the toe of the valley slope (i.e. greater than 15 metres). Generally, valley systems are considered to be confined where the bank or valley wall has a slope with a gradient of 15% or greater.

Toe Erosion Allowance

For creeks within 15m of Toe of Slope, the following allowances in Table 3-2 must be applied:

Table 3-2 Minimum Toe Erosion Allowance

Soils	Evidence of Bank Erosion	No Evidence of Bank Erosion
Soft Rock	5m	2m
Stiff/Hard Cohesive (clay, silt, tills)	8m	4m
Soft/Firm Non-Cohesive (sand, silt, fill)	15m	7m

Stable Slope Allowance

Slope Inspection Record (Tables 4.1) and Slope Rating chart (Table 4.2) of the MNR guide must be completed to determine stable slope investigation requirements. Each representative slope characteristic in an investigated valley must have corresponding Slope Inspection Record. Information on all Slope Inspection Records shall be consolidated into Slope Stability Chart to determine the level of stability and associated investigation requirements.

Study using accepted geotechnical and engineering principles must be performed under existing condition. Engineering analysis under post-development condition will be required in exceptional cases where development will inevitably encroach the (pre-development) established erosion hazard limit.

Slope profiles to be utilized in geotechnical model must reflect the subsurface layer configuration and saturated zone condition based on available test pit and borehole information.

Erosion Access Allowance

The additional 6-metre erosion allowance, which is the landward extension of the hazard limit, provides for: (1) emergency access to the slope; (2) construction access for regular maintenance and repair in an event of slope failure; and, (3) protection for unforeseen or predicted external conditions which could adversely affect natural conditions or processes.

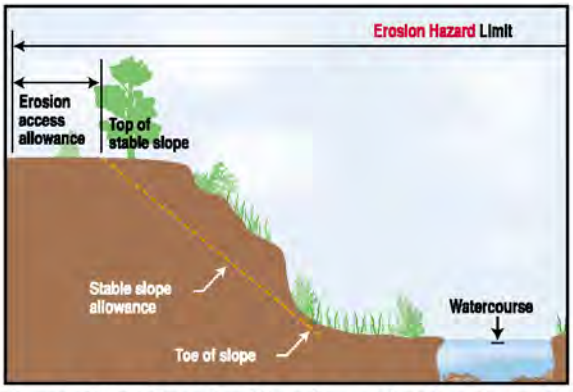


Figure 95 a Confined System, Erosion hazard limit where toe of valley slope is located more than 15 metres from the watercourse

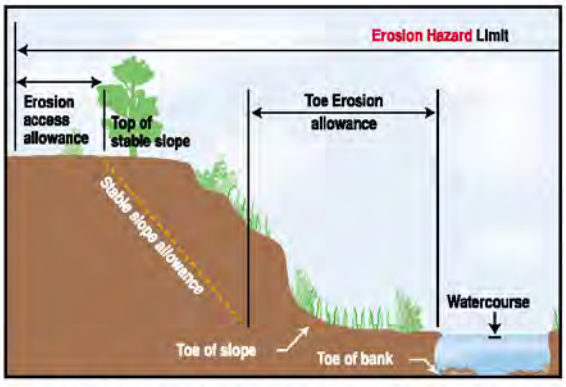


Figure 95 b Confined System, Erosion hazard limit where toe of valley slope is located less than 15 metres from the watercourse

Source: MNR River and Stream Systems Erosion Hazard Limit Technical Guide

Erosion Hazards (continued)

Unconfined Systems

An **Unconfined River and Stream Valley** is one in which a river or stream is present but there is no discernible valley slope (slope inclination less than 15%) or bank that can be detected from the surrounding landscape. The hazard limit associated with an unconfined valley is defined as the maximum extent of the predicted meander belt of the river or stream.

Meander Belt Allowance
20 times the bankfull channel width centered over the meander belt axis or as per the methodology outlined in the Belt Width Delineation Protocol, Parish Geomorphic (January 30, 2004). If empirical equations are used to estimate the meander belt width, a minimum of three methods must be compared. The final meander belt should be taken as the average of the three results.

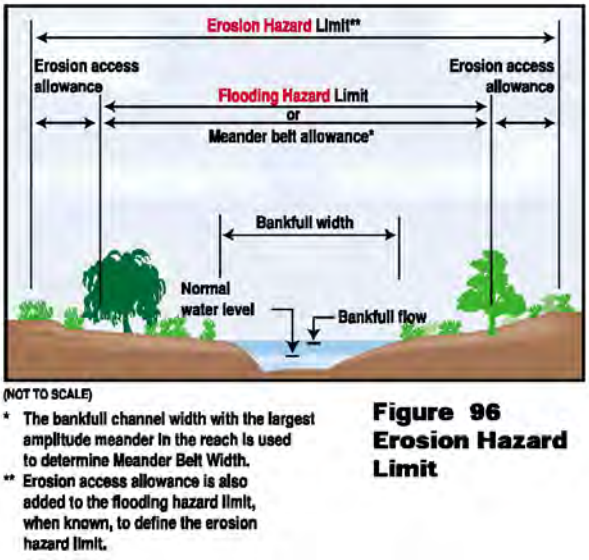


Figure 96 Erosion Hazard Limit

Source: MNR River and Stream Systems Erosion Hazard Limit Technical Guide

Shoreline Hazards

Flood Hazard: 100 year flood level plus allowance for wave uprush.

Erosion Hazard: 100 year flood level plus stable slope allowance and an average annual recession rate of the slope projected to allow for 100 years of future slope recession.

Dynamic Beach Hazard: 100 year flood level plus allowance for wave uprush and dynamic beach processes.

Applicable Natural Hazard Guidelines / References:

- CLOCA's Policy and Procedural Document
- MNR River and Stream Systems Flooding Hazard Limit Technical Guide
- Sections 6.3 and 6.4 in this document
- MNR River and Stream Systems Erosion Hazard Limit Technical Guide
- Lake Ontario Shoreline Hazard Management Plan (Zuzek, 2020)

Table 3-3 Natural Hazard Considerations

Environmental Features[1]
Wetlands and woodlands play an important role in maintaining ecological integrity and watershed health, but they also contribute to the local and larger economies by preventing flooding, attracting tourism, cycling nutrients, filtering our breathing air and drinking water, and providing habitat for wildlife whose activities directly benefit us. CLOCA has approximately 6,024 ha of wetland and 6,683 ha of forest cover in its jurisdiction. These wetlands and woodlands are estimated to contribute over $85 million and $36 million worth of economic services a year, respectively. Protection of these existing natural features and the continued investment in enhancing and restoring degraded or lost features across the jurisdiction not only provides habitat for wildlife, it sustains human health and prosperity. *Source: Ecological Services: Valuing Natural Areas within CLOCA (CLOCA, 2017)* **Fisheries and aquatic habitat** provide cultural, heritage and scientific values, as well as a rich diversity of plant and animal life. Additionally, they support a variety of human interests such as fishing and recreation. The aquatic system is as an important ecological component of watershed health which must be protected.
Siting Outfalls
The siting of stormwater management outfalls should minimize the impact to the natural environment. Disturbance to forested valley slopes and adjacent wooded or wetland habitats needs to be avoided and/or minimized to the extent possible. Levels of disturbance also need to consider any access roads required to maintain the outfall and outfall channel. Outfall locations must be field verified with CLOCA staff. The extent of disturbed area including vegetation removal details must be provided along with an EIS and/or other study to support/justify the location of the outfall and construction details. Other considerations: • Outfalls must located above the 2 year floodplain elevation • Angle of outfall should be in line with the flow of the receiving stream rather than perpendicular to it • Discharging flows onto steep slopes must be avoided. Outfalls should be directed towards gentler slopes where possible. • Flow conveyance and velocity calculations are required for all outfalls. If erosion protection measures are warranted all associated sizing calculations and/or relevant reference tables must be provided (i.e. erosive force specifications for erosion mats, rip-rap sizing, etc.).
Watercourse Crossings
The design of watercourse crossings must consider: • **Hydraulics** Crossings must be sized and located such that there is no increase in upstream or downstream flooding. • **Geomorphology** A geomorphic study is generally required for watercourses with a drainage area of 125 ha or more. All watercourse crossings should provide a span larger than the bank full width of the watercourse. • **Fisheries**

- **Geotechnical Conditions**
  Slope stability is of primary consideration in crossings design. Geotechnical investigation must delineate the erosion hazard limit in the valley slope of the proposed crossing using the Technical Guide - River and Stream Systems: Erosion Hazard Limit (OMNR, 2002).

  Accompanying hydrogeologic assessment must determine subsurface flow; presence of springs and seepages; and groundwater discharge to stream that the proposed project could adversely impact and cause slope instability.
  Structural alteration of the valley slope to accommodate any crossing infrastructure is not a recommended approach.
- **Natural Heritage Features**
  Including but not limited to wetlands, woodlands, habitat of endangered and threatened species, wildlife habitat, and areas of natural and scientific interest (ANSIs).
- **Wildlife Passage**[2]

Applicable Guidelines / References:
[1] CLOCA's Policy and Procedural Document
[2] CLOCA's Instream Barrier Action Plan (Feb 2017)

4.0 Modeling

4.1 Hydrology Modeling

Stormwater runoff calculations for the site must be provided. The preferred runoff model is Visual Otthymo. Other models will be considered upon consultation. For small sites, less than five (5) hectares, manual calculations will be accepted such as the Modified Rational Method.
Runoff coefficients for urban areas should be increased as per MTO Design Chart 1.07 when using the Rational / Modified Rational Method (i.e. for return period of more than 10 years, increase above values as 25-year – add 10%, 50-year - add 20%, 100-year - add 25%) to a maximum of 1.0

All input parameters shall be provided on paper and their sources cited. A printout of all models must be submitted, including a detailed printout of one scenario, a summary printout of all other scenarios, and a schematic of each unique model scenario. Digital copies of all model files must be also be included.

Modeling should be completed using the most current version of the computer software. Proponents wishing to use outdated programs should contact CLOCA and relevant municipalities to obtain approval.

4.2 Hydraulic Modeling

If the site is within the regulation limits and may impact the floodline, hydraulic modeling must be provided. The preferred hydraulic model is the U.S. Army Corps of Engineers HEC-RAS. New models will only be accepted in the most recent HEC-RAS software. Georeferenced models may be required.

4.3 Precipitation

Hydrologic modeling should follow Watershed Plan recommendations when selecting storm distributions. The distributions selected in the approved watershed hydrology model should be used for when addressing flood control criteria. In situations where the development site is small, the storm distribution used in the watershed plan may not be appropriate; a suitable alternative storm distribution should be selected by the consultant. For small sites (site plans), rainfall amounts should be based on the IDF curves for the precipitation station outlined in the municipality's SWM standards. For larger sites (subdivisions) and in the absence of a municipal standard, CLOCA rainfall amounts should be based on the Toronto City Station IDF curves. IDF Curves for this station can be obtained online from Environment Canada. Refer to associated model reference manual for conversion of IDF data into storm files for model input.

4.4 Hydrograph Computation

Sources for all values/approaches must be provided for the selection / calculation of Curve Numbers, Runoff Coefficients, Initial Abstraction, Time of Concentration, Overland Flow Lengths, Manning Roughness Coefficients, Infiltration Rates, Orifice Coefficients, and Weir Coefficients. Detailed calculations and a parameter table summary must be provided including area weighted calculations as required. Typical values/sources are provided in Appendix C.

Hydrograph time of concentration should be calculated based on the Airport Method for catchments with a runoff coefficient less than 0.40, or the Bransby-Williams Equation for catchments with a runoff coefficient greater than 0.40 (based on the weighted catchment C). Other time of concentration formulas may be accepted with the supporting information. A composite time of concentration may be required if ditches or channelized flow is present.

Time to Peak should be calculated as tp = 0.67 tc, where tc is Time of Concentration.
The number of linear reservoirs for the NASHYD command shall equal 3 unless calibration results indicate otherwise.

Where runoff coefficients have been calculated for a development area based on municipal standards, these values should be used to calculate the total imperviousness for the catchment. Runoff coefficients may need to be verified against the proposed landuse. The calculated total imperviousness values used must not be lower than CLOCA's typical impervious values used for watershed studies (see Appendix C).

All hydrologic parameters must be compared to the Master Drainage Plans to ensure compliance. A table must be provided that compares the pre-development peak flows to the post development uncontrolled and controlled peak flows at key nodes.

4.5 Channel Routing

Sufficient channel routing should be incorporated into the hydrologic model.

Rating curves and travel times used in channel routing shall be determined by preliminary hydraulic calculations of the backwater profile or by procedures available in the approved hydrologic model and

shall be included on paper with the submission. Hydrographs should be combined before being routed through watercourse reaches.

Cross-sections required for the hydrologic model routing procedure must be obtained from 1:2,000 topographic mapping, or from field surveys. Cross-sections shall be extended sufficiently to ensure that the flows do not exceed the range of the travel timetable.

The routing computation time step must be relative to the smallest channel section, and at a maximum equal to the hydrograph time step.

Selected Manning's roughness parameters must be in accordance with the values/approaches set out in Appendix C.

4.6 Reservoir Routing

When calculating orifice discharge, the available head in the orifice equation shall be based on the maximum water level less the greater of the centroid of the orifice or downstream ponding elevation including depth of flow in the discharge pipe or channel.

Where routing is applied, the technical report should discuss the method of routing used and assumptions made in determining routed flows. A stage – storage – discharge table must be included and contain the elevations of the outlet and emergency spillway.

Ponds that are designed to provide both quality and quantity control must have stacking storage. The quantity control storage begins above the quality requirements for extended detention.

5.0 Design of Stormwater Management Systems

The Stormwater Management Planning and Design Manual (MOE 2003) and Low Impact Development Stormwater Management Design Guide (CVC/TRCA 2010) provide detailed guidance for the design of stormwater management (SWM) systems. The minimum criteria for the design of SWM systems, as outlined in the Planning and Design Manual must be met. Additional SWM system design requirements and information are provided in the following sections.

5.1 Low Impact Development (LID)

Design of LID's are to be undertaken in accordance with the LID SWM Guide, as well as with applicable Ministry of the Environment, Conservation and Parks (MECP) documents and are to incorporate all appropriate factors of safety. SWM submissions to CLOCA must show that every possible effort has been made to follow the LID approach by incorporating lot level and conveyance controls.

CLOCA may allow the wet pool and extended detention volume of end-of-pipe water quality control facilities to be reduced if sufficient LID measures are incorporated in the design and approval is obtained from MECP and the local municipality. The types of LID's that could be used for this purpose

are infiltration systems (trenches / galleries) and filtration systems (bioswales / rain gardens / enhanced swales) that fully meet the requirements listed below. These LID systems are to be accessible on municipal property or within an easement for long term monitoring and maintenance and be designed in such a manner that the original function can be fully restored in the event of failure. Furthermore, the LID would need to be one that provides an enhanced level of treatment, is designed in accordance with the LID SWM Guide and includes any applicable safety factors. The allowable volume reduction will be based on the amount of impervious area tributary to an LID that has been sized to treat the volume of runoff from a 25 mm rainfall event. For example, the total imperviousness of a site is 55% (say 10 ha of a total site area of 18 ha). Of the 10 ha, 3.6 ha drains to an LID and the remaining 6.4 ha is untreated by an LID. In this instance, the level of imperviousness for sizing the wet pond in Table 3.2 of the 2003 MOE SWM Manual and extended detention volume can be assumed to be 35% (6.4 ha represents approximately 35% of the total area of 18 ha).

The MECP, local municipality and CLOCA are to be preconsulted regarding the potential reduction of the size of downstream water quality ponds using LID's. For the initial design of the ponds, during the Functional Servicing Report / Draft Plan Approval stage, it is to be assumed that no reduction of the wet pool volume occurs. However, a condition of draft plan approval could state that the draft plan could be redlined to adjust the size of the pond block because of additional detailed analysis and design.

In addition to the requirements set out in the MOE SWM Manual and LID SWM Guide, LIDs are to be designed with the following information and requirements where applicable:

Table 5-1 Design Requirements for LIDs

Design Element	Requirements
Acceptable Practices	Refer to **Table 2-1** for LIDs accepted as being able to meet design criteria associated with water quality, erosion control or water balance requirements.
Geotechnical & Hydrogeological Considerations	A Geotechnical and/or Hydrogeological report signed and sealed by a qualified licensed professional is required to support any LID design. The report must include soils information, infiltration rate testing details, and seasonal high groundwater levels determined through monitoring wells. Monitoring wells must be installed with automated water level recorder (e.g. levelogger, diver or equivalent). At a minimum, groundwater level monitoring must be completed for one seasonal cycle (one year). At least one monitoring well at a strategic location must be maintained to facilitate monitoring during construction and post project completion, if required by CLOCA.

Design Element	Requirements
Design Infiltration Rate	Design infiltration rate must be determined by in-situ field testing at the location of the proposed infiltration measure (LID). A minimum of one test must be conducted at the bottom elevation of the proposed LID. Additional tests may be required where changes in the soil are observed below the proposed bottom elevation of the LID. <u>Acceptable methods for determination of infiltration rate:</u> • Guelph or Borehole Permeameter • Double Ring • Percolation test <u>Unacceptable methods:</u> • Slug test • Grain Size Analysis • Soil textural classification • Other types of infiltration rate testing may be acceptable upon consultation with staff. Testing should occur during periods of seasonally high groundwater. Testing should not occur during a precipitation event, within 24 hours of a significant rainfall event (>15mm depth) or when temperatures are below freezing. A safety factor between 2 to 3 must be applied to the infiltration rate. An underdrain should be provided in all LIDs with an infiltration rate less than 15mm/hr. Note: One-metre separation must be maintained between the bottom of the BMP and seasonally high groundwater level on areas that feed aquifers used to supply drinking water, species-at-risk habitats; and/or Areas of Natural and Scientific Interests (ANSI). Groundwater mounding analysis must be performed in areas where the water level rise below the proposed infiltration system could potentially have adverse impacts on nearby existing or proposed structures and slope stability. Refer to: • Site Evaluation and Soil Testing Protocol for Stormwater Infiltration (Appendix C of Low Impact Development Stormwater Management Planning and Design Guide, 2010). • "Design infiltration rate: LID SWM Planning and Design Guide" Sustainable Technologies Evaluation Program, (accessed 10 Aug 2020) https://wiki.sustainabletechnologies.ca/index.php?title=Design_infiltration_rate&oldid=11005
Design calculations	All sizing & drawdown calculations must be provided. Infiltration practices should be designed to fully drain within 48 hours.

Design Element	Requirements
Design calculations (continued)	Typical Void Ratios: • 0.40 for clear stone • 0.35 for sand LIDs used to meet water balance requirements must be sized to infiltrate the post-development infiltration deficit. The annual infiltration deficit determined through the water balance analysis should be converted to a daily rainfall capture rate for LID design using Figure C.1 in Appendix C.
Design Drawings	The drawings must include detailed cross sections through all LIDs. Drawings must show all LID components and material specifications, elevations, depths, water level and outlet details.
Pre-Treatment	Pre-treatment for infiltration facilities (e.g. via OGS, filter strip, forebay, etc.) may be required depending on the source of water to be infiltrated.
Operation & Maintenance	Inspection, operation, and maintenance requirements for all LIDs are to be documented including at a minimum: • Inspection testing methods & frequency • Field inspection data form or checklist including tolerance limits to trigger maintenance actions • List of maintenance tasks & anticipated frequency • Estimated costs Possible requirements to facilitate inspection & maintenance may include: • An overflow for LIDs in the event of blockage. • Inspection / monitoring wells • Standpipes or manholes connected to sub-drains for inspection and routine flushing • Paths for accessing the LID (width of required maintenance equipment) • Easements and/or maintenance agreements • Operations & Maintenance Manual • As-built drawings

LID monitoring requirements	A monitoring plan and program should be developed and submitted for all LIDs to CLOCA's satisfaction. CLOCA's recommended monitoring objectives are outlined below. <u>Monitoring Strategy</u> • LIDs must be inspected during installation as well as post-construction. Details of the LID installation/construction must be provided to CLOCA following construction and shall be included in the final monitoring report. • Monitoring port(s) should be installed within the LID if feasible to monitor the water level such that the infiltration rate of the native soils and draw down time of the facility can be confirmed. Continuous monitoring is preferred. • In some instances, flow monitoring equipment is required where access to the LID is not possible. • The flow/water level data should be reviewed in conjunction with rainfall data. CLOCA may operate a rain gauge near the site. Please contact staff to determine if a CLOCA rain gauge is suitable to the monitoring program. Alternatively, a rain gauge can be installed by the consultant. <u>Timing</u> • Performance monitoring should start after 90% of the lots/development have been constructed, graded, and sodded within the facility's catchment area. • The facilities must be monitored for 2 years with the occurrence of 2 rainfall events >25 mm in 4 hours and 4 events >15 mm within 24 hours. An additional year of monitoring may be required if the above noted events do not occur during the 2 year monitoring period. <u>Results</u> The resulting performance monitoring data shall be analyzed to assess the following in comparison to the approved design: • Fluctuation in the flows in response to rainfall events • Facility draw down time • Volume of water that has infiltrated during draw down A monitoring report must be submitted to CLOCA during each year of monitoring. A final monitoring report will also be required following completion of the monitoring program.

5.2 Stormwater Management Facility Design

In addition to the MECP requirements, SWMFs are to be designed with the following information and requirements where applicable:

Table 5-2 Design Requirements for SWMFs

Design Element	Requirements
Location / siting	SWM ponds and associated grading must be sited in conformity with. or designed to exceed, the minimum standards contained in the Provincial Policy Statement, 2020, Provincial Land Use Plans (Oak Ridges Moraine Conservation Plan, Greenbelt Plan, Growth Plan, CTC Source Water Protection Plan), Regional or Local Official Plans. SWM ponds and associated grading must be located outside of the following: • Regional or 1:100 year flood plain where quantity control features are proposed • 25 year floodplain where facilities are proposed for water quality only • Erosion hazard limits • Natural heritage features and systems • Hydrologic features and systems • Watercourse meander belts and riparian corridors • Unstable slopes and areas susceptible to erosion; and • Setbacks and Minimum Vegetation Protection Zones associated with the above features, established on a site specific basis. In an exceptional circumstance where the facility location is proposed within the floodplain, the proponent should pre-consult with CLOCA staff to determine the acceptability of the location, and any other required design constraints such as, but not limited to: • Applicable land use planning policy would enable the consideration of the proposed location • No loss of floodplain storage, taking into consideration cumulative impacts • No obstruction to flood flows • No negative impacts on the fluvial processes in the floodplain • No impact to natural heritage and hydrologic features and systems and natural hazards.
Major Flows	Major flow should bypass ponds that only provide stormwater quality control to avoid resuspension of accumulated sediment and pollutants. Major flows directed into quantity control ponds must direct flows to the main cell of the SWM pond.
Pond Stacking	Ponds that are designed to provide both quality and quantity control must have stacking storage. The quantity control storage begins above the quality requirements for extended detention.

Design Element	Requirements
Freeboard	A minimum 0.3m freeboard is required above the maximum emergency spill elevation to the top of the pond berm.
Outlet	SWMF outlets must be located above the 2 year floodplain elevation. Generally, the outlet headwall is to be located outside of the setback to the watercourse, all natural heritage features and the Erosion Hazard Limit. CLOCA is to be pre-consulted prior to designing an outlet headwall that encroaches into these features.
Emergency Overflow	The emergency overflow spillway / weir is to be designed to convey the uncontrolled one in 100-year peak flow. Detailed design calculations are required as well as a detail of the weir on an appropriate engineering drawing. In instances where an overland overflow is not feasible, an intake structure must be designed assuming 50% blockage of the inlet grate.
Erosion Protection	Erosion protection details are required on the drawings for Overland Flow Routes, Emergency Overflow Weirs / Spillways, and Pond Inlets / Outlets. Calculations are required in the SWM Report to support the erosion protection material, configuration, sizing, and depth.
Vegetation Planting	A planting plan is required for the SWM facility and outfalls. • The planting strategy is to consider safety, aesthetics, shading, and enhanced pollutant removal. • All facilities must use native plants and non-invasive species only.
Geotechnical, Hydrogeological, and Structural Design	A Geotechnical report is required to support the SWM facility design, location, configuration, water levels, berms, slopes, retaining walls, clay liners, and anti-seepage collars (where applicable). Hydrogeological and Structural design recommendations, details and reports are to be provided as necessary to support infiltration, seasonal high groundwater level, groundwater impacts (to / from facility), and structural components. All supporting design information and reports are to be signed and sealed by a qualified licensed professional (i.e. P.Eng. or P.Geo.)
Berm & Slope construction	Notes on the construction of the SWM pond berms and slopes must be provided on the detailed design drawings (i.e. acceptable soils with low permeability to be used, inspection by a geo-technical engineer and compaction %). These notes are required for both the permanent stormwater management facilities and the temporary sediment ponds where a berm is required to form the facility.

Flood Control Facilities (FCF)	The use of FCFs to control Regulatory peak flows for the purposes of floodplain mapping will only be considered through a rigorous consultation process with the Authority. FCFs are to be designed in accordance with the Lakes and Rivers Improvement Act (LRIA) standards for small dams: • The design must consider the Probable Maximum Flood (PMF). A lower inflow design flood than the PMF may be acceptable provided an assessment of the losses in the event of a dam failure is undertaken in accordance with the 2011 MNRF Technical Bulletin for Classification and Inflow Design Flood Criteria (pages 10-11). The assessment will need to show that a lower IDF is appropriate. • A geotechnical analysis is required to confirm existing/proposed slopes will remain stable during saturated conditions. The analysis must consider the inflow design flood (PMF) in accordance with the LRIA. • Outlet pipes through the existing/proposed slopes must be fitted with anti-seepage collars to inhibit flow of water and possible movement of soil or piping along the outside of the pipe. • The emergency spillway must be designed to safely convey the inflow design flood (PMF) away from the facility. • A minimum freeboard of 0.3m is required above the maximum spillway flow depth based on the inflow design flood (PMF). • A comprehensive long term operations and maintenance program for the FCF must be developed to ensure the facility is maintained in good order.
Design Drawings	The detailed SWM design drawings must include detailed cross sections through the facility, control structure and outfall. Drawings must show the maintenance access, erosion protection, and outlet details.
Operation & Maintenance	An Operations & Maintenance Manual must be prepared for SWM facilities in accordance with the MOE SWM Manual (2003).

5.3 Parking Lot, Underground and Rooftop Storage

CLOCA does not encourage the use of parking lot, underground and rooftop storage for stormwater management because of the potential for flood damages and because the continual functioning of such devices cannot be guaranteed. Through normal operating conditions, parking lot, underground and rooftop storage expose the site owner, Municipality, and Conservation Authority to potential liability for property damage. Additional liability may be incurred should the site owner remove control structures, which could cause flooding and erosion problems downstream.

Typically, design ponding values do not accurately represent anticipated ponding depths or flooding frequencies, as the design does not consider impacts of partially blocked grates and outlets, or

localized rainfall patterns such as short duration, intense rainfall bursts typical of summer thunderstorms. Since vehicles may be flooded, with water entering the passenger compartment at depths of less than 0.30m, the use of parking lot storage represents a significant liability risk. Similarly, the retention of stormwater on rooftops increases the potential for property damage.

The developer must be aware of the potential liabilities associated with parking lot, underground and rooftop controls, and that CLOCA or the local municipality will not be liable for any damages related to the installation, operation, modification or removal of proposed parking lot, underground or rooftop controls.

Parking lot, underground and rooftop storage is to be designed with the following information and requirements where applicable:

Table 5-3 Design Requirements for Parking Lot Storage

Design Element	Requirements
Allowable Ponding Depth within Parking Lot	Max 0.3m or in accordance with Municipal standards
Emergency Overflow	An emergency overflow system must be provided to allow all runoff exceeding the 100 year storage to be safely routed from the site to a suitable outlet.
Design Drawings	The following must be shown on the design drawings: • maximum ponding extent • elevation and storage volume at each ponding location • orifice / pipe restrictions, inverts, and design flows

Table 5-4 Design Requirements for Underground Storage

Design Element	Requirements
Design Requirements & Calculations	The design of underground storage facilities must adhere to the following: • Underground storage facilities must be located above the 100 Year Flood Elevation • A Geotechnical and/or Hydrogeologic report signed and sealed by a qualified licensed professional is required to support underground storage facilities. Open bottom systems are encouraged if located above the seasonally high groundwater level. If the facility is to be located below the water table a liner may be required.

Design Requirements & Calculations (continued)	• An emergency overland flow route must be provided to allow all runoff exceeding the 100 year storage to be safely routed from the site to a suitable outlet • All sizing calculations must be provided. Calculations must also be provided confirming the 100 year flows can be captured and conveyed to the storage system.
Erosion and Sediment Control, Construction & Maintenance	Erosion and sediment control measures must be provided to prevent sediment from entering underground storage facilities during construction. Inspection, operation, and maintenance requirements are to be documented including inspection testing methods & frequency, list of maintenance tasks & anticipated frequency Pre-treatment for underground storage facilities is encouraged to ensure the design storage volume does not become reduced due to sediment buildup and to reduce future maintenance requirements.
Design Drawings	The engineering drawings must include detailed cross sections through the underground storage system. Drawings must show all components & material specifications, elevations, depths, maximum water level and inlet/outlet details.

Table 5-5 Design Requirements for Rooftop Storage

Design Element	Requirements
Type	Tamper-proof structures are to be selected wherever possible
Emergency Overflow	An emergency weir overflow or scuppers should be provided at the maximum design water elevation. Splash pads or erosion protection must also be indicated.
Submission Details	Design submissions must indicate: • the type of control to be installed (i.e., product name and manufacturer) • the number and placement of proposed drains and weirs • product specifications showing design release rates for each structure • the maximum ponding depth, drawdown time and detained volume at each structure • total release rate and detained volume for the roof

5.4 Oil/Grit Separators

Oil/Grit Separators (OGS) are to be designed with the following information and requirements where applicable:

Table 5-6 Design Requirements for OGSs

Design Element	Requirements
Acceptable Usage Acceptable Usage (continued)	Oil/grit separators (OGS) will not provide effective removal of nutrients, but may be used as spill controls, pre-treatment devices or as source/end-of-pipe controls (as part of a treatment train approach) for water quality control. They are typically used for small sites or infill development (typically 5 ha or less) where a water quality control pond/wetland is not feasible.
Sizing Criteria	OGS's must be sized for enhanced level water quality protection (80% TSS removal) and to capture and treat a minimum of 90% of the runoff volume that occurs for a site on a long-term average basis.
TSS Removal Efficiency	CLOCA will accept that OGS devices designed as per manufacturer specifications to achieve 80% Total Suspended Solids (TSS) removal, operating alone, can achieve a TSS removal efficiency of 50%. As such, it will be necessary to incorporate a series of BMPs in a treatment train to achieve the required 80% TSS removal rate. In such cases, the total removal rate of the treatment train is based on the removal rate of the second BMP applied to the fraction of the TSS load remaining after the runoff has passed through the first BMP. Removal rates for various stormwater practices is provided in Table 5-7 below.

Table 5-7 Removal Efficiencies for Various Stormwater Practices

Stormwater Practice[1]	TSS Removal Efficiency (%)
Bioretention	80
Permeable Pavement	80
Infiltration Systems	80
Vegetated Filter Strips	30
Enhanced Swales	80
Sand or Media Filters	75
Wet Retention Ponds	80
Dry Detention Ponds	60
Constructed Wetland	80
Oil Grit Separator	50

[1] Stormwater practices must be designed to treat the 25mm storm in accordance with the MOE SWM Manual, 2003 to achieve the listed removal efficiency. Similarly, LIDs must be designed in accordance with the LID SWM Guide.

<table>
<tr><th>Design Element</th><th>Requirements</th></tr>
<tr><td>TSS Removal Efficiency (continued)</td><td>
Higher removal efficiency claims (> 50%) may be considered if they are supported by the Canadian Environmental Technology Verification (CETV) Program or have obtained verification through the New Jersey Corporation for Advanced Technology (NJCAT) and certification by the New Jersey Department of Environmental Protection (NJDEP).

An example of how the total TSS removal rate should be calculated for a treatment train is provided below the table.

<u>TSS Removal Rate Calculations</u>
Equation for total TSS removal rate (R) for two BMPs in series:

R = A + B – [(A X B) / 100]

Where:
R = Total TSS Removal Rate
A = TSS Removal Rate of the First or Upstream BMP
B = TSS Removal Rate of the Second or Downstream BMP

Example of tabular TSS removal rate calculation:

<table>
<tr><th></th><th>Starting TSS Load</th><th>Removal Rate</th><th>TSS Removed</th></tr>
<tr><td>OGS</td><td>100%</td><td>50%</td><td>50.0%</td></tr>
<tr><td>Vegetated Filter Strip</td><td>50%</td><td>30%</td><td>15.0%</td></tr>
<tr><td>Infiltration System</td><td>35%</td><td>80%</td><td>28.0%</td></tr>
<tr><td></td><td></td><td>Total TSS Removal</td><td>93.0%</td></tr>
</table>
</td></tr>
<tr><td>Particle Size Distribution</td><td>
The particle sizing distribution used to size an OGS should be a fine distribution similar to the MOE's particle size distribution unless a different PSD is required in accordance with the unit's performance certification.

Table 5-8 MOE Particle Size Distribution
<table>
<tr><th>Particle Size (µm)</th><th>% of Particle Mass</th></tr>
<tr><td>< 20</td><td>20</td></tr>
<tr><td>20 – 40</td><td>10</td></tr>
<tr><td>40 – 60</td><td>10</td></tr>
<tr><td>60 – 130</td><td>20</td></tr>
<tr><td>130 – 400</td><td>20</td></tr>
<tr><td>400 – 4000</td><td>20</td></tr>
</table>
</td></tr>
</table>

Reporting Requirements	The specifications of any OGS models proposed for a development must be signed and sealed by a Professional Engineer. The required submission of information for review and approval by CLOCA must include design computations documenting the estimated performance, supported with well documented sizing (computer modeling) program, CADD details and maintenance requirements. The OGS make and model specified on the approved Stormwater Management Report cannot be substituted with an “equivalent” model later i.e. OGS notations including "or approved equivalent" will not be accepted on the drawings.

6.0 Submission Requirements

Thorough and concise submissions allow for effective and timely responses and are of benefit to the proponent and the review agency. It is essential that submissions provide all the information necessary and in an appropriate format to allow for a complete review, thorough understanding, and appropriate response. The following sections describe the submission requirements for an effective approval process. Submissions that lack clarity or complete information extend the review process and will require additional submissions to complete the approval process.

Technical reports are to be prepared in such a manner that they are considered 'stand-alone', such that the entire work can be recreated by any qualified person without the need to refer to any other material. Further, any qualified person (i.e. P.Eng. or C.E.T.) must be able to recognize and understand all the methods, approaches, basic data, and rationale used in the design calculations. Apart from proprietary models, equations are required for all provided calculations. All model input and output files are to be provided in hard copy in the report and in digital format on a CD / DVD or digital storage device that has been labelled and dated. All rainfall files are also to be provided in digital format on CD / DVD or digital storage device. All formulas and values used by the program must be clearly identified in the report. Supporting calculations are to be provided in the report.

A complete set of engineering drawings and Stormwater Management Report outlining all the proposed works must be circulated to CLOCA. Final reports, engineering plans and drawings must be signed and sealed by a Professional Engineer registered with Professional Engineers Ontario. A complete Stormwater Management Report will also include, at a minimum, all items listed Appendix A – Stormwater Management Checklist. CLOCA reserves the right to return the submission if it is incomplete. Application re-submissions shall include an itemized response letter outlining how each comment has been addressed.

6.1 Study Requirements for Different Planning Stages

The following table provides direction on the required study contents for various stages of the planning process from a Stormwater Management perspective. The table does not include requirements related to planning, hydrogeology, natural heritage, municipal or regional matters. If any of the study components from a higher level stage were not completed for some reason, they will need to be completed at the current stage.

Table 6-1 Required Study Contents

Planning Stage	Required Studies	Required Study Contents
Official Plan Amendments, Secondary Plans	Sub-watershed Study	• Regional/Regulatory flood impact assessment • Peak flow targets • Water quality targets • Design criteria for erosion control • Water balance targets • Baseflow and temperature targets/ recommendations • Hydraulic analysis & floodplain mapping for unmapped tributaries (typically areas with drainage areas <125ha) • Meanderbelt assessment (if applicable) • Stable top of slope delineation (desktop exercise) • New road crossing evaluations / checklists (hydraulics, fish passage, wildlife passage, etc.)
Block/ Neighbourhood Plans	MESP / MDP	• SWMF locations & approximate sizing • LID strategy • Conceptual Grading and Servicing Study which identifies required services / improvements to municipal infrastructure required to support development
Draft Plan of Subdivision, Zoning By-law Amendments, Consents (Severances)	FSR	• Top of bank staking / slope stability analysis • Minor & major flow routes identified, and capacities verified • Preliminary sizing for SWM Facility • SWM outfall locations (may require site walk with approval agencies) • LID siting, footprints, soils and infiltration values, and preliminary sizing

Plan of Subdivision, Site Plans	SWM Report	• Detailed SWMF design • Detailed LID design • Floodline alteration (cut and fill) detailed submission to support red-line amendments to draft plans or site plan approval
	SWM Brief	• Detailed BMP design (SWMFs, LIDs, OGS, etc.)
Minor Variances, Single Lot Residential Development (<0.5ha)		Study requirements are site specific and may include the above studies

6.2 Vertical Datum

The Canadian Geodetic Vertical Datum of 2013 (CGVD2013) is now the new reference standard for heights across Canada. This height reference system replaced the Canadian Geodetic Vertical Datum of 1928 (CGVD28). More information can be found at the Natural Resources Canada website: https://www.nrcan.gc.ca/height-reference-system-modernization/9054

CLOCA has begun adopting the new datum moving forward for floodplain mapping updates. For clarity, all drawings which include contour/elevation data or floodlines must state the vertical datum used.

Adjustments between elevation data sets is acceptable where different datum are used. The methodology used to adjust the data must be fully documented. One acceptable method is to use the Ministry of Natural Resources and Forestry's (MNRF) provincial geodetic control database for Ontario to compare different datum at any benchmark location throughout CLOCA's jurisdiction. The offset difference between the different datum can then be applied to convert one of the sets of elevation data.

The MNRF Control Survey Information Exchange (COSINE) database is available online: http://www.gisapplication.lrc.gov.on.ca/cosineONT/Index.html?site=cosine&viewer=OntarioViewer&locale=en-US

6.3 Subcatchment Delineation – Internal & External Drainage Areas

Provide internal and external drainage plans with boundaries for pre and post development conditions based on field reconnaissance supplemented through the use of topographic maps and aerial photo interpretation.

Sources must be provided for all topographic information used in the analysis. Reference information should include the: map title, author, publisher, scale, vertical datum source, publishing date and flown date, or surveyor name and survey date.

Watershed points of interest must be included in the discretization scheme (i.e. ponds, road crossings,

railways). CLOCA's watershed boundaries and subwatershed boundaries, as developed in CLOCA hydrologic models, shall be provided in PDF format upon request.

6.4 Floodplain Mapping

Complete Floodplain Mapping submissions must include the following.

Topographic Mapping:

- Floodplain mapping should be shown on scalable topographic mapping with 1 meter contour intervals for the full floodplain mapping reach.

- The source (company, date, method, benchmark/datum, etc.) of the topographic mapping must be stated on the plan.
- The mapping should show features by air photo or definition of features including all structures, watercourse crossings, vegetation, etc.
- The mapping must include a key plan, north arrow, date, engineers name/stamp, project title, and legend.

When submitting floodplain mapping the following information is required:

- Explanation of how the starting water level was determined.
- A description and/or tables of flow values to explain how/where flow values utilized in the model were determined.
- Scalable topographic maps (one for existing conditions, one for proposed conditions) showing contours and grading, cross-sections, and flood lines.
- Complete and labeled cross-sections with flood elevations
- Both 100 year and Regional storm floodlines (clearly labelled) for regulatory floodline mapping, and clearly labelled return period storm floodlines where required
- Hard copy and electronic files of the input and output for existing and proposed conditions

Other considerations:

- Where two sources of base mapping are to be used (i.e.: survey data and topo maps), a thorough comparison of the two datasets must be completed to verify that the sources are compatible.
- Floodplain mapping reaches must extend well beyond the study site and include any downstream obstructions such as roadways and culverts that may affect the flood elevation of the study area.
- The floodplain mapping must NOT include proposed grading or fill placement, unless the natural floodline is clearly shown, and the altered floodline, grading, and filling are all very clearly shown and labelled.

6.5 Cut and Fill

Hazard lands, including defined valleys, riverine meander belts, and floodplains, are not suitable for development. Development applications should clearly delineate hazard features and demonstrate that the development is wholly outside of the hazard limits. In rare instances, the floodline along a development boundary is irregular and makes the optimization of the development lands difficult. In

some of these instances, the floodline can be regularized through a balanced cut and fill operation. A cut and fill operation will only be considered where the development limit is defined by the floodline.

Balanced Cut and Fill is a technique that is used to adjust the shape of the floodplain by altering the shape of the landscape. A cut and fill will transfer floodwaters from one area to another as a result of the manipulation of the land's contours. Achieving a balance of cut and fill is critical to ensure that the grading operation does not cause a detrimental impact on the floodplain. Both flood hydraulics and flood storage must be analyzed to ensure there is no loss of storage and no hydraulic impact. This is achieved by removing a volume of earth at the appropriate elevation and location to compensate for areas within the flood plain to be filled. The suitability of cut and fill operations is extremely site-specific. It should be recognized that in conducting a cut and fill operation, the objective is not to reduce the area of the floodplain, but to change the shape of the floodplain.

In all instances, pre-consultation with CLOCA is required to ensure a cut and fill operation is appropriate. In reviewing applications that will require cut and fill, the following policies will be applicable.

General Balanced Cut and Fill Policies

Any proposals that will require cut and fill operations within the jurisdiction of the Authority and within the flooding hazard limit must be in accordance with the following policies and guidelines and must be to the satisfaction of the Authority.

- The preservation of valleylands, wetlands and natural vegetation must be considered in all proposed cut and fill operations. The proponent must ensure no adverse impact on natural features and functions.
- All cut material shall be required to be moved to an area that is outside of the flood plain.
- The amount of cut material must be equal to or greater than the volume of fill proposed for placement within the flood plain. Cut and fill must be balanced in 0.3 m (1 foot) increments. An excess of cut volume may be permitted at any given increment, however, inadequate cut volume will not be permitted.
- No negative impacts on the hydraulic conveyance capabilities of the watercourse will be permitted. The proposed site grading (cut and fill) must be designed to result in no increase in upstream water surface elevations and no increase in flow velocities in the affected river cross-sections, under a full range of potential flood discharge conditions (1:2 year to 1:100 year return periods and Regional storm); compliance with this requirement shall be demonstrated by means of hydraulic computations completed to the satisfaction of the Conservation Authority.
- Depending on the location of the proposed works, a geotechnical evaluation may be required to ensure the long-term stability of the works.

Cut and Fill Plan Requirements

Compliance with the cut and fill requirements shall be demonstrated by means of detailed plans prepared by a professional engineer which clearly show the existing and proposed grading in plan view and in cross section, accompanied by the designer's computations of the volume of flood plain storage to be displaced by proposed fill and the volume of the compensating flood plain storage to be created by means of the proposed excavation. At a minimum, all plans for cut and fill operations shall contain the following:

- Detailed calculations of total fill volumes and total cut volumes.
- Cross sectional plots to scale showing existing and proposed flood lines and ground areas.
- Detailed contour/topographic plan to scale showing existing conditions and proposed works.
- A hydraulic analysis as deemed necessary by the Authority (i.e. HEC-RAS modelling).
- A geotechnical analysis may be required as deemed necessary by the Authority.
- Sediment control plans and landscape restoration plans

Hydraulic Analysis Requirements

To ensure that there is no significant impact on upstream or downstream flooding and erosion potential, a hydraulic analysis may be required for existing and proposed conditions. The analysis must include the floodplain mapping submission requirements as outlined above.

As Built Grading Plan Requirements

Where site alterations are permitted the proponent shall submit a final as built grading plan immediately upon completion of the approved works. The plan, prepared by a professional engineer or surveyor, shall indicate that the grades achieved on the site do maintain stage storage in conformity with the approved plan and provide appropriate flood protection for new development.

7.0 Climate Change

The Ontario Climate Consortium (OCC) completed a climate modeling exercise to update climate projections for the Region of Durham. The study provided projections of the climate that Durham Region will experience in the short (2011-2040), medium (2041-2070) and long term (2071-2100) compared to the baseline period of 1971-2000. Details of the analysis are documented in a "Guide to Conducting a Climate Change Analysis at the Local Scale: Lessons Learned from Durham Region" prepared for the Regional Municipality of Durham by OCC (February 14, 2020).

The analysis conducted by OCC demonstrated that Durham Region will likely experience a warmer and wetter climate, with a longer growing season. More variable weather patterns and higher intensity storms with greater amounts of precipitation in all seasons is also anticipated. This is expected to have implications on urban and riverine flooding, natural hazard areas, water quantity and quality, terrestrial and aquatic habitats, and flora/fauna species. CLOCA is committed to preparing for the impacts of a changing climate on our watersheds by:

- Promoting conservation of headwaters, wetlands, forests, and areas of natural cover.
- Reviewing land use plans and development proposals to ensure development is directed away from areas susceptible to flooding and erosion.
- Promoting the use of Green Infrastructure and Low Impact Development (LID) to reduce runoff, prevent flooding and protect water quality.
- Continually considering and integrating climate change adaptation strategies where appropriate into its policies and programs.

CLOCA may require any of the following climate change considerations be incorporated into development applications:

- Climate change sensitivity analyses
- Climate change risk evaluation associated with natural hazards
- Flexible design approaches
- Allocation of land and/or easements to accommodate future stormwater management measures
- Provisions for freeboard/buffers (horizontal and vertical)
- Application of a climate change factor of safety to stormwater management designs.
- Pre- or post-construction monitoring

APPENDIX A
STORMWATER MANAGEMENT CHECKLIST

Central Lake Ontario Conservation

GENERAL

☐ Site Description

- Location – nearest roads, watershed & subwatershed
- Existing Conditions – land use on site & surrounding areas
- Proposed Conditions
- Drainage Area – for the site, tributary & watershed
- Watercourses, Wetlands - present on site, and type (permanent or intermittent)
- Drainage patterns and ultimate drainage location/outfall

☐ Background Information

- Previous Reports and Relevant SWM Requirements
- Existing Models
- Geotechnical Report

☐ Figures

- Location Plan
- Pre-Development Drainage Area Plan (include topography, external areas)
- Post Development Drainage Area Plan (include topography, external areas)
- Proposed SWMF locations
- Proposed Site Plan – grading and servicing
- Erosion and Sediment Control Plan

QUANTITY CONTROL

- ☐ Criteria Outlined
- ☐ Runoff Coefficient
- ☐ Pre-Development Peak Flow (m^3/s)
- ☐ Post Development Uncontrolled Peak Flow (m^3/s)
- ☐ Post Development Controlled Peak Flow (m^3/s)
- ☐ Facility Type

QUALITY CONTROL

- ☐ Level of Protection
- ☐ Drainage Area to Facility (ha)
- ☐ Percentage Impervious – total and directly connected

☐ SWM Facility Monitoring and Maintenance Requirements
☐ Facility Type

WATER BALANCE / GROUNDWATER

☐ Soils / Hydrogeology Report
☐ Groundwater Elevations
☐ Pre & Post Development Water Budget
☐ Special Construction Considerations and Recharge Measures
☐ Infiltration testing to support LID implementation

CONSTRUCTION EROSION & SEDIMENT CONTROL

☐ Erosion & Sediment Control Plan
☐ Temporary Erosion Controls
☐ Sizing of Sediment Basins and details
☐ Rock check dam locations and details
☐ Silt fence location and details
☐ Outlet location
☐ Sequencing and Maintenance/Inspection schedule

HAZARD LAND MANAGEMENT

☐ Flood lines shown on plans (include topography and geodetic datums, labelled cross-sections)
☐ Valley top of bank, stream erosion, and steep slope allowances assessed (confined stream systems only)
☐ Meander belt defined (in unconfined stream systems only)

HYDROLOGIC ANALYSIS

☐ Digital Hydrology Model and associated rainfall input
☐ Schematic representation of pre and post development hydrologic models
☐ Hydrology Summary Output for pre and post development conditions
☐ Hydrology Detailed Output for one scenario

HYDRAULIC ANALYSIS

- ☐ Digital Hydraulics Model
- ☐ Text describing all the geometry and flow option included with the model
- ☐ Text describing any changes that have been made to a CLOCA supplied model
- ☐ Drawing showing the location of all sections in relation to the subject property
- ☐ Hydraulics Summary Output Table – Section Number, Flow, Water Surface Elevation

STORMWATER MANAGEMENT SYSTEMS

A) Low Impact Development

- ☐ Required storage volume for infiltration
- ☐ Sizing calculations as per MOE and LID Manuals
- ☐ Dimensions, elevations, cross-sections / profile, material specifications
- ☐ Soils information & seasonal groundwater elevations
- ☐ Operations & maintenance plan
- ☐ Monitoring Plan

B) Stormwater Management Facility

- ☐ Permanent Pool Storage Requirements
- ☐ Permanent Pool Volume Provided
- ☐ Forebay Depth
- ☐ Forebay % of Total Facility Area
- ☐ Side Slopes above Permanent Pool
- ☐ Side Slopes below Permanent Pool
- ☐ Permanent Pool Depth
- ☐ Length to Width Ratio
- ☐ Extended Detention Storage Requirements
- ☐ Extended Detention Volume Provided
- ☐ Extended Detention Depth
- ☐ Drawdown time (hrs)
- ☐ Total Quantity Storage Required
- ☐ Total Quantity Storage Provided
- ☐ Outlet Design

- ☐ Stage – Storage – Discharge
- ☐ Emergency Overflow Weir Design
- ☐ Capacity of Overflow Weir
- ☐ Design of Overflow Weir
- ☐ Geotechnical Considerations (Groundwater impacts, Liner & Berm Construction Requirements)
- ☐ 0.3m of free board
- ☐ Planting Plan

C) OGS

- ☐ Approved Manufacturer
- ☐ Model Number
- ☐ Sizing Calculations Included
- ☐ TSS Removal (%)
- ☐ Annual Runoff Treated (%)

OTHER

- ☐ All engineering drawings must be included
- ☐ Rainfall Data
- ☐ Storm sewer design sheets
- ☐ Storm sewer design drainage plan, showing areas and runoff coefficients
- ☐ All reports and plans signed and sealed

APPENDIX B
WATERSHED CRITERIA

Stormwater Criteria for CLOCA'S Watershed

Watershed	Master Plans	Hydrology	Floodplain Mapping	Water Quantity	Water Balance	Stream Erosion
Lynde Creek	Lynde Creek Master Drainage Plan Update (AECOM, ongoing study) Lynde Creek Watershed Plan (CLOCA 2020) Brooklin Secondary Plan, Stage 3 Final Report (Candevcon, 2018) Town of Whitby Stormwater Quality and Erosion Control Enhancement Study (MMM 2001) Lynde Creek Sub Tributary MDP (Sernas 2001) Lynde Creek Water Resource Management Strategy (Gartner Lee 1994) Brooklin Master Drainage Plan (Cosburn Patterson Wardman 1992)	Hydrologic Modeling for Lynde Creek (CLOCA, 2010)	Flood Plain Mapping - Lynde Creek Watershed (Earth Tech, 2008)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans. Quantity Control (2-100 year storm) not required south of Dundas Street (refer to Lynde Creek MDPU for further details).	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Oshawa Creek (Including Goodman and Montgomery Creeks)	Two-Zone Floodplain Mapping and Flood Mitigation Study (Greck 2020) Oshawa Creek Watershed Plan (CLOCA 2020) Kedron Part II Planning Area Master Environmental Servicing Plan Addendum (Candevcon 2019) Brooklin Secondary Plan, Stage 3 Final Report (Candevcon, 2018) Northwood Business Park Master Stormwater Management Plan (Greck 2016) Oshawa Creek Watershed Management Plan (CLOCA 2002)	Oshawa Creek Hydrologic and Hydraulic Modeling (CLOCA 2014)	Oshawa Creek Floodplain Mapping (CLOCA 2014) Two-Zone Floodplain Mapping and Flood Mitigation Study (Greck 2020)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans. Northwood Business Park: No flood controls are required for the regional storm event. On Goodman Creek, post development flows are to be controlled to pre-developed levels for the 1-100 yr design storms. The 100 year flow control target is 44.9 L/s/ha. No flood controls are required for the main branch of Oshawa Creek.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge. Zero discharge permitted for the first 7mm of rainfall amount (stormwater runoff) from all developed (impervious) areas for Northwood Business Park, as per Master Plan.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans Northwood Business Park: For sites smaller than 5 ha from all developed (impervious) areas, zero discharge for the first 15mm of rainfall amount (stormwater runoff) or cash in lieu. For sites greater than 5ha from all developed (impervious) areas, 24-48 hour extended detention storage for the first 25mm of rainfall amount (stormwater runoff).

Stormwater Criteria for CLOCA'S Watershed

Watershed	Master Plans	Hydrology	Floodplain Mapping	Water Quantity	Water Balance	Stream Erosion
Bowmanville & Soper Creeks	Soper Creek Main and East Branches Subwatershed Study (Aquafor Beech, ongoing study) Bowmanville / Soper Creek Watershed Plan (CLOCA 2020) Brookhill Neighbourhood Subwatershed Study (Aquafor Beech, 2005) Northwest Bowmanville Master Drainage Study, Update for Jackman Creek Tributary (Sernas, 1996) Master Drainage Plan for West Branch of Soper Creek (MMM, 1991) Northwest Bowmanville Master Drainage Study (Sernas, 1989) Northeast Bowmanville Stormwater Management Report (Sernas, 1991)	Hydrologic Modeling for Bowmanville & Soper Creeks (CLOCA, 2011)	Bowmanville Creek and Soper Creek Floodplain Mapping Study (Aquafor Beech, 2009)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans: Bowmanville Creek Main Branch - Quantity control not required	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans Brookhill Tributary – Distributed Runoff Control (DRC) approach as outlined in the MOE SWM Manual (2003) must be used to provide erosion control within stormwater ponds.

Stormwater Criteria for CLOCA'S Watershed

Watershed	Master Plans	Hydrology	Floodplain Mapping	Water Quantity	Water Balance	Stream Erosion
Black, Harmony, Farewell Creeks	Black / Harmony / Farewell Creek Watershed Plan (CLOCA 2020) Taunton Community Stormwater Master Plan (Sernas, 2004) Harmony Creek Subwatershed Plan Study (Aquafor Beech, 2001) Black Creek Tributary Master Drainage Study (Sernas, 1991) Macourtice Tributary of Black Creek Master Drainage Study (Sernas, 1991) Courtice Stormwater Management Study (TSH, 1991) Harmony Creek Watershed Stormwater Management Study (TSH, 1990) Erosion Control & Bank Stabilization (Simcoe Engineering, 1978) Taunton Corridor Study (Greck & Associates)	Hydrologic Modeling for Black, Harmony and Farewell Creeks (CLOCA, 2015)	Black, Harmony, and Farewell Creeks Floodplain Mapping Study (Aquafor Beech, 2010)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Westside Creek	Master Drainage Study, Westside Creek (Sernas 1992) & Addendums (1997/1998)	Westside Creek Hydrologic and Hydraulic Modeling (CLOCA 2013)	Westside Creek Hydrologic and Hydraulic Modeling (CLOCA 2013)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans

Stormwater Criteria for CLOCA'S Watershed

Watershed	Master Plans	Hydrology	Floodplain Mapping	Water Quantity	Water Balance	Stream Erosion
Pringle Creek	Pringle Creek Master Drainage Plan Update (Candevcon 2018) Brooklin Secondary Plan, Stage 3 Final Report (Candevcon, 2018)	Pringle Creek Master Drainage Plan Update (Candevcon 2018)	Pringle Creek Master Drainage Plan Update (Candevcon 2018)	Control of post-development flows for the 2 through 100 year storm events to pre-development levels for lands north of Highway 401.	For Development Areas > 5ha or located within an identified HVRA or ESGRA; Completion of a hydrogeological and water balance assessment. Mitigate impacts to infiltration in the form of LID measures to match post-development to pre-development recharge. For Development Areas <5ha and not located within an identified HVRA or ESGRA; Retention, detention or infiltration at a minimum, of the first 5mm of runoff from impervious surfaces.	For Development Areas >5ha; Extended Detention of the 25mm rainfall event for a minimum of 48 hours. For Development Areas <5ha; A "best efforts" approach through the implementation of LID measures is recommended to help prevent erosion. See also erosion sites in Master Plan
Tooley Creek	Robinson Creek & Tooley Creek Subwatershed Study (Aquafor Beech, ongoing study) Robinson Creek & Tooley Creek Watershed Management Plan (AECOM, 2011) Clarington Energy Business Park Master Drainage Plan (AECOM, 2011)	Hydrologic and Hydraulic Modeling for Tooley Creek (CLOCA 2012)	Hydrologic and Hydraulic Modeling for Tooley Creek (CLOCA 2012)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Darlington Creek		Hydrologic and Hydraulic Modeling for Darlington Creek (CLOCA 2010)	Hydrologic and Hydraulic Modeling for Darlington Creek (CLOCA 2010)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans

Stormwater Criteria for CLOCA'S Watershed

Watershed	Master Plans	Hydrology	Floodplain Mapping	Water Quantity	Water Balance	Stream Erosion
Corbett Creek	Corbett Creek Master Drainage Plan Update and Floodplain Mapping (TMIG 2020)	Corbett Creek Master Drainage Plan Update and Floodplain Mapping (TMIG 2020)	Corbett Creek Master Drainage Plan Update and Floodplain Mapping (TMIG 2020)	Post-development peak flow rates must not exceed the corresponding pre-development peak flow rates for the 2-year through 100-year design storm events. For redevelopment of existing developed sites, peak flow rates must also be controlled to the capacity allocated to the site in the design of the downstream minor and major drainage systems.	Post-development infiltration is required to match pre-development infiltration with remedial measures. As a minimum, redevelopment sites are required to retain a minimum of 5mm runoff for infiltration, evapotranspiration, or reuse.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Robinson Creek	Robinson Creek & Tooley Creek Subwatershed Study (Aquafor Beech, ongoing study) Robinson Creek & Tooley Creek Watershed Management Plan (AECOM, 2011) Robinson Creek Master Drainage Plan, Sernas, 1993	Hydrologic and Hydraulic Modeling for Robinson Creek (CLOCA, 2010)	Hydrologic and Hydraulic Modeling for Robinson Creek (CLOCA, 2010)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans.	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Bennett Creek	Bennett Creek Watershed Master Drainage Study (TSH, 2008) South Bowmanville Industrial Park Stormwater Drainage Study (Dillon, 1988)	Bennett Creek Floodplain Mapping Update (CLOCA, 2013)	Bennett Creek Floodplain Mapping Update (CLOCA, 2013)	Quantity Control (2-100 year storm) required unless otherwise noted in Master Plans. Within the South Bowmanville Industrial Park Area post-development flows must be controlled to the following release rates: 2-year storm: 25 L/s/ha 100-year storm: 85 L/s/ha	Water balance required for all sites within an HVRA or ESGRA area. Remedial measures are required to match pre- and post- development recharge.	Runoff from a 25mm rainfall event must be retained on site through infiltration, evapotranspiration, reuse, bio-retention, etc. to the maximum extent practical with a minimum of 5mm. Any remaining runoff volume from the 25mm event must be detained on site for 24 to 48 hours. See also erosion sites in Master Plans
Lake Ontario	Lake Ontario Shoreline Hazard Management Plan Update (Zuzek, 2020)					

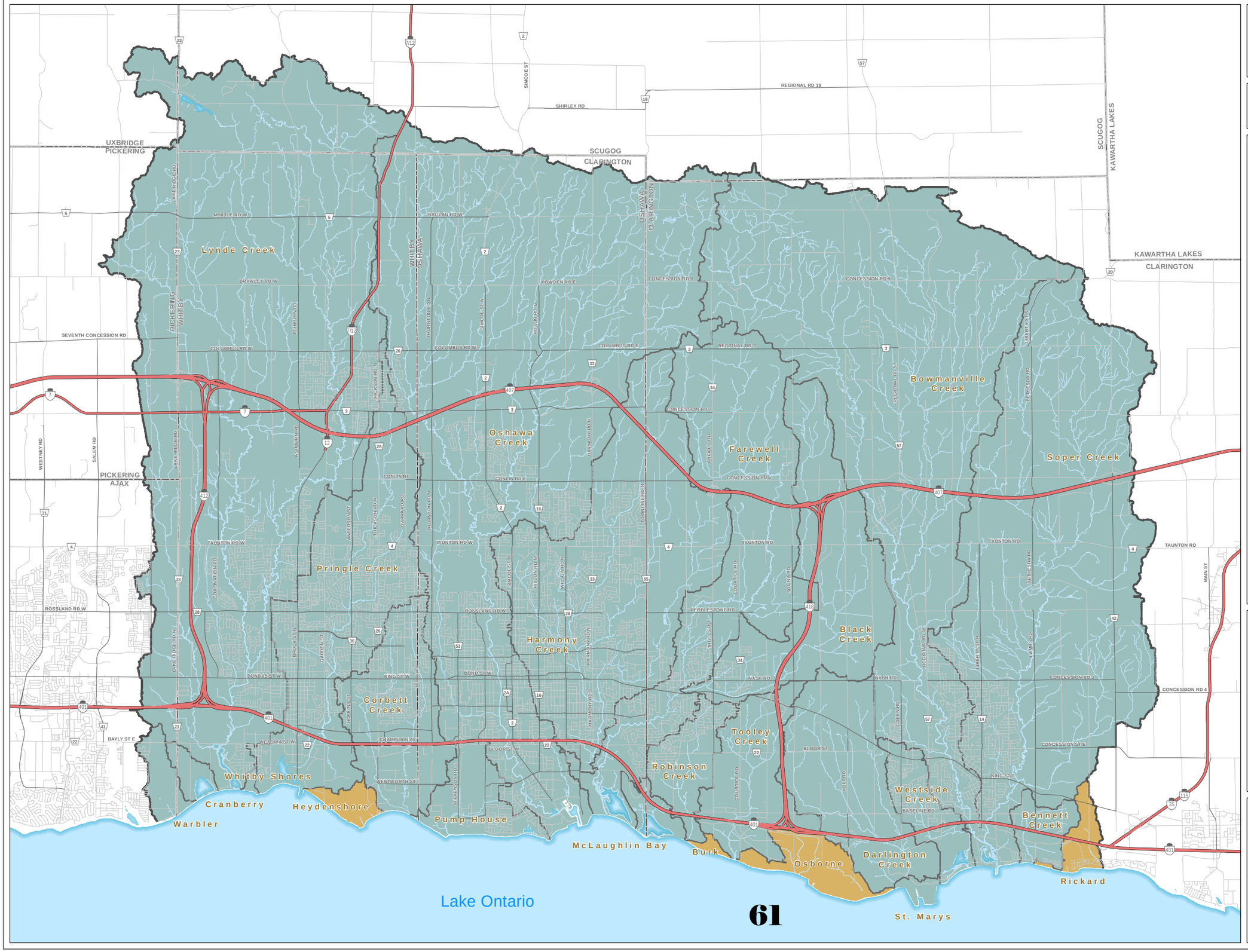
Central Lake Ontario Conservation

Water Quality Criteria

Watershed Name	Level of Protection	Reason
Soper Creek	Enhanced	Cold Water Fish Habitat
		Drains to PSW
Bowmanville Creek	Enhanced	Cold Water Fish Habitat
		Drains to PSW
Westside	Enhanced	Drains to PSW
Darlington	Enhanced	Diverse Fish Species
Tooley	Enhanced	Diverse Fish Species
Farewell Creek	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Black Creek	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Robinson	Enhanced	Diverse Fish Species
Corbett	Enhanced	Drains to PSW
Harmony Creek	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Oshawa Creek	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Goodman	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Pringle Creek	Enhanced	Drains to PSW
Mclaughlin Bay Marsh	Enhanced	Drains to PSW
Lynde Creek	Enhanced	Drains to PSW
		Cold Water Fish Habitat
Warbler Creek	Enhanced	Originates from PSW Coastal wetland at outlet
Pump House	Enhanced	Drains to PSW
Osborne Creek	Normal	Drains directly to Lake Ontario
		More Data Required
Bennett Creek	Enhanced	Cold Water Fish Habitat
Rickard Creek	Enhanced	Connected to Lake Ontario Presence of large riparian wetland near outlet
Cranberry Marsh	Enhanced	Drains to PSW
Heydenshore	Normal	More Data Required
Burk	Normal	More Data Required

The Central Lake Ontario Conservation Authority

Water Quality Criteria



Legend

Water Quality Criteria

- Enhanced
- Normal

Basedata

- CLOCA Scientific Boundary
- Watershed Boundary
- Lake
- Drainage

Transportation Network

- Provincial Highway
- Major Road
- Minor Road

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Kilometres

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Map Compiled by the Central Lake Ontario Conservation Authority,
100 Whiting Ave., Oshawa, Ontario, L1H 3T3

This map is for information purposes only and the Central Lake Ontario Conservation Authority takes no responsibility for, nor guarantees, the accuracy of all the information contained within the map.

Source: CLOCA, 2020; Regional Municipality of Durham, 2020; MNR, 2020.

Projection: NORTH AMERICAN DATUM 1983 UNIVERSAL TRASVERSE MERCATOR (6 DEGREES) PROJECTION, ZONE 17, CENTRAL MERIDIAN (81 DEGREES WEST)

Date Printed: April 27, 2020

Central Lake Ontario Conservation

APPENDIX C
TYPICAL HYDROLOGIC VALUES & SOURCES

Initial Abstraction (I_a) / Depression Storage (DPSI)

Rural / Undeveloped Catchments

Land Use	I_a
Woodlot & Forrest	10
Landfill & Aggregate	10
Pasture/Meadow	8
Crop	7
Greenspace	5
Impervious areas	1.5
Lakes and Wetlands	0

Urban / Developed Catchments

Land Use	I_a / DPSI
Residential	1.5
Industrial & Commercial	1.5
Transportation & Utility	1.5

Manning's n Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. Main Channels			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. Flood Plains			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200
3. Mountain Streams, no vegetation in channel, banks usually steep, with trees and brush on banks submerged			
a. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. Bottom: cobbles with large boulders	0.040	0.050	0.070

B. *Lined or Built-Up Channels*			
1. Concrete			
a. Trowel finish	0.011	0.013	0.015
b. Float Finish	0.013	0.015	0.016
c. Finished, with gravel bottom	0.015	0.017	0.020
d. Unfinished	0.014	0.017	0.020
e. Gunite, good section	0.016	0.019	0.023
f. Gunite, wavy section	0.018	0.022	0.025
g. On good excavated rock	0.017	0.020	
h. On irregular excavated rock	0.022	0.027	
2. Concrete bottom float finished with sides of:			
a. Dressed stone in mortar	0.015	0.017	0.020
b. Random stone in mortar	0.017	0.020	0.024
c. Cement rubble masonry, plastered	0.016	0.020	0.024
d. Cement rubble masonry	0.020	0.025	0.030
e. Dry rubble on riprap	0.020	0.030	0.035
3. Gravel bottom with sides of:			
a. Formed concrete	0.017	0.020	0.025
b. Random stone in mortar	0.020	0.023	0.026
c. Dry rubble or riprap	0.023	0.033	0.036
4. Brick			
a. Glazed	0.011	0.013	0.015
b. In cement mortar	0.012	0.015	0.018
5. Metal			
a. Smooth steel surfaces	0.011	0.012	0.014
b. Corrugated metal	0.021	0.025	0.030
6. Asphalt			
a. Smooth	0.013	0.013	
b. Rough	0.016	0.016	
7. Vegetal lining	0.030		0.500

C. *Excavated or Dredged Channels*			
1. Earth, straight and uniform			
a. Clean, recently completed	0.016	0.018	0.020
b. Clean, after weathering	0.018	0.022	0.025
c. Gravel, uniform section, clean	0.022	0.025	0.030
d. With short grass, few weeds	0.022	0.027	0.033
2. Earth, winding and sluggish			
a. No vegetation	0.023	0.025	0.030
b. Grass, some weeds	0.025	0.030	0.033
c. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
d. Earth bottom and rubble side	0.028	0.030	0.035
e. Stony bottom and weedy banks	0.025	0.035	0.040
f. Cobble bottom and clean sides	0.030	0.040	0.050
3. Dragline-excavated or dredged			
a. No vegetation	0.025	0.028	0.033
b. Light brush on banks	0.035	0.050	0.060
4. Rock cuts			
a. Smooth and uniform	0.025	0.035	0.040
b. Jagged and irregular	0.035	0.040	0.050
5. Channels not maintained, weeds and brush			
a. Clean bottom, brush on sides	0.040	0.050	0.080
b. Same as above, highest stage of flow	0.045	0.070	0.110
c. Dense weeds, high as flow depth	0.050	0.080	0.120
d. Dense brush, high stage	0.080	0.100	0.140

Ref. Hec-RAS User's Manual

Curve Number (CN)

Landuse & Description		Hydrologic Soil Group (AMC II)						
		A	AB	B	BC	C	CD	D
Woods		36	48	60	67	73	76	79
Meadow		30	44	58	65	71	75	78
Open Space/ Pasture		49	59	69	74	79	82	84
Crop		62	68	74	78	82	84	86
Residential	8000m^2, ~ 12% impervious	46	56	65	71	77	80	82
	4000m^2, ~ 20% impervious	51	60	68	74	79	82	84
	2000m^2, ~ 25% impervious	54	62	70	75	80	83	85
	1300m^2, ~ 30% impervious	57	65	72	77	81	84	86
	1000m^2, ~ 38% impervious	61	68	75	79	83	85	87
	<500m^2, ~ 65% impervious	77	81	85	88	90	91	92
Commercial/ Industrial		89	98	92	98	94	98	95
Streets and Roads	Urban Cross-section	98	98	98	98	98	98	98
	Rural Cross-section	83	98	89	98	92	98	93
Impervious Areas		98	98	98	98	98	98	98
Lakes/Wetland/Ponds		50	50	50	50	50	50	50

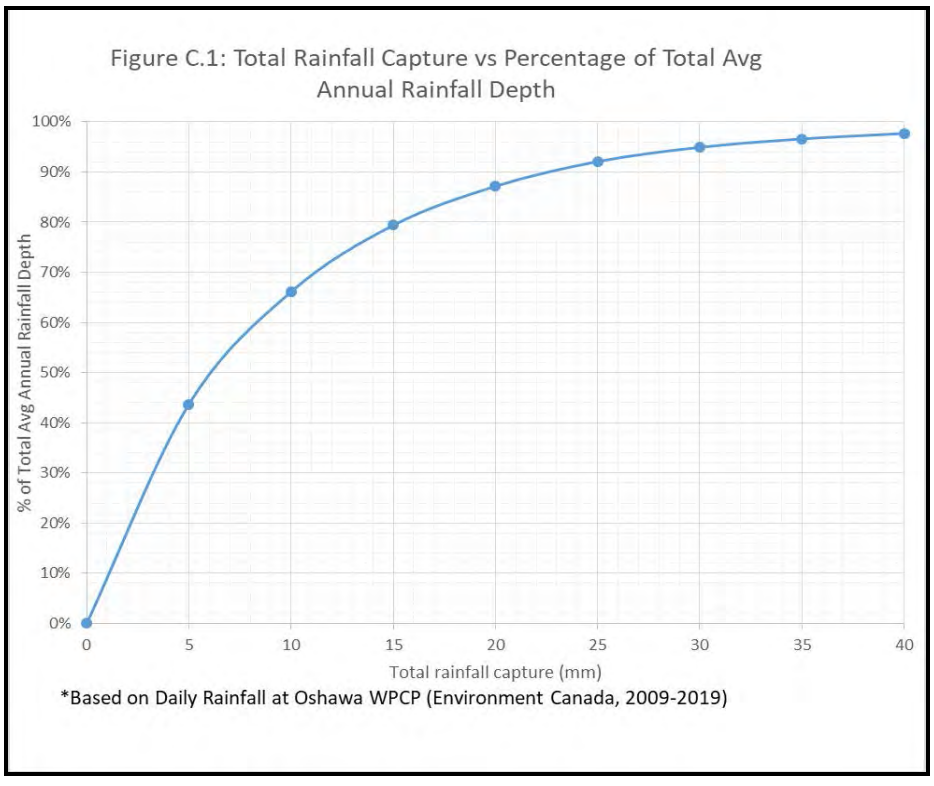
* Adapted from U.S. Department of Agriculture (1986), U.S. Soil Conservation Services (1972) & MTO Drainage Manual (1984)

** CLOCA does not support the use of CN*

Total Impervious / Directly Connected Impervious Values[1]

Landuse	TIMP	XIMP
Parks/Open Space	0%	0%
Low Density Residential	45%	23%
Medium Density Residential	60%	40%
High Density Residential	80%	65%
Industrial / Commercial / Institutional	90%	90%
Urban Residential – Mixed Use	90%	90%
Transportation / Utility – Parking Lot	90%	90%
Transportation / Utility – Corridor	50%	50%
Transportation / Utility – Greenspace	0%	0%
Transportation / Utility – Utility Transfer Station	90%	90%
Landfill / Aggregate	50%	50%
Gravel Areas	90%	90%

[1] CLOCA's typical imperviousness values used for watershed studies



APPENDIX D
CONSULTATION RECORD

Section	Comment	Response
Reviewing Agency: City of Pickering		
5.1	The City of Pickering does not allow the wet pool and extended detention volume of end-of-pipe water quality control facilities to be reduced if sufficient LID measures are incorporated in the design. Suggestion: CLOCA may allow…… with municipal approval, etc.	Comment noted and addressed. Please see updated Section 5.1.
Appendix C	Based on current development applications in the City of Pickering, the total and directly connected imperviousness values provided in the revised guidelines are very low.	Please note the impervious values provided in the guidelines are CLOCA's typical impervious values used for watershed studies. Section 4.4 of the guidelines indicates runoff coefficients for development applications should be based on municipal standards and that runoff coefficients/imperviousness may need to be verified against the proposed landuse. The guidelines only indicate calculated total imperviousness values used must not be lower than CLOCA's typical impervious values used for watershed studies (Appendix C). As such, the values in the table remain unchanged.
Reviewing Agency: LSRCA		
Section 4.6, 3rd Paragraph	Typically quantity control is above the permanent pool. Extended detention is still active storage and provides routing for quantity control. Stage Storage Discharge curves/calcs generally incorporate the extended detention and 2-100 controls.	Section 4.6 references CLOCA's stacked storage policy which requires the quantity control storage volume to be 'stacked' above the extended detention volume. In other words, the extended detention volume cannot be counted towards the required quantity control storage volume. This requirement has been in place at CLOCA for many years. At this time, there is no intent to revise it.
Reviewing Agency: KSGS Consulting		
Section 2.1	Would retention of the runoff from a 25mm storm mean that there would be no need for extended detention in an end of pipe SWM facility. Most developments would over control on site to allow road runoff without retention. Would the road runoff still need to be subject to extended detention?	Retention of the full 25mm storm may eliminate the need for extended detention in an end of pipe SWM facility - if the design fully meets all requirements in the guidelines, and if approval is obtained from the local municipality and MECP. It is not possible to provide 25mm retention through infiltration with uncontrolled road runoff. All site runoff from a 25mm event would need to be retained on site. It is possible, however, that over control within a SWM pond would be acceptable to allow road runoff to drain uncontrolled.
Section 2.4, 1st Paragraph	The way I read the need for a water balance, it is only with areas of HVRA and ESGRA. All other areas would not require a water balance. Was this the intent?	Yes, currently only developments with an HVRA or ESGRA designation on all or a portion of the property are required to complete a water balance.
Section 2.4, 3rd Paragraph	When is this requirement triggered? The way it is phrased does not make it seem like it is explicitly required. May want to revise wording. Or include verbiage to state that consultation is required with CLOCA.	Main trigger is the permeability of the layer below the infiltration system, which is determined by borehole information and substantiated by infiltration testing. Paragraph has been rephrased for clarity.
Section 4.6, 1st paragraph	Should it not read "lesser of"	Agreed, wording was unclear and has been modified to: *"When calculating orifice discharge, the available head in the orifice equation shall be based on the maximum water level less the greater of the centroid of the orifice or downstream ponding elevation including depth of flow in the discharge pipe or channel. "*
Table 5-1, Design Infiltration Rate	Guidance on safety factor provided in Appendix C as well. Note below provides reference but not clear as it suggests 2-3 depending on uncertainty of measured design infiltration rate.	Thank-you for pointing this out. The requirement was taken from the new LID wiki guide by STEP. The criteria has been simplified to requiring a safety factor of 2-3 with reference to the web page now been included for further details.
Table 5-2, Outlet	Table 3-3 indicates that outfalls in general should be cited above the 2-year flood elevation	The text has been revised to indicate all outfalls should be above the 2-year flood elevation.
Appendix B, Water Quality Criteria Figure	Wondering if different colour scheme would better differentiate the watershed boundaries.	Agreed, a different colour scheme would better differentiate the watershed boundaries. However, as almost all watersheds require Enhanced control it is not necessary to differentiate between the watersheds. The figure remains unchanged.
Reviewing Agency: Region of Durham		
	Below is a List of comments from Transportation Design and Transportation Infrastructure divisions at the Region of Durham. In general, the technical guidelines are directed to subdivision and commercial development applications. There is some disconnect between the requirements for these types of applications and what is feasible for implementing as part of a road reconstruction or road rehabilitation project. While the Region isn't looking to be exempt from these requirements, we would like to have the understanding from CLOCA that we will work with CLOCA to complete a "best efforts" approach to fulling the requirements of these guidelines.	Please note CLOCA will continue to work alongside the Region of Durham on road reconstruction/rehabilitation projects as it has in the past. A "best efforts" approach from the Region to fulling the requirements of these guidelines will certainly be considered where this is deemed appropriate/necessary.
Section 7.0	1. The Climate Change section (Section 7) refers to the 2014 Climate Change Projection study completed by SENES consultants. Recently, the Region completed a more detailed climate projection study (by Ontario Climate Consortium). These guidelines should refer to this updated study.	Reference to SENES report removed, and recent OCC report is now referenced.

Table 3-1	2. Under the Confined Systems section on page 15 & 16, it would be helpful to have a sketch showing the various dimensions.	Figures have been included as requested.
Table 3-1	3. Could you please provide a definition for Confined Systems and Unconfined Systems.	Definitions have been included as requested.
Table 3-3	4. Under the Siting Outfalls section in the angle of outfall bullet, is there a recommended range (e.g. 30-60 deg.?) between the outfall and the stream?	A recommended range has not been provided in the guidelines, however 30-60 degrees is reasonable.
Table 3-3	5. Under Watercourse Crossings, could you please specify the Natural Features that need to be considered.	"Natural Features" has been revised to "Natural Heritage Features" as defined in the Provincial Policy Statement and CLOCA's Policy and Procedural Document. The intent of the table is to list high level considerations for crossings and not to give an exhaustive list of all possible Natural Heritage Features that may be encountered. A list of some features which may need to be considered has been included, however please note this is not a comprehensive list. Pre-consultation with CLOCA staff is highly recommended. Study by an environmental professional in consultation with CLOCA Planning and Natural Heritage Staff may be required.
Section 2.4	6. Under the Water Balance/Groundwater, there are a significant number of regional roads located within the HVRA and ESGRA areas. Is the Region going to be required to complete a water balance assessment when we are reconstructing or rehabilitating a roadway (typically a rehabilitation includes paved shoulders for cycling)? Since the Region is working within a fixed right-of-way which includes ditches in rural areas, it's usually not feasible to match preconstruction infiltration where a widening has occurred. As noted above, under these scenarios the Region is looking to work with CLOCA for a "best efforts" approach to maximize infiltration.	See response above.
	7. Typically on most Regional Right of Way's there is very little room to implement stormwater controls for both quantity and quality control. While the Region isn't looking to avoid these implementing these controls, we would like CLOCA to recognize the Region will take a "best efforts" approach, where implementing full controls isn't feasible.	See response above.
Table 5-1	8. Where the Region is able to implement controls, the under the groundwater monitoring for LID's, the requirement for continual monitoring for a minimum of one year is of concern. While we understand the need for the monitoring to establish the yearly high water mark, this would typically result in close to a year delay in most projects. Typically we aren't able to establish if LID measures are even feasible until later in the design process, usually closer to time that we're getting ready to go to tender. We would like know if there are any alternatives to see if we can both establish LID measures on our road projects without the year-long study and still achieve minimum ground water separation requirements.	See response above.
Table 5-1	9. Under the LID monitoring requirements, the timing refers to subdivision developments, could you please elaborate if this is needed and timing requirements for road construction projects.	See response above.
Table 5-5	10. Under the Oil/Grit Separator section with the respect to not accepting "or approved equivalent" on drawings. The Region has a concern with this as we are not allowed to sole source products on our tenders or tender drawings. The Region needs to keep the "or approved equivalent" on their drawings to maintain an equitable and open bidding process among the various manufacturers.	See response above.
Table 6-1	11. Under Table 6-1 Required Study Contents. Are the recommendations for road reconstruction projects.	Table 6-1 is intended to inform development applications and not road reconstruction projects.
	12. The report talks about Best Management Practices early in the report, then later changes this to the acronym BMP without defining it.	Section 2.1 now includes the BMP acronym after the full terminology is used.
Table 2-1	13. Table 2-1 Spelling error (Stornwater).	Typo corrected.
Reviewing Agency: Municipality of Clarington		
P. 11	1. Is there a connection between the use of an underground system, storage tanks and impacts to water balance/groundwater?	Unlined (no impervious layer) underground system and storage tanks with overflow systems may be designed to maintain pre-development water balance and/or groundwater recharge.
P. 11	2. In this section, are there any implications or additional study requirements with the high density proposals where underground parking structures are the required - ie centres/corridors - referring to projects lately that speak to a long term permit to take water to be underground parking structure dry?	Yes, Hydrogeological studies are required to provide information on impacts of long-term dewatering activities. This includes estimating the volume of dewatering discharge should determine the impacts to downstream environment, e.g. potential flooding. Also the chemical quality and temperature of discharge water must be considered as this may impact the ecological condition in the receiving area.

P. 17, Siting Outfalls	3. Natural Hazard Considerations -can reference be made to local OP policies that may speak to this?	Section 2 has been revised to note all submissions must meet the requirements of Local Official Plan policies. Second paragraph under Section 3 (Natural Hazard Requirements) has also been revised to indicate hazard limits/setbacks must be delineated in accordance with municipal Official Plans.
P. 17, Siting Outfalls	4. Outfalls adjacent to valleys are generally located within the Open Space which is ultimately transferred to the Municipality. For private outlets, the Municipality typically requires an easement for long term maintenance - is this sufficient? Should outlets in open spaces be avoided where possible?	Siting storm outfalls is very dependent on site specific details, however, CLOCA generally concurs with the requireement for an easement for long term maintenance over private outlest and avoiding outlets in open spaces where possible. No changes to the guidelines have been made at this time.
P. 17, Siting Outfalls	5. There should be reference to EIS and other studies to support/justify location/contstruction details during the development application process.	Requirement for an EIS and/or other study to support/justify the location of the outfall and construction details has now been included in this section.
P. 17, Siting Outfalls	6. There are exceptions to these requirements through the OP.	Section 2 and 3 now references local OP Policies.
P. 20, Section 5.1 - LID	7. The location and type would have to be site dependent and determined by the Municipality.	Noted. The following text was added to the guideline: "and approval is obtained from MECP and the local municipality."
P. 22, Table 5-1 , Operation and Maintenance	8. Depending on the type and location of the LID, this will be difficult for the Municipality to maintain.	Understood. O&M Manual will still be required from consultant.
P. 24, Tabel 5-2, Design Requirements for SWMFs	9. Long term Operation and Maintenance Manuals should be included in these requirements.	Requirement added
P. 24, Tabel 5-2, Location Siting	10. Buffers would be applied in accordance with local OP	Local OP has now been referenced.
P. 26, Section 5.3 Parking Lot Storage and Rooftop Storage	11. Developer/owner shall be responsible for any damages to outletting Municipal infrastruture or property should proposed design fail.	The guidelines discourage the use of these types of systems and includes the following text: *The developer must be aware of the potential liabilities associated with parking lot, underground and rooftop controls, and that CLOCA or Municipality will not be liable for any damages related to the installation, operation, modification or removal of proposed parking lot, underground or rooftop controls.*
Discussion Comments	MOC is interested in adopting this guideline as part of our Municipal Design Guidelines. There are some issues to work out with GRCA as Clarington is in both CA's.	Noted. CLOCA staff are available for further discussion if required.
	Many developments are proposing tanks as SWMFs. Are they appropriate? Is there criteria for planning/construction? Is there any good data on how these are maintained over time?	A table has now been included in the guidelines outlining criteria for underground storage. See Section 5, Table 5.4.
	Who will be the approval authority be for SWMFs and associated plans? The Municipality would prefer to be the final approval agency for facilities that will become the Municipality's responsibility to operate and maintain, including planting plans, etc.	Both the municipality and CLOCA should continue to review and approve SWMFs and associated plans. The reviews are complementary in that generally speaking the municipality's review is focused on the proposed infrastructure and CLOCA's review is focused on watershed impacts.

APPENDIX E
RECORD OF BOARD ENDORSEMENT

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: October 20, 2020

FILE: AGRD12

APPROVED BY C.A.O. CD

S.R.: 5705-20

MEMO TO: Chair and Members, CLOCA Board of Directors

FROM: R. Perry Sisson, Director, Engineering and Field Operations
Louie Jakupi, Senior Water Resources Engineer

SUBJECT: **Corbett Creek Floodplain Mapping Update (TMIG 2020)**

Corbett Creek Floodplain Mapping has been completed in association with the the Town of Whitby Corbett Creek Master Drainage Plan Update Study (TMIG 2020). CLOCA provided LiDAR topographic base mapping for the project, and provided background Geographic Information System analysis, and hydrologic and hydraulic modelling. The project was funded by the Town of Whitby and National Disaster Mitigation Program grant.

The floodplain mapping is important for multiple purposes within CLOCA's core business including:

- Administration of Regulation 42/06 and development application review

  The flood plain mapping will be used to update our Regulated Area during our annual regulation mapping amendments. The CLOCA Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses is based on preventing development within hazardous areas such as flood plains. Updated flood plain mapping is an important component of the Regulated Area.

- Plan review input

  CLOCA provides advice to our municipal partners for planning applications, with natural hazard determination and establishment of acceptable limits for development. Flood plain mapping provides important natural hazard information.

- Flood Forecasting and Warning

  CLOCA relies on flood plain mapping to determine the extent of flooding and the potential for impacts on private property and public roadways. The digital flood plain mapping can be used with interactive flooding databases and predictive models, that allows us to run various storm scenarios, and predict extent of flooding, and specific property impacts based on weather forecasts, and current conditions.

The 2020 study and floodplain mapping will replace the 2005 study and floodplain mapping. Although the updated floodplain mapping did not result in significant changes to the extent of the regulatory floodplain, the updated mapping does reflect recent developments that were not included in the former mapping. The new mapping is based on LiDAR topography from CLOCA surveyed in 2018 and utilizes the recently adopted Canadian Geodetic Vertical Datum (CGVD2013). The update to LiDAR topography and an air photography base also provides more accurate information and improved visual presentation. A sample floodplain map is attached for both the 2005 floodplain mapping and the same area with the current floodplain mapping.

Cont'd

FILE: AGRD12 October 20, 2020
S.R.: 5705-20

The Corbett Creek Master Drainage Plan Update was completed with a public consultation process that provided members of the public with opportunities to review and comment on the project. The Master Drainage Plan was received for information by the Town of Whitby in September of this year. The complete Study and floodplain mapping are available upon request.

RECOMMENDATION:

THAT Staff Report #5705-20 be received for information; and,
THAT the Flood Plain Mapping for Corbett Creek be endorsed and accepted for implementation with CLOCA regulations and programs.

Attach.
RPS/LJ/bb
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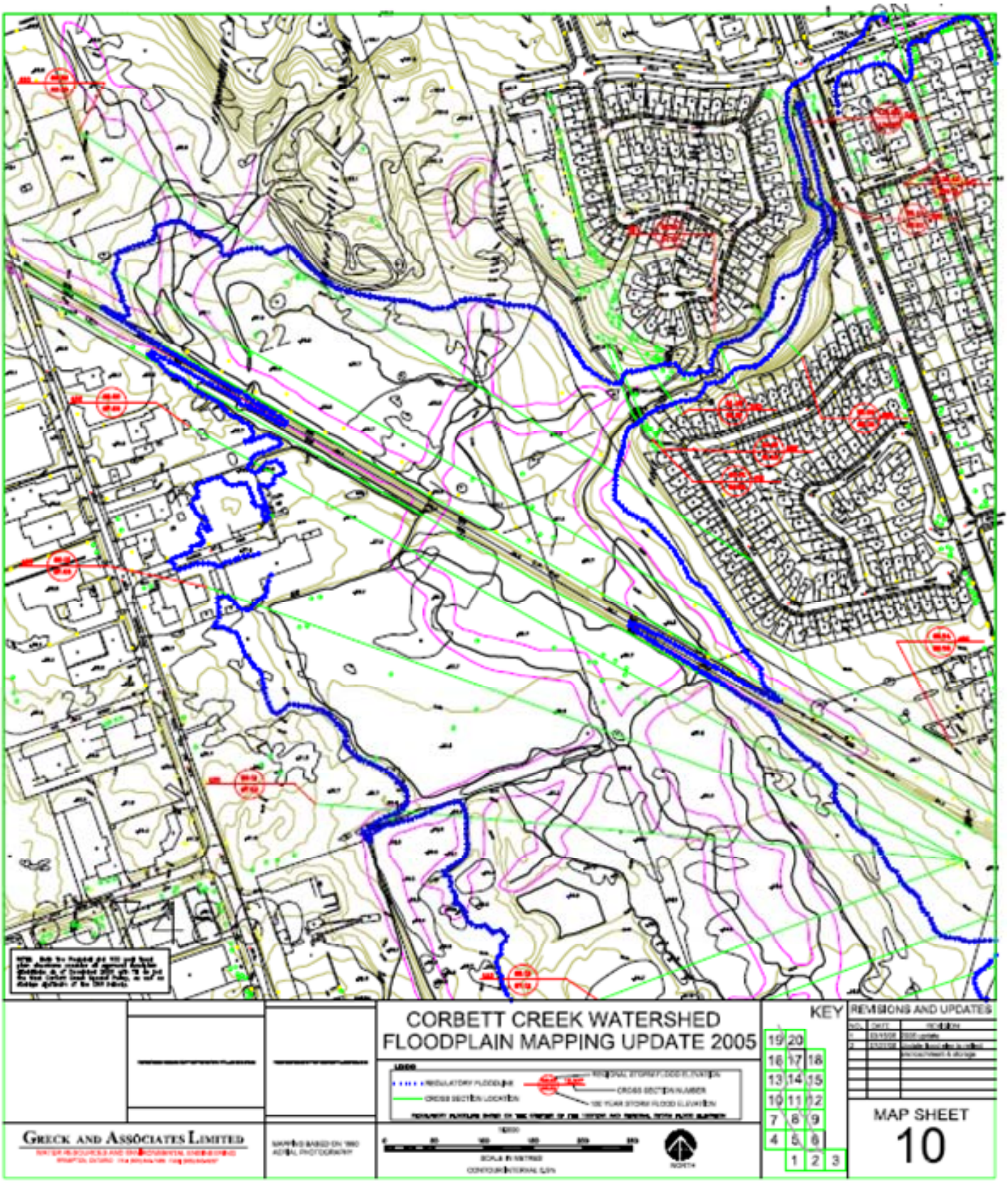
2005 Floodplain Mapping



CENTRAL LAKE ONTARIO CONSERVATION
LEGEND
REVISIONS AND UPDATES
NO. DESCRIPTION BY DATE
1 FIRST SUBMISSION E.T/T.D JUNE 2020
NOTES:
1. This map is prepared for use in conjunction with the Corbett Creek Master Drainage Plan Update dated May, 2019 prepared by TMIG Ltd.
2. Flood Plain modeling was prepared by TMIG using HEC-RAS 5.0.7, May 2020.
3. LIDAR mapping has been prepared by Airborne Imaging Inc. in March 2019 for use by Central lake Ontario Conservation Authority.
4. LIDAR mapping and Regulatory Flood Elevation in Canadian Geodetic Vertical Datum of 2013 (CGVD2013).
5. Orthophotography (2018) provided by the Town of Whitby.
TMIG
MAP SHEET
CC13
CC7
CC12
CC6
CC11
CC5
CC10
CC4
CC9
CC3
CC8
CC2
CC1
CORBETT CREEK
REGULATORY FLOOD PLAIN MAPPING
SHEET NUMBER: CC5
Date: 2020-07-08

REPORT
CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: October 20, 2020

FILE: LALC1

S.R.: 5707-20

APPROVED BY C.A.O.

TO: Chair and Members, CLOCA Board of Directors

FROM: Perry Sisson, Director, Engineering & Field Operations
Dan Hope, Land Management & Operations Supervisor

SUBJECT: **Summer/Fall 2020 – Conservation Areas Update**

The following report provides an update on land management and field operation activities within our Conservation Areas during the summer/fall months of this year.

Further to our Board Report in the Spring of 2020 and as members are aware the global pandemic forced the closure of the Purple Woods Conservation Area – Maple Syrup Festival. Shortly after, on March 25th all CLOCA owned and operated Conservation Areas closed as well. This approach was consistent with the vast majority of Conservation Authorities throughout the Province of Ontario. CLOCA enforcement staff continued to work closely with officers from neighbouring Conservation Authorities, Municipalities, Conservation Officers (MNRF) and Durham Regional Police Services to ensure that lands and infrastructure owned by CLOCA were secure and closures respected.

Discussions surrounding the possibility of re-opening began in mid - May. It was clear that our number one priority was the health and safety of the public and staff. Following much careful review and consideration (and after a closure of approximately two months), we officially re-opened our Conservation Areas on May 20, 2020. The timing of our re-opening was consistent many other Conservation Authorities and proved to be extremely valuable in allowing people to reconnect with nature. The following list of safety precautions was implemented as part of our Conservation Areas re-opening strategy:

- Revenue collection switched predominantly to "card only" in order to discourage the handling and collection of coin at our "Pay & Display" meters. CLOCA staff conducted an extensive educational campaign that focussed specifically on COVID-19 precautions, social distancing and appropriate payment methods (ie: pay by card, purchase annual vehicle pass etc). CLOCA re-allocated staff from various departments in order to

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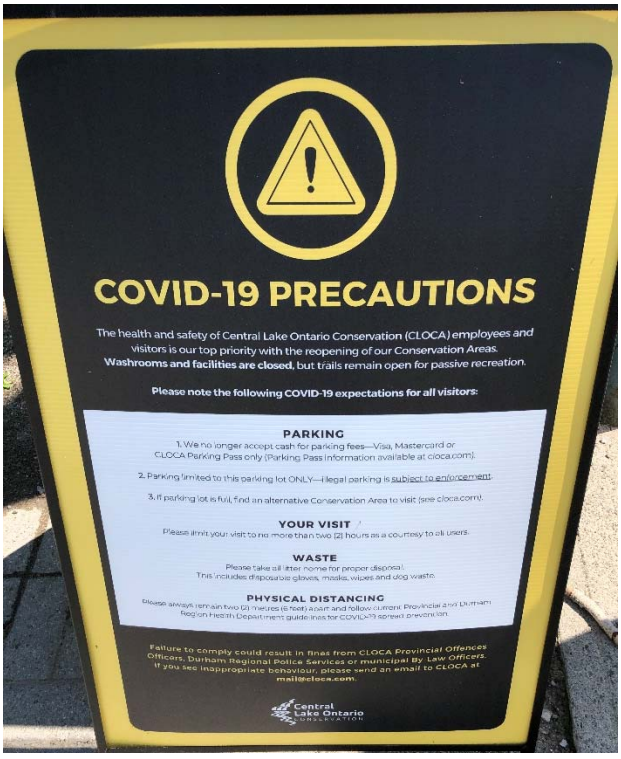
ensure that CLOCA representatives were in our Conservation Areas when they were at their busiest. Special thanks to all CLOCA staff who came together and contributed to the delivery of this messaging in our Conservation Areas.

- CLOCA COVID-19 specific signage and social distancing signs were developed, installed, and maintained at all of our Conservation Areas, including kiosks, access points, and trail heads. Consistent messaging was communicated in person, via our website and social media.
- Washrooms were closed and signed accordingly. Closures were coordinated in consultation with officials from the Durham Region Health Department.
- Social distancing "separators" and directional arrows were painted / on the ground at our busier locations in order to encourage safe distancing.
- CLOCA Areas and Land Management staff switched to specific work rotations in order to ensure the following:
  - CLOCA staff had their own dedicated vehicle
  - Time could be allocated for thorough cleaning/disinfection procedures
  - Areas staff/officers could be visible in our Conservation Areas 7 days per week



Conservation Area Inspection Work

Most of the inspection work has been completed for the 2020 season in accordance with our CLOCA Board approved Conservation Areas Inspection Policy (Res.#95/16). CLOCA Areas staff continue to complete work at our Conservation Areas to rectify "action items" that were flagged by our inspections. Items flagged include (but are not limited to) signage replacement, trail and access laneway washout repair, fence repair work, ditching, bridge repair work etc. Much of our work continues to revolve around hazard tree/limb removal. Our formal Conservation Area inspections yield the majority of the action items however, concerns are also communicated to us by our Conservation Areas users via the Conservation Areas emergency phone line and/or by email.

Cont'd

FILE: LALC1 October 20, 2020
S.R.: 5707-20

Lynde Shores Conservation Area – The Pay and Display meter at Lynde Shores received an upgrade to accommodate more modern, efficient and safer payment technologies (ie. tap, debit, credit etc). We are still working through some minor wrinkles with the new payment technology however, the response from the public has been extremely positive. Here are before and after photos of the machine and new signage:

BEFORE:

AFTER:

Long Sault Conservation Area – Minor infrastructure upgrades have been completed (where cost feasible) within many of our Conservation areas. An example of such improvements would be the replacement of the single panel fence surrounding the Long Sault parking lot that was in a state of disrepair. Areas staff replaced the fence with a post and board style.

BEFORE:

AFTER:

Cont'd

FILE: LALC1 October 20, 2020
S.R.: 5707-20

Land Management/Conservation Area Revenue Collection

Since our re-opening on May 20th, revenue generation within our Conservation Areas continues to exceed expectations. The following table represents Conservation Areas Revenue from January 1 to September 30, 2020. Visitors continue to flock to our natural spaces as families seek a safe space and a healthy escape to nature. The significant increase in visitors at all of our locations has been quite apparent. The increase in visitors to our areas has been accompanied by an increase in compliance related initiatives such as enforcement, parking, litter, vandalism, theft etc. The benefits of having CLOCA staff currently on work rotations covering 7 days per week through this pandemic has been substantial.

Table 1; Annual Parking Revenue

	Lynde Shores Pay & Display	Heber Down South Pay & Display	Heber Down Dog Park Pay & Display	Long Sault Pay & Display	Westside Pay & Display	Enniskillen Pay & Display	Stephen's Gulch Pay & Display	Parking Passes All Areas	ANNUAL TOTALS
2017	$69,715.05	$39,696.60	$2,573.35	$10,470.96	$2,162.15	$3,616.00	$4,214.60	$18,644.22	$151,172.83
2018	$81,279.10	$23,946.95	$12,152.75	$17,808.25	$2,125.55	$3,861.40	$4,732.55	$24,572.54	$170,479.09
2019	$85,163.80	$26,941.30	$13,622.95	$18,326.60	$2,042.35	$3,838.35	$5,590.10	$24,423.57	$179,949.02
2020	$98,946.82	$39,318.00	$17,371.90	$25,150.15	$0.00	$10,584.00	$8,749.55	$46,492.27	$246,612.69

Notes: 2020 revenue represents January 1, 2020 through September 30, 2020 only. Conservation Areas were closed from March 25th through May 20, 2020. Bowmanville Westside machine is coin only and will be tallied in December 2020.

CLOCA Main Office

Land management staff have been in close contact with DRPS about issues that we continue to experience at our Administrative Office. "After hours" activity has been reported on several occasions and CLOCA staff continue to monitor our lands between our Administrative Office and Wentworth Street. As Board Members may recall, we had an issue with trespass/homeless shelters in 2018. Staff continue to collect dozens of "biohazard/sharp objects" and have safely disposed of them at the Durham Region Landfill. Another temporary shelter on CLOCA property was removed in early October 2020. DRPS continue to assist where they can with patrolling this location after hours.

An individual at the Administrative Office was observed (after hours on camera footage) hanging/pulling on a few of the valves associated with the Enbridge gas meter. Upon further inspection by Enbridge the valves were found to be badly damaged and were repaired by Enbridge. CLOCA staff are in the process of installing a fence around the emergency backup generator and the gas meter.

Small Drinking Water Systems Regulation

In September 2020, we completed our four-year review of our certified Small Drinking Water Systems (SDWS) with a drinking water inspector from the Durham Region Health Department. The inspector was pleased with the performance and maintenance of both of our SDW Systems located at the Enniskillen Conservation Area (Education Centre) and the Purple Woods Heritage Hall. Maintenance inspections will continue to be completed at regular frequencies on these systems and we continue to operate in accordance with Ontario Regulation 319/08 (Small Drinking Water Systems Regulation).

RECOMMENDATION:
THAT Staff Report #5707-20 be received for information.

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REPORT
CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: October 20, 2020

FILE: ASSA6

APPROVED BY C.A.O. CD

S.R.: 5706-20

MEMO TO: Chair and Members, CLOCA Board of Directors

FROM: Chris Darling, Chief Administrative Officer
Patricia Lowe, Director, Community Engagement

SUBJECT: **Draft Strategic Plan 2021-2025**

At the June 16th Board meeting, staff provided a work plan for our Strategic Plan update. Since that time, we have conducted a variety of consultation sessions through online meetings and surveys to solicit insight and feedback, helping to shape a framework for the update. Based on the input received from CLOCA staff, watershed stakeholders, and the general public, we created a draft framework. This framework was shared again with CLOCA staff and our municipal partners through an online survey, personal conversations and emails providing us with further confirmation that the draft goals and strategic directions will provide the necessary focus to be successful in meeting our needs over the next five years. The result is the draft Strategic Plan 2021-2025 included in this report.

Through our review and feedback received to date, we found that the 2016-2020 Strategic Plan vision, mission and strategic goals and objectives remains relevant. As a result, the updated draft Strategic Plan is more of a refresh and builds on the existing Strategic Plan. The updated Plan continues to focus on five primary goals for our organization, which better align with corporate roles and responsibilities than the previous plan. The draft Plan is also a higher-level strategic document with less details on individual tasks or products. The intent of the updated Plan is to provide the necessary focus and guidance to allow for the identification of tasks/actions through annual workplans and budget and business plan development.

At this time, we would like to receive feedback from the Board members on the updated draft Plan. We want to ensure the Plan contains the direction and aspirations we need over the next five years to ensure success. We welcome your comments, insight, and feedback either at the Board Meeting, via email, personal conversations with staff or through the online survey below. We would appreciate your input no later than Friday November 6, 2020. We anticipate providing a final version of the Strategic Plan 2021-2025 in a report to the CLOCA Board of Directors at the November 17, 2020 Board meeting for final approval.

Link to survey: https://www.surveymonkey.com/r/NY5WNMC

RECOMMENDATIONS:
THAT staff Report #5706-20 be received for information; and,
THAT Board members provide their input by Friday November 6, 2020.

Attach.

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Vision	Healthy Watersheds for Today and Tomorrow
Mission	Advancing integrated watershed health through engagement, science, and conservation
Core Values	Times change and priorities shift, but there is a set of timeless principles – our core values – that individually and collectively define who are and the way we want to deliver service.

As an organization, we committed to the following five compass directions:

Conservation

In all of our actions, we are committed to protecting, preserving, and enhancing the watershed. We are conservation advocates, land stewards and trusted advisors promoting science-based watershed management and working with others to improve watershed health and public safety

Protection

We are dedicated to a healthy, sustainable natural environment and protecting our communities from flooding and erosion

Innovation

We value innovation and knowledge. We strive to see differently and think creatively to foster new ideas and offer better services and programs for the watershed community.

Excellence

We strive to consistently provide the highest standard of customer service, along with the highest standard of care for our watershed.

Collaboration

We are team players, committed to building relationships with our partners and achieving remarkable results across the watershed. We are collaborators and partners of choice and we encourage others to be watershed champions.

Leadership

We are passionate and dedicated to the work that we do. We are ethical, accountable, transparent, inclusive, and committed to inspiring others to value the critical role that healthy watersheds play in sustaining our quality of life. We lead by example and inspire others to do the same.

DRAFT

Goal One

Conserve, Restore, and Enhance Natural Resources through Integrated Watershed Management

Business Functions

- Watershed Science Lab (Research, Monitoring, Data Collection & Analysis)
- Watershed Planning
- Source Water Protection
- Restoration Implementation
- Groundwater Management
- Private Land Stewardship

Key Objectives

- Improve understanding of watershed ecosystem and its response to human and natural environmental stressors to support informed decision making
- Expand network of protected greenspace and conservation authority land holdings
- Implement updated integrated watershed plans and other action plans to guide landuse planning, protection, restoration, and stewardship initiatives
- Collaborate with partners to reduce the impact of environmental stressors such as climate change

Goal Two

Support Healthy Communities and the Protection of People and Property from Flooding and Erosion

Business Functions

- Environmental Plan Review
- Regulation Administration and Enforcement
- Flood Forecasting and Warning (Research, Monitoring, Data Collection & Analysis)
- Natural Hazard Modelling and Mapping

Key Objectives

- Increase capacity to predict flood events and flood vulnerable areas
- Provide timely and expert technical advice and land use tools and resources to our partner municipalities
- Improve understanding of natural hazards and to inform risk management actions
- Mitigate potential risk to people and property from natural hazards through regulation, administration, and compliance
- Improve flood event warning systems and communication

Goal Three

Remain Dedicated to the Protection, Management, and Safety of Conservation Areas

Business Functions

- Conservation Area Management Planning
- Acquisition of Conservation Land
- Conservation Area Enforcement
- Conservation Area Stewardship and Restoration
- Conservation Area Property Management

Key Objectives

- Continue to implement a land protection and acquisition strategy
- Identify appropriate opportunities for enhanced use/revitalization/optimal use of Conservation Areas and Facilities
- Enhance ecological integrity of conservation areas
- Provide high quality positive and safe experiences in our conservation areas
- Design, implement, and manage Conservation Area infrastructure that respects natural heritage features

DRAFT

Goal Four

Create a More Knowledgeable and Connected Watershed Community through Engagement and Education

Business Functions

- Education Programs (Curriculum 1 to 12) In Your Watershed
- Education Programs (General Public)
- Community Outreach and Stewardship
- Volunteer Network
- Corporate Festivals
- Corporate Communication and Branding

Key Objectives

- Connect people with nature, culture, and greenspace to promote environmental awareness, appreciation, and action
- Increase school participation in environmental education and stewardship
- Provide programs that respond to and reflect a diverse community
- Communicate a recognized brand that reflects our corporate culture, our goals, and strategic actions to our watershed audiences

Goal Five

Demonstrate Business Excellence through Effective Customer Service, Engaged Employees, and Innovation

Business Functions

- Governance and Organization Effectiveness
- Corporate Partnerships
- Effective Client Services
- Financial Services and Annual Budget
- Organizational Human Resources and Health and Safety
- IT and GIS support services

Key Objectives

- Foster provision of efficient, effective, and client-focused programs and services
- Engage employees with measurable continuous improvement outcomes
- Establish a strong culture of collaboration
  Improve corporate sustainability outcomes through operation, procurement, and business practice improvements
- Continue to strive for diversity, equity, and Inclusiveness
- Continue to modernize data and mapping management resources and services to support stakeholder and corporate priorities

DRAFT

UNFINISHED BUSINESS

#	Subject	Origin	Direction	Responsible	Expected Response
1.	Cedar Crest Beach Erosion & Plan 2014	SR #5684-20	Item tabled on May 12, 2020	P. Sisson	
2.	Conservation Authority Representative on the International Joint Commission Public Advisory Group (PAG)	SR #5702-20	Item tabled on September 15,2020	C. Darling	

REPORT
CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: March 17, 2020

FILE: NFFE13, PSSG4177

APPROVED BY C.A.O.

S.R.: 5684-20

TO: Chair and Members, CLOCA Board of Directors

FROM: Perry Sisson, Director, Engineering & Field Operations

SUBJECT: **Cedar Crest Beach Erosion and Plan 2014**

During the January 2020 Board of Directors meeting, the following resolution was approved:

THAT Resolution #97 from the November 19, 2019 Board Meeting be rescinded
THAT CLOCA staff be directed to:

1. **Report back to the Board with written clarification from BAIRD regarding BAIRD's comments in the report about the impact the St Mary's Pier has had on erosion by starving the beaches along Cedar Crest in Clarington and specifically, whether Baird believes the pier is a significant contributor to erosion; and**
2. **Report back to the Board if there is a fee associated.**

With respect to direction #1 and #2, in the Port Darlington Shore Protection Concepts report (Baird, 2018), the following comments were provided with respect to sediment transport on the Port Darlington shoreline:

Baird's previous experience with the wave field on Lake Ontario indicates that waves arrive at the study shoreline from two different directions, namely; southwest and east. Southwesterly waves are more frequent. The direction of Longshore Sediment Transport (LST) along a shoreline depends on the relative angle between the local shoreline orientation and incoming wave direction. Since waves arrive from two different directions, sediment along the study shoreline is expected to move back and forth depending on the wave conditions. Figure 2.14 shows the net transport direction; net transport is in a westerly direction from the bluffs at the west end of the study shoreline resulting in closure of the mouth of the flood channel and creation of the small fillet beach deposit on the east side of the St. Marys Cement pier. Along the remainder of the study shoreline, net transport is to the east. It is possible that some Sediment is bypassing the breakwaters at the entrance to Port Darlington Harbour. The rate of bypassing cannot be quantified without further studies using more recent bathymetry information. Bathymetry contours around the breakwaters (Figure 2.11) do not feature a bypassing shoal, therefore, the rate of bypassing is not expected to be significant. As the breakwaters are in a state of disrepair, it is also likely that sediment is being transported over (e.g. by wind) and through the armourstone structures.

The piers at St. Marys are approximately 650 m long (measured from the nearby shoreline) and extend to -8 m CD. It is expected that they act as a complete barrier to alongshore movement of granular sediment (i.e., sand and gravel) and, therefore, there is no exchange of granular sediment between west and east shorelines on either side of the piers. As a result, at present local bluff erosion and any potential sediment load from the creeks are the only sources of beach size material to the shoreline between Port Darlington and St. Marys Cement. Net alongshore transport in the study area is generally towards the east. This means that St. Marys piers would block any potential supply of sediment available (e.g., through bluff erosion) from the westerly shorelines. In fact, shoreline comparisons for the shoreline immediately west of the St. Marys piers conducted previously by Baird indicated a growing fillet beach since construction of the piers. Comparison of the 2000 and 2007 shorelines indicated approximately 2,000 m3 of sand had been deposited annually in the local fillet beach immediately west of the piers.

Cont'd

In summary, there are three potential impacts by the St. Marys piers on the study shoreline: 1) interruption of sediment supply from the shorelines west side of the piers (approximately 2,000 m3/year as evident from formation of the fillet beach on the west side of the piers); and 2) reversal of longshore transport along the shoreline immediately east of the piers (as evident from formation of the fillet beach on the east side of the piers); and 3) loss of sediment supply from the shoreline protected by the St. Marys piers.

CLOCA staff have communicated with the author of the report on several occasions regarding this discussion of impacts of the St Marys pier. The author provided a very approximate quantification of the impacts of the pier by using a simple observation of the amount of beach sediments accumulated on the west edge of the pier. Baird provided the following written response:
"… This will confirm that we have nothing to add to our report with respect to Section 2.4. Our work did not include technical studies to evaluate potential impacts of St. Marys Pier on the shoreline to the east. The report includes a very brief summary of potential impacts. It further states, a detailed study would be required to confirm and quantify these impacts."

Baird further provided a work plan to complete an analysis of impacts of the pier on sediment transport. The proposal is appended as **Attachment #1** to this report.

3. Report back to the Board commenting on:
a) The role Plan 2014 has played in the regulation of Lake Ontario water levels, including answering whether it was a contributing factor to flooding; and
b) Whether Plan 2014 has performed as advertised "to protect against extreme water levels and prepare us for climate change". Staff are to consult with TRCA and IJC in preparing its report.

With respect to direction #3, there have been a number of reviews of the performance of Plan 2014 and Lake Ontario flood levels, from the International Joint Commission as the regulating authority, and from independent parties. The Ontario Ministry of Natural resources and Forestry retained a Special Advisor to review recent flooding in Ontario including Great Lakes flooding, and to consider policies and activities that influenced flooding. The Advisor, Mr. Doug McNeil, P.Eng. provided a report with a summary of the flooding events, discussion, and 66 recommendations, as reported in previous CLOCA staff report 5674-20. With respect to the Lake Ontario flooding, the report notes the following:

4.6.2 Comparison to Flooding Conditions in 2017
The causes of record high Lake Ontario water levels in 2017 and regulation of outflows under Plan 2014 were studied and reported on by the Board (see the IJC report titled: "Observed Conditions and Regulated Outflows in 2017," May 25, 2018, https://ijc.org/sites/default/files/2018-08/ILOSLRB_FloodReport2017.pdf). The Board attributed the extreme high levels mainly to record precipitation received across the Lake Ontario-St. Lawrence River basin, noting that wet weather was also experienced upstream in the Lake Erie watershed. Lake Ontario water levels rose rapidly, setting record highs by the end of May. In response, in all but three weeks of the year, outflows from the lake were determined by either the maximum flow limits set by Plan 2014 or by deviations from Plan 2014. The Board concluded that Plan 2014 did not cause the high levels in 2017 or contribute to them in any significant way.

Flooding in 2017, among other impacts, were reported on by the IJC's Great Lakes-St. Lawrence River Adaptive Management Committee as part of their ongoing evaluation of the IJC's regulation of lake outflows in the Great Lakes (see the IJC report titled: "Summary of 2017 Great Lakes Basin Conditions and Water Level Impacts to Support Ongoing Regulation Plan Evaluation," November 13, 2018, https://ijc.org/sites/default/files/2018-11/GLAM_2017_MainReport_FINAL20181129_2.pdf).

Cont'd

The Committee evaluated the impacts on multiple interests, including flooding, from a variety of sources. They noted, however, that much of the quantitative economic and environmental data was not available at the time of reporting.

Impacts to coastal properties in 2017 were reported as widespread, with reports of flooded homes, roads, driveways, trails, lawns, emergency response, and extensive sandbagging efforts to protect houses and properties. In Ontario, flooding of residential property and buildings along the Lake Ontario shoreline was observed with particularly hard-hit areas including portions of Toronto Island, Clarington, Brighton, and Prince Edward County. On the upper St. Lawrence River, shoreline flooding was observed particularly in the Thousand Islands area. From the IJC's report, Figure 5-25 highlights the percent of shoreline survey respondents that indicated flooding impacts. In Ontario, along the lake shoreline, a local State of Emergency was declared for a portion of the Municipality of Clarington shoreline as well as all of Prince Edward County. The Mohawks of the Bay of Quinte also declared an emergency for their territory in response to high water levels. ***Independent review of the 2019 flood events in Ontario, (October 2019)***

The report further states that "… *Based on an analysis of the information available for all of the systems that experienced flooding in 2019, nothing points to human error or the negligent operation of water control structures as the cause of the flooding. The sheer amount of water (snow and rainfall) on the landscape directly contributed to the flooding. Measures taken by water managers everywhere were effective in reducing the magnitude of flooding and associated damages throughout the drainage basins."*

CLOCA staff conferred with staff from TRCA and the IJC in review of the performance of Lake Ontario water level regulation during the extreme water levels of 2017 and 2019.

TRCA recently completed the ***Toronto Islands Flood Characterization and Risk Assessment Report, (Baird 2020).*** Baird reviewed simulated water levels by Environment Canada under Plan 58 and Plan 2014 for the period of 1900 to 2008. The simulations indicate that Plan 2014 will vary from Plan 58DD by allowing spring high water levels to increase by approximately 0.05 to 0.15 m. The highest increases in spring high water levels occur for moderate floods with return periods of 10 and 25 years. The plans are nearly identical at extreme high water levels, and any difference in water levels is related to how the plans function before extreme high water levels are reached.

This analysis is further supported by the assessment of 100 year water levels under pre-project, Plan 58DD, and Plan 2014 conditions by Zuzek Inc. through the Lake Ontario Shoreline Hazards Plan, as shown on previous CLOCA report 5658-19. This analysis indicates that Plan 2014 will result in an increase of 0.07 m to the 100-year flood level when compared to Plan 58DD, but still significantly reduces the water level from pre-project conditions.

Baird notes "…*The key difference between Plan 2014 and Plan 1958DD is the increased natural variability of Lake Ontario water levels. However, no significant difference exists between the two plans under extreme weather conditions, as the regulation of outflows becomes determined by safety considerations (I-limit, F-limits, and L-limits) rather than the Plan 2014 rule curve. "*

The following chart from the Baird study shows the effectiveness of Lake Ontario water level regulation compared to levels that would have been experienced without regulation ("pre-project"):

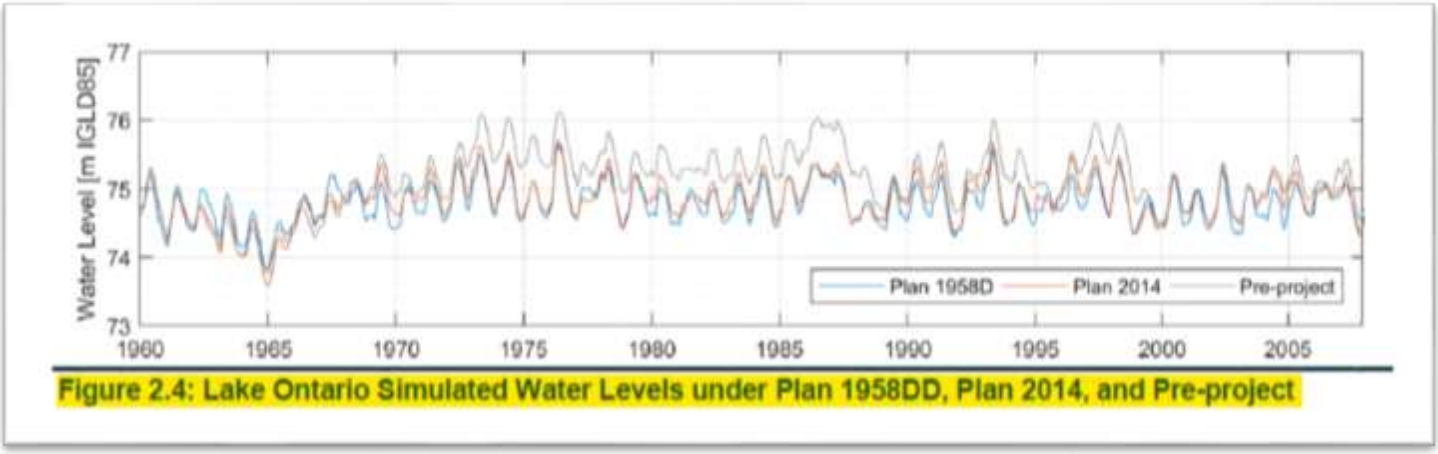
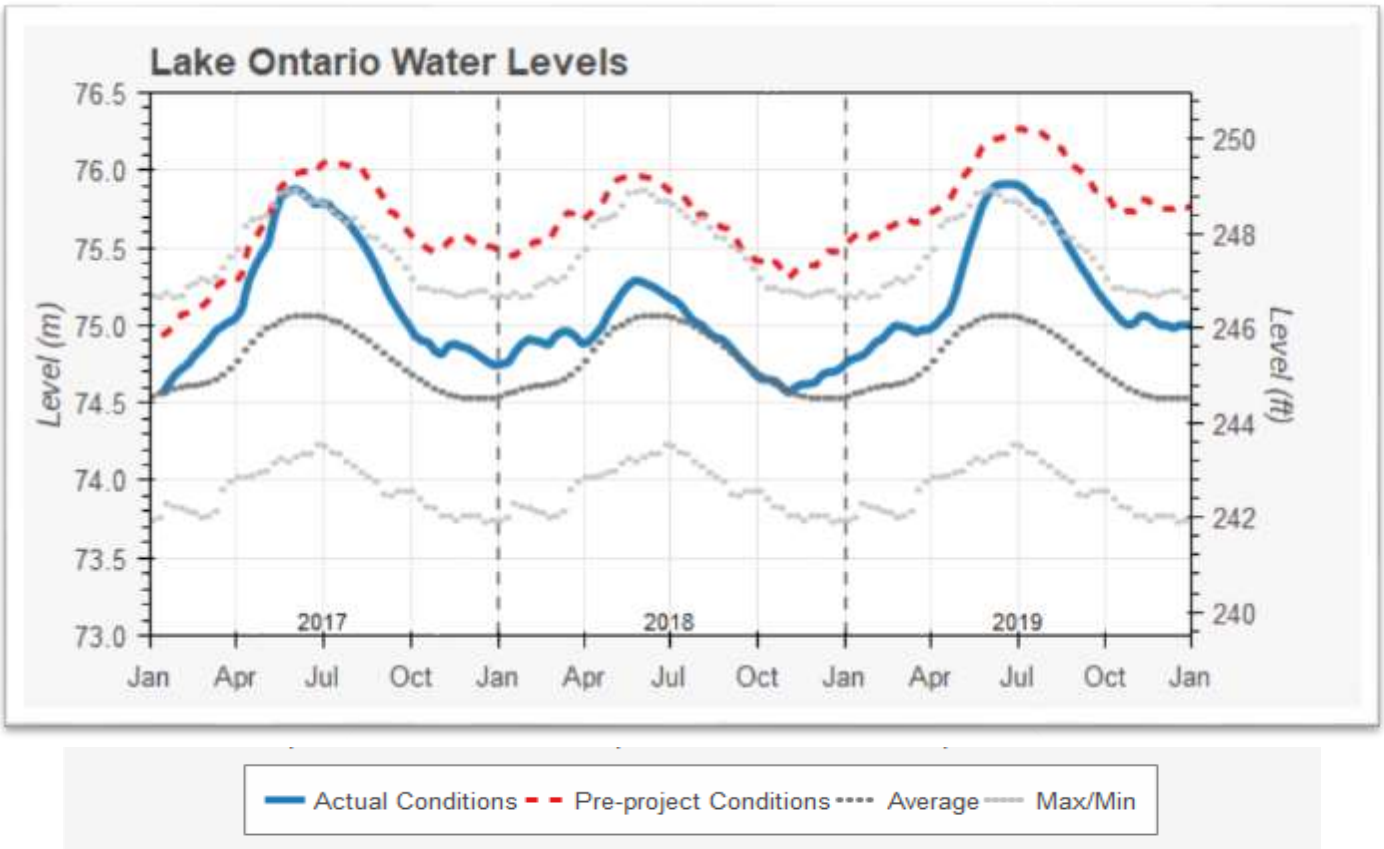


Figure 2.4: Lake Ontario Simulated Water Levels under Plan 1958DD, Plan 2014, and Pre-project

Environment Canada simulated quarter-monthly water levels for Lake Ontario under Plan 2014, Plan 1958DD, and Pre-project conditions (Baird 2020)

The International Joint Commission has provided extensive information including Frequently Asked Questions and Answers, as attached as **Attachment 2**. The following chart was also provided by the IJC to show the effect of the water level regulation throughout 2017, 2018 and 2019. The chart plots the actual water levels for the three year period and also charts the water levels that would have been experienced if Plan 2014 and the Moses Saunders Dam and channel works were not in place. As the chart shows, flooding on Lake Ontario would have been approximately 0.3m higher in both 2017 and 2019 without the water level regulation. Furthermore, without regulation, extreme water levels and flooding would also have occurred in 2018, when no significant flood events were actually experienced.



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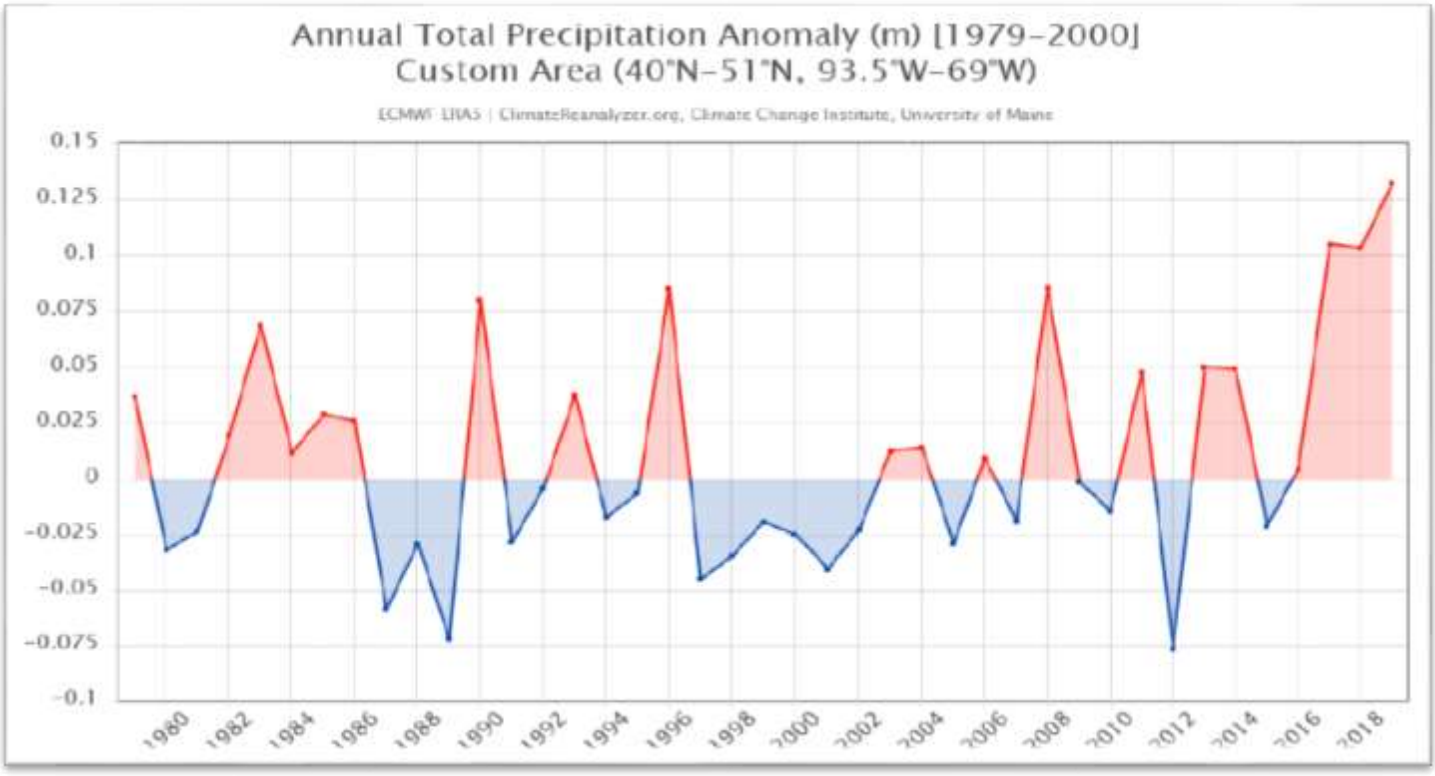
These charts shows that the water level regulation throughout the duration of Plan 58 and Plan 2014 has greatly reduced the impact of flooding on Lake Ontario.

Information provided recently by the IJC shows the natural variability that we have experienced in the Great Lakes watershed. The following chart shows the annual precipitation in the Great Lakes watershed since 1980 to 2019 in relation to long term average. The chart shows annual precipitation has been well above average since 2016, and is the most significant deviation from normal in the forty year period.



The impact of Climate Change of Great Lake water levels is uncertain. With the climate change trends generally accepted as warmer, wilder, and wetter, the resulting impacts on the Great Lakes include:

- More winter precipitation, but fewer snow events and more rain events
- More snow melt events, less ice formation and stability
- More evaporation off Great Lake surfaces with less ice cover, and warmer temperatures
- More wind events, and less ice protection of shorelines during winter and spring

Increased winter precipitation may result in more water in the watershed during the critical spring period, however the increase in snow melting and rain events during the winter may allow for more runoff through the winter and less release during the spring freshet. If warmer temperatures result in a reduction of ice cover in the St Lawrence River, greater release of water from Lake Ontario may be possible, however, if greater period of unstable ice occur, releases from Lake Ontario will be reduced to prevent ice jamming. Increased evaporation from the Lake s may be balanced by increased annual precipitation. Generally, greater uncertainty is the only impact that is consistently agreed upon.

The limits of the current Seaway works are already being demonstrated through the past few years of extreme water levels. The Moses Saunders Dam and seaway works have a finite limit based on the capacity of the dam and channel, and are further confounded by the need to balance upstream and downstream flooding, and the amount of development that exists within the flood limits of Lake Ontario and the St Lawrence River system.

Cont'd

To address climate change, an adaptive approach is required that employs the four stages and natural hazard management:

i) *Avoid* natural hazards by ensuring new development is safely located beyond the extent of natural hazards.
ii) *Accommodate* infrastructure and existing development within natural hazards with resilient construction techniques (example: flood proofing structures).
iii) *Protect* infrastructure and existing development with measures to limit the impact of natural hazards (example: shoreline erosion protection)
iv) *Retreat* or relocate infrastructure and existing development from high risk areas

Summary

In summary, it is apparent that water level regulation has been effective in reducing the effect of Lake Ontario extreme water levels. Without water level regulation, flood damages would have been significantly greater than experienced over the past three years.

Water levels and flow through Lake Ontario and the St Lawrence Seaway effects the shipment of goods, generation of hydro-electricity, recreational boating, municipal water supply, and riparian flooding and erosion. The water level regulation plan must consider all of these interests, and use the utilize the abilities of the Moses Saunders Dan and waterway by following the regulation Plan to best manage the water supply from the natural hydrology of the Great Lakes and Ottawa River watersheds.

The IJC continue to operate beyond the limits of Plan 2014. Release rates have consistently been above the maximum L-Limit for navigation, and the opening of the 2020 shipping season has been delayed to April 1st to allow for continued high release rates through March. The balancing of flood impacts on the St Lawrence against the Lake Ontario shoreline continues to be an important consideration, and recent surveys from affected landowners and of flood damages will be important for any further considerations and adjustments of the Plan.

Although it appears that the water level regulation plans have been effective in attenuating the effects of high water levels on Lake Ontario, the IJC has continued to review the regulation Plans through the Great Lakes Adaptive Management (GLAM) committee. The GLAM recently announced a three million dollar investment to complete an expedited review of the water level regulation. The announcement states *"…No regulation plan will be able to prevent the extremely high water levels and flows experienced during these periods of record-setting water supplies. However, the IJC remains fully committed to finding the best solutions possible for managing water levels and flows, especially during the s periods of extreme conditions."*

CLOCA staff will monitor the progress of the Lake Ontario water level regulation plan review, and participate as appropriate.

RECOMMENDATION:
THAT Staff Report #5684-20 be received for information.

PS/lv
Attachment 1- Proposal by Baird
Attachment 2- IJC Questions and Answers
Attachment 3- SR 5658-19
Attachment 4- GLAM announcement

Hi Perry,

Happy New Decade!

As promised, this email provides an itemised scope of work for a technical study to assess potential impacts of St Marys' piers on ongoing shoreline change and flooding processes along the reach of shoreline located between the Piers and Port Darlington jetties. As noted in Baird (2018) report, there are three potential impacts by St Marys' piers on the sediment budget of the subject shoreline: 1) interruption of sediment supply from the shorelines west side of the piers (as evident from formation of the fillet beach on the west side of the piers); 2) reversal of longshore transport direction along the shoreline immediately east of the piers (as evident from formation of the fillet beach on the east side of the piers); and 3) loss of sediment supply from the shoreline protected by the piers. It is also unclear if the presence of the Pier may have any impact on its nearby flood levels. The following scope of work intends to document/clarify the above points:

1. Data collection and review. Cost: $5,000
2. Detail bathymetric (multibeam) and topographic surveys of the study area to collect latest lakebed and beach elevation information, assess existing conditions, and compare with historic information. This task must be completed by a licenced surveyor under Baird's guidance. Our experience with similar projects suggests the cost would be roughly around $40,000 to $50,000.
3. Geotechnical investigations (sediment sampling, jet probes, sub-bottom profiling, etc.) to define type, size, thickness, and spatial distribution (or extents) of sediment on the lakebed as well as composition and contents of sediment in the bluffs. I do not have a quote for this task but the cost could be of the same order as #2.
4. Shoreline, top of bluff line, and bathy-topo comparisons in GIS to quantify/update volume changes including sediment volumes trapped on the east and west sides of the piers. Cost: $15,000 to $20,000
5. Numerical modelling of waves, hydrodynamics, and sediment transport with and without St Marys' piers in place to establish corresponding shoreline conditions, evaluate potential differences, and assess potential impacts of the piers. Any potential impact of the piers on flood levels will also be evaluated using the hydrodynamic model. Cost: ~90,000
6. Reporting and one meeting to present the results. Cost: $20,000

Please note that all provided costs are approximate. The above scope is not to assess potential impacts of the Darlington Port jetties (assuming they have been always in place).

Hope you will find the above helpful.
Please do not hesitate to call with any questions/comments.

Many thanks,
Mohammad

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Lake Ontario-St. Lawrence River 2019 High Water Levels Questions and Answers

The following background paper was prepared and reviewed by staff on behalf of the International Joint Commission (IJC) and its International Lake Ontario-St. Lawrence River Board (ILOSLRB).

Over the past several months, the Board has heard from many citizens and communities and seen first-hand the devastating impacts that high water conditions in 2019 have had on shoreline properties and local economies around Lake Ontario, surroundings sectors, and on the upper and lower St. Lawrence River. The Board has taken extraordinary measures to try to alleviate impacts from these exceptional conditions, while considering the consequences for all activity sectors along the Lake Ontario - St. Lawrence River system.

While the conditions of both 2017 and 2019 were exceptional in many ways, similar high water events have occurred throughout the history of Lake Ontario - St. Lawrence River regulation and have the potential to occur again in the future. As such, the purpose of this document is to provide accurate information related to the causes of the high water levels in 2019, as well as actions taken by the Board in attempts to address these conditions through regulation of outflows. The intent is to inform shoreline residents, businesses and communities of the capacity and limitations of outflow regulation to affect conditions so that we can work collectively to identify and assess potential solutions to better prepare for the possibility of extreme conditions and high water events in the future.

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Causes of the 2019 High Water Event

Question 1. What are the causes of high water levels in 2019?

Answer: Too much water entering Lake Ontario from a flooded Lake Erie, and nowhere for it to go but into a flooded St. Lawrence River.

Explanation:

These two primary factors, each stemming from above-normal precipitation, caused Lake Ontario levels to rise rapidly in the spring of 2019, eventually exceeding their record-peak of 2017, and resulting in wide-spread flooding, erosion and other high-water impacts.

Figure 1: Lake Ontario at Brighton, Ontario, 29 May 2019 (source: Lower Trent Region Conservation Authority)

The 2019 high water event was basin-wide, caused primarily by wet weather conditions across the entire Great Lakes – St. Lawrence River system. These conditions have persisted for several years and increased in intensity more recently, notably in 2017, and again during the several months of fall and winter leading up to the spring of 2019. These persistently and at times exceptionally wet conditions

culminated in record or near-record high water levels and flows across the entire Great Lakes – St. Lawrence River basin.

On Lake Ontario and the St. Lawrence River specifically, after the record-wet conditions of 2017 followed by a more average spring-summer 2018, generally wet weather started again in late-fall 2018 and persisted through the spring of 2019. Similar wet conditions upstream on the upper Great Lakes resulted in record-high water levels and flooding there, and culminated in record-high inflows from Lake Erie into Lake Ontario by spring. Downstream of Lake Ontario, a late, heavy snowmelt coupled with an extremely wet spring resulted in record-high flows from the Ottawa River into the lower St. Lawrence River and rapidly rising water levels downstream. This required a significant reduction in Lake Ontario outflows and further contributed to rapidly rising water levels and eventual flooding throughout the Lake Ontario – St. Lawrence River system.

The high water levels were not caused by regulation of outflows or by Plan 2014. Water levels of both Lake Ontario and the lower St. Lawrence River would have been higher in both 2017 and 2019 had the St. Lawrence Seaway and Moses-Saunders Dam never been constructed, and the higher levels would have lasted for a longer duration.

Figure 2: St. Lawrence River at Lake Saint-Pierre, Quebec, 4 May 2019 (source: Transport Canada)

Question 2. How do high water levels on the other Great Lakes affect Lake Ontario and the St. Lawrence River?

Answer: Since water flowing from Lake Erie through the Niagara River tends to be the largest component of the total inflow to Lake Ontario, when water levels of the upper Great Lakes (including Lake Erie) are high, the flow of water into Lake Ontario also tends to be high. This raises water levels of Lake Ontario and increases the amount of water that must be released through the St. Lawrence River.

Explanation:

The Great Lakes and St. Lawrence River form an interconnected system of water bodies and river channels (Figure 3). With record-high water levels reached or exceeded across the basin in 2019, this represents an exceptionally high volume of water flowing through the system, the vast majority of which makes its way into Lake Ontario and then out through the St. Lawrence River.

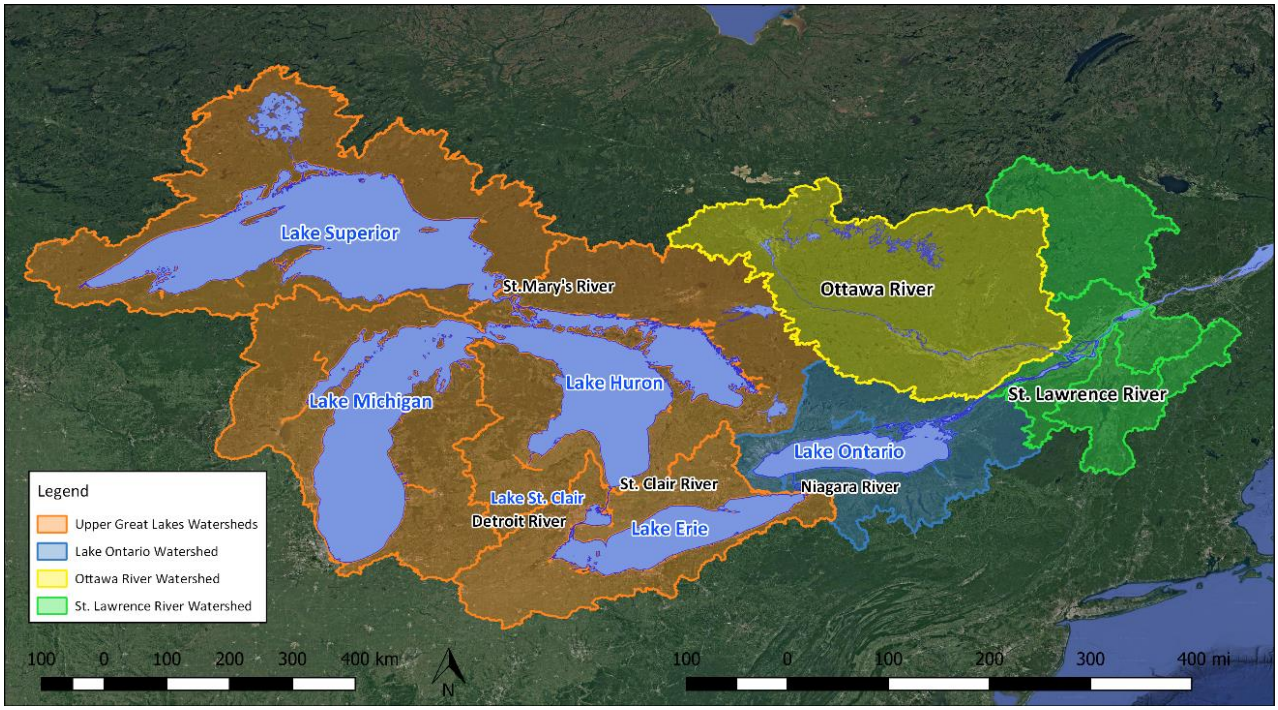

Figure 3: Map of the Great Lakes - St. Lawrence basin. Water from the upper Great Lakes basin (orange) discharges through the Niagara River and into Lake Ontario. This, plus water entering Lake Ontario from its own basin (blue), all flows out the St. Lawrence River, where it combines with water entering from the Ottawa River basin (yellow) near Montreal and other local tributaries (green), before continuing on to the Atlantic Ocean.

Starting at Lake Superior, water passes through the St. Marys River into Lake Michigan-Huron (hydraulically considered one lake due to their wide, deep connection at the Straits of Mackinac). Outflows through the St. Marys River are regulated by the IJC's International Lake Superior Board of Control (ILSBC). Similar to Lake Ontario and the St. Lawrence River, regulation of St Marys River outflows must take into consideration water levels and impacts both upstream and downstream on Lake Superior and Lake Michigan-Huron. From Lake Michigan-Huron, water flows uncontrolled through the St. Clair

River, into Lake St. Clair and then downstream through the Detroit River, which empties into Lake Erie. Water from Lake Erie flows uncontrolled through the Niagara River and Welland Canal into Lake Ontario, before eventually making its way into the St. Lawrence River on its way to the Atlantic Ocean.

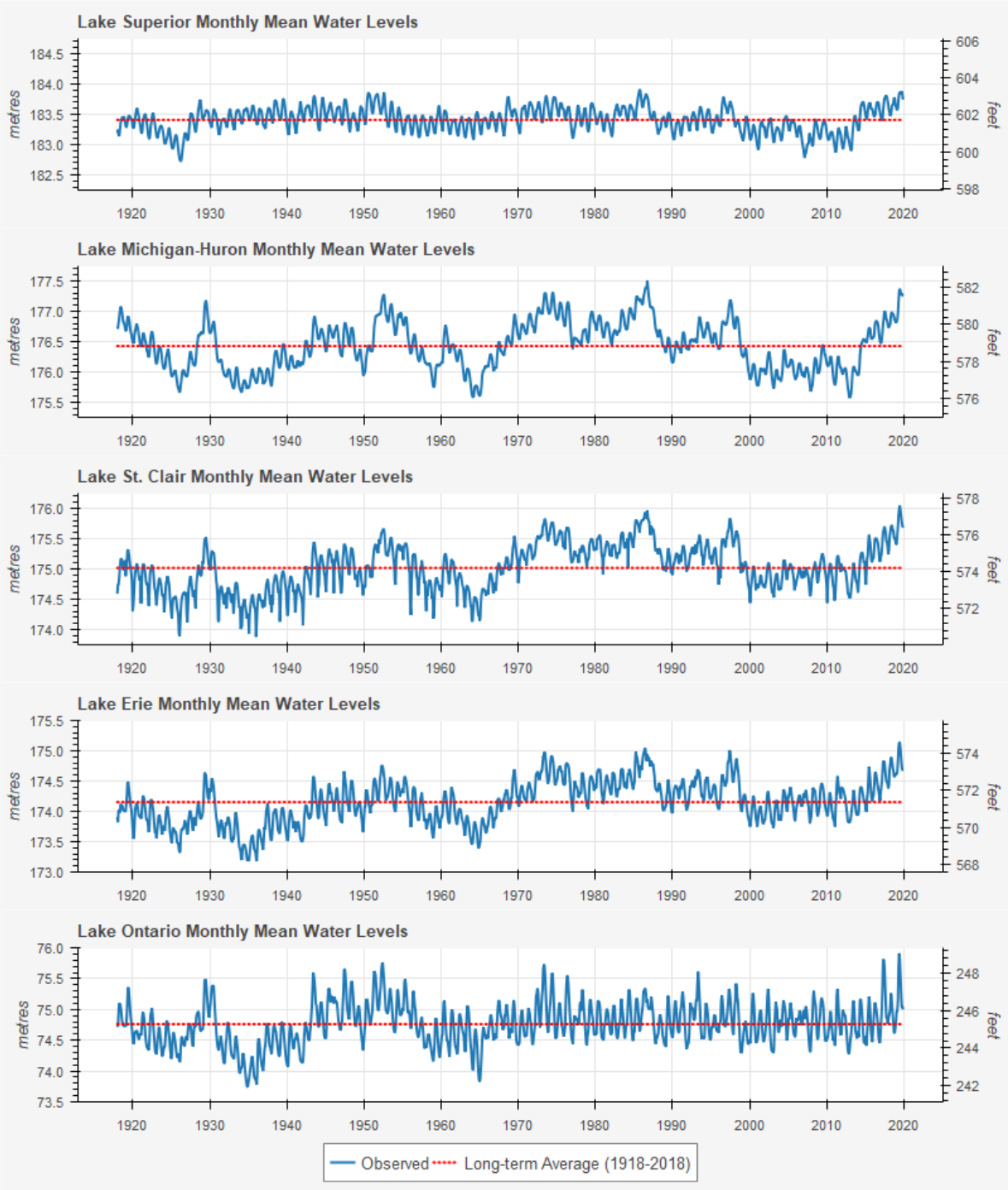

Figure 4: Great Lakes water levels show periods of highs and lows occurring throughout the past century

Water levels fluctuate naturally on the Great Lakes due primarily to weather driven variations in water supplies, with periods of high and low water levels occurring throughout recorded history (Figure 4).

Water supplies include water flowing in from the lake upstream and from precipitation (rain/snow) that falls directly on the lake and its surrounding watershed, minus the water that leaves the lake through evaporation. Water also flows out of each lake, through its outlet channel, and into the downstream water body. Over longer periods lasting more than several years, outflows tend to equal inflows; otherwise, lake levels would continually rise or fall. However, over shorter periods of days, weeks and months, differences in the amount of water entering and leaving the lakes cause their levels to rise or fall, and can result in periods of high or low levels that may persist for up to several years.

After nearly 15 years of below-average water levels on Lake Superior and Lake Michigan-Huron, water levels of the upper Great Lakes started rising in 2013, and have been well above-average for several years. Then in 2019, following several months of wet weather, water levels on Lake Superior, Lake St. Clair and Lake Erie each exceeded their seasonal record-highs in early-May, prior to record-highs being exceeded on Lake Ontario in late-May. Lake Michigan-Huron was at or near record-highs since the end of May, but did not exceed them in 2019.

What is the International Niagara Control Works?

A partial structure exists above Niagara Falls on the Niagara River, known as the International Niagara Control Works. Operation of this structure does not change the total flow of the Niagara River and has no measurable effect on Lake Erie water levels; rather, it is used to direct water to the power plants or over Niagara Falls in order to meet the apportionment objectives of an agreement between Canada and the United States known as the Niagara River Treaty of 1950.

Whether regulated or unregulated, high Great Lakes water levels also result in high outflows. With all of the Great Lakes above or near record-highs, this represents an unprecedented volume of water in the Great Lakes system, and other than water lost to evaporation, it all eventually makes its way into Lake Ontario and out the St. Lawrence River.

Question 3. Did the outflow from Lake Erie through the Niagara River set a record in 2019 and how did this contribute to Lake Ontario's record-high water levels?

Answer: Yes, record-high outflows from Lake Erie, into Lake Ontario, occurred in the spring and were a primary cause of the record-high levels on Lake Ontario in 2019, even more so than in 2017.

Explanation:

Lake Ontario receives the majority of its water from Lake Erie - about 85 percent on average, with most of it entering from the Niagara River and a much smaller amount entering from the Welland Canal. The total flow out of Lake Erie is completely uncontrolled.

Leading into 2019, water levels of the upper Great Lakes, including Lake Erie, had been above average for several years. This was followed by generally persistent, widespread, above-average precipitation during the winter and spring of 2019, resulting in rapidly rising water levels, with the upper Great Lakes reaching levels not seen since the previous record-highs of the mid-1980s.

Lake Erie exceeded historical records starting in early-May 2019 and these record-highs continued through summer (Figure 5). This resulted in above-record inflows from Lake Erie into Lake Ontario. In terms of magnitude, inflows from Lake Erie in May 2019 alone added the equivalent of 113 cm (44 inches) of water to Lake Ontario. This is 24 cm (9.4 inches) more than the average May input, and compared to May 2017, Lake Erie added an extra 2 cm (0.8 inches) per week of water to Lake Ontario in May 2019.

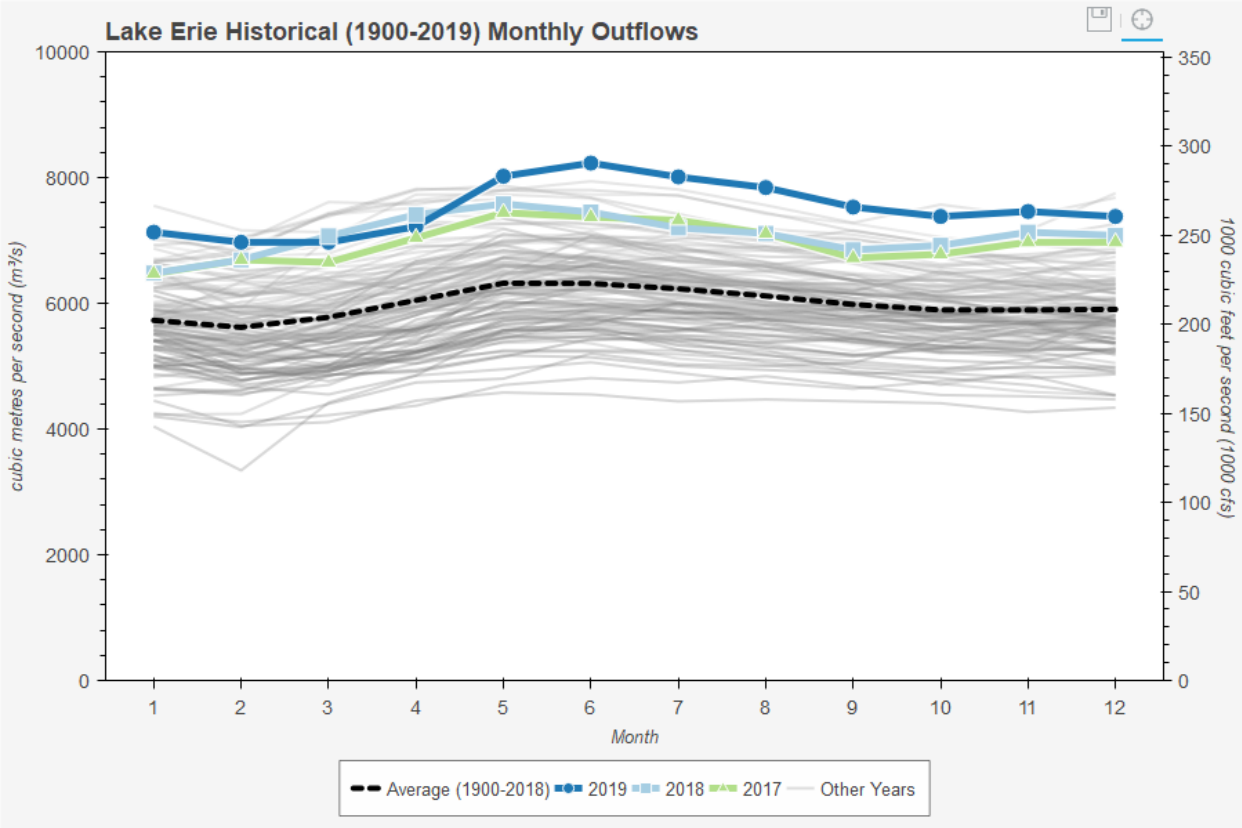

Figure 5: Lake Erie monthly mean outflows, each line representing an individual calendar year (1900-2019). Record- or near-record-high inflows were experienced throughout 2019.

Question 4. How much precipitation was received around Lake Ontario and the St. Lawrence River prior to spring 2019, and how does this compare to 2017?

Answer: While total precipitation across the Lake Ontario – St. Lawrence River basin was less than during the record-breaking January – May period of 2017, precipitation was again well-above normal and for a prolonged period, starting around late-fall of 2018 and continuing through spring 2019.

Explanation:

The most significant precipitation totals were observed along the northern and eastern shores of Lake

Ontario, and downstream along the St. Lawrence and Ottawa Rivers.

For example, from November through May (Table 1), 555.6 mm (21.9 inches) of precipitation was recorded at Toronto, ON, the 4th highest total recorded at this location over this seven-month period since 1938, while in Watertown, NY, a total of 823.7 mm (32.4 inches) was recorded during this same seven-month period, the 2nd highest total at this location since 1898. Downstream, the 717.8 mm (28.3 inches) recorded at Montreal, QC, was the 5th highest November to May total since 1942, while the 613 mm (24.1 inches) recorded in Ottawa, ON was the 7th highest on record since 1890.

Table 1: Total precipitation across the Lake Ontario – St. Lawrence River basin, November to May 2019

Location	Station Name (ID)	Period of Record	Nov 2018 - May 2019 Precipitation		Nov - May Historical Statistics		
			Total	Historical Rank	Average	Maximum	Year
Buffalo, NY	Buf. Niagara Intl (USW00014733)	1938-2019	675.1 mm (26.58 in.)	11th	557.8 mm (21.96 in.)	770.9 mm (30.35 in.)	1990-1991
Rochester, NY	Roc. Greater Intl (USW00014768)	1926-2019	499.6 mm (19.67 in.)	29th	459.7 mm (19.67 in.)	647.4 mm (25.49 in.)	***2016-2017***
Watertown, NY	Watertown, NY (USC00309000)	1898-2019	823.7 mm (32.43 in.)	2nd	576.5 mm (22.7 in.)	827.0 mm (32.56 in.)	2008-2009
Toronto, ON	Toronto LBP Intl A. (6158733)	1938-2013	555.6 mm (21.87 in.)	4th	426.3 mm (16.78 in.)	581.2 mm (22.88 in.)	***2016-2017***
	Toronto Intl A. (6158731)	2013-2019					
Ottawa, ON	Ottawa CDA (6105976)	1890-2019	613.0 mm (24.13 in.)	7th	470.3 mm (18.52 in.)	715.8 mm (28.18 in.)	1946-1947
Montreal, QC	Montreal Intl A. (7025251)	1942-2019	717.8 mm (28.26 in.)	5th	547.2 mm (21.55 in.)	745.6 mm (29.35 in.)	***2016-2017***

Other areas around the basin, particularly those to the south of Lake Ontario in the state of New York, did not see as much precipitation through the fall, winter and early-spring. For example, Rochester, NY, saw 499.6 mm (19.67 inches), which is above-average, but only the 29th highest November to May total on record since 1926. This differs from 2017, where the entire Lake Ontario, Ottawa and St. Lawrence River basin saw very high precipitation amounts over a shorter period, with many locations setting records for the period of January through May 2017.

Nonetheless, while conditions across Lake Ontario and the St. Lawrence River basins were generally wetter overall in 2017 than in 2019, inflows from Lake Erie and the Ottawa River were substantially greater in 2019.

Question 5. Did Lake Ontario total inflows set records in 2019 and how do they compare to 2017?

Answer: Yes, new record monthly inflows were set in February and May 2019, and the combination of generally wet weather and high inflows from Lake Erie caused Lake Ontario's net total supply (total inflows) to be near or above historical records for several months prior to the record-high water levels being reached in spring.

Explanation:

Water levels on Lake Ontario began rising in November 2018 in response to wet weather and rising Lake Erie levels. Net total supplies (Figure 6) to Lake Ontario in November and December 2018 were the 4th and 5th highest for those months on record, respectively.

Record-precipitation fell across the Lake Ontario - St. Lawrence River basin in 2017, but inflows from both Lake Erie and the Ottawa River were substantially greater and record-setting in 2019.

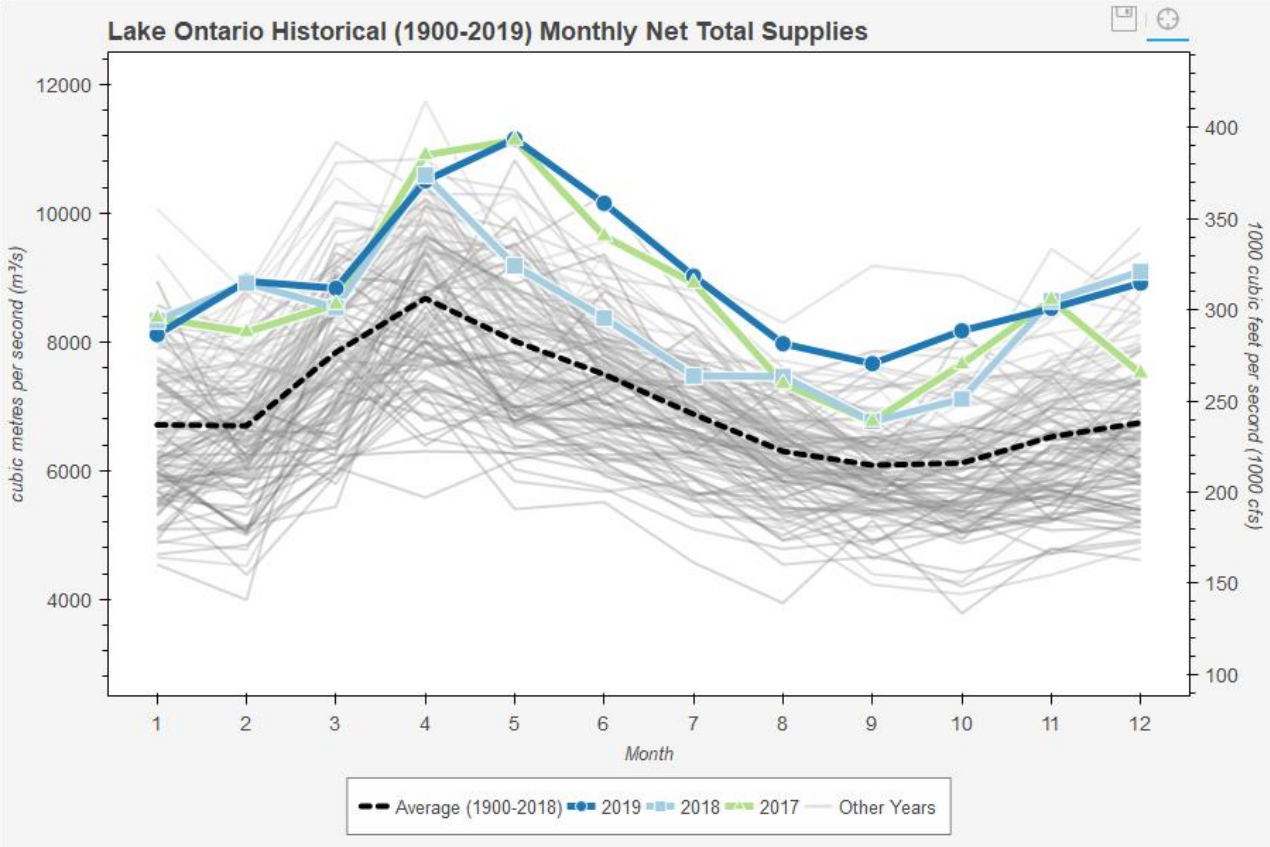

Figure 6: Lake Ontatio monthly mean net total supplies, which include inflows from Lake Erie, over-lake precipitation and basin runoff, minus evaporation. Each line represents an individual calendar year (1900-2019). Record- or near-record-high inflows were experienced throughout 2019.

January and February saw high inflows continue. Record-high net total supplies were recorded for the month of February 2019, following just one year after the previous February record set in 2018.

The spring started somewhat drier in March and early-April, but inflows from Lake Erie remained high and ensured net total supplies remained well above-average.

Table 2: Lake Ontario net total supplies (inflows): highest months recorded since 1900

Rank	Year	Month	Net Total Supply
1	1993	April	*11,700 m^3/s (413,200 cfs)*
2	***2019***	***May***	***11,150 m^3/s (393,800 cfs)***
3	***2017***	***May***	***11,040 m^3/s (389,900 cfs)***
4	1976	March	*10,970 m^3/s (387,400 cfs)*
5	***2017***	***April***	***10,830 m^3/s (382,500 cfs)***
6	1973	April	10,800 m^3/s (381,400 cfs)
7	1973	March	10,680 m^3/s (377,200 cfs)
…	…	…	…
12	***2018***	***April***	***10,550 m^3/s (372,600 cfs)***
13	***2019***	***April***	***10,500 m^3/s (370,800 cfs)***

The remainder of spring was exceptionally wet. Total inflows to Lake Ontario during April 2019 were very high, the 8th highest April on record and the 13th highest net total supply recorded in any month of the year. Inflows to Lake Ontario are typically at their annual peak in the month of April, but instead of decreasing in May, net total supplies increased. According to provisional data, May 2019 exceeded the previous record set for the month of May in 2017. May 2019 recorded the second highest total inflow for any month of the year dating back to 1900, and April-May 2019 combined are the 2nd highest two-month total ever recorded, behind only April-May 2017.

Question 6. Why did Lake Ontario start rising in November 2018?

Answer: Water levels of Lake Ontario began rising in November 2018 in response to wet weather and rising Lake Erie levels, which caused increasing inflows to Lake Ontario through the Niagara River.

Explanation:

Net total supplies to Lake Ontario in November and December 2018 were the 4th and 5th highest on record for those months, respectively.

Lake Ontario outflows, which were already well above average, also increased at the same time that inflows began to rise (Figure 7). The high outflows resulted in continued low levels on Lake St. Lawrence during this period, and yet despite the increase, outflows could not fully offset the rising inflows at that time.

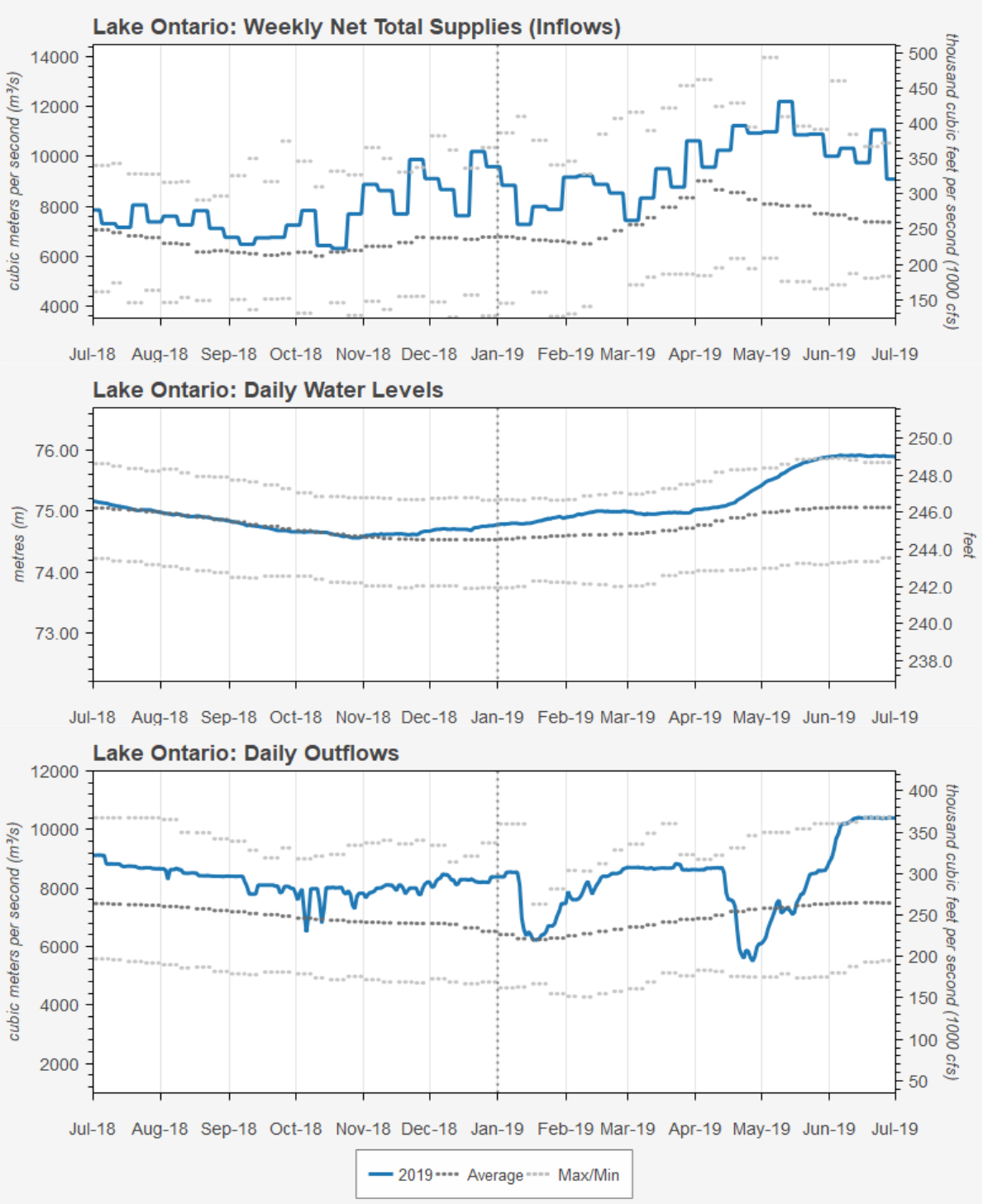

Figure 7: Lake Ontario net total supplies, i.e., inflows (top) were above average from 1 July 2018 through 30 June 2019, at times exceeding record-highs. Lake Ontario water levels (middle) were near-average during summer/early-fall 2018, but started rising in late-fall as inflows rose rapidly. Outflows (bottom) were well-above average throughout this 12-month period, except when temporarily limited by ice formation in January/February 2019 and during the record Ottawa River freshet that spring.

Outflows in 2018-2019

Question 7. Why wasn't more water released in 2018 when Lake Erie levels were high and downstream flooding wasn't an issue?

Answer: A lot of water was released from Lake Ontario in 2018 for exactly this reason, and this, along with near-average water levels of Lake Ontario, contributed to very low levels on Lake St. Lawrence during this time.

Explanation:

Prior to the record-high water levels in spring 2019, Lake Erie had been relatively high for several years, as had the other Great Lakes. Outflows from Lake Ontario have reflected this, and in fact, have also consistently been kept very high since the record-flooding of 2017, with the exception of the temporary reductions required during the springs of 2017 and 2019 when flooding was occurring both upstream and downstream.

In fact, throughout the summer and fall of 2018, while Lake Ontario levels were at or near the long-term-average, the high Lake Ontario outflows resulted in very low, and at times record-low, water levels on Lake St. Lawrence, immediately upstream of Moses-Saunders Dam (Figure 8). Click here for a video describing the effects of regulation on water levels in Lake St. Lawrence. Low levels, as well as high current velocities in this area, had impacts on recreational boaters, shoreline property owners and commercial navigation.

Figure 8: Lake St. Lawrence at Croil Island near Massena, New York, 16 September 2018 (source: ILOSLRB)

Question 8. Why wasn't more water released from Lake Ontario during the winter? Why were outflows reduced during January and February?

Answer: Outflows must be temporarily reduced nearly every winter as ice forms on the St. Lawrence River in order to facilitate the formation of a stable ice cover, which reduces the risk of ice jams and allows higher outflows to be released later on.

Explanation:

As ice forms on the St. Lawrence River, outflows can be temporarily reduced to slow down the river current and reduce the forces acting on the fragile ice cover, allowing a solid ice cover to form and stabilize. This helps reduce the risk of ice jams and limits frazil ice growth in the river that can physically block and severely restrict flows. Severe ice jams can result in immediate localized flooding and an immediate reduction in outflows. If such ice restrictions last for a long duration, outflow may be reduced for an extended period during the winter, leading to higher Lake Ontario levels heading into spring.

What is frazil ice?

Frazil ice is composed of loosely consolidated, tiny ice particles that form in flowing water. These particles can look like irregularly shaped pans of slush at the surface, and extreme cold temperatures can cause frazil to form rapidly in open areas. In deep, fast moving water, frazil ice can be transported within the water column, where it may collect and adhere to other ice particles or to the riverbed, narrowing the channel cross-section and restricting flows.

In 2019, ice began forming around mid-January and continued into February. Once ice had formed and stabilized, outflows were increased relatively rapidly thereafter. In fact, the amount of water released during the winter (from December 2018 – February 2019, combined) was relatively high historically, as only 3 years have seen more water released during these three months, those being 1987, 1997 and last year, 2018.

Question 9. Why was more water released in January and February 2018 than during the same months in 2019?

Answer: Compared to 2019, ice formed more rapidly in early-January 2018 allowing somewhat higher outflows to be released earlier on in winter, but overall, outflows were very high during January and February in both years.

Explanation:

Extreme and, at times, record-cold temperatures at the end of 2017 and start of January 2018 allowed ice to form more rapidly and earlier in 2018 than it did in 2019, and this allowed outflows to be increased sooner as well. Regardless, outflows released in January and February in both 2018 and 2019 are historically high, the 2nd and 4th highest on record, respectively (Figure 9). These high winter flows were possible due to consistently cold temperatures and the solid, stable ice conditions that this promoted. By comparison, ice formation in 2017 was much more complicated, as unusual temperature fluctuations

required that Lake Ontario outflows be almost continuously adjusted to manage highly variable ice conditions in the St. Lawrence River. More information on the difficulties of ice management in 2017 can be found in the Board's report on 2017 conditions **here**.

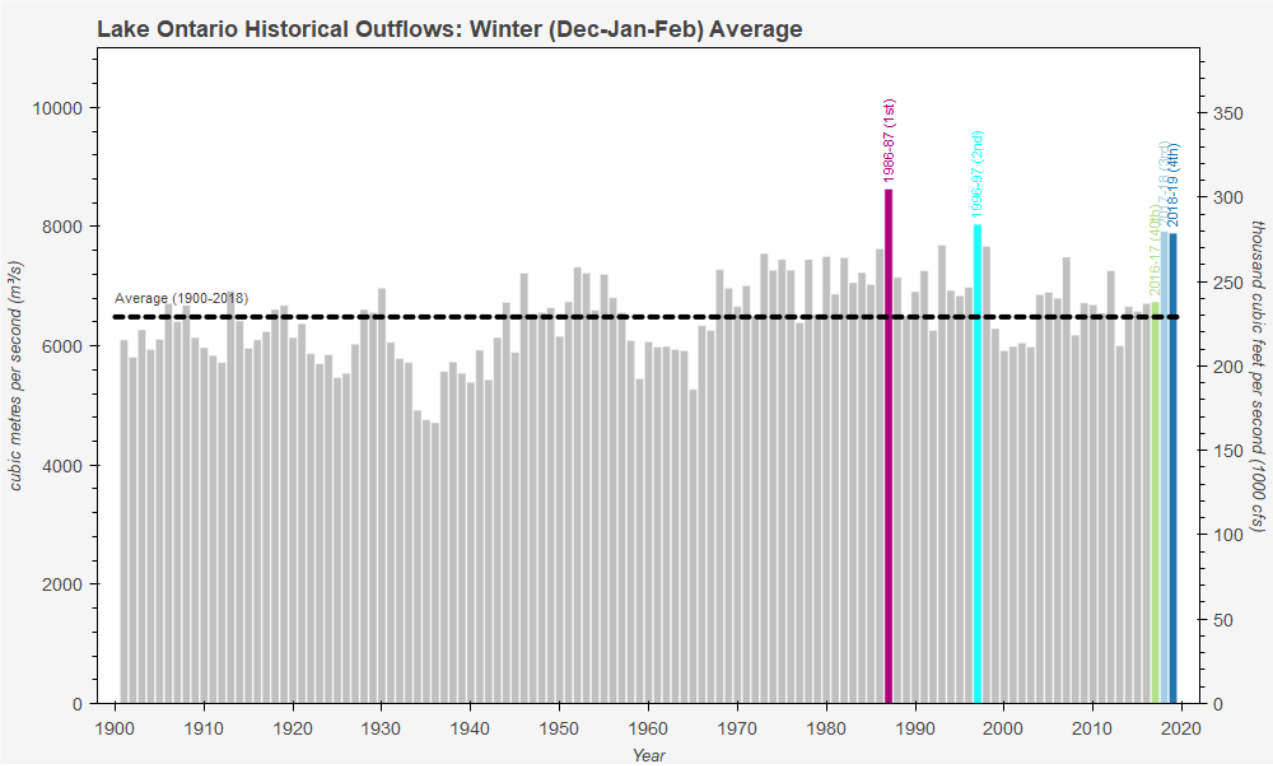

Figure 9: Lake Ontario mean outflows during winter (Dec-Jan-Feb) from 1900-2019. Outflows during the winter of 2018-2019 were on average the 4th highest ever recorded, despite limitations posed by low Lake St. Lawrence levels in December and ice conditions in January/February.

Question 10. Why were outflows from Lake Ontario reduced during the spring of 2019?

Answer: Outflows from Lake Ontario were reduced to mitigate – but not eliminate – damaging flooding in the lower St. Lawrence River during a record-setting Ottawa River freshet in the spring of 2019.

Explanation:

The Ottawa River enters the St. Lawrence River near Montreal and combines with the flow released from Lake Ontario. Each spring, milder temperatures, snowmelt and rainfall increase Ottawa River flows, and the timing and magnitude needs to be considered carefully when regulating Lake Ontario outflows to manage water levels on the St. Lawrence River (see also Question 16 and Figure 15).

In 2019, a heavy snow-pack on the Ottawa River basin lasted into mid-April as a result of colder than normal temperatures in early-spring. Major rains fell over the Ottawa River basin in late-April and

continued into May. These rains combined with the rapid, late snowmelt to result in record-high runoff and flows from the Ottawa River into the St. Lawrence River, and in some places even greater water levels than those seen just two years prior during the record flooding of 2017.

Question 11. Why were outflows during the spring of 2019 lower than during the springs of 2017 and 2018 and why were they lower for so long?

Answer: Outflows from Lake Ontario were, at times, lower in the spring of 2019 because Ottawa River flows were higher (record-high, at their peak) and they lasted for a much longer duration.

Explanation:

Record-high Ottawa River flows lasting a record-duration in 2019 (Figure 10) were caused by the combination of an unusually deep, dense snowpack and a late melt, which occurred at the same time as exceptionally heavy rains in late-April and early-May.

The record-peak Ottawa River daily flow recorded at Carillon Dam in 2019 was 9217 m^3/s (325,500 cfs), higher than the previous record of 9094 m^3/s (321,200 cfs) set 8 May 2017, and more than 3000 m^3/s (105,900 cfs) above the peak daily flow recorded in 2018 of 5860 m^3/s (206,900 cfs).

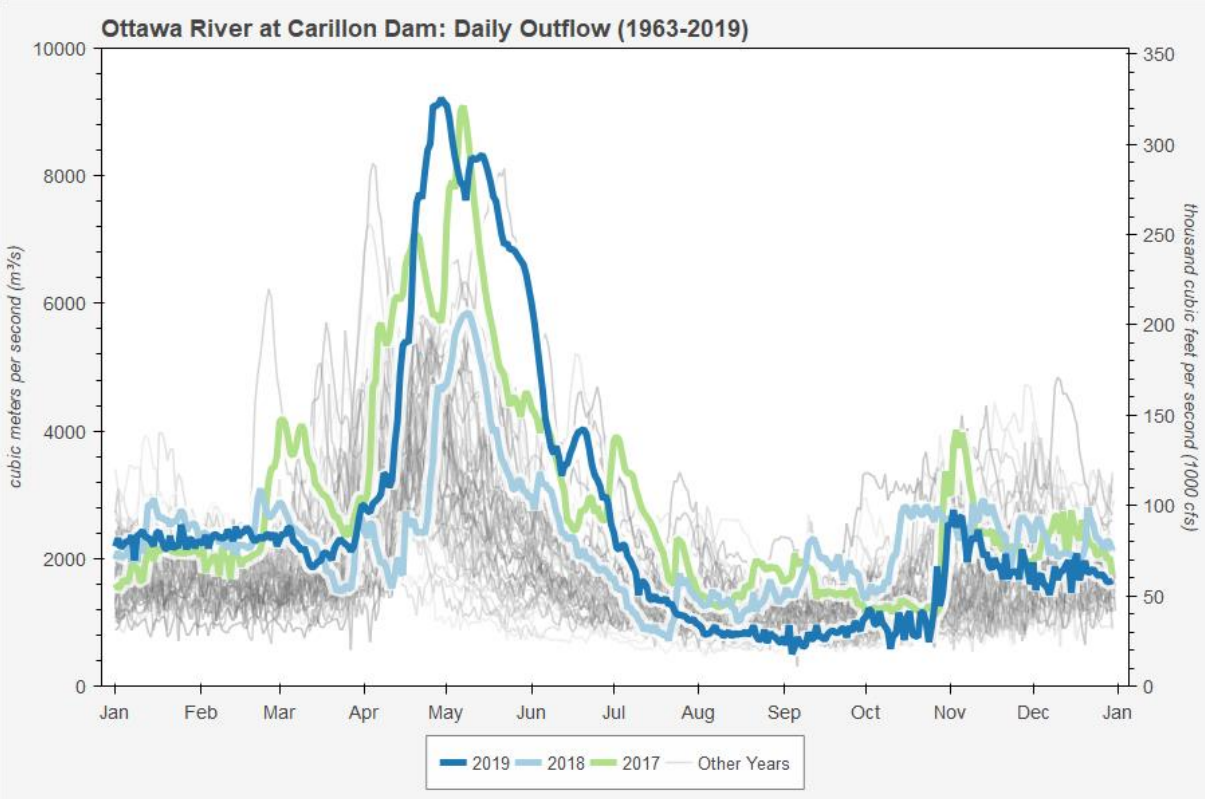

Figure 10: Ottawa River daily flows at Carillon Dam. Each line represents an individual calendar year (1963-2019). Record flows lasting a record duration occurred in the spring of 2019, all entering the lower St. Lawrence River near Montreal.

The exceptionally high Ottawa River flows in 2019 also lasted for a much longer duration. For example, Ottawa River flows were above 8000 m^3/s (282,500 cfs) for 21 days in 2019, but only 6 days in 2017, and Ottawa River flows were above the highest daily flow recorded in all of 2018 (5860 m^3/s (206,900 cfs) on 10 May) from 19 April to 3 June 2019, a full month and a half.

Table 3: Ottawa River flows: highest months recorded since completion of Carillon Dam in 1963

Rank	Year	Month	Ottawa River Flow
1	***2019***	***May***	***7731 m^3/s (273,000 cfs)***
2	1974	May	6459 m^3/s (228,100 cfs)
3	***2017***	***May***	***6138 m^3/s (216,800 cfs)***
4	1976	April	5806 m^3/s (205,000 cfs)
5	***2019***	***April***	***5404 m^3/s (190,800 cfs)***
6	***2017***	***April***	***5340 m^3/s (188,600 cfs)***
7	1979	May	5119 m^3/s (180,800 cfs)
…	…	…	…
16	***2018***	***April***	***4467 m^3/s (157,800 cfs)***

The Ottawa River monthly mean flows also set a new record-high for the month of May 2019, exceeding the previous monthly record in 1974 as well as the second highest on record in 2017 by more than 1000 m^3/s (35,300 cfs). April 2019 was also the 5th highest month on record, and the months of April and May 2019 combined far exceed any previous 2-month period.

Question 12. How can outflows impact navigation safety?

Answer: Outflows were increased and sustained at record-high rates for an extended period in the summer of 2019 to increase the rate of decline on Lake Ontario, but this also increased the current velocity of the St. Lawrence River and increased the risks to safe commercial navigation.

Explanation:

The Board's priority in 2019 was to reduce the impacts of high water conditions on shoreline riparians, businesses and communities both upstream and downstream in the Lake Ontario – St. Lawrence River system. In doing so, the Board must consider the degree of relief that can be provided, as well as the consequences to all interests, including navigation.

Starting 10 June, as flooding conditions subsided downstream in the lower St. Lawrence River, outflows were increased above the flows that would have been prescribed by Plan 2014 in order to increase the rate of water level decline on Lake Ontario. By 13 June, outflows reached the record-high outflow of 10,400 m^3/s (367,300 cfs). This flow rate was first achieved in 2017 and constitutes the highest flow ever released on a sustained basis. These record-matching outflows were maintained from mid-June through mid-August, even longer than in 2017.

When outflows are increased, this increases the velocity of currents in the St. Lawrence River. To maintain safe conditions for navigation during the sustained, record-high flows, the Seaway entities imposed speed limits, no passing restrictions and other mitigation measures.

Releasing higher outflows than those set by the Board during the summer of 2019 would have increased currents in the international section of the St. Lawrence River to an extent that would have effectively forced the stoppage of commercial navigation. This would have further impacted people's lives and

disrupted the economy throughout the Great Lakes region, without providing significant additional relief on Lake Ontario.
Furthermore, the gradual decline of Lake Ontario and upper St. Lawrence River levels through the summer months caused the velocity in the river to gradually increase, even while outflow was maintained at the same record-rate. This presented additional challenges, and eventually, maintaining record-high flows was no longer safe for navigation. As a result, starting in mid-August, flows were gradually reduced to ensure safe river currents and to allow ship transits to continue.

Question 13. How effective were the deviation strategies of 2017 and 2019 compared to the strategy employed during the summer of 1993, when outflows were set at alternating rates that temporarily stopped commercial navigation?

Answer: The Board's deviation strategy in 2017 and 2019 resulted in continuously higher outflows released for a longer duration when compared to the strategy in 1993. Record-sustained outflows averaging 10,400 m^3/s (366,900 cfs) were released for 54 days in 2017 and 69 days in 2019. Compared to 1993, when outflows averaged 10,190 m^3/s (359,900 cfs) over just 23 days, the strategies employed in 2017 and 2019 allowed more water to be removed from Lake Ontario, a greater rate of lowering and more rapid relief to Lake Ontario riparians, and with fewer impacts on other stakeholders.

Explanation:

In both 2017 and 2019, Lake Ontario outflows were set higher than those released in 1993 on a weekly basis and were sustained for a longer period, while permitting navigation to continue with the Seaway's mitigation measures in place. The flow of 10,400 m^3/s (366,900 cfs) is the highest sustained outflow on record. In 2019, this flow of 10,400 m^3/s was maintained from 13 June to 21 August, and over those 69 days, this record-outflow removed the equivalent of about 3.17 m (10.4 ft) of water from Lake Ontario. This is more than the total number of days that the same record-outflow was sustained during the summer of 2017, when it lasted from 14 June to 8 August, and removed just over 2.5 m (8.2 ft) of water.

The only time higher outflows have ever been released for any duration was during the high-water event of 1993, when temporary, 24-hour flow increases from 9900 to 10,900 m^3/s (349,600 to 384,900 cfs) occurred approximately twice per week from 20 May to 11 June 1993. Over this 23-day period, outflows were increased a total of seven times and the Seaway suspended navigation during each of these 24-hour flow increases. The average outflow over the entire 23 days that this strategy was implemented in 1993 was 10,190 m^3/s (359,900 cfs), equivalent to removing 104 cm (41 inches) of water from Lake Ontario, much less than what was achieved in 2019 and in 2017, and with greater impacts on other interests.

Overall, the outflows released during the summers of 2017 and 2019 were record-setting (Figure 11). The higher sustained outflows in 2017 and 2019 were made to lower water levels in consideration of Lake Ontario and upper St. Lawrence River riparian interests primarily, but other interests throughout the Lake Ontario – St. Lawrence River system were also considered. In addition to commercial navigation, the safety of recreational boaters and other users along the St. Lawrence River would have also been impacted by a strategy involving fluctuating outflows, both in the upper and lower St.

Lawrence River. The higher temporary outflows that this strategy would have entailed would have also increased high-water impacts downstream, including flooding and erosion along the lower St. Lawrence River. Instead, the strategy in 2017 and 2019 resulted in more predictable conditions for all users, while still ensuring record-high releases and a greater rate of lowering of Lake Ontario than was achieved in 1993, and with fewer impacts on other stakeholders.

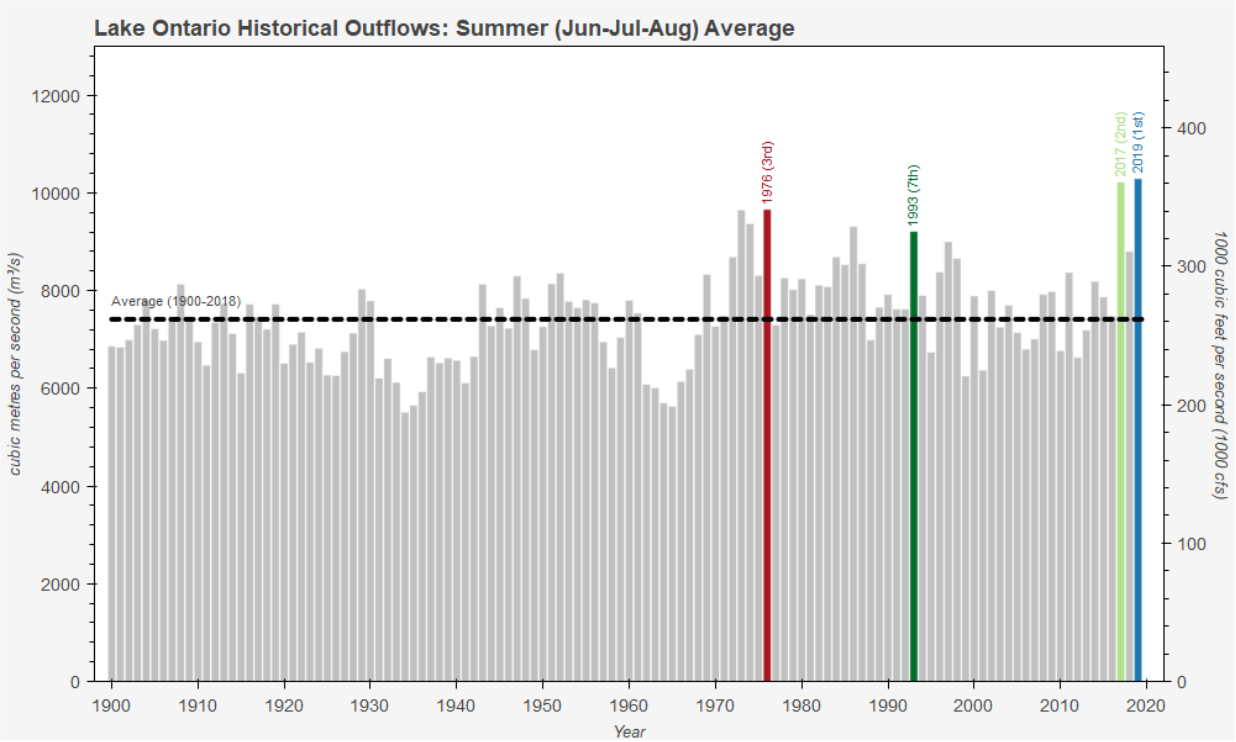

Figure 11: Lake Ontario mean outflows during summer (Jun-Jul-Aug) from 1900-2019. Outflows during the summer of 2019 were the highest ever recorded, exceeding the previous record set in the summer of 2017.

Question 14. Why were flows reduced in October for Lake St. Lawrence boat haul-out?

Answer: High outflows from Lake Ontario contribute to low levels on Lake St. Lawrence. Flow reductions were necessary to create enough depth for Lake St. Lawrence boaters to access boat ramps and lifts.

Explanation:

The extremely high outflows, especially after Lake Ontario reached lower levels in August, reduced the level of Lake St. Lawrence just upstream (west) of Moses-Saunders Dam at Cornwall, Ontario and Massena, New York. This left many boats grounded, and many marinas and boaters unable to remove their vessels prior to winter. Reducing the outflow for one weekend in the fall (12-13 October 2019) raised the level of Lake St. Lawrence sufficiently to assist with boat haul-out without any significant impact on the level of Lake Ontario.

Figure 12: Lake St. Lawrence at Long Sault, Ontario, 10 October 2019 (source: ILOSLRB)

Effects of Regulation

Question 15. Would water levels have been lower without the St. Lawrence Seaway and Moses-Saunders Dam?

Answer: No, water levels of both Lake Ontario and the lower St. Lawrence River would have been higher in 2017, 2018 and 2019 had the St. Lawrence Seaway and Moses-Saunders Dam never been constructed, and the higher levels would have lasted for a longer duration.

Explanation:

In addition to the construction of Moses-Saunders Dam and the navigation locks, the St. Lawrence Seaway project involved significant dredging in the upper St. Lawrence River. This makes it physically possible to release higher outflows now than prior to the project.

As a result, higher regulated outflows are generally released when Lake Ontario is high, prior to and following the spring Ottawa River freshet, which lowers Lake Ontario's water level. Moses-Saunders Dam makes it possible to reduce outflows to below what they would have been without the project, which reduces the peak level in the lower St. Lawrence River during the spring Ottawa River freshet.

The outflow conditions that would occur without the St. Lawrence Seaway/Moses-Saunders Dam project can be simulated using a relationship between the observed water levels and flows that occurred prior to the construction of the project (Figure 13). This relationship is known as the pre-project relation. The left plot compares the actual weekly mean outflow from 2017 through 2019 to the pre-project outflows calculated weekly for the same inflows or supplies to Lake Ontario. Similarly, the top right plot compares the weekly mean water level of Lake Ontario from 2017 through 2019 to the simulated pre-project level based on the pre-project outflows, while the bottom right plot compares the actual and pre-project weekly mean levels of Lake St. Louis.

Regulation reduces the severity of high water impacts on both Lake Ontario and the lower St. Lawrence River. In 2017 and 2019, it reduced the peak and duration of flooding; in 2018, it helped prevent flooding altogether.

As shown, the project and regulation allowed higher outflows than the natural, pre-project river channel before and after the spring. In 2019, this reduced the peak Lake Ontario level by approximately 35 cm (13.8 inches) and hastened the decline afterwards. It also allowed outflows to be temporarily reduced during the critical flooding downstream at Lake St. Louis when the Ottawa River flows were at record-highs, reducing the peak level at Lake St. Louis by over 50 cm (1.6 ft).

On its own, regulation cannot prevent flooding during periods of extreme wet weather and high inflows. However, the project and regulation do reduce the severity of high water impacts, on both Lake Ontario and the lower St. Lawrence River. During the extremely wet conditions and high inflows in 2017 and 2019, it reduced the peak and duration of flooding that occurred. In 2018, under more moderately high inflow conditions, the project and regulation were able to help prevent flooding altogether.

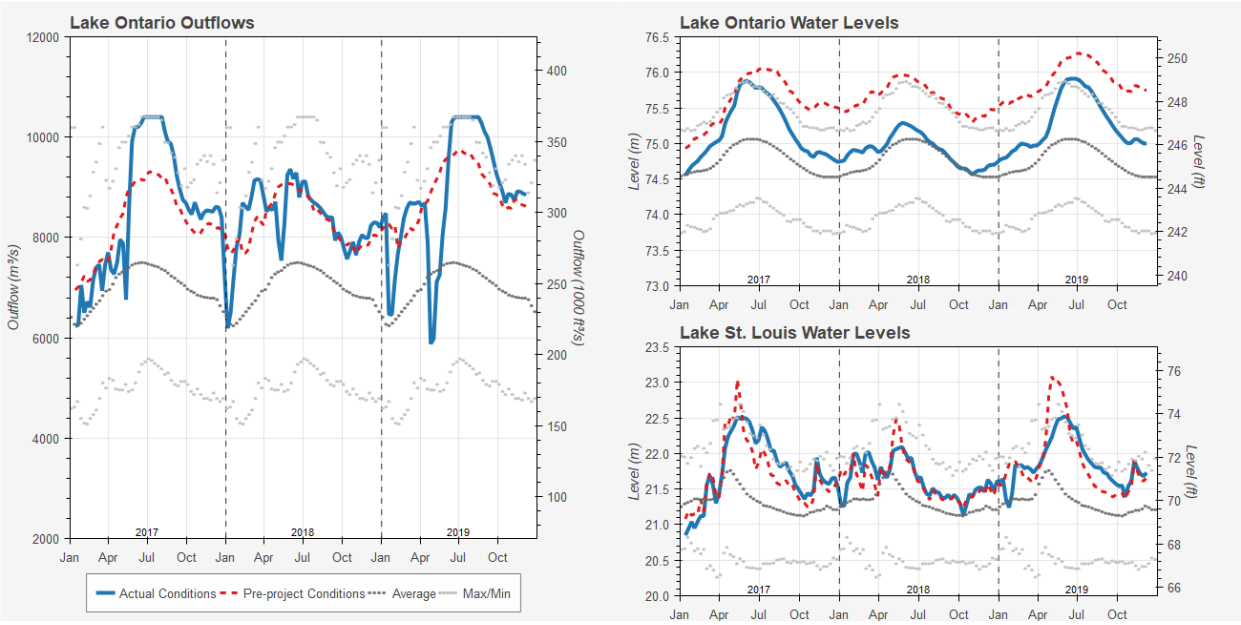

Figure 13: Actual (observed) versus pre-project (simulated) conditions from 2017 through 2019. Channel excavations during construction of the project allowed actual Lake Ontario outflows (left) to be higher before and after spring. This resulted in lower Lake Ontario water levels (top right) in general, and lower Lake St. Louis water levels (bottom right) during the spring of all three years, including 2018 when flooding was prevented.

Question 16. Did Plan 2014 cause the high water levels?

Answer: No, the high water levels were caused by wet weather and record-high inflows from Lake Erie and the Ottawa River.

Explanation:

The record-high water levels in 2019 followed persistently above-average precipitation across the Great Lakes basin that lasted several months, and which resulted in record-high inflows from Lake Erie, as well as the record-high flows from the Ottawa River system. These high inflows dictated how outflows from Lake Ontario had to be managed in 2019, and have dictated outflows in general since as far back as 2017.

During the summer and fall of 2018, outflows largely followed the Plan 2014 maximum L-limit. The maximum L-limit sets outflows at the highest rates possible in consideration of the level of Lake Ontario and the impacts that these high flows have on the upper St. Lawrence River, including increased current velocities and low levels on Lake St. Lawrence, both of which affect commercial navigation and recreational boating. The Plan 2014 maximum L-limit is based on a similar limit within the previous regulation plan, Plan 1958-D. However, the Plan 2014 L-limit allows for higher outflows than the Plan 1958-D version, as it better reflects modern ship capabilities and commercial navigation infrastructure, as well as knowledge gained through nearly 60 years of operations under the previous regulation plan.

In November and December 2018, as conditions turned wet, water levels of Lake Ontario began to rise.

As they did, outflows were also increased, again according to the maximum safe flow for navigation, which increases as levels of Lake Ontario rise. This generally continued until ice formation began. During this two-month period, outflows averaged 8120 m^3/s (286,800 cfs), the 7th highest November-December average on record (1900-present) and equivalent to removing 2.19 m (7.19 ft) of water from Lake Ontario during this time. Nonetheless, total inflows averaged 8840 m^3/s (312,200 cfs) over the same time, the 4th highest on record for November-December and equivalent to adding 2.39 m (7.84 ft), which accounts for the water level rise during this period despite the high outflows.

In the second week of January 2019, cold temperatures caused ice to begin forming in the critical areas of the St. Lawrence River. As has been done regularly since regulation began in 1960, outflows were temporarily reduced as ice formed on the St. Lawrence River to prevent ice jams that could have severely restricted flows and resulted in immediate localized flooding. These operations are done according to the I-limit of Plan 2014, which prescribes the maximum flow for safe ice formation. This rule is also based on similar rules and operational experience gained from decades operating under Plan 1958-D. This past winter, unlike the winter of 2017, the ice cover formed relatively rapidly starting on 11 January and a stable ice cover was largely established a couple of weeks later (Figure 14). Outflows were generally increased thereafter, again according to the maximum safe flow possible to ensure safe and stable ice conditions continued.

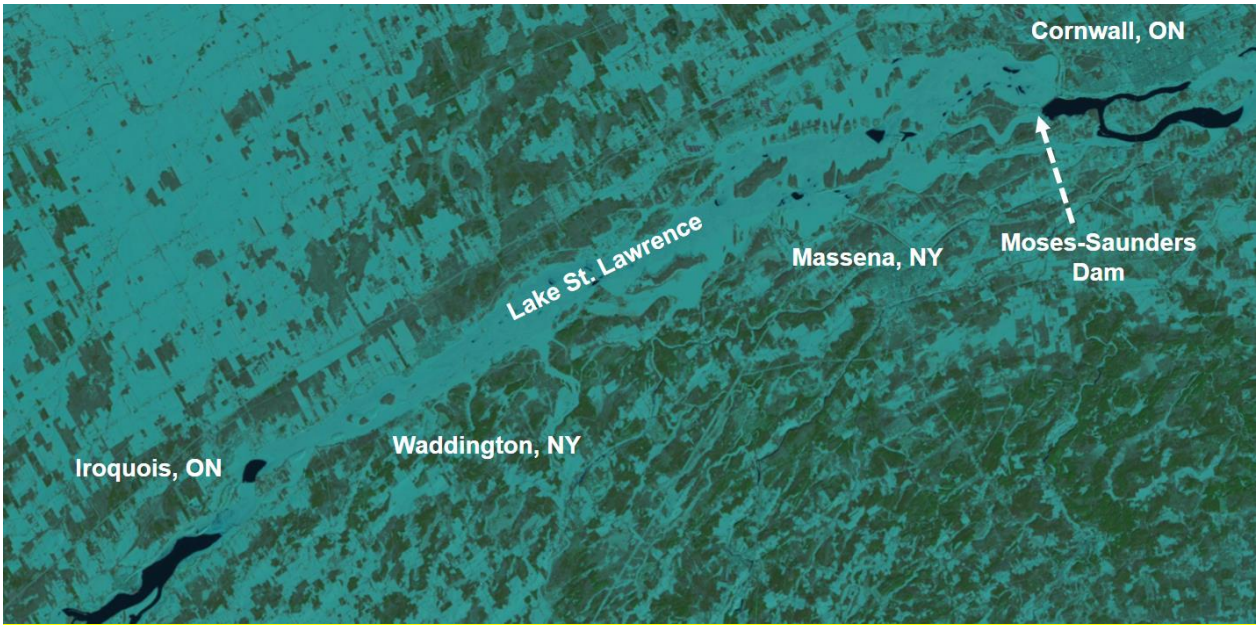

Figure 14: Lake St. Lawrence ice coverage, 2 February 2019 (satellite imagery: USGS Landsat)

Ice cover on the St. Lawrence River reduces the cross-sectional area and increases the roughness of the channel, which then also causes water levels immediately upstream of Moses-Saunders Dam on Lake St. Lawrence to drop. From February and continuing into March of 2019, outflows were increased to the maximum flow that could be released from Lake Ontario, while still maintaining minimum water levels on Lake St. Lawrence to protect municipal and domestic water intakes. These minimum levels also help ensure that the ice cover remains stable.

Despite the necessary reductions to allow for ice formation and to maintain minimum levels on Lake St.

Lawrence, outflows from Lake Ontario were very high in comparison to outflows that have been released historically during this period. The total amount of water released during the three winter months from December 2018 to February 2019 was the 4th highest on record, having only been exceeded in the winters of 1986-87, 1996-97 and recently in 2017-2018.

Outflows in March remained high and near or at the maximum outflow that would maintain minimum Lake St. Lawrence levels. Cold weather also caused ice conditions to persist somewhat later than normal. On 26 March, the St. Lawrence Seaway opened for the season, and with Lake Ontario still high, outflows began to be set according to the maximum safe flow for navigation. The outflow in March was the 6th highest on record, and despite well-above average inflows from Lake Erie, Lake Ontario only rose 2 cm (0.8 inches), the 11th smallest rise recorded during the month of March since 1900.

Cool weather and high outflows continued into mid-April. The cool weather maintained a very deep, dense snowpack in the Ottawa River basin. Starting on 14 April, milder temperatures and heavy rainfall began and persisted for several days. This rain combined with a rapid snowmelt, caused Ottawa River flows to increase to record-rates, exceeding the previous record-high set in 2017. With rising levels on Lake St. Louis due to the Ottawa River outflow, the Plan 2014 F-limit began to apply to balance high water upstream on Lake Ontario and the upper St. Lawrence River with high water downstream on Lake St. Louis and the lower St. Lawrence River.

The outflows during most of the summer/fall of 2018 and the first five months of 2019 were set according to rules of Plan 2014 – namely, the "I" (ice) limit, "L"-limit and "F" (flood) limit (a description of these limits is also available online in the Board's FAQs). These are all maximum flow limits, designed on the basis of how the Board had operated during similar conditions in the past when it often had to deviate from Plan 1958-D to achieve similar results. The maximum flow limits only apply when Lake Ontario outflows prescribed by Plan 2014 are high, and their intent is to limit outflows from being so high as to cause immediate impacts to interests within the St. Lawrence River system.

At the start of May 2019, water levels exceeded the Criterion H14 high triggers, giving the Board authority to deviate from the rules of Plan 2014. Outflows were increased throughout the month of May as the Ottawa River generally subsided (Figure 15), in order to continue balancing ongoing high water conditions in the lower St. Lawrence River with increasing water levels upstream on Lake Ontario and the upper St. Lawrence River. Beginning in June, the Board deviated from the rules of Plan 2014, and released higher outflows to provide relief to Lake Ontario shoreline property owners. Starting on 10 June, as flooding conditions subsided downstream, outflows were increased above those prescribed by Plan 2014, up to the maximum possible without stopping commercial navigation on the St. Lawrence Seaway. At this time, outflows matched the highest flows ever previously released on a sustained basis, which first occurred during the summer of 2017, and these unprecedented outflows were maintained from mid-June into mid-August 2019. Outflows were then gradually reduced as Lake Ontario levels declined, but remained 200 m^3/s (7100 cfs) above the normal maximum L-limit flow for safe navigation (Figure 16). This higher rate of outflow enabled continued lowering of Lake Ontario, while also maintaining safe conditions in the St. Lawrence River.

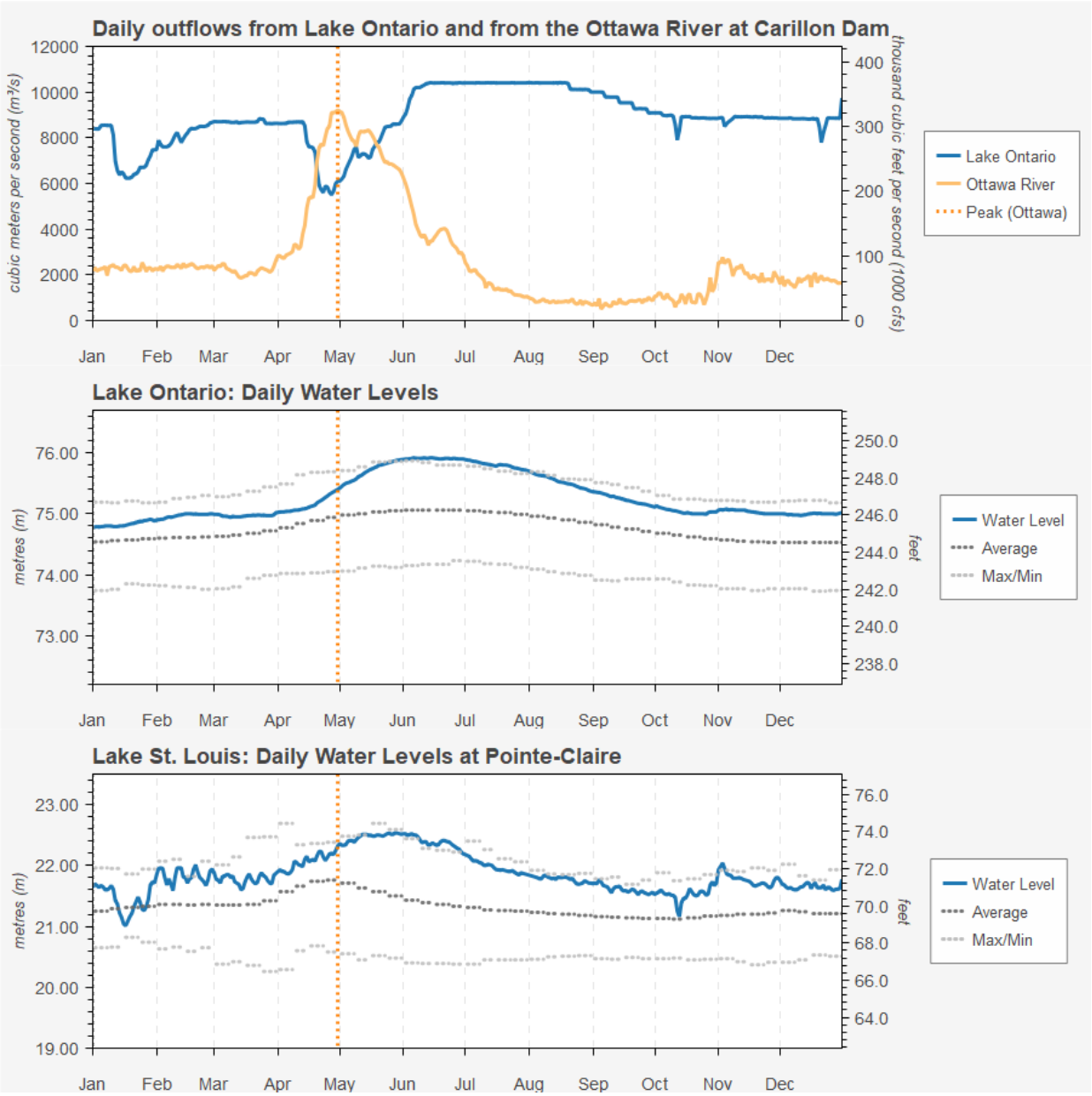

Figure 15: Lake Ontario outflow reductions in spring 2019 compared to timing of peak Ottawa River flows, Lake Ontario levels and Lake St. Louis levels

In summary, the Board managed outflows during the unusual and extreme weather conditions from November 2018 through late-May 2019 according to Plan 2014 rules that were based on Board operations under the previous regulation plan, Plan 1958-D. During this entire period, water supplies coming into Lake Ontario were consistently high, reaching record-breaking levels in May, and neither regulation plan would have been able to take significantly more water off Lake Ontario quickly enough to make a meaningful difference in water levels and prevent the flooding in 2019.

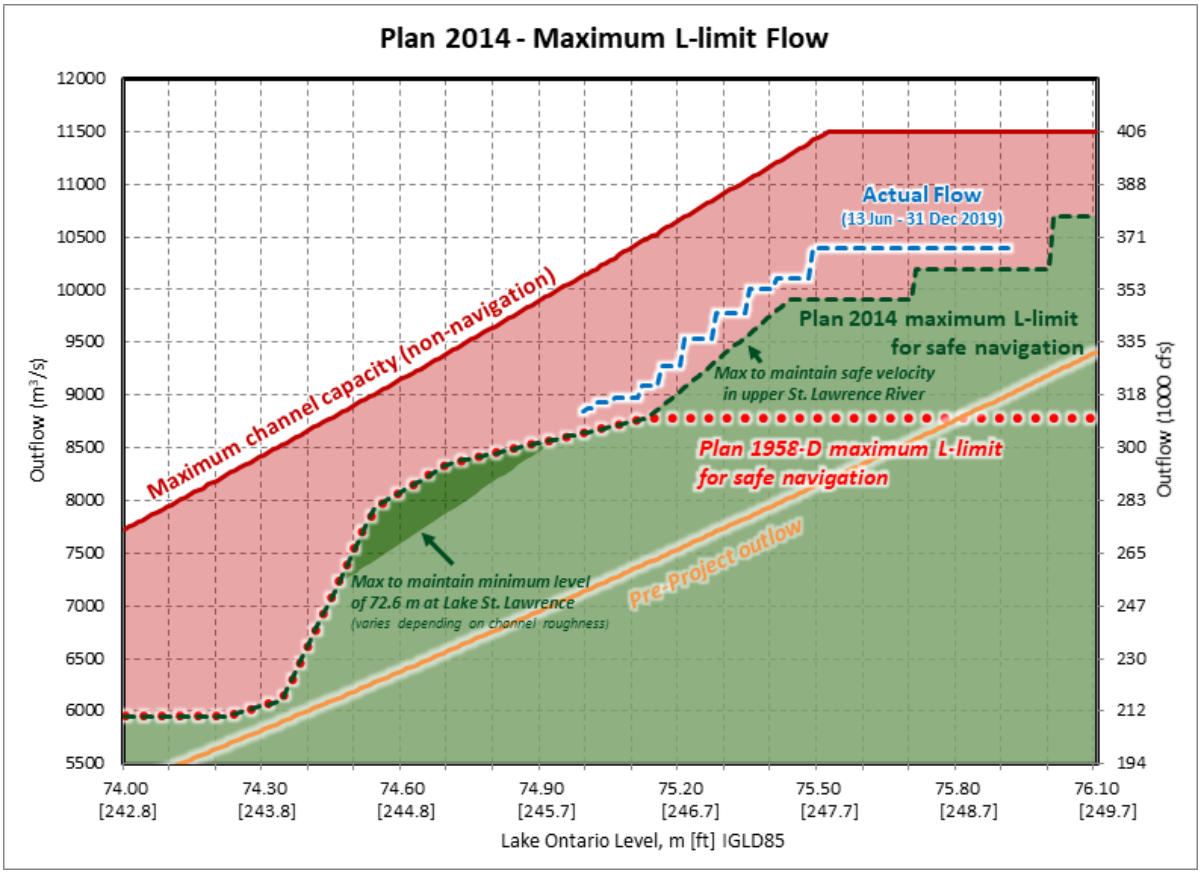

Figure 16: The Plan 2014 L-limit prescribes the maximum outflow that can be released for a given Lake Ontario level, while still permitting safe navigation in the St. Lawrence River. This maximum outflow declines as water levels decline because as they do this reduces the capacity and increases current velocities in the St. Lawrence River. However, the Plan 2014 L-limit prescribes higher outflows than both pre-project conditions and the Plan 1958-D L-limit, and in 2019 outfows above the L-limit were released for an extended period as the Board deviated from Plan 2014 and tried to remove additional water from Lake Ontario.

Question 17. Did Plan 2014 hold water back to intentionally raise the level Lake Ontario?

Answer: No, water levels rose because of high inflows, which are uncontrolled, even while Plan 2014 outflows were well above average and at maximum flow limits throughout much of 2018 and 2019.

Explanation:

The uncontrolled, natural factors that directly influenced Lake Ontario water levels in 2018 and 2019 were also the primary factors in determining – and often constraining – outflows during this time, including:

- wet weather in late-fall and winter;
- ice conditions in the St. Lawrence River in winter;
- high and eventually record-high inflows from Lake Erie;

- deep, dense snowpack and late snowmelt coinciding with major rainfall resulting in record-flows from the Ottawa River basin; and,
- wet spring conditions around Lake Ontario itself.

It was these natural factors that at times limited how much outflow could be released under Plan 2014, not the rules themselves. These natural factors would have had the same impact on the system and similar reductions in outflow would have needed to be considered under any regulation plan, including the previous Plan 1958-D.

In fact, despite these natural constraints, total releases from Lake Ontario under Plan 2014 were well above average during much of 2018 and 2019. During the summer and fall of 2018, a combination of high Plan 2014 outflows and near-average levels of Lake Ontario resulted in very low (and at times record-low) levels of Lake St. Lawrence, limiting further outflow increases during this period. Following that, and notwithstanding the reductions needed to establish a stable ice cover, high outflows continued to be prescribed by Plan 2014 during most of the winter, again resulting in very low levels on Lake St. Lawrence.

Figure 17: St. Lawrence River at Lake St. Louis, Maple Grove, Quebec, 2 June 2019 (source: IJC)

Outflows were temporarily reduced according to Plan 2014 during the record Ottawa River freshet in spring. While these reductions are built into the F-limit rule of Plan 2014, similar actions have been taken in the past under the previous regulation plan, and regulation of outflows under any plan would have to be done in consideration of the exceptional spring conditions and the resulting impacts, both upstream and downstream. Following the spring, outflows were increased to record-setting rates as downstream flooding subsided in early-June. As described in a previous answer, without the project the levels of Lake Ontario would have been even higher in 2019.

Figure 18: Lake Ontario at Greece, New York, 28 May 2019 (source: ILOSLRB)

Question 18. Did operation of dams on the Ottawa River system help to reduce flows to the St. Lawrence River?

Answer: Yes. While the IJC has no authority over the dams in the Ottawa River system, as was the case in 2017, those dams were operated to reduce high flows and flooding all along the Ottawa River, and this helped reduce peak flows into the St. Lawrence River near Montreal as well.

Explanation:

In response to the extreme flooding on the Ottawa River system, every measure was taken to reduce discharges from upstream reservoirs. Further information on operations in the Ottawa River system are available on the Ottawa River Regulation and Planning Board website and a video presentation summarizing the 2019 high water event is also available.

Flood reservoirs in the northern, regulated parts of the Ottawa River basin were lowered during winter to create space to allow much of the spring runoff to accumulate in the reservoirs. The storage space allowed for reduced river flows during the spring to reduce peak flood levels throughout the Ottawa River. These actions also reduced the peak flows entering the St. Lawrence River and this helps mitigate flood impacts in the Montreal area as well. For example, at the peak of the Ottawa River flood on 30 April 2019, the combined flow reduction due to the reservoir storage amounted to approximately 5000 m^3/s (176,600 cfs) in reduced discharge from Carillon Dam, the most downstream dam on the Ottawa River. This equates to more than 50 cm (1.6 ft) at Lake St. Louis on the St. Lawrence River and is in addition to the effects that Lake Ontario regulation had in reducing the peak levels here. During flood events, the safety and security of riparian residents and the integrity of water retention structures take priority over hydropower production.

While flow reductions were significant, there are limitations to using the dams to reduce flows on the Ottawa River, particularly under the extreme conditions experienced in 2019. Storage capacity in the Ottawa River basin is small compared to the total volume of the annual spring freshet (i.e. the surge that occurs in the spring when rains combine with snowmelt). Total runoff from the 2019 spring freshet was nearly four times the total storage volume of the reservoirs in the basin. In addition, approximately 60 percent of the drainage area of the Ottawa River basin is uncontrolled and has no significant reservoir storage capacity. The extreme rainfall received in late-April and early-May 2019 was widespread, including significant totals in the northern part of the Ottawa River basin where there was heavy snow waiting to melt, and also over the uncontrolled southern portion of the basin at the downstream end of the system, closest to the St. Lawrence River. The physical geography of this southern area does not allow further storage of flood waters – in fact, this was clearly illustrated in 2017 and 2019 by the extensive and severe flooding that occurred along the lower Ottawa River during the record-flows in late-April and early-May.

Question 19. Would the Board have had more flexibility to release water if Plan 1958-D had been in place leading up to the record-high levels of 2019?

Answer: Likely not, as outflows from Plan 2014 were already near or at the maximum that could be released from Lake Ontario without causing additional impacts on interests throughout the system.

Explanation:

It is impossible to know exactly how the Board would have responded under Plan 1958-D in the lead-up to the spring flooding. Such decisions are based on uncertain information and with considerable subjectivity.

However, during extremely wet conditions, the constraints imposed by the capacity of the system are the same, and outflows with the new plan are very similar to those that would have occurred operating with the old plan. This is because the Plan 2014 rules that apply during such wet conditions were designed to reflect the Plan 1958-D rules plus what was learned through years of experience with deviations from Plan 1958-D during similarly wet conditions in the past. Under Plan 1958-D, the Board needed to deviate frequently from the outflow rules to address conditions (the plan plus deviations is known as 1958-DD). Deviations from Plan 1958-D rules were often needed to address winter ice conditions, adjust for the effects of high or low Ottawa River flows on the lower St. Lawrence River, and to maximize outflows to moderate Lake Ontario flooding while maintaining safe conditions for navigation. These conditions had to be addressed by deviations from Plan 1958-D, but are now included and considered directly in the outflow rules for Plan 2014.

Natural factors – including record-high inflows from Lake Erie and from the Ottawa River system – would have had the same impact on the system, and similar reductions in outflow would have needed to be considered under any regulation plan, including the previous Plan 1958-D

For example, had the Board been operating under Plan 1958-D prior to the spring flooding in 2019, the Board would have certainly considered the potential increased risk that high inflows from Lake Erie throughout 2018 would have posed to Lake Ontario. However, high Lake Erie flows have historically not proven to be a strong indicator of spring flooding during the following year. Furthermore, Lake Ontario had reached seasonal average levels by the summer, and remained near average through the fall of 2018. Plan 2014 was nonetheless prescribing maximum L-limit outflows throughout this time, largely in response to the continuing high inflows from Lake Erie, resulting in extremely low levels on Lake St. Lawrence, immediately upstream of Moses-Saunders Dam.

Given this, it is possible that the Board may have operated in such a way that it would have caused slightly higher levels on Lake Ontario and the St. Lawrence River in the latter half of 2018 and possibly continuing into 2019. Under Plan 1958-D the Board may have reduced outflows below the maximum safe flow for navigation during the summer of 2018 in order to raise levels of Lake St. Lawrence and thereby providing some relief to those having to cope with the record-low levels there at the time. The Board had done this under similar circumstances in the past while operating under Plan 1958-D.

In January 2019, winter weather conditions would have dictated the same outflow reductions under

both plans to ensure safe ice formation and lower the risk of ice jams in the St. Lawrence River. Stable ice conditions allowed high outflows in February and March 2019, but also again caused low water levels upstream of the dam, which increased risk to municipal water intakes (this risk would have been considered under both plans). As ice melted in March, and prior to the Seaway opening later that month, outflows remained very high (just slightly below maximum values). Given that forecasts at the start of March 2019 did not suggest the extreme weather to come, it is unlikely that the Board would have deviated from Plan 1958-D to increase the outflow significantly; had the Board done so, this would have reduced Lake Ontario water levels by at most 5 cm (less than 2 inches). When the Seaway opened in late-March, Plan 2014 again set outflows at maximum safe rates for navigation, as would have been done under Plan 1958-DD. During April and May, the record-breaking Ottawa River flows and severe flooding downstream of the dam would have limited outflows from Lake Ontario under both plans.

In summary, additional deviation authority may have resulted in small differences in outflows prior to the spring of 2019, but this would have made little difference in the water level of Lake Ontario and the St. Lawrence River by spring when record-high inflows began, and the differences may have made flood conditions worse, not better.

Question 20. Why not draw Lake Ontario down each fall so that there is sufficient storage to prevent flooding in the spring?

Answer: The outcome would have immediate consequences on other interests and will not reliably prevent future flooding impacts on Lake Ontario.

Explanation:

Plan 2014 does attempt to draw down Lake Ontario levels when water supplies are high, as they have been in the fall of 2017, 2018 and again in 2019. This helped to successfully prevent flooding in 2018. However, the physical capacity simply does not exist to prevent flooding in years when winter and spring water supplies upstream and downstream are as extreme as those experienced in 2017 and again in 2019.

Previous studies have shown that it is not possible to prevent all flooding on Lake Ontario, even if this was the only objective of the regulation plan (e.g., see final report by the International Lake Ontario – St. Lawrence River Study Board, pg 33). Furthermore, the impacts that can occur during low water years must be considered. For example, if there is a drought in the following spring, drawing down Lake Ontario as much as possible each fall would result in significant impacts to other interests. Extreme fall drawdowns are also known to have detrimental impacts to environmental restoration interests as well.

Potential Future Measures in 2020 and Beyond

Question 21. What further actions can be taken to lower water levels and reduce the risk of flooding in 2020?

Answer: Outflows will remain high in 2020. The IJC has given the Board authority to continue deviating from Plan 2014 even after Lake Ontario falls below the criterion H14 trigger levels, and this will allow the Board to further increase outflows whenever opportunities arise considering the impacts that these flow increases will have on other interests of the system.

Explanation:

The Board has had authority to deviate from Plan 2014 since 7 May 2019, after Lake Ontario rose above the high water trigger levels known as criterion H14. In light of the present extraordinary circumstances, the IJC has given the Board authority to deviate from Plan 2014 even after Lake Ontario falls below the criterion H14 trigger levels.

The outflow released from June through December 2019 was the highest ever recorded for this seven-month period. High outflows are expected to continue to be released in 2020 as the Board continues to consider all possible measures to lower the level of Lake Ontario as rapidly and as much as possible, heading into next spring. The Board has been reviewing data from the past three years to better understand when potential opportunities to deviate from Plan 2014 might be available over the next several months, and what the effects of such deviations might be on water levels and interests throughout the Lake Ontario - St. Lawrence River system.

Forecasts indicate that Plan 2014 outflows will be very high and at or near maximum values for several months. The IJC's decision will allow the Board to further increase outflows when opportunities arise considering the impacts that these flow increases will have on other interests of the system. These opportunities are expected to remove a small amount of additional water from Lake Ontario to reduce the risk of high water in 2020.

However, the Board stresses that while an outflow strategy can influence water levels, the main driver is weather, especially when wet conditions are as extreme as they were in 2017 and 2019. Likewise, the amount of additional lowering that will be achieved through deviations will largely depend on weather and water supply conditions, and whether or not a flood occurs during the spring of 2020 will also depend on weather conditions and water supplies over the winter and spring months, not the regulation plan. While the Board and the Plan are doing all that can be done, no flow management plan can eliminate the risk of future flooding.

Question 22. Are these high water levels of 2017 and 2019 the "new normal"?

Answer: Extreme high water levels are never normal, but they have occurred in the past and they will occur again in the future – when, or how frequently, is uncertain.

Explanation:

The primary cause of high water levels is always the same - wet weather. Record-precipitation caused the record-high water levels in 2017, and persistent, widespread wet weather also led to record-high inflows from Lake Erie and the Ottawa River system in 2019, resulting in new record Lake Ontario levels. Weather and water supply conditions are uncontrolled and highly unpredictable – we know extremes have occurred in the past and we expect they will occur again in the future, so we must be better prepared for the next event, even though it is difficult to know how soon that will be.

Question 23. How can shoreline residents and businesses prepare for potential future high-water events?

Answer: It is imperative that shoreline residents and businesses assess and address risk by considering all available options when living near any body of water that can potentially cause damage or harm.

Explanation:

Shoreline property owners have been impacted by two record-high water events within three years. Multi-year high water events occurring in close succession are not new – for example, Lake Ontario rose above 75.50 m (247.70 ft) and caused shoreline damages in 1973, 1974 and 1976. However, the severity of the events in 2017 and 2019 is alarming.

No regulation plan can eliminate the risk of future flooding. The only reliable means of avoiding high water impacts is through shoreline resilience measures

It is impossible to predict with any certainty the frequency of occurrence of such extreme events, but it is highly probable that extreme high and low water events will occur again at some point in the future. In the short term, it is important for residents and businesses with at-risk properties to consider "resilient" approaches to shoreline management and implement strategies to minimize the potential negative impacts.

Unfortunately, there are no simple or easy solutions, but it is absolutely essential to assess and address risk by considering all available options when living near any body of water that can potentially cause damage or harm.

There is not a "one size fits all" solution to preparing for extremes. Some of the options for consideration may include both engineered and non-engineered approaches, or a combination of actions to find the most optimal response to local conditions. Some examples include:

Engineered Resiliency Responses

- Shoreline Protection - seawalls, revetments, groins, bulkheads, etc.
- Beach nourishment
- Flood proofing/ relocating vulnerable structures and roads
- Floating docks/dock extensions/modular board walks
- Dredging
- Marina facility relocations
- Water intake and sewer modifications
- Coastal wetland construction to mitigate losses
- Soft engineering/green infrastructure (e.g. re-vegetation of shoreline)

Non-Engineered Adaptive Responses

- Integrated shoreline management planning
- Zoning restrictions/ setbacks
- Acquisition of vulnerable properties, non-functional marinas
- Improved flood plain mapping/ technical services
- Alteration of recreational boating season
- Cargo load adjustments
- Abandoning non-functional water intakes

Figure 19: Lake Ontario beach at Cobourg, Ontario, 29 May 2019 (source: Ganaraska Conservation)

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: September 17, 2019
FILE: IMS: NFFE13, PSSG4177
S.R.: 5658-19

APPROVED BY C.A.O.

TO: Chair and Members, CLOCA Board of Directors

FROM: Perry Sisson, Director – Engineering and Field Operations

SUBJECT: **Lake Ontario Water Levels**

Purpose and Background
A staff report (#5688-19) was provided in May 2019 to inform the Members of the Board of the current and forecasted Lake Ontario water levels, flooding and erosion concerns, and CLOCA responsibilities and actions. The Board provided the following resolution for the report:

1. ***Refer the matter back to Staff for comment on the role Plan 2014 has played in the regulation of Lake Ontario water levels, including answering whether it was a contributing factor to flooding;***
2. ***What role CLOCA can play re: working with United Shoreline Ontario, a grassroots community based organization which has the mandate of uniting residents and municipalities of the North shore of Lake Ontario;***
3. ***Provide further information on the areas of flooding outlined in Report #5638-19 and propose solutions to the issue of flooding, with specific reference to the areas mentioned in the final paragraph but also including northern Municipalities;***
4. ***That the report appear on the September 17 2019 agenda.***

The following report provides the requested information.

1) Plan 2014 and Lake Ontario Water Levels
The Great Lakes are a chain of 5 Lakes that are the largest surface freshwater system on earth, with a drainage basin area of more than 500,000 square kilometres and shared jurisdiction between Canada and the United States. Lake Ontario, the lowest Lake in the system, receives drainage from the other Great lakes, and discharges to the St Lawrence River. Of the water draining through Lake Ontario, about 85% flows in from Lake Erie, with the remaining 15% contributed directly from the Lake Ontario drainage basin. The enormity of this hydrological system, under extreme and record setting climactic conditions, is beyond human control.

Prior to the 1950's, the Great Lakes were unregulated, and the water levels and shoreline impacts were unmanaged. Recognizing an opportunity to improve transportation of goods through the St Lawrence River and Great Lakes system, Canada and the United States created an agreement to work collaboratively to not only provide navigation channels but also create hydro-electricity on the shared waters. The St Lawrence Seaway and Power Project commenced in 1954 to provide navigation channels for movement of freight, and the Moses Saunders Dam for the generation of hydro-electricity. Deep navigation channels and locks, and the Dam were officially opened in 1959. The navigation channels also allowed for greater outflow from Lake Ontario, while the dam provided some ability to control the outflow to the St Lawrence system. Water levels of Lake Ontario and the St Lawrence River have been managed since the completion of these works with less severe high water and low water events than natural conditions would have created.

A water level plan was established for the operation of the Moses Saunders Dam. Plan 1958 was created by analysing Lake Ontario water supplies between 1860 and 1954, and was intended to keep Lake levels above 74.15m during the navigation seasons, and below 75.4m for flood protection. Several alterations to the Plan were made to adjust for problems experienced with low water levels and it was recognized that it would be necessary to occasionally deviate from the Plan when adjustments were needed to relieve level problems, but still recognize multiple interests. Attachment #1 shows Lake Ontario

Cont'd

water levels for the period of 1918 through 2016. The plot shows the natural water level fluctuations up to 1959 including multiple years of extreme high levels and extreme low levels. The remaining plot shows the Lake water levels under Plan 1958 through Plan 58DD. It is notable that water levels exceeded the intended maximum level of 75.4m three years during the 1970's and twice in the 1990's.

The 1958 water level plans were intended to provide a balanced approach to a number of interests:

- Provide navigation for transportation of freight through the St Lawrence River and Lake Ontario
- Provide for hydro-electricity generation
- Provide recreational boating
- Protect against flooding and erosion of shoreline properties

Between 2000 and 2014 The IJC examined alternative Plans to better balance the various interests. The International Joint Commission provided a History of Water Regulation in the Lake Ontario St Lawrence River Basin and stated "…In the ensuing decades, shoreline development in the region continued to grow. New homes were built, many residents converted summer cottages to year-round residences, and recreational boating grew to become a significant economic activity. But greater development also meant that greater impacts were felt from fluctuating water levels, particularly on occasions when water supplies were more extreme than Plan 1958-D was designed to handle. By the 1990's, there was growing dissatisfaction with the current regulation plan." Recognizing that Plan 1958 had not considered ecosystem health, and that the water level regulation had caused significant harm to coastal wetland environments, the IJC also studied alternative plans to include protection of natural processes and shoreline environment including coastal wetland protection in the list of interests. After a very lengthy process involving extensive consultation and debate, Plan 2014 was approved and implemented in 2016, with the intention of providing a Plan that continues to balance the interests as previously stated, and also providing consideration for ecosystem health.

The IJC provided rational for the new plan and impact assessments for the proposed changes:

> *"…there was general, and often strong, support for Plan 2014. For example, the U.S. Environmental Protection Agency (USEPA) supported Plan 2014, writing that Plan 1958DD has significantly degraded Lake Ontario wetlands and vital fish and wildlife populations, and that Plan 2014 would increase the diversity and functioning of 26,000 ha (64,000 acres) of coastal wetlands. Conservation Ontario wrote to explain the significant economic value of wetlands and asserted that Plan 2014 would contribute to the economic, ecological and social well-being of the Lake Ontario and St. Lawrence River. The U.S. Department of the Interior wrote that Plan 2014 would best meet the stated goals and that it represented the most logical approach to bringing water level regulation into the 21st century. The City of Montreal supported Plan 2014, as well. The Nature Conservancy noted that selecting Plan 2014 would reverse decades of environmental harm, while rejecting it would not solve the coastal impact problems that would have to be confronted no matter the regulation plan. Audubon New York wrote to advise that Plan 2014 was central to the long-term success of the Great Lakes Restoration Initiative and the overall restoration of this important ecosystem. Ducks Unlimited commented that the IJC and other principal interests had done an outstanding job of balancing the needs and requirements of all the major parties, and encouraged the IJC to implement Plan 2014."*

Lake Ontario – St Lawrence River Plan 2014 (International Joint Commission, June 2014)

Both Plan 2014 and Plan 1958DD protect coastal development from damage that would occur on Lake Ontario without regulation. Studies show that average annual coastal damages on Lake Ontario would be approximately $46 million under natural conditions, approximately $18 million under plan 1958DD and approximately $20 million under Plan 2014.

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FILE: NFFE13, PSSG4177 September 17, 2019
S.R.: 5658-19

Lake Ontario-St Lawrence River Plan 2014: Summary of Benefits and Impacts (IJC 2016)

The adjacent figure from the Lake Ontario- St Lawrence River Plan 2014 (IJC 2014) shows the Lake Ontario water levels for Plan 2014 versus the former Plan 58DD using both historical (1900-2008) water supply records as well as stochastic water supplies that included wetter and drier conditions than have been experienced in the historical record. The figure shows that Plan 2014 will allow both historical and stochastic (probabilistic) maximum water levels to increase by less than 0.1m.

Figure 17

Lake Ontario Water Level Ranges, Plan 2014 and Plan 1958DD

The stochastic water supply data include much wetter and drier periods than have been recorded. Plan 2014 maximum Lake Ontario levels are 6 cm (2 in) higher than Plan 1958DD for the historical simulations, shown as solid lines in the figure above, as well as for the stochastic simulations, shown as dashed lines.

2017 and 2019 Record Lake Levels

During high water level and flood conditions, the IJC utilizes dam operations in an attempt to minimize damage throughout the Lake Ontario-St Lawrence River system. This sometimes results in reducing Lake Ontario outflow despite flooding of Lake Ontario shoreline, when serious flooding is occurring in the lower St Lawrence (i.e., Montreal area).

After the establishment of Plan 2014, Lake Ontario hit record high water levels in 2017, and again in 2019. Flood damages were experienced around the Lake Ontario shoreline and in the St Lawrence River system over extended periods of time, and shoreline erosion has been greatly accelerated with the two years of extreme water levels. There has been a great deal of discussion of the possible link between the new water level management plan and the extreme water levels experienced.

CLOCA, in association with the Ganaraska Region and Lower Trent Conservation Authorities, is updating the 1990 Lake Ontario Shoreline Hazard Study for the shoreline reach between Ajax and Brighton. Zuzek Inc., a coastal engineering company, has been retained to complete the study, with completion expected by the end of 2019. The attached graph (Attachment #3) was provided by Zuzek Inc. during a recent Steering Committee meeting for the study, and provides insight regarding the influence of water level regulation on Lake Ontario water levels. The graph is based upon statistical analysis of modelled and measured lake level data provided by Environment Canada for the time period between 1900 and 2017. This analysis was provided in the spring of 2019 prior to the new record high water levels in Lake Ontario. The 2019 data will be added to the analysis for the final report.

The analysis shows the 100 year (levels that have a 1% chance of occurring in any given year) static Lake Ontario water levels that would be experienced under various scenarios including:

- No regulation (natural conditions prior to the Moses Saunders dam and channel works)
- Plan58DD (the plan used prior to 2014)
- Plan 2014 (the plan in current use)

Actual measured maximum water levels are also included in the chart to compare actual maximum levels against the 100 year water levels. The chart shows that without regulation, the 100 year Lake levels would reach extreme levels more than 0.3m higher than the regulated scenarios. The natural scenario would also allow for much higher 100 year water levels through the winter, spring and fall months also. This scenario would result in much greater flood damage as well as significantly increased rates of shoreline erosion.

Plan 2014 allows the Lake level to be slightly higher than the previous Plan 58DD. The analysis shows the effect of Plan 2014 over the previous plan is an increase in 100 year flood level of about 0.1m, and is consistent with the IJC assessments.

Cont'd

In 2017, snow melt and rainfall resulted in above average water levels for all the Great lakes, but extreme runoff from the Ottawa River watershed and Lake Ontario drainage basin resulted in severe flooding of the lower St Lawrence River and record high water levels in Lake Ontario. The Great Lakes-St Lawrences River Adaptive Management (GLAM) Committee completed a thorough investigation of the 2017 water management, as documented in the Great Lakes Basin Conditions and Water Level Impacts to Support Ongoing Regulation Plan Evaluation (GLAM, November 2018). The report concludes that the water levels experienced in 2017 under Plan 2014 would have been the same if the former Plan58DD had been in effect. The report provides findings and suggested next steps for the adaptive management of water level regulation including:

- Continue to test and improve simulation models to include more variations in climactic conditions and reduce uncertainty in predictions.
- Continue to study and evaluate Plan 2014's maximum flow limits for:
  - flooding and erosion impacts (F-limit) of Lake Ontario and the St Lawrence River
  - river level and velocity (L-limit) for navigation
- Examine trigger levels (levels that allow for deviation from the Plan) for extreme conditions

In 2019 high water levels returned. All of the Great Lakes experienced extreme water levels, with flooding and erosion impacts experienced on the shorelines. These levels have very little to do with water regulation, but everything to do with an extreme amount of water in the system provided by the Great Lakes drainage basin.

Lake	Average Summer Level	2019 Summer level	Difference
Lake Ontario	75.1m	75.9m (Record)	0.8m
Lake Erie	174.3m	175.2m (Record)	0.9m
Michigan-Huron	176.7m	177.4m (Record)	0.7m
Superior	183.5m	183.9m (Record)	0.4m

Under the extreme conditions experienced in 2017 and 2019, given the enormity of the Great Lakes system and the fact that inflows to Lake Ontario from the Niagara River and Lake Erie are unregulated, no other actions could have been taken under any regulatory plan or approach to prevent flooding. Widespread and record setting precipitation and water volumes from snow melt brought water volumes that led to flooding on the shoreline of Lake Ontario beyond human control. Thus, events of unusual magnitude or severity are referred to as natural hazards (Understanding Natural Hazards, MNR, 2001). In this case, the natural hazard of the Lake Ontario flood plain.

Nevertheless, it will be important to continue to take an adaptive management approach to the Lake Ontario water level plans, with further examination of the most recent record Lake levels, climate change scenarios, and variations on plans that may provide improved regulation.

2) United Shoreline: Ontario

The United Shoreline: Ontario website provides information for the organization. According to the website, this is "…a grass-roots community based organization with the mandate of uniting the residents and municipalities of the north shore of Lake Ontario in one voice", and an objective "…to engage governments and private home owners toward the protection of lakeshore homes, families, businesses, emergency responders and municipalities from violent or wide-spread lake surge flooding."

United Shoreline raises awareness of impacts to shoreline property from Lake Ontario water levels and shoreline erosion. CLOCA staff requested information on membership, and involvement of municipalities and Conservation Authorities with US:O through the US:O website, but have not yet received the information.

Cont'd

CLOCA has a role with natural hazard management that includes:

- Identifying natural hazards and limits
- Regulating development to limit conflict with natural hazards
- Providing monitoring services and flood forecasting and warning information to assist with emergency response
- Providing technical advice and services to mitigate the risk of flooding

CLOCA would be happy to receive more information, suggestions, and concerns from homeowners on the shoreline as well as United Shoreline: Ontario, and can provide responses and information under our role. CLOCA staff have reviewed and circulated a recent "Understanding Plan 2014 for Municipalities" presentation from United Shoreline: Ontario, and have registered for a webinar entitled "Why is Lake Ontario Flooding and What Needs to Change".
CLOCA continues to work closely with our municipal partners and lakeshore communities to protect people and property from natural hazards.

3) Shoreline Damage Centres
The current source of information for natural hazards along the Lake Ontario shoreline within CLOCA's watershed is the Lake Ontario Shoreline Management Plan by Sandwell Swan Wooster Inc, (1990). This report provides flood and erosion limits that have been utilized to develop regulation limits when Ontario Regulation 42/06 provided CLOCA the authority and responsibility to regulate development along the Lake Ontario shoreline in 2006. The Sandwell report also documented shoreline Damage Centres and suggested protection measures that could be employed to manage the risk at these locations. The damage centres are areas where structures exist in close proximity to a shoreline reach with high risk of flooding or erosion. The Sandwell study will be replaced with the Shoreline Hazards Management Plan currently in progress by Zuzek Inc. However, until the Zuzek report is finalized in late 2019, the 1990 report continues to be relied upon. The 1990 documented damage centres and recommended shoreline protection measures are:

C1: Crystal Beach, Whitby

The Crystal Beach community is located behind a bluff and partially backed by the Corbett Creek Marsh (coastal wetland). The Marsh outlets to the lake with a barrier beach system, and to the west of the beach, the bluff builds to heights of 5 metres. The reach is located immediately to the east of Thickson's Point, a land feature that likely acts as a littoral barrier and limits the amount of sediment passing to the Crystal Beach reach. The bluff is within metres of Crystal Beach Road, and boulder and armour stone revetments have been placed to protect the road and water service that lies within the road allowance.

The Sandwell report notes that low lying areas are prone to flooding from the Marsh during storm events, and the bluff is subject to relatively high erosion rates because of the orientation and proximity to Thickson's Point. The report recommends an armour stone revetment where shoreline protection is required. Works such as stone revetments will require monitoring and maintenance as wave energy continuously works to shift the armouring.

C2: Stone Street, Oshawa

Approximately 45 homes are located on the Lake Ontario bluff on the south side of Stone Street. The bluff reaches heights of about 10m and some homes are within 15m of the bluff. The Sandwell report notes that the bluff protrudes lakeward relative to adjacent shorelines, and is therefore exposed to wave action and erosion. Residents have placed concrete, sheet piling, drums, and tires in an attempt to arrest erosion of the lower portion of the bluff. Sandwell notes these measures are "totally inappropriate" and suggests that offshore breakwaters or headlands with artificial beach placement, in combination with acquisition of private properties and conversion to parkland as the ideal solution.

C3: Muskoka Ave/ Kluane Ave, Oshawa
A 14m tall bluff projects into the Lake at Kluane Avenue, and is prone to wind and wave activity. The bluff height diminishes to the west where a number of homes remain on the shoreline. Approximately 7 homes exist within this damage centre, and the City of Oshawa has effectively acquired homes from this area and enlarged the Lakeview Park.

Cont'd

FILE: NFFE13, PSSG4177 September 17, 2019
S.R.: 5658-19

C4: Port Darlington Beach, Clarington

The Sandwell report focuses on the Cedar Crest Beach portion of Port Darlington, and describes the 50 houses on the and sand spit prone to both flooding from the Westside Creek Marsh and lake Ontario. The report suggests a dyke to protect properties from the riverine flooding, and placing beach materials between off shore breakwaters. Detailed studies are suggested to ensure beach placement would not create a silt problem in the harbour approach channel. The report also notes the high cost for protection of this area, and the possibility for acquisition of the entire beach area.

Other Shoreline Areas of Concern

Through the mapping of floodlines and erosion limits, CLOCA is aware of other shoreline locations where possible shoreline damage centres exist. These include the Wilmot Retirement village (bluff erosion), South Service Road (low bluff erosion) East Beach Road (bluff erosion), West Beach Road (flooding and dynamic beach erosion), Cove Road (bluff erosion), Halls Road (bluff erosion), and Ontoro Boulevard (flooding and bluff erosion).

Shoreline Protection

Where structures are at risk from Lake Ontario flooding (including storm surge and wave uprush), the most appropriate solution is to relocate the structure out of the area of flood risk. Where this cannot be accomplished, floodproofing structures and preparing emergency plans are measures that can reduce some of the risk associated with flooding. Flood protection barriers may be possible, but are generally expensive to build and maintain, creating an on-going liability and sometimes a false sense of security.

Shoreline erosion is most often managed by hardening the shoreline with armour stone or sheet piling, or construction of groins to break waves and trap sediment. These works, if well engineered, can be affective, but have high capital costs, annual maintenance costs, and lifespan replacement costs (perpetual costs).

It is also important to recognize the impacts of shoreline protection. Any time that a natural process is interrupted, off-setting impacts are likely. Shoreline erosion is a natural process where beaches and bluffs erode during high water and wave events. The process converts the energy of the wave into the work of moving sediment. The eroded sediments are carried offshore, but will be placed back on the shoreline over time, as beach material.

When shoreline armouring is placed to arrest shoreline erosion, the immediate impacts are: the loss of the beach at the armouring site because of scouring at the toe of the armouring and the inability of sediment to reach the upper beach zone; and the deflection of the wave and energy which can result in increased erosion of the closest unprotected shoreline area. Armouring shorelines also depletes the amount of sediment in the natural system. CLOCA's shoreline is currently about 25% hardened through both public and private shoreline armouring. It follows that the beaches on CLOCA's shoreline have 25% less sediment available than they would have naturally received.

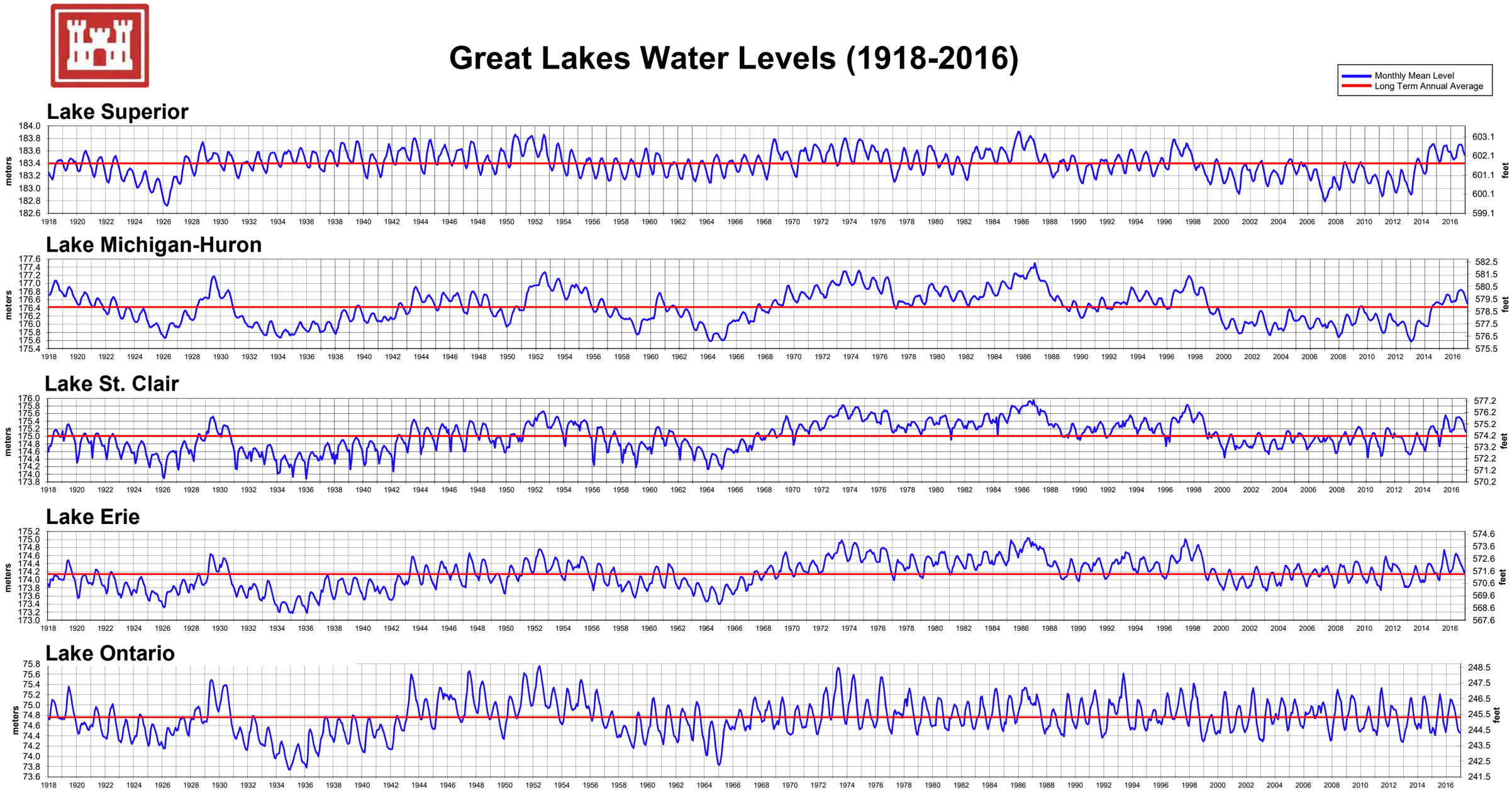
Similarly, groynes act to break waves and trap sediment. These features provide protection to the adjacent shoreline, but may intercept sediment that would otherwise travel to a beach further removed from the site.

The extreme water levels, flooding, and shoreline erosion, are all reminders of the importance of CLOCA's regulatory role to limit development in hazardous locations and the need to effectively implement long-standing provincial land use policy for Natural Hazards such as Lake Ontario flooding and erosion hazards through local Official Plans and zoning by-laws. The Lake Ontario Shoreline Hazard Management Plan will provide updated information and recommendations to assist CLOCA and our municipal partners with the future management of our shoreline.

RECOMMENDATION:
THAT Staff Report #5658-19 be received for information.

PS/ms
Attach.

Great Lakes Water Levels (1918-2016)

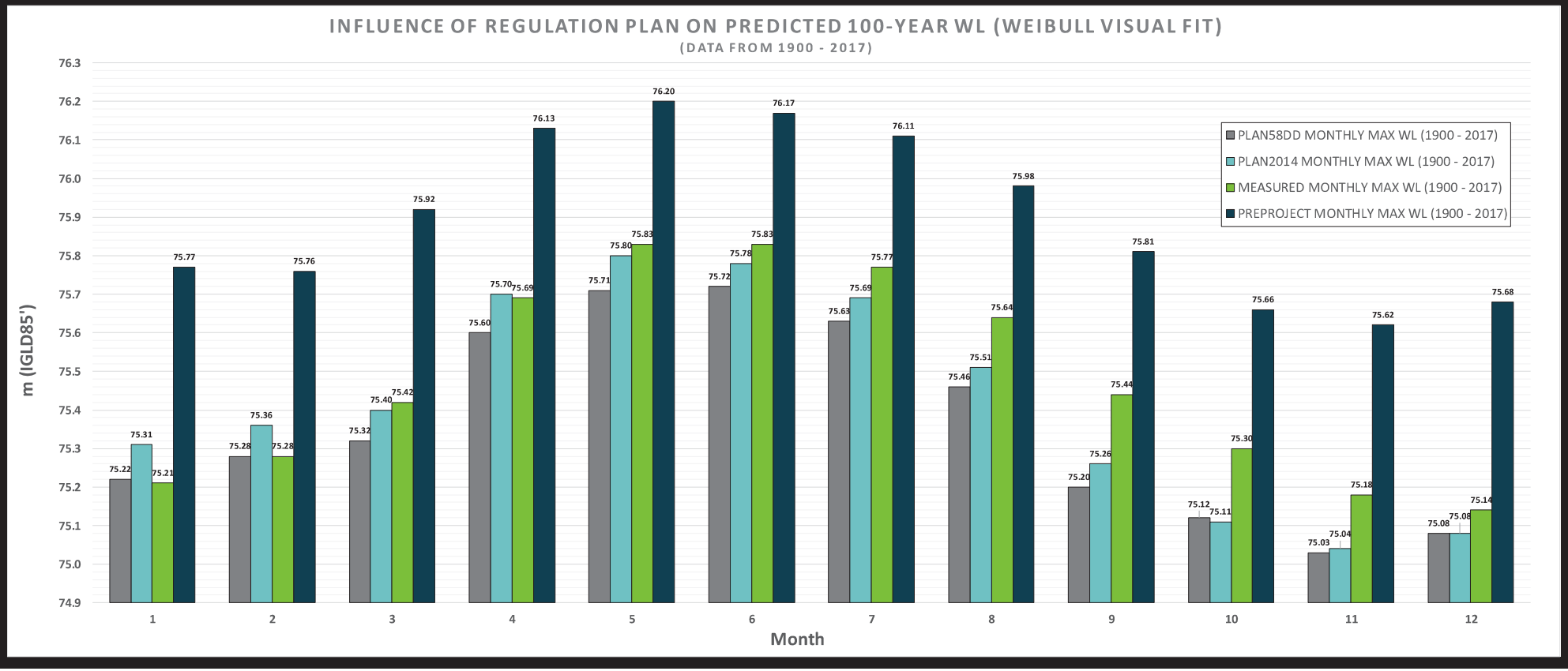


The monthly average levels are based on a network of water level gages located around the lakes.

Elevations are referenced to the International Great Lakes Datum (1985).

Water Levels – Static WL

- Influence of regulation plan:



Environment and Climate Change Canada | Environnement et Changement climatique Canada

Volume 27, Number 7
July 2019

LEVELnews

Great Lakes — St. Lawrence River Water Levels

Beginning-of-July levels of all Great Lakes are at or above record-highs

Due to continued high water levels, the risk of accelerated coastline erosion and flooding to low-lying areas continues. For local sources of information on this, see the following sections of this edition of LEVELnews.

All of the Great Lakes began July at or above their record high levels, when we look at our period of record from 1918 to 2018. Parts of the St. Lawrence River also continued to experience high levels, including areas around Montreal Harbour.

Record high levels could continue for the remainder of the summer for all the Great Lakes, if wet conditions continue. However if they receive average water supplies, all lakes will be entering their seasonal decline by mid to late summer. However, even if the remainder of the summer and fall are very dry, forecasts for all of the lakes predict above average water levels through to the beginning of winter.

Continued wet conditions in June resulted in record high June-monthly-mean levels on lakes Superior, St. Clair, Erie and Ontario. Lake Michigan–Huron was just below its June-monthly-mean record.

Great Lakes Water Level Information

Lake	June 2019 Monthly Mean Level		Beginning-of-July 2019 Level	
	Compared to Monthly Average (1918–2018)	Compared to One Year Ago	Compared to Beginning-of-Month Average (1918–2018)	Compared to One Year Ago
Superior	39 cm above	28 cm above	36 cm above	25 cm above
Michigan–Huron	77 cm above	34 cm above	79 cm above	35 cm above
St. Clair	81 cm above	27 cm above	86 cm above	30 cm above
Erie	79 cm above	25 cm above	83 cm above	30 cm above
Ontario	85 cm above	69 cm above	85 cm above	74 cm above

Canada

The beginning-of-July water levels for Lake Erie and Lake Ontario are the highest beginning-of-month levels that have ever been recorded since 1918, at any time of the year on these lakes. Lake Superior's and Michigan–Huron's beginning-of-July water level are a record high for this time of year, but higher beginning-of-month water levels have been recorded at other times of the year.

Be prepared for high water

With beginning-of-July levels of all the lakes at record-high or near-record-high values, all should be prepared for its impacts during summer. Stakeholders with interests along the lakeshore that are susceptible to shoreline erosion or are in low-lying areas should pay close attention to any weather systems that generate strong sustained winds. Such weather systems can result in a storm surge possibly causing localized flooding and accelerated erosion due to waves reaching higher up on the shoreline. With current lake levels, waves could reach elevations that have not been affected since prior to 1918.

Property owners around the Great Lakes should be following information from their local responsible agencies on high water impacts. For those planning activities around the Great Lakes this summer it is a good idea to check current local conditions before heading out. Be prepared for some possible impacts such as flooding of beaches, boat ramps, docks, low-lying parks, campgrounds, property and structures.

To help you plan your summer and keep you safe, consult the sources of information on flood conditions in your area. You will find references in the "Information on flooding" section. As well it's a good idea to check current water levels and wave forecasts when planning for activities around the lakes. Sources of current water levels and marine wave forecasts are provided in the "Current water levels, marine forecasts" section below. Property owners around the Great Lakes are also strongly encouraged to consult the information provided by their local responsible agencies on high water impacts on a regular basis.

Information on flooding

Great Lakes water levels are hard to predict weeks in advance due to natural variations in weather. To stay informed on Great Lakes water levels and flooding, visit the Ontario flood forecasting and warning program web site at https://www.ontario.ca/flooding.

Local flood watches and flood warning information are issued in Ontario by Conservation Authorities at https://conservationontario.ca/conservation-authorities/find-a-conservation-authority/ or Ministry of Natural Resources and Forestry district office at https://www.ontario.ca/page/ministry-natural-resources-and-forestry-regional-and-district-offices.

Additional information can also be found at the International Lake Superior Board of Control web site, https://www.ijc.org/en/lsbc, and the International Lake Ontario–St. Lawrence River Board web site, https://ijc.org/en/loslrb.

More information is also provided in the "Water levels forecast" section at the end of this newsletter.

June Precipitation over the Great Lakes[1,2]

Great Lakes Basin	**109%**	**Lake Erie (including Lake St. Clair)**	**124%**
Lake Superior	**87%**		
Lake Michigan–Huron	**114%**	**Lake Ontario**	**121%**

June Outflows from the Great Lakes[1]

Lake Superior	**123%**	**Lake Erie**	**130%**
Lake Michigan–Huron	**128%**	**Lake Ontario**	**136%**

[1] As a percentage of the long-term June average.
[2] US Army Corps of Engineers
NOTE: These figures are preliminary.

Information on current water levels and marine forecasts

With lake levels changing day-to-day the Government of Canada Great Lakes water levels and related data website at: https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/great-

lakes-levels-related-data.html provides a source for web sites on up-to-date Great Lakes water levels.

Daily levels: Current daily lake wide average levels of all the Great Lakes are available on the Government of Canada Great Lakes water levels and related data website by clicking on "Daily water levels for the current month". The daily average water level is an average taken from a number of gauges across each lake and is a good indicator of the overall lake level change when it is changing relatively rapidly due to the high precipitation recently experienced.

Hourly levels: Hourly lake levels from individual gauge sites can be found at the Government of Canada Great Lakes Water Level Gauging Stations website at: http://tides.gc.ca/eng/find/region/6 provides hourly water levels. These levels are useful for determining real-time water levels at a given site, however it should be noted that they are subject to local, temporary effects on water levels such as wind and waves.

Marine forecasts: A link to current Government of Canada marine forecasts for wave heights for each of the Great Lakes can be found on the Great Lakes water level and related data web page under the "Wave and wind data heading". Current marine forecasts for lakes Superior, Huron, Erie and Ontario are available by clicking on the link of the lake you are interested in. To view a text bulletin of recent wave height forecasts for all of the Great Lakes click on the "Wave height forecasts for the Great Lakes and St. Lawrence River" link.

June monthly levels

All the Great Lakes had well-above-average monthly-mean water levels in June and lakes Superior, Erie and Ontario had record-high values (1918–2018).

Lake Superior was 39 cm above its period-of-record (1918–2018) June monthly-mean water level and 28 cm above its level in June 2018. This set a record high value for the month, surpassing the previous June record set in 1986 by 8 cm, but is still 7 cm below the record-high monthly-mean level set in October 1985.

Lake Michigan–Huron's monthly-mean level in June was 77 cm above average, 34 cm above last June's level, the 2nd highest June mean level on record and just 1 cm below the record set in 1986.

Lake Erie's monthly-mean level was 79 cm above average, 25 cm above its level the same time last year and 10 cm higher than the previous record set in 1986. This is now the highest mean-monthly level on record.

Lake Ontario's June monthly-mean level was 85 cm above average, 69 cm higher than a year ago, and 10 cm higher than the previous record set in June 2017.

Lake level changes

All of the Great Lakes, except Lake Superior, had above-average rises over the month of June, due mainly to continued above-average precipitation.

Lake Superior's levels rose only 3 cm in June, significantly less than its average (1918–2018) rise of 8 cm.

Lake Michigan–Huron rose by 10 cm when on average it rises of 6 cm.

Lake Erie's level rose by 10 cm, five times its average rise of 2 cm.

Lake Ontario rose by 1 cm when on average in June it falls by 1 cm.

Beginning-of-July lake levels

At the beginning of July lakes Superior, Erie and Ontario all had record high levels for that time of the year. Lake Michigan–Huron's level tied its record high value.

Lake Superior's beginning-of-July level was 36 cm above average (1918–2018) and 25 cm higher than July 2018. This beginning-of-July level is 4 cm higher than the previous record-high value set in 1943, but 6 cm below the record high monthly-mean level of October 1985.

Lake Michigan–Huron's beginning-of-July level was 79 cm above average and 35 cm higher than its level at the same time last year. This equalled the Lake Michigan–Huron record high set at beginning of July 1986.

Lake Erie was 83 cm above average at the beginning of July and 30 cm higher than the same time last year. This was 14 cm higher than the record high beginning-of-July level set in 1986.

Lake Ontario's level at the start of July was 85 cm above average and 74 cm higher than the water levels last year. This also set a new record by 12 cm over the beginning-of-July record set in 2017. Lake Ontario levels reached a maximum daily-average level of 75.92 m by June 6, which was 4 cm higher than the record-high daily-average level first set on May 25, 2017. Levels gradually fell to 75.82 m on July 11 due to very high outflow from the lake.

At the beginning of July, all of the lakes were at least 65 cm above their chart datum level.

Water levels forecast

Relative to their beginning-of-July levels and with average water supplies for this time of year, lake Superior and Michigan–Huron rise over the month of July, while lake Erie and Ontario enter their seasonal decline.

Looking ahead into early fall, and based on their beginning-of-July levels and past conditions on the lakes (1918–2018), continued seasonal record-high water levels are forecasted for all the lakes for the remainder of the summer, if the lakes continue to receive above-average water supplies. If the wet trend changes and very dry conditions occur, all of the lake levels will remain well above average into October.

Lake Superior's probable range of future lake levels looking forward to October are between 19 cm and 41 cm above average. This forecast, based on beginning-of-July conditions, indicates that if the lake receives average water supplies it will be near or above seasonal record levels for August and September, but will only just reach the October 1985 period-of-record high (1918–2018) if it receives very wet water supplies. Lake Superior is forecasted to be only 1 cm above its period-of-record high of October 1985 if very wet conditions are seen between the beginning of July and October, but if average water supplies are seen it will be 9 cm below its October 1985 record high. However, because the August and September seasonal records are considerably below October's, it will only take above-average water supplies to keep its levels above seasonal August and September records.

The probable range of values until October for Lake Michigan–Huron are between 64 cm and 94 cm above average. Within this probable range of values, Lake Michigan–Huron could break its seasonal records for August and September by a few centimetres, but only if conditions are very wet. However its levels in October are likely to be from 12 cm to 42 cm below its period-of-record high, which occurred in October 1986.

The probable range of values for Lake Erie up to October are between 48 cm and 81 cm above average. If very wet conditions occur, Lake Erie could exceed record high levels by 15 cm within the probable range of future lake levels, however it is more likely to stay just above its seasonal-record-high values for August and September and drop below record values by October.

Lake Ontario's probable range of levels are between 26 cm above average with very dry conditions and 77 cm above average with very wet conditions. Lake Ontario's levels could stay above record high values by as much as 8 cm through to October if very wet conditions occur, but more likely to drop below seasonal-record-high values.

For more information on the probable range of water levels consult the July 2018 edition of LEVELnews.

For a graphical representation of recent and forecasted water levels on the Great Lakes, refer to the Canadian Hydrographic Service's monthly water levels bulletin at: https://waterlevels.gc.ca/C&A/bulletin-eng.html.

FOR MORE INFORMATION:

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Expedited review of Plan 2014 begins

Facebook Twitter

Date
March 03, 2020

The International Joint Commission (IJC) recently received $1.5 million in funding from the United States, with an additional $1.5 million in matching funds from Canada, to investigate possible improvements that could be made to Lake Ontario outflow regulation activities.

Extremely wet conditions over the last several years have driven record-high water levels and river flows in the Lake Ontario-St. Lawrence River system. This 18- to 24-month investigation will focus on gathering information to help inform the critical decisions needed to best manage these extreme conditions, and on providing information that may lead to long-term improvements to the regulation plan.

This effort will be managed by the Great Lakes-St. Lawrence River Adaptive Management (GLAM) Committee, a sub-committee to the IJC's International Lake Ontario-St. Lawrence River Board, International Niagara Board of Control, and the International Lake Superior Board of Control. The GLAM Committee provides all of the Great Lakes control Boards, including the International Lake Ontario-St. Lawrence River Board, with the scientific data and analysis required to review the performance of regulation plans so that the Boards can evaluate potential changes to those plans. The GLAM Committee has already started executing tasks in support of this expedited review to help the Board with key decisions for this spring.

"The IJC is committed to making this an open and transparent review and is in the process of creating a special advisory group to support the GLAM Committee through this process," according to Jane Corwin, US Co-Chair of the IJC.

This advisory group will be made up of people representing a wide range of interests throughout the Lake Ontario-St. Lawrence River system. “The advisory group will create an invaluable, direct connection between the review and those impacted by water levels and flows throughout the system,” said Pierre Béland, Canadian Co-Chair of the IJC.

No regulation plan will be able to prevent the extremely high water levels and flows experienced during these periods of record-setting water supplies. However, the IJC remains fully committed to finding the best solutions possible for managing levels and flows, especially during these periods of extreme conditions.

Contact:

Sarah Lobrichon (Ottawa) 613-992-5368 lobrichons@ottawa.ijc.org

Frank Bevacqua (Washington) 202-736-9024 bevacquaf@washington.ijc.org

REPORT
CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

DATE: September 15, 2020

FILE: PSSG4185, PSSG4177 **APPROVED BY C.A.O.** CD

S.R.: 5702-20

MEMO TO: Chair and Members, CLOCA Board of Directors

FROM: Chris Darling, Chief Administrative Officer

SUBJECT: **Conservation Authority Representative on the International Joint Commission Public Advisory Group (PAG)**

At the June 16th, 2020 CLOCA Board meeting, the following resolution was endorsed:

THAT a letter be sent to Conservation Ontario, that they request a seat on the International Joint Commission Public Advisory Group for a Conservation Authority representative; and, THAT Conservation Ontario reach out to Conservation Authorities requesting a representative to sit on the International Joint Commission Public Advisory Group

Conservation Ontario was advised of this resolution on June 17th, 2020. Conservation Ontario subsequently consulted with the IJC requesting that they confirm if a CA representative could be considered for the Public Advisory Group. Attached is the e-mail response received from Internal Joint Commission (IJC) indicating that they are not supportive of adding a conservation authority representative on the PAG, however, IJC did reference that conservation authorities will be engaged by the Great Lakes Adaptive Management Committee to assist in the review of Plan 2014 through future surveys and data sharing.

As a result, Conservation Ontario indicated they would assist in promoting meetings with the local conservation authority experts on shoreline impacts.

RECOMMENDATION:
THAT Staff Report #5702-20 be received for information.

Attach.

CD/lv
S:\REPORTS\2020\sr5702_20.docx

From: Lobrichon, Sarah [mailto:lobrichons@ottawa.ijc.org]
Sent: Friday, September 4, 2020 4:34 PM
To: Bonnie Fox <BFox@conservationontario.ca>
Subject: RE: Inquiry regarding Representation on Public Advisory Group

Hello Bonnie,

I hope that you and your family are coping well during these challenging times.

Apologies for the late response to your email regarding Conservation Ontario representation on the Great Lakes-St. Lawrence River Adaptive Management Committee (GLAM)'s Public Advisory Group (PAG) to assist in conducting Phase 1 of the Expedited Review of Plan 2014.

The International Joint Commission (IJC) has assembled an advisory group that reflects a broad range of citizen interests and perspectives from across the Lake Ontario-St. Lawrence River system. While it would be unmanageable to include people from every conceivable interest from all regions in the basin, we are confident that the perspectives of Lake Ontario shoreline communities will be well represented on the PAG.

Furthermore, it is important to also point out that the PAG is not the only means through which the GLAM Committee will seek input on Phase 1 of its expedited review. The IJC has hired a professional facilitator to lead GLAM's engagement with and municipal staff along the shoreline of Lake Ontario and the St. Lawrence River and collect impact information related to the 2017 and 2019 high water events. Our contractor, Kennedy Consulting, will be reaching out to individual municipalities as well Conservation Ontario and the Association of Municipalities of Ontario to in the very near future to conduct a high-water impacts survey and organize and conduct a series of information exchange meetings.

We appreciate your willingness to help with the expedited review and will ensure that the facilitator reaches out to Conservation Ontario directly when it organizes its municipal meetings. Participation by the Ontario Conservation Authorities will help ensure that GLAM receives the information it needs to conduct a balanced review of shoreline impacts across the Lake Ontario-St. Lawrence River system.

Have a wonderful long weekend,

Sarah Lobrichon
Public Affairs Advisor | Conseillère en affaires publiques
International Joint Commission | Commission mixte internationale
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234, avenue Laurier Ouest, 22e étage, Ottawa (Ontario), Canada K1P 6K6
Telephone | Téléphone 613-794-8592 / Facsimile | Télécopieur 613-993-5583

Imagine two countries sharing hundreds of lakes and rivers along their border without conflict

Imaginez deux pays qui partagent des centaines de lacs et de rivières le long de la frontière sans conflit

www.ijc.org

From: Bonnie Fox [mailto:BFox@conservationontario.ca]
Sent: September 2, 2020 3:35 PM
To: Lobrichon, Sarah
Subject: FW: Inquiry regarding Representation on Public Advisory Group

From: Bonnie Fox
Sent: Friday, July 17, 2020 7:26 PM
To: 'lobrichons@ottawa.ijc.org' <lobrichons@ottawa.ijc.org>
Subject: Inquiry regarding Representation on Public Advisory Group

Hi Sarah,

We've received the attached letter to request a seat for a conservation authority representative on the Public Advisory Group. I assume this request is further to the PAG you formed in May 2020 to review the water regulation plan.

Could you please confirm whether a CA representative would be considered and if yes, could you please provide a terms of reference and brief details on the time commitments required. I would need this material to solicit nominations from across the CAs.

All the best,

Bonnie Fox, CAE
Manager, Policy and Planning
Conservation Ontario
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Newmarket, Ontario
L3Y 3W3