AGENDA
A meeting of the Council of the Corporation
of the Town of Northeastern Manitoulin and the Islands
to be held on Tuesday, February 21st 2023
at 7:00 p.m.

1. **Call to Order**

2. **Approval of Agenda**

   Deputation : Georgian Bay Association – Municipal Planning Comparison
   Climate Change

3. **Disclosure of Pecuniary Interest & General Nature Thereof**

4. **Minutes of Previous Meeting**
   i. Confirming By-Law 2023-07

5. **Planning Applications**
   i. Consent application, 2023-01 – Albert, Stephen and Paul Rolston

6. **New Business**
   i. Tender Award – Sand/Salt Shed
   ii. Donation request – Little Current & District Fish and Game Club
   iii. Request for Support – AMO Housing and Homelessness Campaign

7. **Minutes and Other Reports**
   i. Project Lifesaver Donor update

8. **Adjournment**

Municipal Planning Comparison Project
Executive Summary
Georgian Bay Association | December 2022

GBA reviewed and compared the Strategic Plans (SP), Official Plans (OP) and Comprehensive Zoning Bylaws (CZB) of the five municipalities where Georgian Bay Association members reside (the "GBA Area") as of December 2022.

The Municipalities are listed alphabetically below:

Township of the Archipelago (TOA)
Township of Carling (TOC)
Township of Georgian Bay (TGB)
Town of Northeastern Manitoulin and the Islands (NEMI)
Municipality of Killarney (MOK)
(collectively, the "Coastal Municipalities")

The ultimate goal of the project is to identify potential changes to regulations that would improve coastal protections in the GBA Area.

GBA's Definition of Coastal Protection

Protection of the natural environment, biodiversity, water quality and ecology of the lands and waters of the eastern and northern coasts of Georgian Bay for the benefit of the public, by promoting and defending sound planning standards, and protecting the integrity of municipal planning regulations, in order to ensure that development is sustainable and environmentally responsible.

Purpose & Goals

GBA understands that the regulations in each municipality vary according to population, geographic features, historical development, and demographics. Additionally, we did not include site specific policies or community plans due to the scope of the project. This collaborative project took around one year to complete and drew on publicly available information with significant assistance from staff at the Coastal Municipalities.

The purpose of the Municipal Planning Comparisons Project (MPCP) is to:

- Identify where planning regulations align or differ;
- Share key findings from the review and comparison; and
- Provide commentary on how coastal protection could be enhanced.

The goals of the MPCP are to:

- Initiate discussions and action among the coastal municipalities aimed at improving coastal protection through positive changes to planning regulations.
- Identify opportunities to increase harmonization of planning regulations, where considered beneficial for a given municipality.
- Share concerns about increased development pressures.

Key Findings & Commentary

Through the review, the project has produced several key findings, summarized below:

Waterfront Residential

Lot specifications (minimum lot/island area, frontages, coverages and setbacks) vary significantly and there is a lack of clarity and consistency regarding additional dwellings and shoreline structures (cabins, boathouses, docks etc.) and their permitted uses. These policies would benefit from a clear and consistent strategy to balance the maximizing of environmental protections with the needs of property owners for sufficient living space and facilities/services.

If such a strategy is not in place, then concerns arise around:

- Potential over-development from additional dwellings, facilities, services and shoreline structures;
- Increased stress on existing services (specifically septic systems); and
- Potential impacts on the natural shoreline, sightlines of neighbours, species at risk and other sensitive habitat, and water quality.

The projected increase in water levels variability also suggests that a review of high-water marks and setbacks would be prudent, particularly for septic systems. Changes to high-water marks and setbacks will affect these policies.

Waterfront Commercial

Lot specifications, lot/island area, frontage, and setbacks, vary among the coastal area municipalities and there is a lack of clarity on permitted uses in waterfront commercial designations between islands and mainland.

Provided there is minimal adverse impact on the environment, consideration could be given to more flexible regulations for marinas, resorts and tourist operations to enable them to operate when water levels are extremely high or low.

Environmental Protection and Open Space:

There is a lack of clarity on the differences between natural state and open space, and permitted uses and structures varied significantly.

Consideration could be given to adopting similar terminology and permitted uses among the five municipalities.

Lot subdivisions

Coastal protection could be improved by applying more restrictive regulations (than apply under the Ontario Planning Act) and inclusion of specific wetland and natural heritage areas policies for lot subdivision applications.

Blasting and dredging

Blasting and dredging can be an important tool to allow for water access in periods of extreme low water levels, particularly for marinas. Consideration could be given to developing clear and consistent site alteration by-laws on land modification using blasting and dredging to balance such needs with ensuring environmental protections are maintained.

Intent

GBA is not making recommendations but rather providing commentary on the findings through the lens of coastal protection. However, highlighting differences will enable municipalities and communities to see how others regulate certain planning matters, which could lead to discussions among the Coastal Municipalities on a more consistent approach that draws on the sound practices identified by the project.

CLIMATE CHANGE IN THE GREAT LAKES BASIN:

SUMMARY OF TRENDS AND IMPACTS

Acknowledgements

This summary report has been prepared by the Ontario Climate Consortium (OCC), and Toronto and Region Conservation Authority (TRCA) in partnership with Environment and Climate Change Canada (ECCC) in support of the Climate Change Impacts Annex of the Great Lakes Water Quality Agreement (GLWQA). The authors wish to acknowledge the contribution of the following individuals to the development of this document:

- Shaffina Kassam, Environment and Climate Change Canada
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- Greg Mayne, Environment and Climate Change Canada
- Frank Seglenieks, Environment and Climate Change Canada
- Wendy Leger, Environment and Climate Change Canada
- André Guy Temgoua, Environment and Climate Change Canada
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- Michael Bortolussi, Toronto and Region Conservation Authority
- Dana Lambert, Toronto and Region Conservation Authority
- Michael Notaro, University of Wisconsin-Madison
- Beth Hall, University of Purdue

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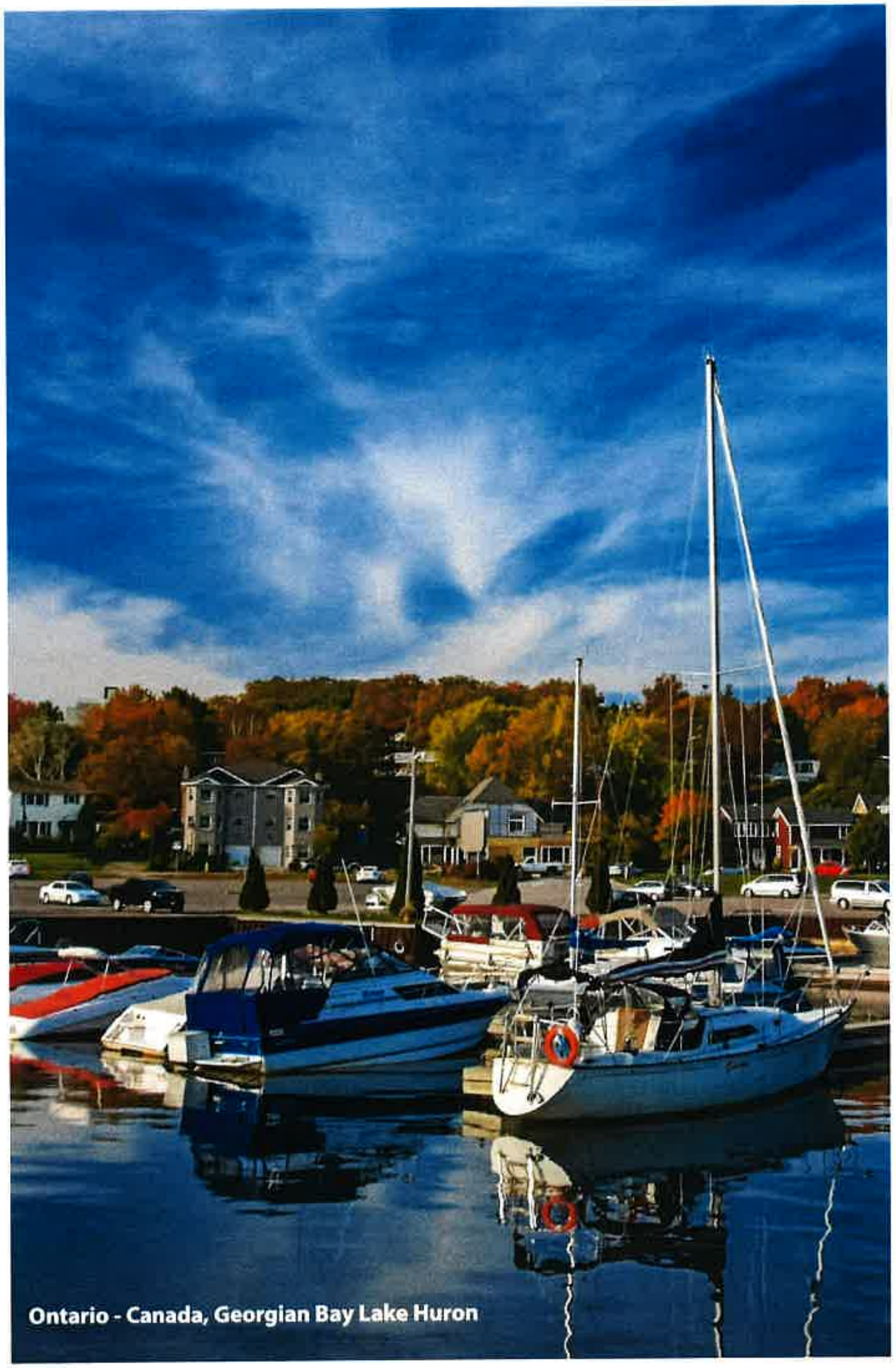


Ontario - Canada, Georgian Bay Lake Huron

Executive Summary

Under the 2012 Canada-United States Great Lakes Water Quality Agreement (GLWQA), the Climate Change Impacts Annex Subcommittee coordinates efforts to identify, quantify, understand, and predict climate change impacts on the waters of the Great Lakes, and shares information that Great Lakes resource managers need to proactively address these impacts. The purpose of this report is to characterize historical and future climate trends within the Great Lakes basin, and to summarize the impacts that are already being felt by communities across the basin. This report was created for the Climate Change Impacts Annex Subcommittee and is intended to further the understanding of climate change impacts in the Great Lakes basin.

This report translates technical climate and hydrological data into practical information for decision-makers based on climate and water level projections, developed by Environment and Climate Change Canada (ECCC) and ice cover projections developed by the Nelson Institute Center for Climatic Research (CCR), respectively. Observed historical data was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Great Lakes Environmental Research Laboratory (GLERL). This report also seeks to enhance understanding of climate change impacts based on a review of peer-reviewed and grey literature to help inform adaptation and resilience-building efforts across the region.

By the end of the century, significant changes in over-land air temperature, over-lake precipitation, water levels, and ice cover are anticipated across the Great Lakes under a moderate (RCP 4.5) and high-emissions (RCP 8.5) scenarios. Similar climate and hydrological trends were found for all lakes, though each lake may experience these changes differently.

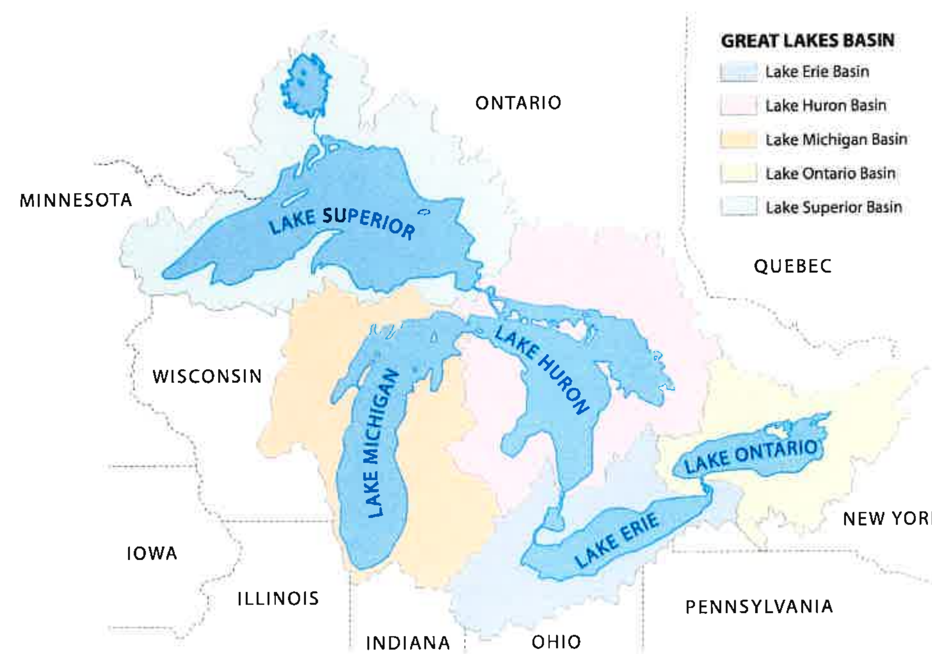
Point Pelee National Park, Lake Erie

1.0 Introduction

Climate change is threatening the health of the Great Lakes and the many ecosystem services they provide.

The Great Lakes contain one-fifth of the world's fresh surface water (Great Lakes Commission, 2021). Spanning two nations and many Indigenous communities, the Great Lakes provide drinking water to 40 million people (see Figure 1). Its large network of streams, lakes, wetlands, grasslands, and forests are home to more than 3,500 species of plants and animals (Wuebbles et al. 2019). The Great Lakes also support many industries, including shipping, hydropower, agriculture, fishing, tourism and recreation, and provide important cultural and spiritual connections for people. If the Great Lakes region were a country, it would have the third largest economy in the world (Desjardins, 2017). However, climate change is threatening the health of the Great Lakes and the many ecosystem services they provide, affecting the people, plants, and animals across the basin who rely on the Great Lakes.

Figure 1: Map of the Great Lakes Basin



BOX 1: ABOUT THE METHODOLOGY USED TO DEVELOP THE HYDROCLIMATE PROJECTIONS FOR THE GREAT LAKES BASIN

The projections used in this report have been developed by Environment and Climate Change (ECCC) and the Nelson Institute Center for Climatic Research (CCR) at the University of Wisconsin-Madison. Observed historical data was retrieved from the NOAA-Great Lakes Environmental Research Laboratory (GLERL).

What are Climate Projections?

Climate projections are simulations of what Earth's climate may look like in the future using climate models to simulate different atmospheric, oceanic, and land processes that influence climate. These simulations are based on plausible future scenarios of emissions patterns from human activities and concentrations of greenhouse gases and aerosols in the atmosphere (typically until 2100), known as Representative Concentration Pathways (RCPs). There are four main RCPs, representing scenarios of high emissions (RCP 8.5), moderate emissions (RCPs 4.5 and 6.0), and low emissions (RCP 2.6). These scenarios are based on different assumptions of future socioeconomic and technological developments, such as changes in population growth, technology, energy, and land use.

How Did ECCC Develop the Climate and Water Level Projections Used in this Report?

Not all climate models are able to capture the Great Lakes and their dynamics. In order to obtain simulated responses of future climate within the Great Lakes basin, ECCC used data from select climate models that do capture the Great Lakes at sufficiently high resolution, as well as simulating lake processes, including lake evaporation. Modelled data from the Coupled Model Intercomparison Project Phase 5 (CMIP5) were available from NA-CORDEX, the North American component of the International Coordinated Regional Downscaling Experiment program sponsored by the World Climate Research Program (WCRP).

Two climate change scenarios were used, including RCPs 4.5 and 8.5, which represent the most commonly modelled scenarios. Under RCP 4.5, an intermediate climate change scenario, global average temperatures could increase by 1.7 to 3.2°C (or 3.1 to 5.8°F) compared to 1986-2005 by the 2090s (Government of Canada, 2018). Under RCP 8.5, the high-emissions scenario, global average temperatures could increase by 3.2 to 5.4°C (or 5.8 to 9.7°F) compared to 1986-2005 by the 2090s.

RCP 8.5 was simulated by seven model runs, while RCP 4.5 was simulated by six model runs. The modelled data have resolutions that range from approximately 25 km by 25 km to approximately 45 km by 45 km.

Lake level projections have been determined based on over-lake precipitation, runoff into the lake, over-lake evaporation, water flow, and the regulation plans that control outflows from Lake Superior and Lake Ontario. Both the over-lake precipitation and over-lake evaporation were taken directly from the modelled data available from NA-CORDEX. A hydrological model called, WATFLOOD, was used to calculate surface runoff and the flow from rivers into each of the lakes.

Projections were developed to the end of the century on a monthly basis for various key climate parameters and water levels to inform the coastal wetland climate change vulnerability assessment as part of the "Assessing and Enhancing the Resilience of Great Lakes Coastal Wetlands" project. This report summarizes several of these key hydroclimate parameters.

How Did CCR Develop the Ice Cover Projections Used in this Report?

Unlike climate and water level projections, ice cover projections are only available for RCP 8.5. Ice cover projections were simulated by six model runs and have resolutions of approximately 25 km by 25 km. These simulations also include representation of the Great Lakes and their thermodynamics. Projections were developed to the end of the century on a daily basis.

For more detailed information about the methodology used by ECCC to develop the climate and water level projections and adjust for biases, please see Appendix A. For information about the methodology used by CCR to develop the ice cover projections and adjust for biases, please see Appendix B.

2.0 Historical and Future Climate Trends

"It is unequivocal that human influence has warmed the atmosphere, ocean and land"– The Intergovernmental Panel on Climate Change, Sixth Assessment Report (2021)

In the last seven years (2014-2020), global average surface temperatures have been the warmest on record, with 2020 tied with 2016 as the warmest year (The Earth Observatory, 2021). As human activities continue to impact the climate, we will likely continue to see more record-breaking temperatures in the future. Human activities are estimated to have caused global average temperatures to increase by approximately 1˚C (or 1.8˚F) above pre-industrial levels (IPCC, 2018). In the contiguous United States, the regions bordering the Great Lakes are warming faster than the rest of the country (Hayhoe et al. 2018; Wuebbles et al. 2019). Meanwhile in Canada, average surface temperatures are warming twice as fast as the rest of the world as a whole, with northern Canada warming even faster (Government of Canada, 2019a).

As global climate change and the rate of warming over the Great Lakes continue, we can expect to see more changes to the climate across the basin in the coming decades. The following subsections provide a summary of how over-land air temperature, over-lake precipitation, lake levels, and ice cover have changed within the basin and how these are expected to continue to change until the end of the century. In order to prepare for the impacts of climate change on communities and ecosystems across the basin, it is important to understand what the future climate might look like.

The historical climate and hydrological data used in this report were retrieved from the NOAA-Great Lakes Environmental Research Laboratory (GLERL).

For the climate and water level projections, observed historical and modelled future data are compared across 30 consecutive years (i.e. 1961-2000, 2006-2035, 2036-2065, and 2066-2095). Meanwhile, for the ice cover projections, data is only available for 20 consecutive years (i.e. 1980-1999, 2040-2059, and 2080-2099). Using data from multiple decades is important to ensure that climate trends are not driven by occasional extremes.

In some cases, the graphs display observed historical data up to the most recent year with data available in order to capture the breadth of historical variation and/or avoid a break in the timeline when data is displayed as a continuous time series. Historical climate data is currently available up to 2019 for over-lake precipitation, lake levels, and ice cover, while historical climate data for over-land air temperature is available up to 2014.

Projections are presented for individual lakes where possible (see Table 1). For most parameters (except ice cover), lakes Michigan and Huron are presented as a single unit as they are hydrologically one body of water. Georgian Bay is part of Lake Huron and stakeholders interested in projections for this area should use the projections available for Lake Michigan-Huron. Projections for Lake St. Clair are only available for lake levels. For those interested in over-land air temperature and over-lake precipitation projections for Lake St. Clair, we suggest considering the projections available for Lake Erie.

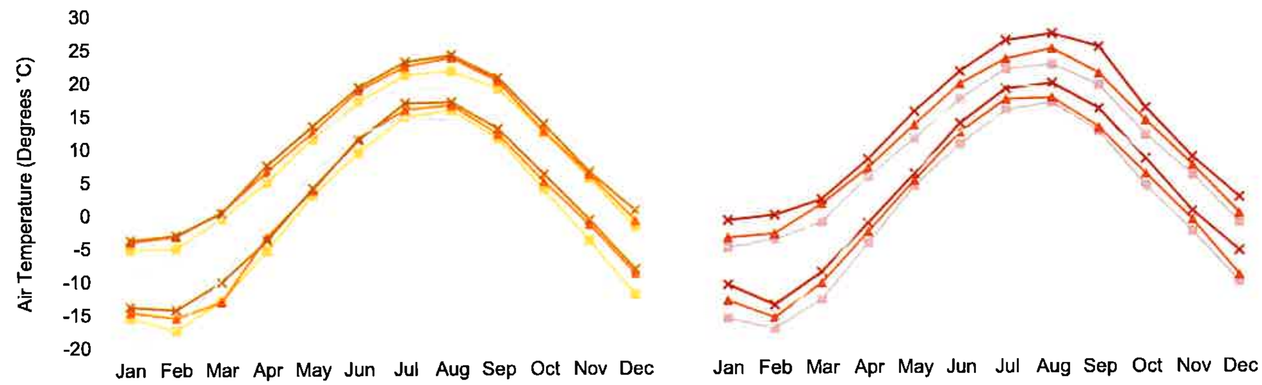
Table 1: Overview of climate and hydrological projections available by lake in this study.

LAKE	OVER-LAND AIR TEMPERATURE	OVER-LAKE PRECIPITATION	LAKE LEVELS	ICE COVER
Superior	✓	✓	✓	✓
Michigan -Huron	✓	✓	✓	(presented as two lakes)
Erie	✓	✓	✓	✓
St. Clair			✓	
Ontario	✓	✓	✓	✓

Figure 2: Historical and projected average over-land air temperature under RCPs 4.5 and 8.5 by month and time period for:

a) Lake Superior, b) Lake Michigan-Huron, c) Lake Erie, and d) Lake Ontario. Projected land air temperatures under both climate change scenarios are presented side by side with RCP 4.5 on the left and RCP 8.5 on the right. The dotted grey area shows historical land air temperatures averaged by month between 1961 and 2014 that fall within the 5th and 95th percentiles. Future air temperatures are projected for three time periods: 2030s, 2050s, and 2080s, with each represented by a different colour and pattern. The top lines represent the 95th percentile of the projected values under six RCP 4.5 model runs and seven RCP 8.5 model runs, respectively, and the bottom lines represent the 5th percentile.

a) Lake Superior



b) Lake Michigan-Huron

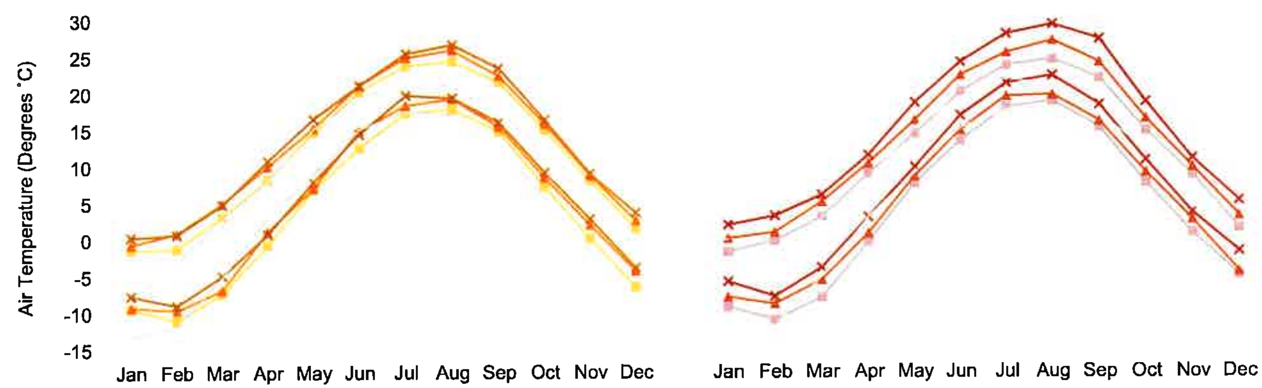


Table 2. Historical and projected annual and seasonal average over-land air temperatures under RCP 4.5 by time period.

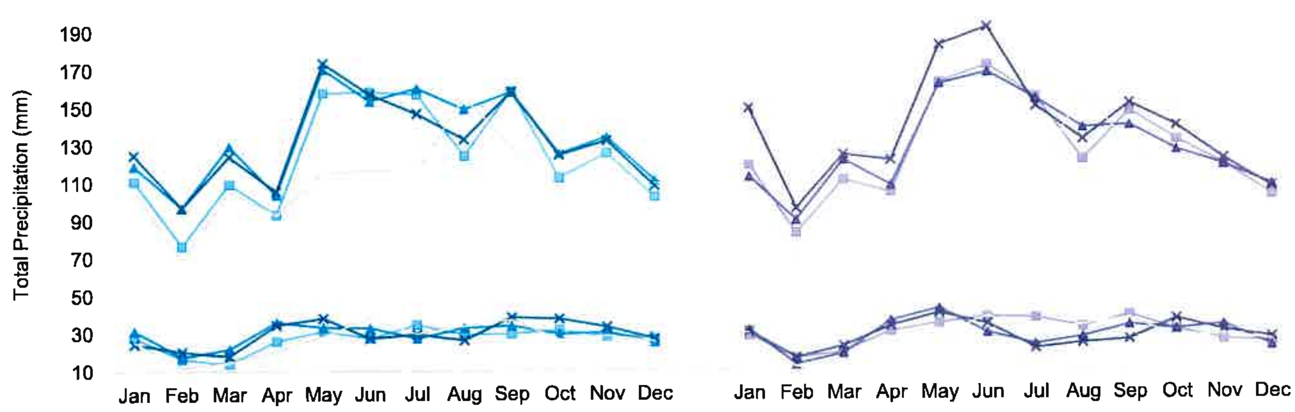
LAKE AND TIME PERIOD	Historical and Projected Values Under RCP 4.5 (°C)					Difference from Corresponding 1961-2000 Values (°C)				
	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Winter (DJF)	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Winter (DJF)
LAKE SUPERIOR										
Historical (1961-2000)	2.4	1.8	15.8	4.7	-12.7	-	-	-	-	-
2030s (2006-2035)	3.9	0.5	16.6	7.9	-9.2	1.5	-1.3	0.8	3.2	3.5
2050s (2036-2065)	5.2	1.6	17.9	8.8	-7.3	2.8	-0.2	2.0	4.1	5.4
2080s (2066-2095)	5.9	2.3	18.5	9.5	-6.6	3.5	0.6	2.7	4..8	6.1
LAKE MICHIGAN-HURON										
Historical (1961-2000)	6.2	5.3	18.7	8.2	-7.2	-	-	-	-	-
2030s (2006-2035)	7.6	4.6	19.5	11.0	-4.5	1.4	-0.8	0.8	2.9	2.7
2050s (2036-2065)	8.9	5.6	20.7	12.0	-2.8	2.6	0.3	2.0	3.9	4.4
2080s (2066-2095)	9.5	6.3	21.2	12.7	-2.3	3.2	1.0	2.6	4.5	4.9
LAKE ERIE										
Historical (1961-2000)	9.1	8.2	20.8	10.8	-3.4	-	-	-	-	-
2030s (2006-2035)	10.4	7.8	21.6	13.4	-1.3	1.3	-0.4	0.9	2.7	2.1
2050s (2036-2065)	11.6	8.8	22.8	14.4	0.1	2.5	0.6	2.1	3.7	3.5
2080s (2066-2095)	21.1	9.4	23.3	15.1	0.5	3.0	1.2	2.6	4.3	3.9
LAKE ONTARIO										
Historical (1961-2000)	7.3	6.2	19.3	9.2	-5.5	-	-	-	-	-
2030s (2006-2035)	8.6	6.0	19.4	11.5	-2.3	1.3	-0.2	0.1	2.3	3.2
2050s (2036-2065)	9.8	7.0	20.5	12.6	-0.9	2.5	0.8	1.2	3.3	4.6
2080s (2066-2095)	10.3	7.6	21.0	13.2	-0.5	3.0	1.4	1.7	4.0	5.0

Ice huts on Lake Superior

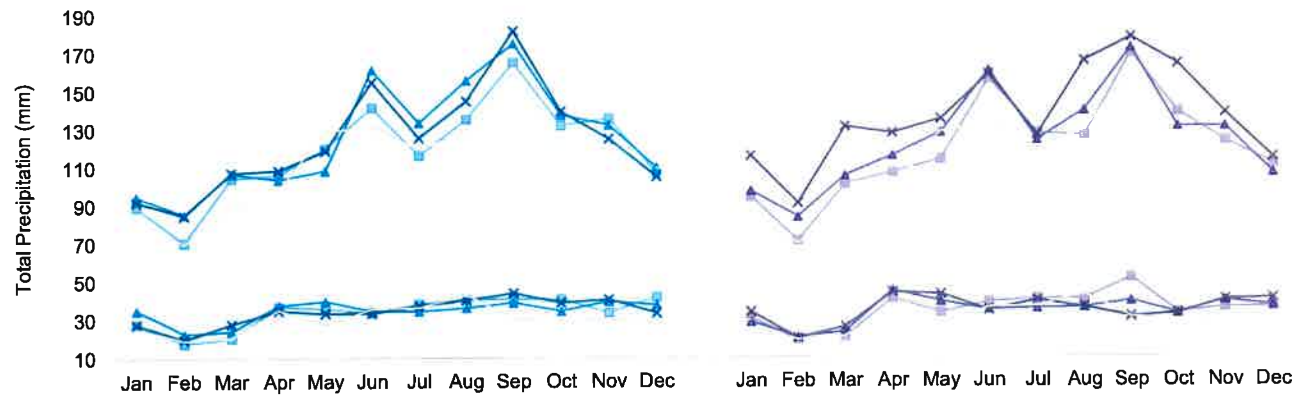
Figure 3: Historical and projected total over-lake precipitation under RCP 4.5 and 8.5 by month and time period for:

a) Lake Superior, b) Lake Michigan-Huron, c) Lake Erie, and d) Lake Ontario. Projected over-lake under both climate change scenarios are presented side by side with RCP 4.5 on the left and RCP 8.5 on the right. The dotted grey area shows historical over-lake precipitation averaged by month between 1961 and 2019 that fall within the 5th and 95th percentiles. Future over-lake precipitation is projected for three time periods: 2030s, 2050s, and 2080s, with each represented by a different colour and pattern. The top lines represent the 95th percentile of the projected values under six RCP 4.5 model runs and seven RCP 8.5 model runs, respectively, and the bottom lines represent the 5th percentile.

a) Lake Superior



b) Lake Michigan-Huron



Measured (1961-2019), 5th and 95th Percentile
RCP 4.5 (2030s), 5th and 95th Percentile
RCP 4.5 (2050s), 5th and 95th Percentile
RCP 4.5 (2080s), 5th and 95th Percentile
RCP 8.5 (2030s), 5th and 95th Percentile
RCP 8.5 (2050s), 5th and 95th Percentile
RCP 8.5 (2080s), 5th and 95th Percentile

Table 4. Historical and projected annual and seasonal average total over-lake precipitation under RCP 4.5 by time period

LAKE AND TIME PERIOD	Historical and Projected Values Under RCP 4.5 (mm)					Percentage Difference from Corresponding 1961-2000 Values (%)				
	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Winter (DJF)	Annual	Spring (MAM)	Summer (JJA)	Fall (SON)	Winter (DJF)
LAKE SUPERIOR										
Historical (1961-2000)	755.1	163.5	231.3	213.8	146.5	-	-	-	-	-
2030s (2006-2035)	857.4	203.8	250.1	230.8	172.6	14%	25%	8%	8%	18%
2050s (2036-2065)	898.3	219.9	255.3	242.3	180.8	19%	34%	10%	13%	23%
2080s (2066-2095)	908.7	233.3	246.6	245.5	183.3	20%	43%	7%	15%	25%
LAKE MICHIGAN-HURON										
Historical (1961-2000)	808.3	188.5	228.2	229.5	162.2	-	-	-	-	-
2030s (2006-2035)	873.0	193.0	245.0	257.2	177.8	8%	2%	7%	12%	10%
2050s (2036-2065)	915.3	201.8	255.7	265.9	191.9	13%	7%	12%	16%	18%
2080s (2066-2095)	910.5	207.0	247.2	266.4	189.9	13%	10%	8%	16%	17%
LAKE ERIE										
Historical (1961-2000)	909.6	228.8	252.0	239.8	189.0	-	-	-	-	-
2030s (2006-2035)	960.6	221.3	275.4	267.4	196.4	6%	-3%	9%	12%	4%
2050s (2036-2065)	1002.2	228.3	283.5	283.0	207.4	10%	0%	13%	18%	10%
2080s (2066-2095)	991.8	230.2	279.0	276.8	205.8	9%	1%	11%	15%	9%
LAKE ONTARIO										
Historical (1961-2000)	846.6	203.2	213.5	235.1	194.9	-	-	-	-	-
2030s (2006-2035)	938.8	210.7	240.5	276.1	211.6	11%	4%	13%	17%	9%
2050s (2036-2065)	970.9	220.5	247.8	278.3	224.3	15%	9%	16%	18%	15%
2080s (2066-2095)	970.5	218.5	245.4	280.7	225.9	15%	8%	15%	19%	16%

Under both climate scenarios, average total over-lake precipitation is anticipated to increase in all seasons and annually over the next century though the amount may vary from year to year. As Figure 3 illustrates, the greatest changes in total over-lake precipitation are anticipated among projected values that fall within the 95th percentile across all lakes. Meanwhile, projected values that fall within the 5th percentile are expected to remain relatively similar to measured historical data (1961- 2019), with some months showing an increase.

Overall, changes in 95th percentile monthly total over-lake precipitation are not uniform across the lakes. For some lakes, the projections indicate precipitation patterns that vary greatly from measured historical data. For Lake Superior, the greatest changes in the 95th percentile of total over-lake precipitation are expected for the months of May, June, July, and September under both climate scenarios. For Lake Michigan-Huron, the greatest changes are anticipated for the months of March and June under both climate scenarios. For Lake Erie, the greatest changes are anticipated for the months of April, June, August, and September. Meanwhile for Lake Ontario, increases in total over-lake precipitation are anticipated for most months of the year. When coupled with the projected increases in over-land air temperatures (as discussed in Section 2.1), more extreme precipitation can be expected over the Great Lakes as warmer air can hold more moisture to produce heavier storms.

The greatest increase in total over-lake precipitation is expected for Lake Superior under both climate scenarios, followed by Lake Ontario. Annual total over-lake precipitation has historically (1961-2000) ranged from 755 mm (or 29.7 inches) over Lake Superior to 909 mm (or 35.8 inches) over Lake Erie. Under RCP 4.5, annual total over-lake precipitation could increase by 20 percent over Lake Superior and 9 percent over Lake Erie by the end of the century. While under RCP 8.5, annual total over-lake precipitation is expected to increase even further by 24 percent over Lake Superior and 18 percent over Lake Erie by the end of the century. These projections indicate significant increases in annual total over-lake precipitation across the basin.

Changes in seasonal average total over-lake precipitation is anticipated to vary by lake. Under RCP 4.5, the greatest increases in precipitation by the end of the century are generally anticipated for fall and winter, with the exceptions of Lake Superior where spring shows the largest increase (43 percent increase compared to average spring totals between 1961-2000), and Lake Ontario where summer shows similar increases as winter (15 percent increase compared to average summer totals between 1961-2000). Meanwhile under RCP 8.5, the greatest increases are generally anticipated for spring and winter, with the exception of Lake Erie where fall shows similar increases as spring by the end of the century (19 and 20 percent increase, respectively, compared to average seasonal totals between 1961-2000). With warmer winters, snowfall is expected to decrease on average, with more precipitation falling as rain instead of snow.

2.3 Lake Levels (ECCC Projections)

KEY FINDINGS:

- Lake level projections indicate significant deviations from lake-specific, long-term averages (1918-2019) across the basin with a slight upward trend apparent on all lakes in the latter half of the coming century.
- Projections indicate the potential for more frequent and severe extreme high and extreme low water levels.
- The greatest variation in lake levels is anticipated for lakes Michigan-Huron, Erie, St. Clair, and Ontario.

Lake levels refer to the surface water level of the Great Lakes (see Figure 4). Currently, lake levels are referenced to the International Great Lakes Datum 1985 (IGLD85; see Box 3 for more information).

to Lake Erie, and then out through the Niagara River over Niagara Falls into Lake Ontario, before moving through the St. Lawrence River and into the Atlantic Ocean (see Figure 4). As noted previously, lakes Michigan and Huron are measured as one body of water because they share the same surface elevation above sea level and are connected at the Straits of Mackinac (NOAA, 2021c). Outflows from Lake Superior and Lake Ontario are overseen by binational regulatory boards and regulated through dams and control structures that can influence, but not control, water levels in the lakes (International Joint Commission [IJC], 2020). While outflows from Lakes Michigan-Huron, Erie, and St. Clair have no controls (US Army Corps of Engineers, 2021). It is important to note that ability to alter lake levels through the regulation plan is limited and dominated by changes in water supplies, which are driven by weather (Government of Canada, 2019b).

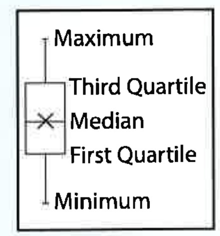
The lake level projections included in this report have been determined based on most, but not all, of the aforementioned factors that can alter water levels, including over-lake precipitation, runoff into the lake, evaporation, water flow, and the regulation of lakes Superior and Ontario outflows. It is important to note that these projections are not predicting exactly what future water levels will be for a certain year. Instead, they represent an envelope of possible values that the actual values will likely come from in the future.

Some projections for Lake Ontario under two RCP 8.5 models resulted in extremely high values due to the potential over-exaggeration of water accumulation from all Great Lakes flowing into Lake Ontario in the future and therefore have been excluded from our analysis. These extreme values have been excluded because it is impossible to anticipate what changes to the regulation plan might be made that would alter flows out of the system if extremely high inflows were to occur in Lake Ontario in the future. It is important to remember that projections of climate parameters and lake levels are based on current understanding of the climate system and assumptions made about the future behaviour of society, which will result in the amount of greenhouse gases that will be put into the atmosphere. There are many uncertainties and assumptions that are inherent in these projections and thus the projections are most useful in showing general trends of what could happen in the future.

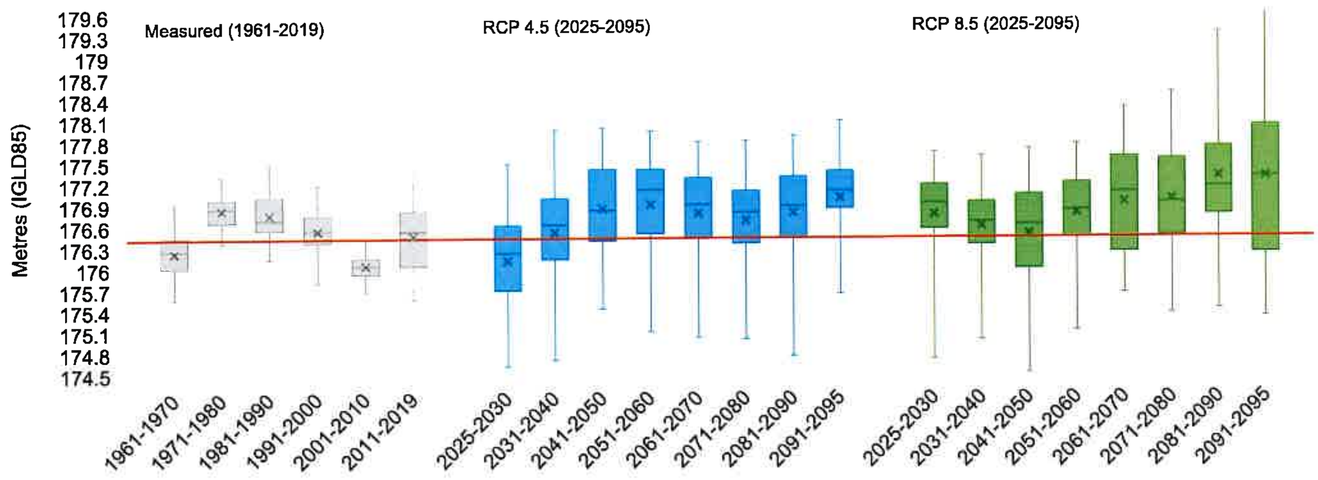
Figure 5 presents a series of graphs showing historical and projected lake levels averaged by decade for each lake under both climate scenarios. Note that some periods are averaged over less than 10 years (i.e. 2011-2019, 2025-2030, and 2091-2095). Historical lake levels are displayed from 1961-2019, while projections under both climate scenarios are displayed from 2025 to 2095. Lake-wide, long-term averages (1918-2019) are presented for each lake, which are benchmarks used in forecasting models and monitoring of the Great Lakes' water budget (NOAA, 2021a). These graphs are intended to show the long-term variation in water levels, using box and whisker plots to show the minimum, maximum, average, and different quartiles for each period (see Box 4 for information on how to interpret box and whisker plots).

BOX 4: HOW TO READ BOX AND WHISKER PLOTS

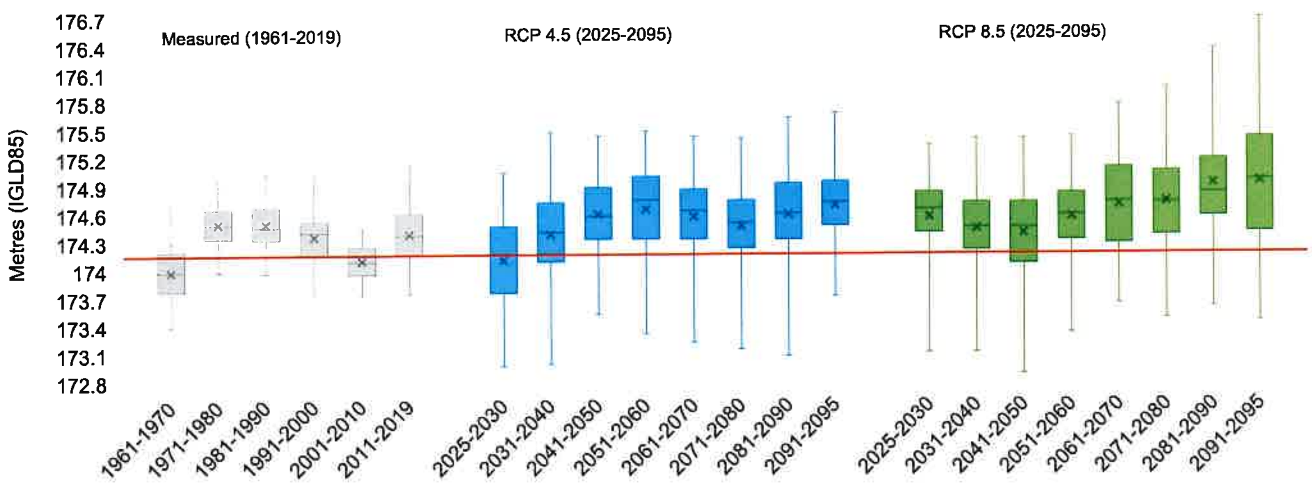
Box and whisker plots are a form of graph that present a breakdown of the data by quartiles (or 25 percent increments). The bottom whisker starts with the minimum value and represents the range of the first quartile. The middle line in the box represents the median (or second quartile). From the median to the top of the box is the third quartile. The top whisker shows the range of the fourth quartile, ending with the maximum value. The average can also be displayed, which is represented by an 'x' symbol in this report.



b) Lake Michigan-Huron



c) Lake Erie



These graphs illustrate the cyclical nature of Great Lakes water level fluctuations, with some high periods and some low periods. The minimum and maximum values projected under both climate scenarios show the full range of possible lake levels that could be observed over each time period, including the most extreme values. Figure 5 illustrates a high degree of variation within each time period, signaling the potential for more frequent and severe extreme high and extreme low water levels in the coming decades. The lakes that are unregulated (i.e. lakes Michigan-Huron, Erie, and St. Clair) show a great degree of variation in future lake levels. Projections for Lake Ontario also indicate a great degree of variation. While outflows from Lake Ontario are regulated, inflows are uncontrolled (McNeil, 2019). There are also limits to the amount of outflow that can be released from Lake Ontario due to the flow capacity of the St. Lawrence River.

Figure 6 presents another set of graphs showing historical and projected lake levels for each lake under both climate scenarios averaged by month and time period (historical, 2030s, 2050s, and 2080s). These graphs illustrate the anticipated changes in lake levels averaged over the short, medium, and long-term future compared to measured historical data (1961-2019) across the two climate scenarios. The 5th and 95th percentile values are presented to highlight the range of possible average lake levels for each month. These ranges are anticipated to grow in the coming decades (i.e. there will likely be higher highs and lower lows), indicating once again that more frequent and severe extreme high and low water levels can be expected across all lakes in the future. Significant increases in 95th percentile lake levels are anticipated under RCP 8.5, while significant increases in 95th percentile lake levels are also anticipated under RCP 4.5 for lakes Superior and Ontario.

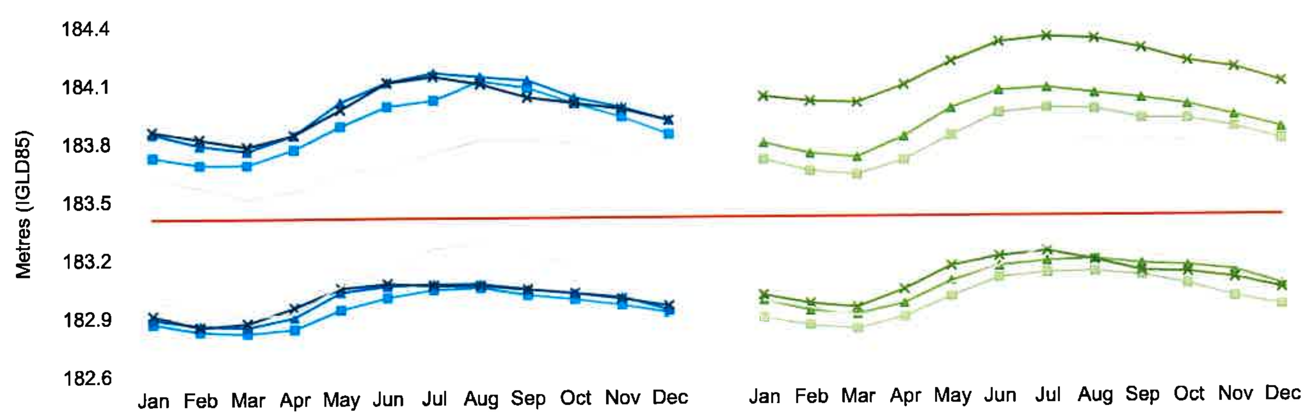
Seasonal variation in Great Lakes water levels is well defined with relatively low water levels in the winter months, rising water levels in the spring and summer, and decreasing water levels in the late summer and early fall with less precipitation and increasing lake evaporation (Quinn, 2002; Gronewold and Stow, 2014). This seasonal variation seems to be persistent under both climate scenarios in the coming decades.

Tables 6 and 7 present average lake level values in metres (IGLD85) and deviation from the lake-wide, long-term averages (1918-2019) for each lake.

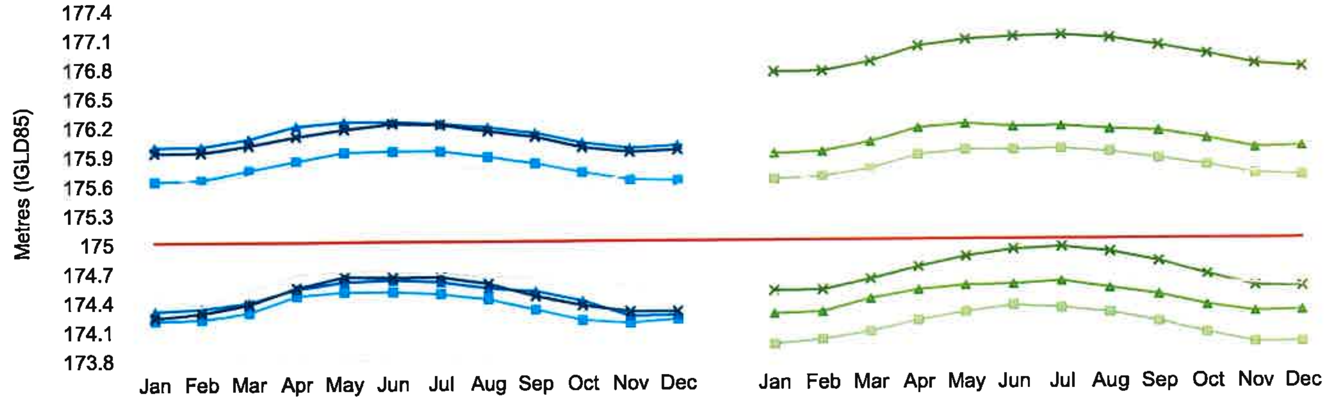
Figure 6: Historical and projected average lake levels under RCP 4.5 and 8.5 by month and time period for:

a) Lake Superior, b) Lake Michigan-Huron, c) Lake Erie, d) Lake St. Clair, and e) Lake Ontario. Projected lake levels under both climate change scenarios are presented side by side with RCP 4.5 on left and RCP 8.5 on the right. The dotted grey area shows historical lake levels averaged by month between 1961 and 2019 that fall within the 5th and 95th percentile range. The red line shows the long-term average reported for each lake between 1918 and 2019 as a point of reference. Future lake levels are projected for three time periods: 2030s, 2050s, and 2080s, with each represented by a different colour and pattern. The top lines represent the 95th percentile of the projected values under six RCP 4.5 model runs and seven RCP 8.5 model runs, respectively, and the bottom lines represent the 5th percentile.

a) Lake Superior



d) Lake St. Clair



e) Lake Ontario

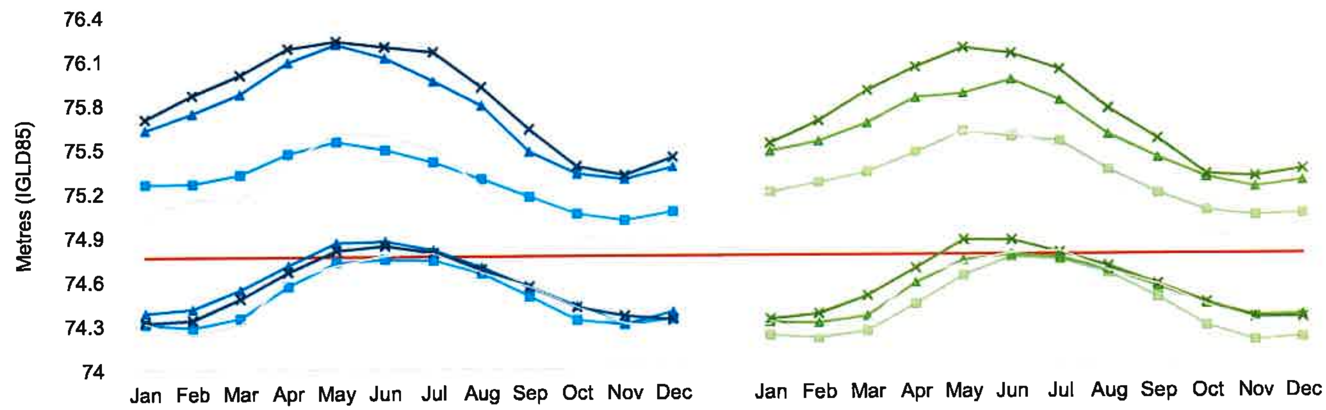


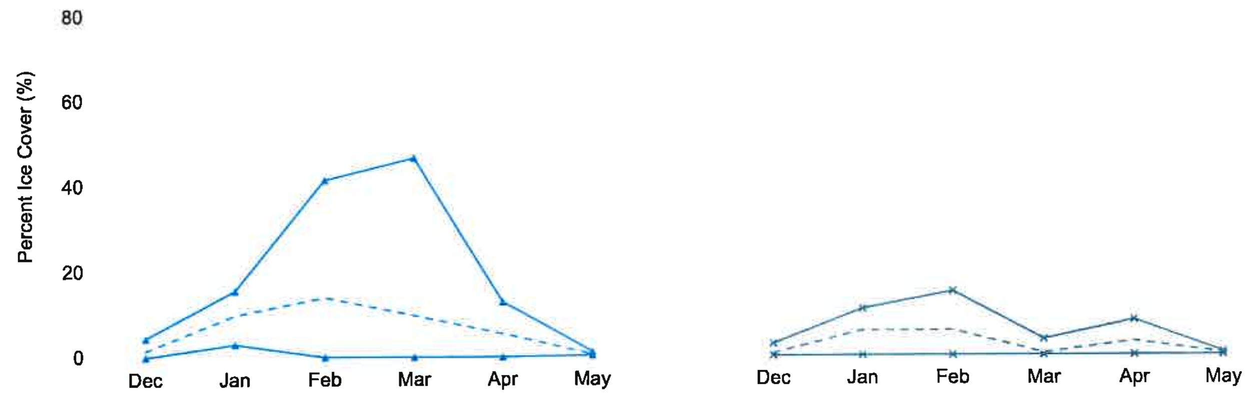
Table 7: Historical and projected annual lake levels under RCP 8.5 by time period

LAKE AND TIME PERIOD	Historical and Projected Values Under RCP 4.5 (m IGLD85)			Difference from Corresponding 1961-2000 Values (m IGLD85)		
	5th	Average	95th	5th	Average	95th
LAKE SUPERIOR					**LONG TERM AVERAGE: 183.41 M**	
Historical (1961-2000)	183.2	183.4	183.7	-	-	-
2030s (2006-2035)	182.9	183.4	184.1	-0.3	0	-0.4
2050s (2036-2065)	182.9	183.5	184.1	-0.3	0.1	0.4
2080s (2066-2095)	182.9	183.6	184.3	-0.3	0.2	0.6
LAKE MICHIGAN-HURON					**LONG TERM AVERAGE: 176.44 M**	
Historical (1961-2000)	175.9	176.6	177.2	-	-	-
2030s (2006-2035)	175.0	176.4	177.5	-0.9	-0.2	0.3
2050s (2036-2065)	175.0	176.7	177.9	-0.9	0.1	0.7
2080s (2066-2095)	175.6	177.1	179.1	-0.3	0.5	1.9
LAKE ERIE					**LONG TERM AVERAGE: 174.17 M**	
Historical (1961-2000)	173.8	174.3	174.8	-	-	-
2030s (2006-2035)	173.3	174.3	175.1	-0.5	0	0.3
2050s (2036-2065)	173.4	174.5	175.4	-0.4	0.2	0.6
2080s (2066-2095)	173.7	174.8	176.1	-0.1	0.5	1.3
LAKE ST. CLAIR					**LONG TERM AVERAGE: 175.03 M**	
Historical (1961-2000)	174.6	175.2	175.8	-	-	-
2030s (2006-2035)	174.0	175.1	176.0	-0.6	-0.1	0.2
2050s (2036-2065)	174.1	175.3	176.3	-0.5	0.1	0.5
2080s (2066-2095)	174.4	175.7	177.2	-0.2	0.5	1.4
LAKE ONTARIO					**LONG TERM AVERAGE: 74.77 M**	
Historical (1961-2000)	74.4	74.8	75.3	-	-	-
2030s (2006-2035)	74.1	74.8	75.6	-0.3	0	0.3
2050s (2036-2065)	74.2	75.0	76.2	-0.2	0.2	0.9
2080s (2066-2095)	74.4	75.1	76.3	0	0.3	1.0

Figure 7: Historical and projected average ice cover under RCP 8.5 by month and time period for:

a) Lake Superior, b) Lake Michigan, c) Lake Huron, d) Lake Erie, and e) Lake Ontario. Projected ice cover under the high-emissions scenario is presented. The dotted grey area shows historical ice cover averaged by month between 1980 and 2019 that fall within the 5th and 95th percentile range. Future ice cover is projected for two time periods: 2040-2059 (left) and 2080-2099 (right), with each represented by a different colour side by side. The top lines represent the 95th percentile of the projected values under six RCP 8.5 model runs, and the bottom lines represent the 5th percentile.

a) Lake Superior



b) Lake Michigan

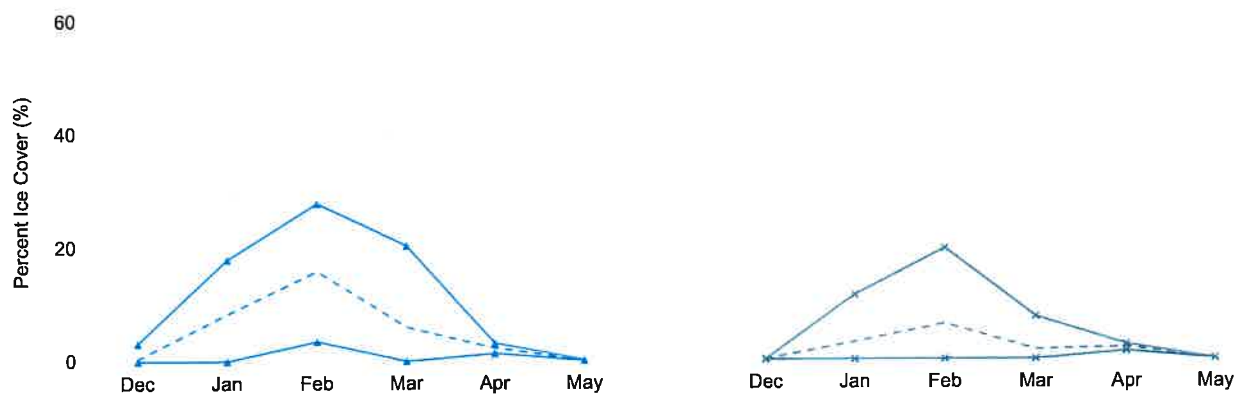


Table 8: Historical and projected average ice cover by ice season (December to May) and season under RCP 8.5 by time period

LAKE AND TIME PERIOD	Historical and Projected Values Under RCP 8.5 (%)			Difference from Corresponding 1980-1999 Values (%)		
	Ice Season	Winter (DJF)	Spring (MAM)	Ice Season	Winter (DJF)	Spring (MAM)
LAKE SUPERIOR						
Historical (1980-1999)	20.6	22.0	19.3	-	-	-
2040-2059	6.9	8.5	5.3	-14%	-13%	-14%
2080-2099	2.7	4.1	1.4	-18%	-18%	-18%
LAKE MICHIGAN						
Historical (1980-1999)	10.8	21.1	6.7	-	-	-
2040-2059	5.5	8.3	2.8	-5%	-7%	-4%
2080-2099	2.2	3.2	1.2	-9%	-12%	-5%
LAKE HURON						
Historical (1980-1999)	22.3	38.0	17.8	-	-	-
2040-2059	14.3	18.1	10.5	-8%	-9%	-7%
2080-2099	8.4	11.2	5.7	-14%	-16%	-12%
LAKE ERIE						
Historical (1980-1999)	25.3	50.9	14.8	-	-	-
2040-2059	13.0	17.1	8.9	-12%	-19%	-6%
2080-2099	6.2	5.8	6.6	-19%	-30%	-8%
LAKE ONTARIO						
Historical (1980-1999)	6.1	12.6	3.5	-	-	-
2040-2059	2.0	3.3	0.8	-4%	-6%	-3%
2080-2099	0.5	0.8	0.3	-6%	-8%	-3%

Table 9: Historical and projected ice season length between December and May under RCP 8.5 by time period

LAKE AND TIME PERIOD	Historical and Projected Ice Season Length During Winter and Spring Under RCP 8.5 (days)			Difference from Corresponding 1981-1999 Values (days)		
	5th	Average	95th	5th	Average	95th
LAKE SUPERIOR						
Historical (1981-1999)	105	139	166	-	-	-
2041-2059	126	134	139	20	-5	-27
2081-2099	112	124	138	7	-15	-28
LAKE MICHIGAN						
Historical (1981-1999)	104	126	157	-	-	-
2041-2059	74	84	93	-30	-42	-64
2081-2099	29	54	66	-75	-72	-91
LAKE HURON						
Historical (1981-1999)	105	131	156	-	-	-
2041-2059	109	118	126	4	-13	-30
2081-2099	65	93	118	-41	-38	-38
LAKE ERIE						
Historical (1981-1999)	67	112	145	-	-	-
2041-2059	63	87	104	-4	-26	-41
2081-2099	0	47	86	-67	-66	-58
LAKE ONTARIO						
Historical (1981-1999)	87	106	129	-	-	-
2041-2059	79	85	94	-8	-21	-35
2081-2099	38	57	73	-48	-50	-56

The mixing of lake waters generally occurs when surface water cools from its maximum temperature in the year, typically in September, and begins to mix with warmer and less dense water at greater depths (Wuebbles et al. 2019). This mixing continues until water reaches a 4°C (or 39.2°F) threshold (the point at which fresh water reaches maximum density). However, when surface water temperature stays above 4°C, the lake may not mix fully to bring nutrients up from the bottom of the lake and bring down critical dissolved oxygen to deeper waters for fish and zooplankton species (Bartolai et al. 2015). This lack of mixing further contributes to increased thermal stratification and enhanced warming of surface water temperatures. Parts of southern Lake Michigan and Lake Ontario reportedly had surface temperature that stayed above 4°C during the winters of 2011/12 and 2016/17 (Wuebbles et al. 2019). As the smallest lake by surface area, Lake Ontario is particularly sensitive to this effect.

BOX 5: WHY IS LAKE SUPERIOR WARMING MORE QUICKLY THAN OTHER LAKES?

A study by O'Reilly and others in 2015 found Lake Superior to be the second fastest warming lake in the world, behind a lake in Sweden. While smaller lakes might be expected to warm more quickly, several factors may be driving the increase in warming in lakes similar to Lake Superior (Chung, 2015). Lakes that are normally covered with ice in the winter are experiencing earlier ice melt in the spring, which exposes the lakes to more solar radiation and increases the amount of heat absorbed by the lake. Summer stratification is also occurring earlier, which reinforces itself by inhibiting the mixing of colder water located at greater depths.

Higher water temperatures promote the growth of certain types of bloom-forming algae and cyanobacteria (Wuebbles et al. 2019). When water temperatures are above 20°C (or 68°F), the growth rates of many bloom-forming cyanobacteria increase (e.g. Microcystis, Anabaena, and Cylindrospermopsis), which can lead to more severe harmful algal blooms (HABs). Of these, the Microcystis and Anabaena species are of greatest concern because they produce toxic chemicals that can damage the liver and nerve tissues, respectively (Michalak et al. 2013). Contact with and consumption of water contaminated with cyanobacteria have been associated with skin and eye irritation, respiratory illness, gastrointestinal illness, and liver and kidney damage (Angel et al. 2018). Given these public health risks, restrictions on fisheries, coastal recreation, and drinking water are usually put in place when HABs occur (Sharma et al. 2018). Even nontoxic algal blooms can have significant impacts on the lakes, making lake water smell and taste bad and sometimes dangerous to drink, depleting oxygen, killing fish, and driving chemical processes that prime the lakes for larger blooms in the future (Michalak et al. 2013; Filippelli and Ortiz, 2020). In recent years, the normally pristine waters of Lake Superior have also experienced algal blooms near the Apostle Islands, an indication of the potential challenges that we might continue to expect under climate change (Wuebbles et al. 2019; Briscoe, 2019c). Meanwhile in Lake Erie, the severity of blooms has generally been on the rise since the early 2000s (Hartig et al. 2020).

Warmer and lower oxygen waters promote increased microbial decomposition and the subsequent release of nutrients (e.g. phosphorous) and contaminants (e.g. mercury and other heavy metals) from bottom sediments (Kling et al. 2003). Heavy metals such as mercury become more soluble (and bioavailable) in the absence of oxygen because oxygen binds with these elements to form insoluble compounds that sink to the bottom of the lake. This may lead to increased uptake by aquatic organisms, leading to increased accumulation of mercury and other contaminants in the aquatic food chain, impacting people and wildlife. When low-oxygen water interacts with Lake Erie's bottom sediments and clay, heavy metals such as manganese and iron are released into the water (Briscoe, 2019a). Low oxygen water is also more corrosive and can damage water pipes, causing foul-smelling and poor-tasting water, and increases the release of trace metals from pipes, which may also pose threats to human health.

BOX 7: THE ICE ROAD CONNECTING BAYFIELD AND MADELINE ISLAND IN LAKE SUPERIOR

Historically, lake ice forms across much of Lake Superior, creating an approximately 3-km (or 1.9-mi) ice road that bridges Bayfield, Wisconsin and Madeline Island (Briscoe, 2020a). This ice road provides free, year-round access for residents of Madeline Island to and from the mainland for food, gas, and other necessities. With declining lake ice cover, the ice road never formed in 2020. As a result, locals had to pay to take the ferry, which represents an additional cost of living. At the same time, the Madeline Ferry Line was losing money because ferrying a few passengers during the off-season is not enough to offset the cost of operation. To mitigate losses, the company added a winter surcharge, which in turn further increased the cost of transportation for residents of Madeline Island.

3.3 Impacts of Flooding, Erosion, and Storms

Flooding and erosion are already causing devastating impacts across the Great Lakes basin. On the western shores of Lake Michigan, for example, houses have begun to slip into the lake because of eroding coastal dunes (O'Connell, 2020b). The frequency and severity of flooding and erosion will likely increase under climate change, with more frequent and intense precipitation, earlier spring snowmelt, more precipitation falling as rain instead of snow, earlier ice breakup, and potentially more frequent extreme high water levels. Increased flooding and erosion can cause damage to infrastructure and property, pose risks to human health and safety, and impact people's mental health and well-being. Flooding and erosion can also increase the resuspension of contaminated sediments and increase the risk of waterborne diseases (Gagnon et al. 2019).

Recent high water levels across the Great Lakes have led to the flooding of homes, driveways, roads, and trails, as well as shoreline erosion, and the loss of beaches and vegetation (McNeil, 2019). Lake Ontario experienced a record-high water level in 2017 of 75.88 m IGLD85 (or 248.95 ft IGLD85), which was subsequently exceeded just two years later in 2019, with a new record of 75.92 m IGLD85 (or 249.09 ft) (IJC, 2019). Areas that were particularly impacted in both years include portions of Toronto Island, Clarington, Brighton, Prince Edward County, the Thousand Islands shoreline area, and the Bay of Quinte in Ontario, Canada (McNeil, 2019). Numerous states of emergency were declared across Canada and the U.S., and the resulting damages and necessary repairs have been costly (see Box 8 for examples of such costs). For residents and business owners along the Lake Ontario shoreline, the events of the past few years have not only brought significant financial impacts but also emotional and mental health impacts (O'Connell, 2020a). As more high and low water levels are anticipated across the Great Lakes under a changing climate, there is need to prepare for both high and low water level conditions (e.g. 2013 record-low water levels in Lake Michigan-Huron).

BOX 8: EXAMPLES OF THE COSTS ASSOCIATED WITH FLOODING, EROSION, AND STORMS

- In 2017, the direct and indirect damages to the City of Toronto, Ontario, due to the closing of Toronto Island Park as a result of high lake levels were estimated to be CA$8 million (McNeil, 2019).
- In 2018, flooding and erosion from spring storms caused CA$3.5 million in damage to 400 homes and cottages between Point Pelee and Wheatley in Ontario (Baxter, 2019).
- In 2019, following recent high water levels on Lake Huron, the Town of Goderich, Ontario, is spending CA$1.5 to 2 million to protect its treatment plant for drinking water, which is located less than 30 m (or approximately 98 ft) from the water's edge (Lupton, 2019).
- A group of Great Lakes mayors has estimated that in 2019, high water levels, flooding, and erosion have caused US$500 million worth of damage in cities throughout the region (O'Connell, 2020b).
- In 2019, the City of Grosse Pointe, Michigan, spent more than US$100,000 to address problems associated with high water levels on Lake St. Clair (Gray, 2020). Another US$50,000 is needed to fix an eroded stormwater outlet into the lake, and a project to reconstruct a seawall damaged by high water levels is expected to cost up to US$12 million.
- In 2020, nine Michigan communities adjacent to Lake Michigan anticipate that US$30 million in projects are needed to address the erosion caused by high water levels (Gray, 2020).

3.4 Impacts on Industries and Livelihoods

The industries and people who rely on the Great Lakes can also be affected by changing climate conditions within the Great Lakes basin. These include impacts to shipping, hydropower production, commercial, recreational and subsistence fishing, agriculture, tourism, and recreation (Hartmann, 1990; Wuebbles et al. 2019).

The Great Lakes/St. Lawrence Seaway serves as a major transportation system and is one of the busiest shipping areas in the world. Shipping can be impacted by both low and high water levels. Low water levels can lead to unsafe conditions for shipping and navigation, especially in the shallower portions of the Great Lakes' channels and harbours. More trips will likely be required in order to move the same amount of cargo, increasing shipping costs and traffic. The dredging of harbours and channels may also be required, which already costs approximately US$20 million per year (Bartolai et al. 2015). High water levels can produce faster moving water in portions of the Seaway that also present unsafe conditions for shipping (Great Lakes-St. Lawrence River Adaptive Management [GLAM] Committee, 2018). This occurred in Lake Ontario during the 2017 high water levels where record outflows of up to 10,400 m3/s (or 367,272 ft3/s) were observed. Any impacts to the shipping industry will have direct impacts on other industries that depend on the Great Lakes for transport (e.g. iron, steel, and grain; Hartmann, 1990).

Lake waters are extensively used for hydropower production. In Ontario, the Great Lakes help generate 80 percent of Ontario's electricity (Ontario Ministry of the Environment, 2016). In the Midwest U.S., most energy production infrastructure are located along waterways (Wuebbles et al. 2019). The Great Lakes provide water for hydropower production as well as the water needed to cool power plants. With more frequent extreme low water levels and warmer water temperatures, less water is available for hydropower production and water levels could more frequently drop below water intake levels. Increased water temperatures also reduce their effectiveness for cooling power plants. As current energy infrastructure has been designed and built based on historical water levels and temperature regimes, changing climate conditions could potentially interrupt or decrease regional power generation.

With climate change, habitat ranges will likely continue to expand for some plant and animal species as warming continues, while ranges shrink or shift northwards for others. For example, smallmouth bass have historically been limited in their northern distribution due to colder temperatures (Alofs et al. 2014, 2015). However, with warmer water temperatures and longer ice-free season, populations of smallmouth bass have proliferated. As voracious predators, their expansion has reportedly led to the reduction of more than 25,000 populations of northern redbelly dace, finescale dace, fathead minnow, and pearl dace throughout lakes in Ontario. With warmer surface waters and reduced ice cover, shallow water habitats in many of the Great Lakes have also become more suitable for invasive species (e.g. carp, round goby, quagga mussel, and zebra mussel; Taylor et al. 2006).

The distribution of forests will also likely change as warmer temperatures lead to the shrinking of boreal forests, and the northward shift of many tree species (e.g. birch, aspen, balsam fir, and black spruce) that will likely be replaced by more southerly species (Great Lakes Integrated Sciences and Assessments [GLISA], 2014). Currently, forest cover makes up approximately 60 percent of land cover within the basin and forms an important part of the Great Lakes ecosystem (Bartolai et al. 2015). As temperatures warm and as the distribution of forests changes, pests and diseases (e.g. LDD moth) are also anticipated to increase, posing further threats to the health of trees and forests across the basin (Kling et al. 2003).

Climate change also poses threats to coastal wetlands, which provide essential habitat for a large variety of plants and animals (Mortsch, 1998; Wuebbles et al. 2019). Over half of all Great Lakes fish species use wetlands for spawning and nursery habitat. It has also been reported that 30 species of waterfowl, 155 breeding bird species, and 55 species of reptiles and amphibians are supported by coastal wetlands across the basin. Coastal wetlands are particularly vulnerable to changing climate conditions and water levels. For example, open shoreline wetlands are vulnerable to high water levels and storm surges that lead to erosion of protective sand spits and bars at barrier-protected wetlands, and loss of wetland habitat. Low water levels can lead to the shrinking of wetlands and reduce hydraulic connectivity. Coastal wetlands are also being affected by coastal erosion. For example, it has been reported that more than 160 hectares of coastal wetlands have disappeared in Rondeau Bay in Chatham-Kent, Ontario, due to the eroding barrier beach (Zuzek, 2020). Currently, ECCC is undertaking a study to assess coastal wetland vulnerability and enhance wetland resilience through adaptation. The vulnerability assessment will provide a better understanding of the climate-related impacts on coastal wetlands and recommend adaptation strategies and actions for enhanced coastal wetland resilience. These results and recommendations will be made available when the study is completed in 2022.

4.0 Looking Ahead

If climate change continues at its current pace, the Great Lakes will be very different by the time our children and grandchildren grow up.

By the end of the century, the climate, water levels, and ice cover over the Great Lakes are anticipated to change significantly.

Over-land air temperatures are expected to increase significantly across the basin compared to 1961-2000. The greatest temperature increases are projected for the fall and winter seasons. Changes in average over-land air temperatures are expected to bring warmer winters, more extreme heat, a longer growing season, heavier precipitation, and less ice cover. The greatest increases in over-land air temperatures are expected for lakes Superior and Michigan-Huron.

Over-lake precipitation is anticipated to increase in all seasons and over the year under both climate scenarios for all lakes, although the increase is generally less in the summer season. Changes in seasonal over-lake precipitation is anticipated to vary by lake and climate scenario. With warmer winters, snowfall is expected to decrease on average, with more precipitation falling as rain instead of snow. The greatest increases in over-lake precipitation are expected for lakes Superior and Ontario.

References

Allan, J. D., McIntyre, P. B., Smith, S. D. P., Halpern, B. S., Boyer, G. L., Buchsbaum, A., Burton, G. A., Campbell, L. M., Chadderton, W. L., Ciborowski, J. J. H., Doran, P. J., Eder, T., Infante, D. M., Johnson, L. B., Joseph, C. A., Marino, A. L., Prusevich, A., Read, J. G., Rose, J. B., … Steinman, A. D. (2013). Joint analysis of stressors and ecosystem services to enhance restoration effectiveness. Proceedings of the National Academy of Sciences, 110(1), 372-377. https://doi.org/10.1073/pnas.1213841110

Alofs, K. M., & Jackson, D. A. (2015). The abiotic and biotic factors limiting establishment of predatory fishes at their expanding northern range boundaries in Ontario, Canada. Global Change Biology, 21(6), 2227-2237. https://doi.org/10.1111/gcb.12853

Alofs, K. M., Jackson, D. A., & Lester, N. P. (2014). Ontario freshwater fishes demonstrate differing range-boundary shifts in a warming climate. Diversity and Distributions, 20(2), 123-136. https://doi.org/10.1111/ddi.12130

Angel, J. R., Swanson, C., Boustead, B. M., Conlon, K., Hall, K. R., Jorns, J. L., Kunkel, K. E., Lemos, M. C., Lofgren, B. M., Ontl, T., Posey, J., Stone, K., Takle, E., & Todey, D. (2018). Chapter 21: Midwest. Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II. U.S. Global Change Research Program. https://doi.org/10.7930/NCA4.2018.CH21

Austin, J. A., & Colman, S. M. (2007). Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophysical Research Letters, 34(6), L06604. https://doi.org/10.1029/2006GL029021

Bartolai, A. M., He, L., Hurst, A. E., Mortsch, L., Paehlke, R., & Scavia, D. (2015). Climate change as a driver of change in the Great Lakes St. Lawrence River Basin. Journal of Great Lakes Research, 41, 45-58. https://doi.org/10.1016/j.jglr.2014.11.012

Baxter, M. (2019, July 22). How to save Lake Erie's disappearing shorelines. TVO. https://www.tvo.org/article/how-to-save-lake-eries-disappearing-shorelines

Briscoe, T. (2019a, November 14). Cleveland Residents Are Used to Their Water Being Brown, Even if They Don't Know Why. The Answer Lies at the Bottom of Lake Erie. The Chicago Tribune. https://pulitzercenter.org/reporting/cleveland-residents-are-used-their-water-being-brown-even-if-they-dont-know-why-answer

Briscoe, T. (2019b, November 14). In the Great Lakes' Most Productive Fishing Grounds, Algae-Fueled Dead Zones Are Eroding Livelihoods. The Chicago Tribune. https://pulitzercenter.org/reporting/great-lakes-most-productive-fishing-grounds-algae-fueled-dead-zones-are-eroding

Briscoe, T. (2019c, November 14). The Shallowest Great Lake Provides Drinking Water for More People Than Any Other. Algae Blooms Are Making It Toxic-And It's Getting Worse. The Chicago Tribune. https://pulitzercenter.org/reporting/shallowest-great-lake-provides-drinking-water-more-people-any-other-algae-blooms-are

Briscoe, T. (2020a, March 19). Ice Shapes Economy, Identity of Lake Superior's Coastal Towns. But It's Disappearing: 'Culture Is Defined by How the World Around Us Looks - and Now That's Changing.' The Chicago Tribune. https://pulitzercenter.org/reporting/ice-shapes-economy-identity-lake-superiors-coastal-towns-its-disappearing-culture-defined

Briscoe, T. (2020b, January 13). On the largest freshwater island in the world, Lake Huron's Native Americans warn of the fragility of water. Chicagotribune.Com. https://www.chicagotribune.com/news/environment/great-lakes/ct-lake-huron-climate-change-native-americans-20200113-tf4vprfjmbgwhepnkh52gssihe-story.html

Brown, L. C. et Duguay, C. R. (2010). The response and role of ice cover in lake-climate interactions. Progress in Physical Geography: Earth and Environment, 34(5), 671–704. https://doi.org/10.1177/0309133310375653

Gronewold, A. D., & Stow, C. A. (2014). Unprecedented Seasonal Water Level Dynamics on One of the Earth's Largest Lakes. Bulletin of the American Meteorological Society, 95(1), 15–17. https://doi.org/10.1175/BAMS-D-12-00194.1

Gronewold, A. D., Fortin, V., Caldwell, R., & Noel, J. (2018). Resolving Hydrometeorological Data Discontinuities along an International Border. Bulletin of the American Meteorological Society, 99(5), 899–910. https://doi.org/10.1175/BAMS-D-16-0060.1

Gunther, T. (2011). Lake Turnover. https://www.nationalgeographic.org/media/lake-turnover/

Hartig, J. H., Francoeur, S. N., Ciborowski, J. J. H., Gannon, J. E., Sanders, C. E., Galvao-Ferreira, P., Knauss, C. R., Gell, G., & Berk, K. (2020). Checkup: Assessing Ecosystem Health of the Detroit River and Western Lake Erie (Occasional Publication No. 11; p. 516). Great Lakes Institute for Environmental Research, University of Windsor.

Hartmann, H. C. (1990). Climate change impacts on Laurentian Great Lakes levels. Climatic Change, 17(1), 49-67. https://doi.org/10.1007/BF00149000

Hayhoe, K., D.J. Wuebbles, D.R. Easterling, D.W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner. (2018). Our Changing Climate. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 72-144. doi: 10.7930/NCA4.2018.CH2

Intergovernmental Panel on Climate Change. (2018). Summary for Policymakers. In Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Intergovernmental Panel on Climate Change. (2021) Summary for Policymakers. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. In Press.

International Joint Commission. (2019). Impacts of the Extreme 2019 Great Lakes High Water Levels Felt Throughout Lake Ontario and the St. Lawrence River. International Joint Commission. https://www.ijc.org/en/impacts-extreme-2019-great-lakes-high-water-levels-felt-throughoutlake-ontario-and-st-lawrence

International Joint Commission. (2020). Water Levels and Flows. International Joint Commission. https://ijc.org/en/what/water-levels

Johnson, R. (2019, January 20). Saugeen Ojibway Nation confronts effects of climate change on whitefish fishery. CBC. https://www.cbc.ca/news/indigenous/saugeen-ojibway-whitefish-fishery-climate-change-1.4982666

Kling, G. W., Hayhoe, K., Johnson, L. B., Magnuson, J. J., Polasky, S., Robinson, S. K., Shuter, B. J., Wander, M. M., Wuebbles, D. J., & Zak, D. R. (2003). Confronting Climate Change in the Great Lakes | Union of Concerned Scientists. The Union of Concerned Scientists and The Ecological Society of America. https://www.ucsusa.org/resources/confronting-climate-changegreat-lakes

Lofgren, B. M., Quinn, F. H., Clites, A. H., Assel, R. A., Eberhardt, A. J., & Luukkonen, C. L. (2002). Evaluation of Potential Impacts on Great Lakes Water Resources Based on Climate Scenarios of Two GCMs. Journal of Great Lakes Research, 28(4), 537–554. https://doi.org/10.1016/S0380-1330(02)70604-7

Ontario Ministry of the Environment, Conservation and Parks. (2020). Minister's annual report on drinking water (2020). Ontario Ministry of the Environment, Conservation and Parks. https://www.ontario.ca/page/ministers-annual-report-drinking-water-2020

O'Reilly, C. M., Sharma, S., Gray, D. K., Hampton, S. E., Read, J. S., Rowley, R. J., Schneider, P., Lenters, J. D., McIntyre, P. B., Kraemer, B. M., Weyhenmeyer, G. A., Straile, D., Dong, B., Adrian, R., Allan, M. G., Anneville, O., Arvola, L., Austin, J., Bailey, J. L., … Zhang, G. (2015). Rapid and highly variable warming of lake surface waters around the globe. Geophysical Research Letters, 42(24). https://doi.org/10.1002/2015GL066235

Patz, J. A., Vavrus, S. J., Uejio, C. K., & McLellan, S. L. (2008). Climate Change and Waterborne Disease Risk in the Great Lakes Region of the U.S. American Journal of Preventive Medicine, 35(5), 451-458. https://doi.org/10.1016/j.amepre.2008.08.026

Quinn, F. H. (2002). Secular Changes in Great Lakes Water Level Seasonal Cycles. Journal of Great Lakes Research, 28(3), 451-465. https://doi.org/10.1016/S0380-1330(02)70597-2

Seglenieks, F. & Temgoua, A.G. 2021. Future hydroclimate variables and lake levels for the Great Lakes using data from the Coupled Model Intercomparison Project Phase 5 (In review).

Sharma, A., Hamlet, A. F., Fernando, H. J. S., Catlett, C. E., Horton, D. E., Kotamarthi, V. R., Kristovich, D. A. R., Packman, A. I., Tank, J. L., & Wuebbles, D. J. (2018). The Need for an Integrated Land-Lake-Atmosphere Modeling System, Exemplified by North America's Great Lakes Region. Earth's Future, 6(10), 1366-1379. https://doi.org/10.1029/2018EF000870

Taylor, M. E., Gray, P. A., & Schiefer, K. (2006). Helping Canadians Adapt to Climate Change in the Great Lakes Coastal Zone. 13(1), 12.

The Earth Observatory. (2021). 2020 Tied for Warmest Year on Record. NASA Earth Observatory. https://earthobservatory.nasa.gov/images/147794/2020-tied-for-warmest-year-on-record

United States Army Corps of Engineers. (2021). Current Regulated Outflows. Detroit District Website. https://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Outflows/Current-Regulated-Outflows/

United States Environmental Protection Agency. (2018). U.S. Action Plan for Lake Erie 2018-2023: Commitments and strategy for phosphorus reduction (p. 119). United States Environmental Protection Agency. https://www.epa.gov/sites/production/files/2018-03/documents/us_dap_final_march_1.pdf

US Environmental Protection Agency. (2021a). Climate Change Indicators: Great Lakes Ice Cover. https://www.epa.gov/climate-indicators/climate-change-indicators-great-lakes-ice-cover

US Environmental Protection Agency. (2021b). Great Lakes Ice Cover. US Environmental Protection Agency. https://www.epa.gov/sites/default/files/2021-04/documents/great-lakes-ice_td.pdf

Vertical Control – Water Levels Subcommittee. (2017). Updating the International Great Lakes Datum (IGLD) Executive Summary. Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data. http://www.greatlakescc.org/wp36/wp-content/uploads/2017/09/IGLD_Update_20170929_Exec_220dpi.pdf

Wang, J., Kessler, J., Hang, F., Hu, H., Clites, A. H., & Chu, P. (2018). Great Lakes Ice Climatology Update of Winters 2012-2017: Seasonal Cycle, Interannual Variability, Decadal Variability, and Trend for the period 1973-2017 (NOAA Technical Memorandum GLERL-170). National Oceanic and Atmospheric Administration. https://www.glerl.noaa.gov/pubs/tech_reports/glerl-170/tm-170.pdf

Statistical downscaling is the other type of downscaling, which relies on an understanding of the historical relationships observed between local climate variables (e.g., precipitation) and large-scale variables (e.g., atmospheric pressure). Mathematical equations are used to define these statistical relationships that have been observed historically and these equations are then applied to projections from GCMs to derive local climate projections.

NA-CORDEX was the only known source of RCM data that was publicly available at the start of ECCC's coastal wetland vulnerability assessment project that had the necessary variables and temporal resolution to accurately calculate water levels. Seven RCMs were included as part of the NA-CORDEX project, and each RCM was driven by a subset of the 6 GCMs. Among these RCMs, ECCC selected ones that had over-lake precipitation, basin temperature, and lake evaporation output available. As a result, 13 RCM-GCM combinations were included in ECCC's study (see Table A-1). Most of these RCMs use a one-dimensional lake model called FLake, which helps to derive more realistic simulations of lake dynamics compared to the absence of any lake model.

Table A-1: List of RCM-GCM Combinations and Associated Details

NO.	RCM	GCM	SCENARIO	RESOLUTION	LAKE MODEL
1	CRCRM5	CanESM2	RCP 4.5	0.22° X 0.22°	FLake
2	CRCRM5	CanESM2	RCP 8.5	0.22° X 0.22°	FLake
3	CRCRM5	CNRM-CM5	RCP 4.5	0.22° X 0.22°	FLake
4	CRCRM5	CNRM-CM5	RCP 8.5	0.22° X 0.22°	FLake
5	CRCRM5	GFDL-ESM2M	RCP 4.5	0.22° X 0.22°	FLake
6	CRCRM5	GFDL-ESM2M	RCP 8.5	0.22° X 0.22°	FLake
7	CRCRM5	MPI-ESM-LR	RCP 8.5	0.22° X 0.22°	FLake
8	CanRCM4	CanESM2	RCP 4.5	0.22° X 0.22°	None – prescribed from driver
9	CanRCM4	CanESM2	RCP 8.5	0.22° X 0.22°	None – prescribed from driver
10	RCA4	CanESM2	RCP 4.5	0.44° X 0.44°	FLake
11	RCA4	CanESM2	RCP 8.5	0.44° X 0.44°	FLake
12	RCA4	Earth_SMHI	RCP 4.5	0.44° X 0.44°	FLake
13	RCA4	Earth_SMHI	RCP 8.5	0.44° X 0.44°	Flake

Lake level projections were developed based on the following factors, including the Net Basin Supply (NBS) of each lake, the inflow of water from the upstream lake, and the outflow to the downstream lake. The NBS refers to the net volume of local water supply coming into each lake.
One way of calculating the NBS is by taking the sum of total over-lake precipitation and runoff into the lake from its surrounding drainage basin, and subtracting the evaporation from the lake (or over-lake evaporation). This is known as the component NBS. Each of the three components of the NBS were calculated separately for each lake and then combined into a single NBS for each lake.

Data for both over-lake precipitation and over-lake evaporation were taken directly from the datasets available from the NA-CORDEX study. Over-lake precipitation refers to precipitation that falls on the lake's surface. Meanwhile, over-lake evaporation refers to the amount of evaporation from the lake's surface.

The use of a hydrological model was necessary in order to determine runoff into the lake from its surrounding drainage basin. Runoff into the lake refers to the sum of water flowing into the lake from all of its surrounding rivers, excluding water from the upstream lake if there is one. While the RCMs provided runoff from each grid cell of the RCM, there is no direct calculation of the amount of flow into each lake. Hence, ECCC used a hydrological model called, WATFLOOD, to calculate runoff into each lake, which is able to route the flow from each grid cell down the river network and into each connecting lake to ensure proper timing of the runoff. This model has been used successfully in the Great Lakes for many years and there is an established method to calculate runoff into each of the Great Lakes. It uses hourly temperature and precipitation data as input to calculate the separation of runoff into surface runoff, interflow, and baseflow. The temperature and precipitation data that were used in the hydrological model were available from the NA-CORDEX project.

The Coordinated Great Lakes Routing and Regulation Model (CGLRRM) was used to calculate the lake levels and flow of the connecting channels for the upper lakes (i.e., Lake Superior to Lake Erie). The CGLRRM uses the NBS for each lake as input and considers the regulation of Lake Superior

Appendix B: Detailed Description of the Methodology Used by the Nelson Institute Center for Climatic Research to Develop the Ice Cover Projections

As noted in Box 1, this Appendix provides a more detailed summary of the methodology used by the Nelson Institute Center for Climatic Research (CCR) to develop the ice cover projections included in this report. The information presented in this summary is based on peer-reviewed articles by Notaro and others (2015; 2016).

The modelled climate data used by CCR also came from the Coupled Model Intercomparison Project Phase 5 (CMIP5). Simulations from six GCMs were dynamically downscaled according to RCP 8.5 using one RCM – RegCM4 (see Table B-1). RegCM4 has a resolution (or a "grid cell") of 25 km by 25 km and was interactively coupled with a one-dimensional energy-balance lake model and lake ice submodel to produce ice cover projections (among other variables) that capture the dynamics of the Great Lakes.

Table B-1: List of RCM-GCM Combinations and Associated Details

NO.	RCM	GCM	SCENARIO	NOTES
1	RegCM4	ACCESS1-0	RCP 8.5	Leap year included
2	RegCM4	CNRM-CM5	RCP 8.5	Leap year included
3	RegCM4	GFDL-ESM2M	RCP 8.5	Adjusted to incorporate leap years
4	RegCM4	IPSL-CM5-MR	RCP 8.5	Adjusted to incorporate leap years
5	RegCM4	MIROC5	RCP 8.5	Adjusted to incorporate leap years; Missing data for 1989
16	RegCM4	MRI-CGCM3	RCP 8.5	Leap year included

The RCM outputs ice thickness for each lake grid cell. When ice thickness is 2 cm or more, 100 percent of ice cover was assumed for that grid cell. Otherwise it was set to 0 percent. Downscaled daily percentage lake ice cover was produced for three time periods: 1980-1999, 2040-2059, and 2080-2099. Given the volume of daily data, the time periods only cover 20 consecutive years. Only data from December to May was analyzed in this report, which represents the typical ice season across the Great Lakes.

WORLD
METEOROLOGICAL
ORGANIZATION

It is as likely as not (48%) that one of the next 5 years will exceed 1.5°C of Global Warming

https://public.wmo.int/en/media/press-release/wmo-update-5050-chance-of-global-temperature-temporarily-reaching-15%C2%B0c-threshold

More volatile and wilder Great Lakes

...conditions continue to change and will be different than we've seen in our lifetimes.

GEORGIAN BAY FOREVER 25 Years

GEORGIAN BAY ASSOCIATION Since 1916

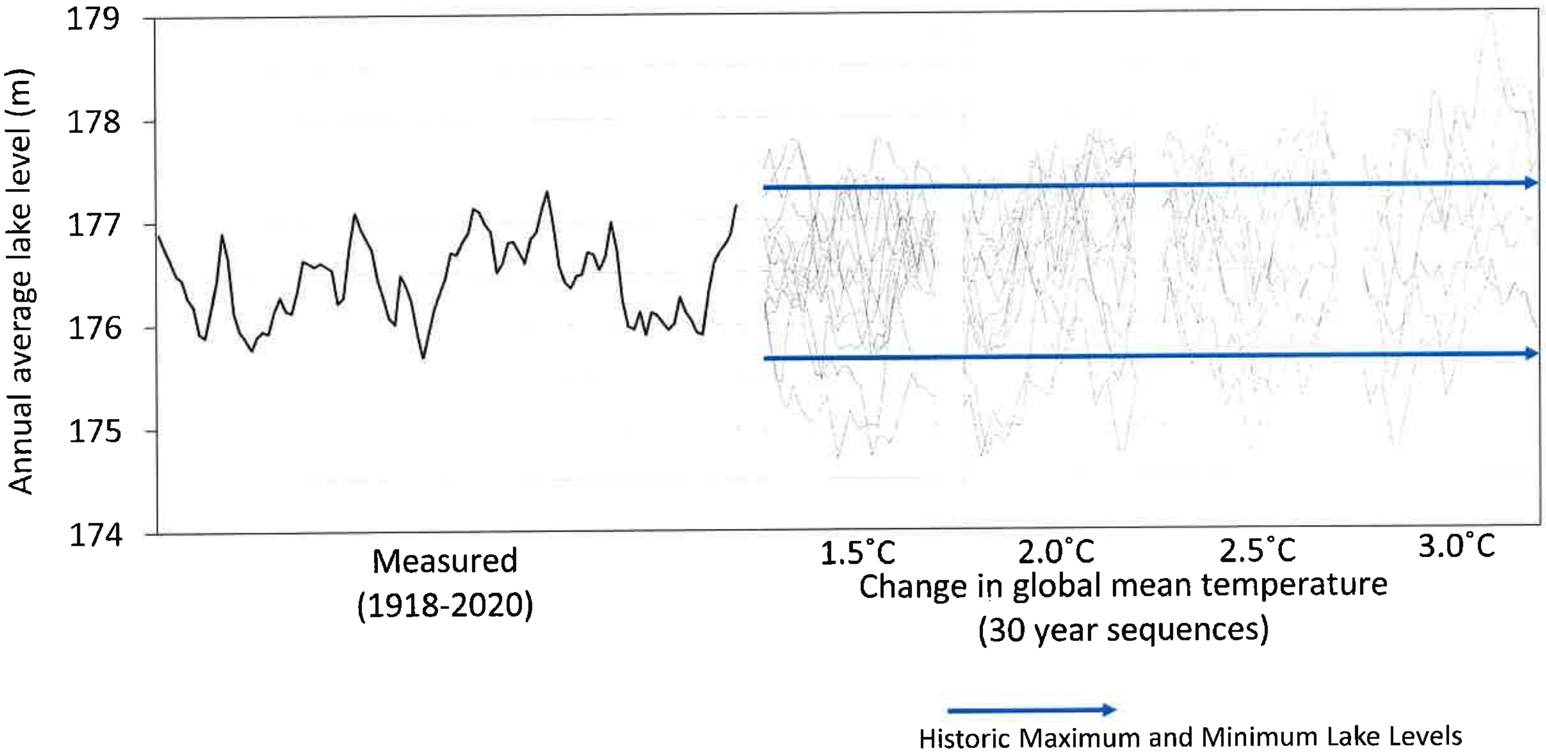
GEORGIAN BAY ASSOCIATION GEORGIAN BAY FOREVER


CLIMATE CHANGE IN THE
GREAT LAKES BASIN:
SUMMARY OF TRENDS AND IMPACTS

Frank Seglenieks, André Temgoua, "Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates", Journal of Great Lakes Research, Volume ... 2022, pp 865-875 (https://www.sciencedirect.com/science/article/pii/S0380133022001381)

New water levels climate modelling

Lake Michigan-Huron



Water Levels 2023

GEORGIAN BAY ASSOCIATION

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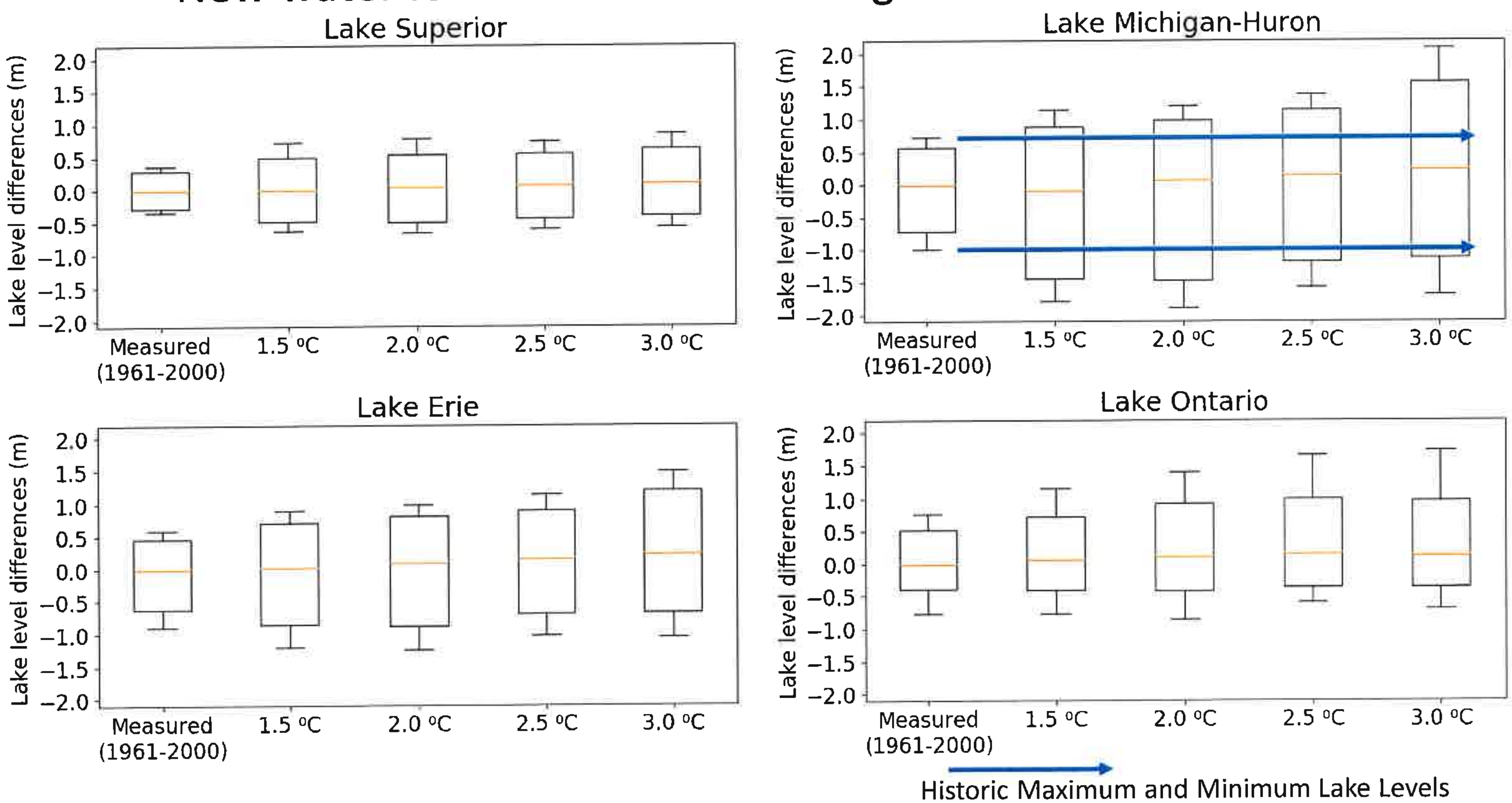
Frank Seglenieks, Andre Temgoua, "Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates", Journal of Great Lakes Research, Volume 48, Issue 4, 2022, pp 865-875 (https://www.sciencedirect.com/science/article/pii/S0380133022001381)

New water levels climate modelling



Water Levels 2023

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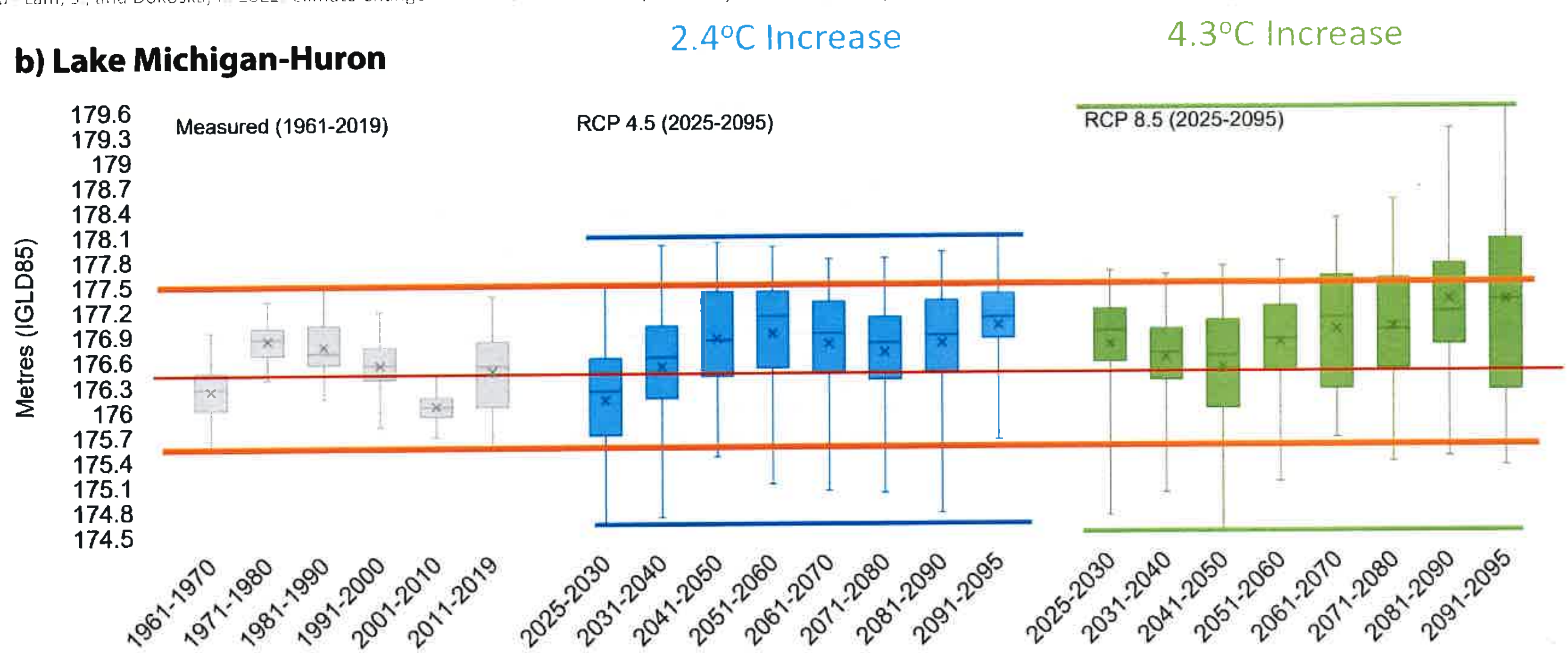
Page 26 - Lam, S., and Dokoska, K. 2022. Climate Change in the Great Lakes Basin:, Summary of Trends and Impacts. Toronto, Ontario: Toronto and Region Conservation Authority

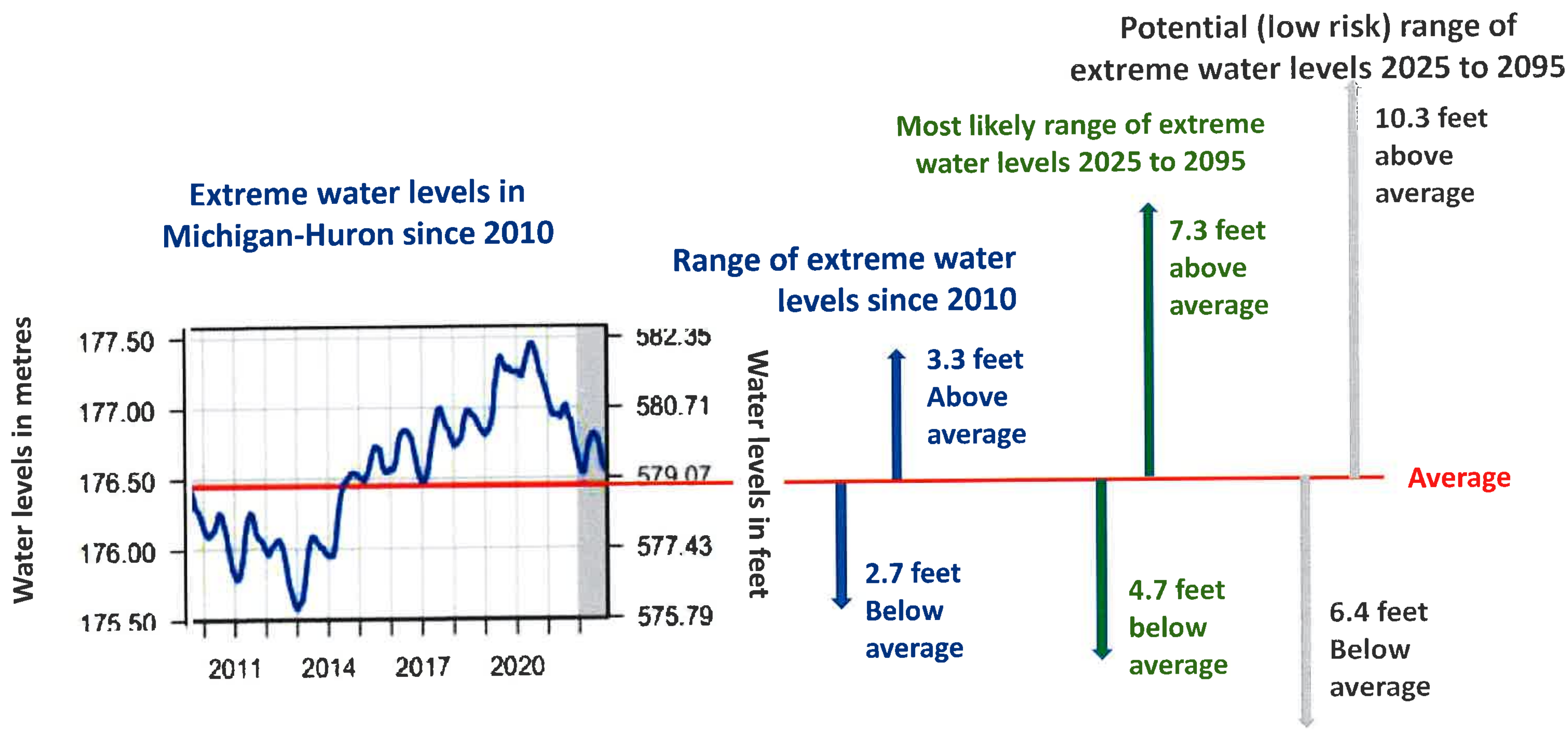


Max Scenario Range historic

Max Scenario Range 2.4°C

Max Scenario Range 4.3°C

	Historic	RCP 4.5	RCP 8.5
High (m)	177.5	178.1	179.6
Low (m)	175.57	174.65	174.5
Range (m)	1.93	3.45	5.1
Range (ft)	6.332	11.319	16.732

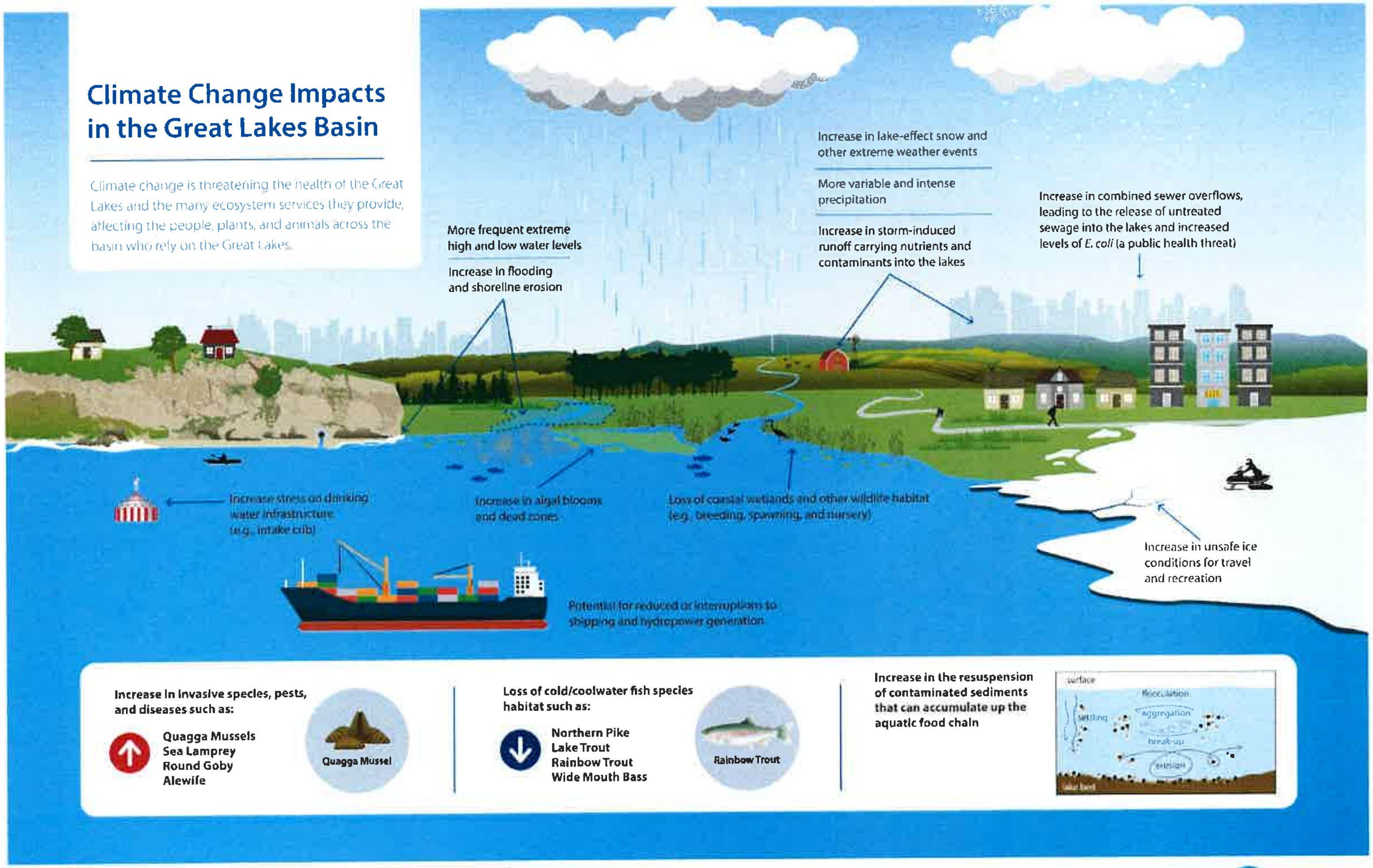

Extreme water levels in Michigan-Huron since 2010
Water levels in metres
177.50
177.00
176.50
176.00
175.50
2011
2014
2017
2020
582.35
580.71
579.07
577.43
575.79
Water levels in feet
Range of extreme water levels since 2010
3.3 feet Above average
2.7 feet Below average
Most likely range of extreme water levels 2025 to 2095
7.3 feet above average
4.7 feet below average
Potential (low risk) range of extreme water levels 2025 to 2095
10.3 feet above average
6.4 feet Below average
Average

Frank Seglenieks, André Temgoua, "Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates", Journal of Great Lakes Research, Volume 48, Issue 4, 2022, pp 865-875 (https://www.sciencedirect.com/science/article/pii/S0380133022001381)

New water levels climate modelling

Lake Michigan/Huron

Percentage Exceedance	Measured (1961–2000)	Change in Global Mean Temperature 1.5 °C	2 °C	2.5 °C	3 °C
1	0.72	1.14	1.20	1.38	2.08
5	0.57	0.88	0.99	1.14	1.57
50	0.00	−0.08	0.07	0.14	0.24
95	−0.72	−1.44	−1.47	−1.18	−1.12
99	−1.00	−1.79	−1.89	−1.57	−1.69
Range (m)	1.72	2.93	3.09	2.95	3.77



Climate Change Impacts in the Great Lakes Basin
Climate change is threatening the health of the Great Lakes and the many ecosystem services they provide, affecting the people, plants, and animals across the basin who rely on the Great Lakes.
More frequent extreme high and low water levels
Increase in flooding and shoreline erosion
Increase in lake-effect snow and other extreme weather events
More variable and intense precipitation
Increase in storm-induced runoff carrying nutrients and contaminants into the lakes
Increase in combined sewer overflows, leading to the release of untreated sewage into the lakes and increased levels of E. coli (a public health threat)
Increase stress on drinking water infrastructure (e.g., intake crib)
Increase in algal blooms and dead zones
Loss of coastal wetlands and other wildlife habitat (e.g., breeding, spawning, and nursery)
Increase in unsafe ice conditions for travel and recreation
Potential for reduced or interruptions to shipping and hydropower generation
Increase in invasive species, pests, and diseases such as:
Quagga Mussels
Sea Lamprey
Round Goby
Alewife
Quagga Mussel
Loss of cold/coolwater fish species habitat such as:
Northern Pike
Lake Trout
Rainbow Trout
Wide Mouth Bass
Rainbow Trout
Increase in the resuspension of contaminated sediments that can accumulate up the aquatic food chain
surface
flocculation
aggregation
settling
break-up
erosion

- "The expanding range of extremes should be considered when making plans for infrastructure that will be affected by these future lake levels." - Frank Seglenieks, André Temgoua, "Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates", Journal of Great Lakes Research, Volume 48, Issue 4, 2022, Page 874.

- “This is because it will be the water levels at the extreme ends of the lake levels that have the potential to have the most impact on the build infrastructure.” - Frank Seglenieks, André Temgoua, “Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates”, Journal of Great Lakes Research, Volume 48, Issue 4, 2022, Page 874.

- "These plans should be adaptable to the range of future lake levels that can plausibly be expected." - Frank Seglenieks, André Temgoua, "Future water levels of the Great Lakes under 1.5 °C to 3 °C warmer climates", Journal of Great Lakes Research, Volume 48, Issue 4, 2022, Page 874.

High Water Marks must be discussed in light of this modelled future regime

	ToA	ToC	TGB	NEMI	MoK
High Water Mark Requirement (Georgian Bay)	176.44 [m] G.S.C. above sea level	176.44 [m] G.S.C. above sea level.	177.4 C.G. D	Not specified	n/a*
Shoreline Setback Requirement (Georgian Bay)	Not specified**	Not specified**	30 [m] from H.W.M ***	Not specified	20 [m] from optimal summer water level
Site Specific Setback Regulations	Yes	Yes	Yes	Yes	No
Elevation above High-Water Mark requirement	Not specified	Not specified	1 [m] above H.W.M	Not specified	Not specified

*high water mark it to be determined by an Ontario Land Surveyor.
** set by Ontario Building Code: for Class 4 & 5 is 15 [m] from lake
***specific setback for septic systems


Municipal Planning Comparison Project
GEORGIAN BAY ASSOCIATION
YOUR VOICE ON THE BAY

World's Largest Fresh Water Archipelago

- The coast is a local, national and international treasure
- The overdevelopment threat is real
- Effective action requires collaboration among local, provincial and national governments, First Nations, residents, communities and businesses
- Strong planning standards and regulations are municipalities' main tool to ensure responsible, sustainable development and protection of the coastal environment

What is Coastal Protection?

Protecting Georgian Bay's

- Natural Environment
- Water Quality
- Biodiversity
- Ecology

THROUGH

- Sound Planning Standards
- Responsible Development
- Municipal Planning Regulations

To Benefit the Environment and the Public

Partnership

The "Coastal Municipalities"

Township of The Archipelago · Township of Georgian Bay Muskoka · Township of Carling Incorporated 1897 · Municipality of Killarney · NEMI Northeastern Manitoulin & The Islands

The five municipalities where GBA members reside on the east and north coasts of Georgian Bay ("GBA Area") participated in the project and provided information and guidance to GBA

Planning Documents

Planning Documents	Policies / By-laws
 Strategic Plans	 Waterfront Designations
 Official Plans	 Environmental Protection Zones
 Comprehensive Zoning By-laws	 General Development

Purpose

- Identify where planning regulations align and differ
- Share key findings
- Provide commentary on how coastal protection could be enhanced

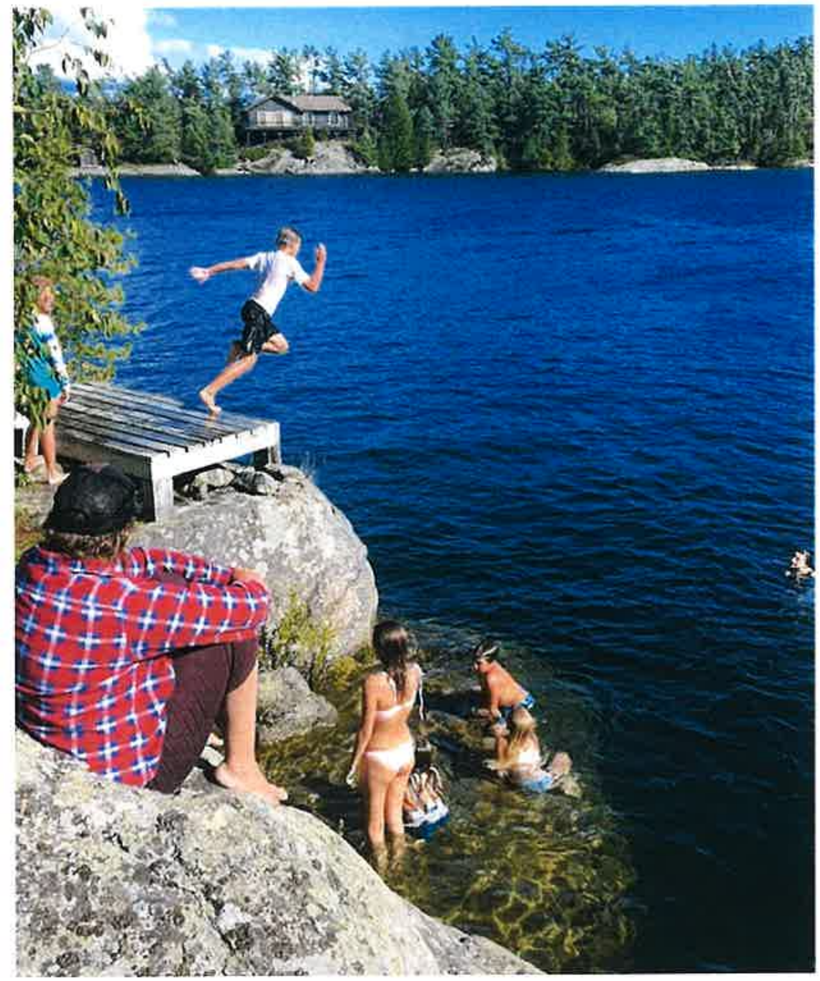
Goals

- Initiate discussions and action
- Identify planning harmonization opportunities
- Share concerns about increased development pressures

Overdevelopment Concerns

GEORGIAN BAY ASSOCIATION

- Additional dwellings and structures
- Increased stress on services (specifically septic systems)
- Natural shoreline and sightline of neighbours
- Balance property owners' rights with protecting the environment



Lake Michigan- Huron Projected Water Levels 2025-95

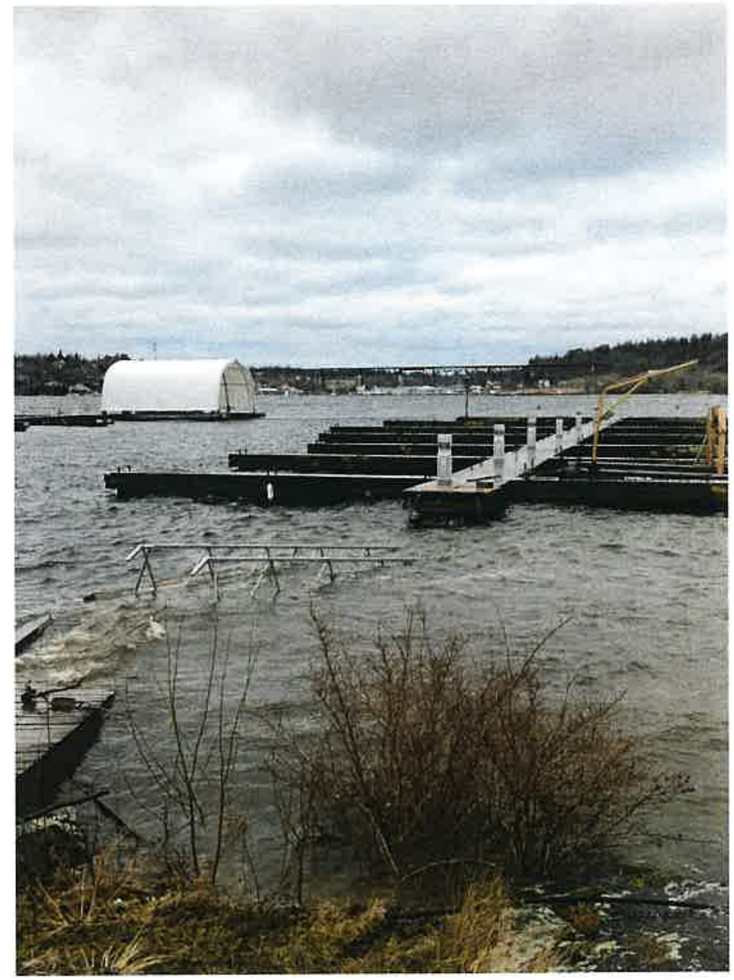
GEORGIAN BAY ASSOCIATION

Past

Water levels increased 6 ft from 2013 to 2019/20 – Historical range has been 6.3 ft

Future

- Low risk scenario: range increases to 16 ft
- Most likely scenario: range increases to 12 ft
- High future probability of 4 ft above 2019/20 and 2 ft below 2013 levels



Increased Water Levels Variability

- High-water mark and setbacks
- Access and operation (residents and commercial)
- Species-at-risk, sensitive habitats and water quality

Waterfront Residential Designation

GEORGIAN BAY ASSOCIATION

- Lot/island area
- Coverage
- Frontage
- Setbacks
- Additional dwellings & structures

Waterfront Commercial Designation

GEORGIAN BAY ASSOCIATION

- Lot/island area
- Coverage
- Frontage
- Setbacks
- Permitted uses (islands vs. mainland)

Environmental Protection and Open Space Zone

GEORGIAN BAY ASSOCIATION

Variation among coastal municipalities

- Permitted uses
- Structures
- Terminology (natural state & open space)

General Development

Lot subdivisions

Variation in size of new lots

The inclusion of specific wetland and natural heritage areas policies

Blasting and dredging

Terms of what policies cover

Each includes protection of the natural shoreline

Points for Further Discussion

GEORGIAN BAY ASSOCIATION

- Identity the key differences
- Identity and develop benchmark planning standards
- Identify sound practices
- Moving towards greater alignment & consistent planning standards
- Actions to protect the environment in the GBA Area?

Next Steps

Exchanging information such as staff reports

Explore creating forums for discussions, e.g. workshops and webinars

GBA hiring independent consultant to identify opportunities for collaboration

Other ideas?

Questions?

References & Information

- Seglenieks, F., & Temgoua, A. (2022). Future water levels of the Great Lakes under 1.5° C to 3° C warmer climates. *Journal of Great Lakes Research*, *48*(4), 865-875.
- Georgian Bay Association Planning Guide
- Andy Metelka – aerial photos slide 8 & 9 in bullet photos
- Official Plan of the Township of the Archipelago Planning Area
- Township of the Archipelago: Comprehensive Zoning By-laws
- Township of Carling Official Plan
- Township of Carling Comprehensive Zoning By-laws
- Township of Georgian Bay Official Plan
- Township of Georgian Bay Zoning By-laws
- Town of Northeastern Manitoulin and the Islands Official Plan
- Town of Northeastern Manitoulin and the Islands Comprehensive zoning by-laws
- Official Plan for the Sudbury East Planning Area
- Zoning By-law Municipality of Killarney
- Project webpage: https://georgianbay.ca/government-affairs/municipal-structure-and-protecting-the-coast-2/municipal-planning-comparison/

Cosette Shipman, GBA Coastal Protection Projects Coordinator
Email: cshipman@georgianbay.ca

THE CORPORATION OF THE TOWN OF NORTHEASTERN MANITOULIN AND THE ISLANDS

BY-LAW NO. 2023-05

Being a by-law of the Corporation of the Town of Northeastern Manitoulin and the Islands to adopt the minutes of Council for the term commencing December 4, 2018 and authorizing the taking of any action authorized therein and thereby.

WHEREAS the Municipal Act, S.O. 2001, c. 25. s. 5 (3) requires a Municipal Council to exercise its powers by by-law, except where otherwise provided;

AND WHEREAS in many cases, action which is taken or authorized to be taken by a Council or a Committee of Council does not lend itself to an individual by-law;

NOW THEREFORE THE COUNCIL OF THE CORPORATION OF THE TOWN OF NORTHEASTERN MANITOULIN AND THE ISLANDS ENACTS AS FOLLOWS:

1. THAT the minutes of the meetings of the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands for the term commencing November 15th, 2022 and held on:

   February 7, 2023
   February 9, 2023

   are hereby adopted.

2. THAT the taking of any action authorized in or by the minutes mentioned in Section 1 hereof and the exercise of any powers by the Council or Committees by the said minutes are hereby ratified, authorized and confirmed.

3. THAT, where no individual by-law has been or is passed with respect to the taking of any action authorized in or by the minutes mentioned in Section 1 hereof or with respect to the exercise of any powers by the Council or Committees in the above-mentioned minutes, then this by-law shall be deemed for all purposes to be the by-law required for approving and authorizing the taking of any action authorized therein or thereby or required for the exercise of any power therein by the Council or Committees.

4. THAT the Mayor and proper Officers of the Corporation of the Town of Northeastern Manitoulin and the Islands are hereby authorized and directed to do all things necessary to give effect to the recommendations, motions, resolutions, reports, action and other decisions of the Council or Committees as evidenced by the above-mentioned minutes in Section 1 and the Mayor and Clerk are hereby authorized and directed to execute all necessary documents in the name of the Corporation of the Town of Northeastern Manitoulin and the Islands and to affix the seal of the Corporation thereto.

READ A FIRST, SECOND AND THIRD TIME AND FINALLY PASSED THIS 21st day of February, 2023.

Al MacNevin	Mayor	Pam Myers	Clerk

The Corporation of the Town of Northeastern Manitoulin and the Islands
Minutes of a Regular Council meeting held Tuesday, February 7, 2023

PRESENT: Mayor Al MacNevin, Councillors: Patti Aelick, Al Boyd, Laurie Cook, Mike Erskine, William Koehler, Dawn Orr, George Williamson, and Bruce Wood.

STAFF PRESENT: David Williamson, CAO
Pam Myers, Clerk

Mayor MacNevin called the meeting to order at 7:00 p.m.

Disclosure of pecuniary interest and the general nature thereof – none.

Resolution No. 10-02-2023
Moved by: A. Boyd
Seconded by: M. Erskine
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands approves agenda.

Carried

Resolution No. 11-02-2023
Moved by: D. Orr
Seconded by: B. Wood
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands now reads a first, second and third time and finally passes By-law 2023-021. Being a by-law to adopt the minutes of Council for the term commencing November 15, 2022 and authorizing the taking of any action therein and thereby.

Carried

Resolution No. 12-02-2023
Moved by: M. Erskine
Seconded by: A. Boyd
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands is satisfied with the Subdivision Agreement as signed by McLay on January 11, 2023 and hereby authorize the Mayor and CAO to sign the agreement on behalf of the Town.

Carried

Resolution No. 13-02-2023
Moved by: L. Cook
Seconded by: M. Erskine
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands donates $300 to the Little Current Lions Club.

Carried

Resolution No. 14-02-2023
Moved by: D. Orr
Seconded by: M. Erskine
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands appoints Allison Brewer and Jill Ferguson to the Community Services Advisory Committee.

Resolution No. 15-02-2023
Moved by: M. Erskine
Seconded by: D. Orr
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands writes the Minister of Immigration, the Honorable Sean Fraser and MP Carol Hughes to request the Manitoulin Island be included in the list of participating communities able to recommend permanent residency for qualified applicants.

Carried

Resolution No. 16-02-2023
Moved by: W. Koehler
Seconded by: L. Cook
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands supports the motion put forth by the Town of Petrolia to have School Boards conduct their own election processes and forwards this motion to the Honorable Steven Lecce, Minister of Education.

Carried

Resolution No. 17-02-2023
Moved by: M. Erskine
Seconded by: B. Wood
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands proceeds In Camera in order to address a matter pertaining to personal matters about an identifiable individual, including municipal or local employees.

Carried

Resolution No. 18-01-2023
Moved by: G. Williamson
Seconded by: D. Orr
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands does now adjourn at 8:14 pm.

Carried

Al MacNevin, Mayor — Pam Myers, Clerk

The Corporation of the Town of Northeastern Manitoulin and the Islands
Minutes of a Regular Council meeting held Thursday, February 9, 2023

PRESENT: Mayor Al MacNevin, Councillors: Patti Aelick, Al Boyd, Laurie Cook, Mike Erskine, William Koehler, Dawn Orr, George Williamson, and Bruce Wood.

STAFF PRESENT: Sheryl Wilkin, Treasurer
Heidi Ferguson, Deputy-Clerk

Mayor MacNevin called the meeting to order at 7:00 p.m.

Disclosure of pecuniary interest and the general nature thereof – none.

Resolution No. 19-02-2023
Moved by: G. Williamson
Seconded by: P. Aelick
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands approves agenda.

Carried

Resolution No. 20-02-2023
Moved by: A. Boyd
Seconded by: B. Wood
BE IT RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands approves the financial reports as presented.

Carried

Resolution No. 21-02-2023
Moved by: M. Erskine
Seconded by: G. Williamson
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands now reads a first, second and third time and finally passes By-Law No. 2023-03, being a by-law to provide for the Interim Tax Levy, provide for the payment of taxes and the charging of penalty and interest.

Carried

Resolution No. 22-02-2023
Moved by: A. Boyd
Seconded by: M. Erskine
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands now reads a first, second and third time and finally passes By-Law No. 2023-04, being a by-law for the Borrowing from TD Canada Trust.

Carried

Resolution No. 23-02-2023
Moved by: M. Erskine
Seconded by: G. Williamson
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands authorizes the Mayor and CAO to enter into an agreement with the Northern Ontario Heritage Corporation for funding for the Spider Bay Marina Pier 6 dock replacement, as per the attached.

Resolution No. 24-02-2023
Moved by: L. Cook
Seconded by: B. Wood
RESOLVED THAT the Council of the Corporation of the Town of Northeastern Manitoulin and the Islands does now adjourn at 7:26 pm.

Carried

Al MacNevin, Mayor

Heidi Ferguson, Deputy-Clerk

NORTHEASTERN MANITOULIN & THE ISLANDS

Project: Application for Consent
File #: Con 2023-01
Owner: Albert, Stephen and Paul Rolston
Legal: Howland Concession 3 Lot 12

Purpose of the Application

The consent application is being applied for the purposes of the creation of a new building lot for the purpose building a residential cottage

Official Plan

Designation – Rural and Hazard

Set back from quarry property is recommended to be 1000 meters – applicant is indicating that the property line will be within a 900 meters of the licensed quarry area.

The applicant has stated that even though part of this property is zoned Hazard the actual flood plain is to the west and north of the area to be severed and furthermore that there has been no flooding during the duration of family ownership of 128 years.

A. Natural Hazards

It is the intent of Council to minimize the risk to public safety and to property by restricting development within areas identified as being susceptible to natural hazard processes, such as flooding, erosion, karst topography, and wildland fire.

1. Development is strictly prohibited in areas of natural hazards for:

   a. Uses associated with hospitals, nursing homes, schools, and day cares, where there is a threat to safe evacuation of the sick, the elderly, persons with disabilities, or the young during an emergency as a result of flooding, failure of flood-proofing, and/or erosion;
   b. Essential emergency services such as fire, police, ambulance stations, and electrical substations that could be impaired in the case of flooding, failure of flood protection works, and/or erosion; and
   c. Uses associated with the disposal, manufacture, treatment, or storage of hazardous substances and outdoor industrial storage.

Decisions should also consider the potential of climate change to increase risks associated with natural hazards.

▪ Flooding Hazards

Flood plain management policies are intended to prevent the loss of life, to minimize property damage and social disruption, and to encourage a coordinated approach to land use and water management.
For the purpose of this Plan, a flood plain shall mean low lying lands adjacent to Lake Huron, inland lakes, and watercourse corridors defined by the 1:100 year flood plus wave up-rush where applicable or defined by specific right-to-flood levels. Flooding hazards, where identified by MNRF, are shown on the Schedules to this Plan.

1. Where a proponent is proposing to develop in close proximity to a watercourse or waterbody where a flood line study has not been completed, the proponent shall be required to undertake a detailed flood line study.
   Development shall not be permitted within the flood plain except for:

   a. Flood *and/or* erosion control structures;

b. Shoreline stabilization;
c. Minor additions *and/or* renovations to existing structures;
d. Minor recreational facilities which, by their nature, must locate near watercourses; or
e. Uses such as agriculture, forestry, conservation, wildlife management, and similar activities, provided that no associated buildings and structures are located on the flood plain.[25]

Lake Manitou's water levels are controlled by a dam operated by MNRF. The minimum and maximum operating ranges are 224.6 metres GSC – 224.75 metres GSC. For the purposes of dam safety, a flood event occurs when lake levels exceeds an elevation of 224.87 metres GSC. New residential development shall not be permitted below the 224.87 metres GSC.

D.7 Land Use Compatibility

Noise, vibration, odour and other contaminants resulting from certain uses can impact adjacent land uses, and the residents, businesses and visitors of the Town. Managing these adverse effects is important to ensuring the health and well-being of residents and the compatibility of neighbouring uses so as not to create conflicts.

1.In reviewing any development application, Council shall be satisfied that the proposed use will be, or can be made to be compatible with surrounding uses in accordance with MOECC guidelines.

2. influence areas and minimum separation distances between industrial land uses and sensitive land uses will be determined in accordance with MOECC Guideline D-6: Compatibility between Industrial Facilities and Sensitive Land Uses. Proponents may be required to provide supporting technical studies, prepared by qualified individuals in accordance with MOECC guidelines, to assist in the evaluation of proposed developments and, where applicable, to determine influence areas, address potential impacts, and identify appropriate separation distances and other mitigation measures.

3. In the absence of technical studies, prepared according to MOECC Guideline D-6 which identify an actual influence area, the minimum separation distances required between industrial uses and residential or other sensitive land uses shall be:

- Class I Industries: 70 metres
- Class II Industries: 300 metres
- Class III Industries: 1,000 metres

With the support of technical studies, prepared under MOECC Guideline D-6, the following minimum separation distances in accordance with MOECC guidelines shall apply between industrial uses and residential or other sensitive land uses:

- Class I Industries: 20 metres;
- Class II Industries: 70 metres;
- Class III Industries: 300 metres.

Separation distances between potentially conflicting land uses shall be measured in accordance with MOECC Guideline D-6.

Where residential or other sensitive land uses are proposed in proximity to aggregate operations or lands zoned to permit future aggregate operations, the standards for Class III Industries shall apply.[29]

All new farm and non-farm development must comply with the Minimum Distance Separation (MDS) Formulae as amended from time to time.

Separation distances or appropriate remedial measures use will be established in the Zoning By-law or through development approval processes.

Residential areas, and other sensitive land uses, such as hospitals and nursing homes, will be protected from undesirable air quality and excessive noise/vibration through good land use planning, site plan control, and building control. Proponents may be required to carry out noise and/or vibration assessments or other technical studies and determine control measures, which are satisfactory to Council, in meeting the MOECC's recommended sound and vibration limits in accordance with MOECC Environmental Noise Guideline NPC-300 or its successors.

For any proposed residential development or other sensitive land use in close proximity to a major source of noise, vibration, or emissions; such as a provincial highway, an airport, a railway, or aggregate operation; or where a development which could be a major source of noise proposes to locate in close proximity to existing residential development or other sensitive land use, the proponent may be required to conduct a noise, vibration, and/or emissions study. The study shall be prepared in accordance with Provincial guidelines, including NPC-300, satisfactory to Town Council and the recommendations may be incorporated into a development agreement. Council will consider any potential noise problem in determining the appropriateness of the proposed development.

Uses proposed within these buffer areas may be subject to noise feasibility and/or detailed noise studies in accordance with MOECC Environmental Noise Guideline NPC-300 or its successors.

Where planning approvals are required for the development of residential or other sensitive land uses within one kilometre of an airport, an impact assessment addressing noise in accordance with NPC-300 and other potential impacts will be required. Impact assessments shall be completed by a qualified consultant and shall describe mitigation measures required to achieve provincial standards for aircraft noise criteria.

E.1.3 Water Access

It is recognized that some properties, by virtue of their bay, island, or shoreline location, may not have direct road access or frontage. Water access properties may be accessed by boat or floatplane or alternative method.

Development may be permitted on the basis of water access only.

Proponents shall demonstrate that they have adequate parking or docking facilities to the satisfaction of the Town as part of a planning application

Zoning
Designation – Rural and Shoreline Residentail

Comments from agencies
No comments from Ministries were received

Comments from the Public
No comments or requests were received from the public.

When Considering Approval, we should consider:

B. Consents

A consent shall only be considered where a plan of subdivision is deemed to be unnecessary, where the application conforms with the policies of this Plan, is consistent with the Provincial Policy Statement, and the consent will generally not result in the creation of more than five new lots on a lot that existed prior to the date of adoption of this Plan, and it does not necessitate the creation of a new municipal road, or the extension of municipal services.

Council shall provide input on municipal conditions of approval for consents.

The proposed lot and retained lot shall have frontage and access on to an opened and maintained public road, or have private road or water access in compliance with the policies of this Plan.

MTO's policy is to allow only one highway entrance for each lot of record fronting onto a provincial highway. AMTO will not allow backlots to create a second entrance on the highway. MTO will not support a consent to separate a home-based business from a residential use which would result in separate entrances for the business and residential parcels.

Lots will not be created which would create a traffic hazard due to limited sight lines on curves or grades.

The lot area and frontage of both the lot to be retained and the lot to be severed will be adequate for existing and proposed uses and will allow for the development of a use which is compatible with adjacent uses by providing for sufficient setbacks from neighbouring uses and, where required, the provision of appropriate buffering.

The proposed lot(s) will not restrict the development of other parcels of land, particularly the provision of access to allow the development of remnant parcels in the interior of a block of land.

The proposed development will be serviced in accordance with the policies of Section E.

Remarks to approval considerations.

This application does not constitute a need for a subdivision

The proposed lot creation will be for disposing on one piece

No Park land dedication will be required.

Suggested Conditions if Approved – to be filed within two years of the Notice Decision for certification

The newly created lot will be registered.

Registered covenant on title to ensure all future owner(s) of new lot can not hold the municipality or Rolstons Quarry liable for any operational issue with the Quarry

Transfer of landform prepared by a solicitor and a schedule to the transfer of landform on which is set out the entire legal description of the parcel,

The applicant must deposit a Reference Plan of Survey in the Land Registry Office clearly delineating the parcels of land approved by The Town of Northeastern Manitoulin and the Islands in this decision and provide the Town Office with a copy.

Prior to final approval by the Town of Northeastern Manitoulin and the Islands, the owner provides confirmation of payment of all outstanding taxes.

NEMI
NORTHEASTERN MANITOULIN & THE ISLANDS

Application for Consent

1. Applicant Information

Name of Owner: Albert P.S. Rolston, Stephen A. Rolston and Paul E. Rolston

Address: P.O. Box 520, 26 Meredith Street E., Little Current, Ont. P0P 1K0

Phone Number: 705 368 2381 Cell: 705 348 2381 Email: steve@rolstons.com

2. Name of Agent

Name of Agent: ____________________

Address: ____________________

Phone Number: __________ Cell: __________ Email: __________

3. Property Description

Geographic Township: Howland Township

Roll #: 5119 040 004 07800 0000

Concession: 12 Lot: 3

RP Plan: ______ Part: ______ Island: ______

Street Address: Not applicable

4. Are there any easements or restrictive covenant's affecting the subject land? ☒No ☐Yes

5. If Yes please describe the easement or covenant and its effect

6. Purpose of Application

Type and Purpose of the application

☒ Creation of a New Lot ☐ Addition to a lot ☐ Easement/ROW

☐ A charge ☐ A lease ☐ A correction of title

7. Other Information

Name of Persons to whom land will be transferred: Stephen A. Rolston

If lot addition what is the current land use: ____________________

8. Description of Subject land and Servicing Information

	Retained	Severance #1	Severance #2
Frontage	300 meters approx	387 meters	
Depth	550 meters	165 meters irreg.	
Area	26 Ha	1.6 Ha	
Use of Property - Existing	vacant bush lands	cottage location	
Proposed			
Buildings - Existing	none	cottage	
Proposed			
Access	☐Provincial Highway ☐Municipal Road Seasonal Road ☐Road Allowance ☐Municipal Road Year Road ☐Right of Way ☒Water Access	☐Provincial Highway ☐Municipal Road Seasonal Road ☐Road Allowance ☐Municipal Road Year Road ☐Right of Way ☒Water Access	☐Provincial Highway ☐Municipal Road Seasonal Road ☐Road Allowance ☐Municipal Road Year Road ☐Right of Way ☐Water Access
Water Supply	☐Publicly owned water system ☐Privately owned communal well ☐Privately owned individual well ☐Lake ☐Other	☐Publicly owned water system ☐Privately owned communal well ☐Privately owned individual well ☒Lake ☐Other	☐Publicly owned water system ☐Privately owned communal well ☐Privately owned individual well ☐Lake ☐Other
Sewage Disposal	☐Publicly owned Sanitary sewage system ☐Privately owned Septic tank ☐Privately owned communal septic system ☐Privy	☐Publicly owned Sanitary sewage system ☒Privately owned Septic tank ☐Privately owned communal septic system ☐Privy	☐Publicly owned Sanitary sewage system ☐Privately owned Septic tank ☐Privately owned communal septic system ☐Privy
Other Services	☐Electricity	☐Electricity	☐Electricity
	☐School Bussing	☐School Bussing	☐School Bussing
	☐Waste Collection	☐Waste Collection	☐Waste Collection

9. Land Use

What is the existing Official Plan designation Shoreline Area & Flood Hazards

What is the existing zoning Rural

10. Please check any of the following use or features on the subject land or within 500 meters of the subject land

Use or Feature	On the Subject Land	Within 500 Metres (Specify distance)
Agricultural operation, including livestock facility or stockyard	Agricultural Pasture lands	
Utility Corridor		
A landfill, active or closed		
A sewage treatment plant or lagoon		
Provincially significant wetland or Significant coastal wetland		
Significant wildlife habitat and/or habitat of endangered species and threatened species		
Fish Habitat		
Flood Plain	flood plain to west and north of severed site,	creak approx. 300 meters north
Mine site, active, rehabilitated or abandoned or hazard		
An active aggregate operation within 1km		Rolston Quarry Inc.(designated quarry area per site plan registered with MNR is over 0.9 km from severed site)
A contaminated site or a gas station or petroleum /fuel storage		
An industrial/commercial use (please specify)		
Known archaeological resources or areas of archaeological potential		

11. History of Subject Land

Has the subject land ever been the subject of any other planning applications? No

☐Official Plan Amendment ☐Zoning By-law amendment ☐Consent Application ☐Subdivision/Condominium Application

Provide details of application and decision: None

12. Former Uses of Subject land and Adjacent Land

Has there been industrial or commercial use on the subject or adjacent land? ☐Yes ☒No

Has the grading of the subject land been changed by adding earth or other material? ☐Yes ☒No

Has a gas station or the storage of petroleum been located on the subject land? ☐Yes ☒No

Is there reason to believe the subject /adjacent land may have been contaminated by a former use ☐Yes ☒No

Has an Environmental Site Assessment or Record of Site Condition been filed? ☐Yes ☒No

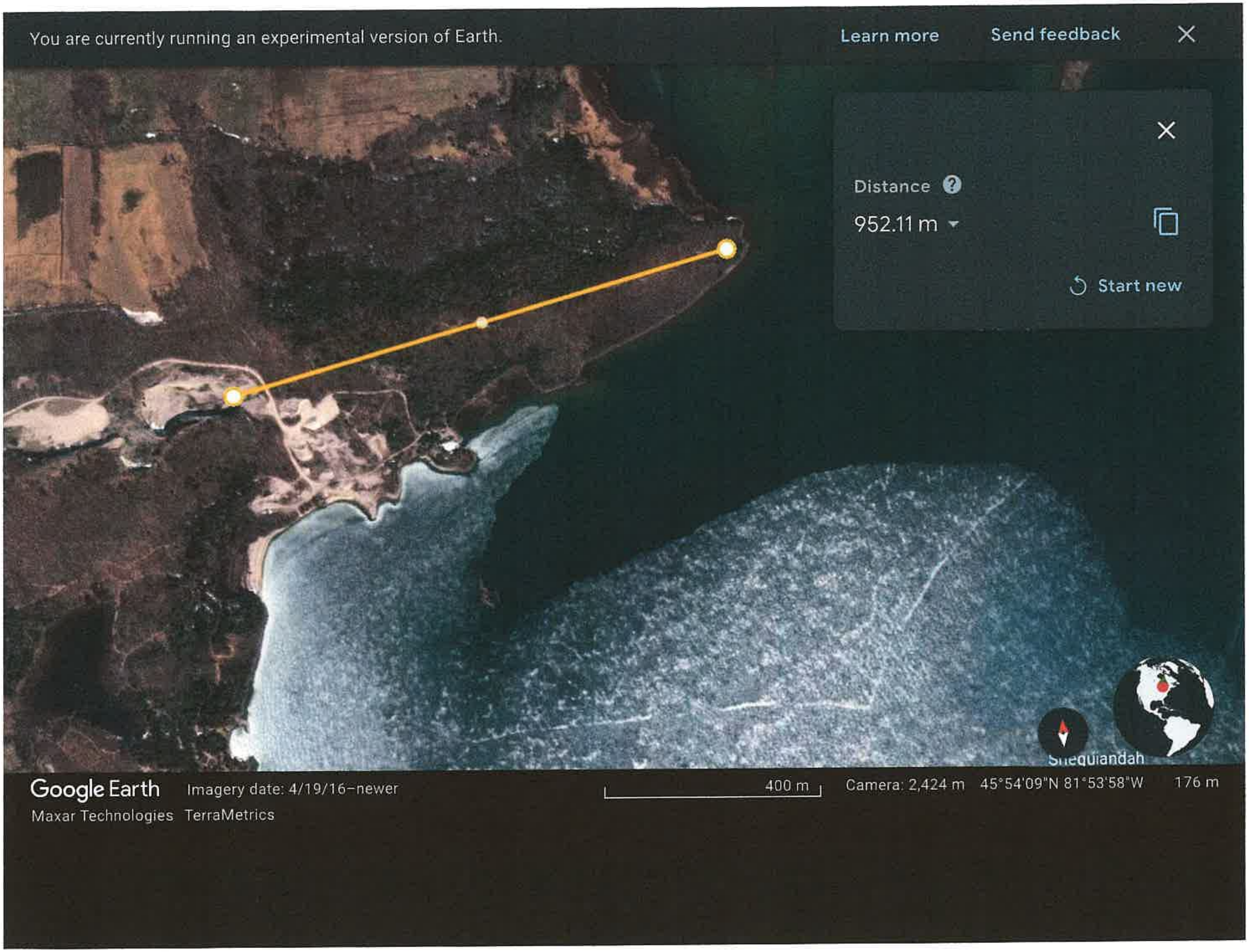
13. Are there currently any other applications on the subject property? ☐Yes ☒No
Please describe application and status.

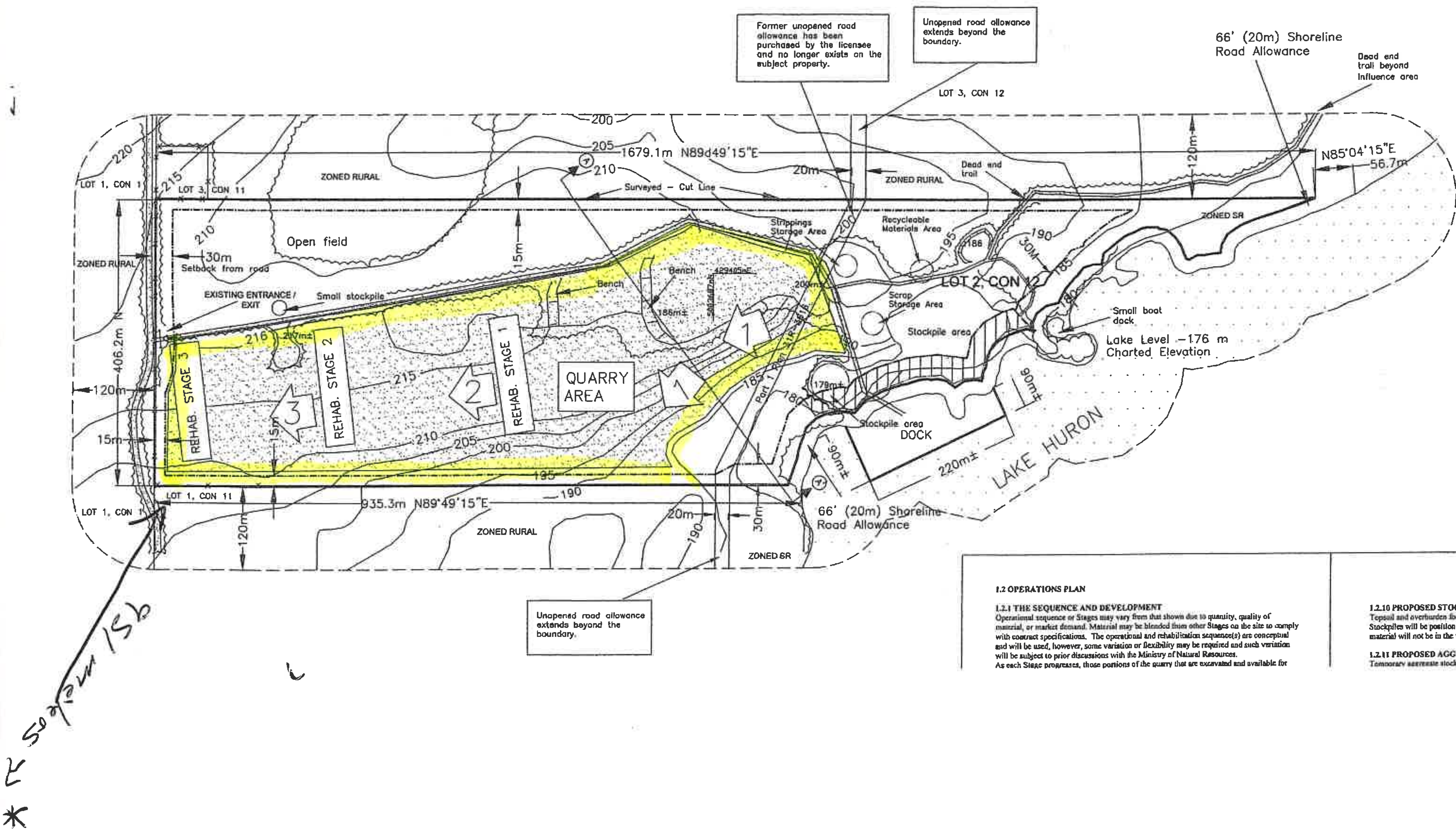
Other Information:

Please identify any and all information you think we will find useful in making a decision.

Prior to the new official plan, this area was designated Shoreline residential. There are low areas to the west and north but not on Frost Point itself. The area has had no flooding during the 128 years our family has owned this land. There is an access road that will accommodate a fire truck. The three stages of Rolston Quarry Inc. designated for extraction are all over 0.9 km from the severed site. Steve Rolston to add covenant to title that land owner cannot complain or sue Municipality or Rolston Quarry Inc. (or subsequent owners) for any issues whatsoever arising from the Quarry operation

165.30 ft
683.39 ft
Area: 3.96 ac
Perimeter: 1,954.69 ft
261.93 ft
261.20 ft
Total: 155.66 ft
155.66 ft


You are currently running an experimental version of Earth.
Learn more
Send feedback
Distance
952.11 m
Start new
Shequiandah
Google Earth
Imagery date: 4/19/16–newer
Maxar Technologies TerraMetrics
400 m
Camera: 2,424 m
45°54'09"N 81°53'58"W
176 m



1.2 OPERATIONS PLAN

1.2.1 THE SEQUENCE AND DEVELOPMENT
Operational sequence or Stages may vary from that shown due to quantity, quality of material, or market demand. Material may be blended from other Stages on the site to comply with contract specifications. The operational and rehabilitation sequence(s) are conceptual and will be used, however, some variation or flexibility may be required and such variation will be subject to prior discussions with the Ministry of Natural Resources.
As each Stage progresses, those portions of the quarry that are excavated and available for

1.2.10 PROPOSED STOCKPILES OF TOPS
Topsoil and overburden found on the site will be
Stockpiles will be positioned at various storage
material will not be in the way of site developme

1.2.11 PROPOSED AGGREGATE STOCKPI
Temporary aggregate stockpiles will be located

Application for CONSENT
Under Section 53 of the *Planning Act*
To be held on Tuesday, February 21st, 2023
at 7:00pm

File No. :	Con 2023-01
Applicant:	Albert, Stephen and Paul Rolston
Legal Description:	Howland, Concession 3, Lot 12
Official Plan:	Rural and Hazard
Zoning:	Rural and Shoreline Residential

PURPOSE OF THE APPLICATION
This is a request to sever a building lot for the purpose of building a cottage.

CONSENT IS REQUIRED FOR THE FOLLOWING:
The request is being made to transfer the severed portion one of the owners.

ANYONE INTERESTED IN THESE MATTERS MAY ATTEND the Town of Northeastern Manitoulin and the Islands public meeting concerning this application. If you have specific comments regarding this application, you may submit a letter to the Secretary-Treasurer of the planning authority prior to or at the meeting.

IF YOU DO NOT ATTEND this Hearing, it may proceed in your absence and, except as otherwise provided in the *Planning Act*, you will not be entitled to any further notice in the proceeding.

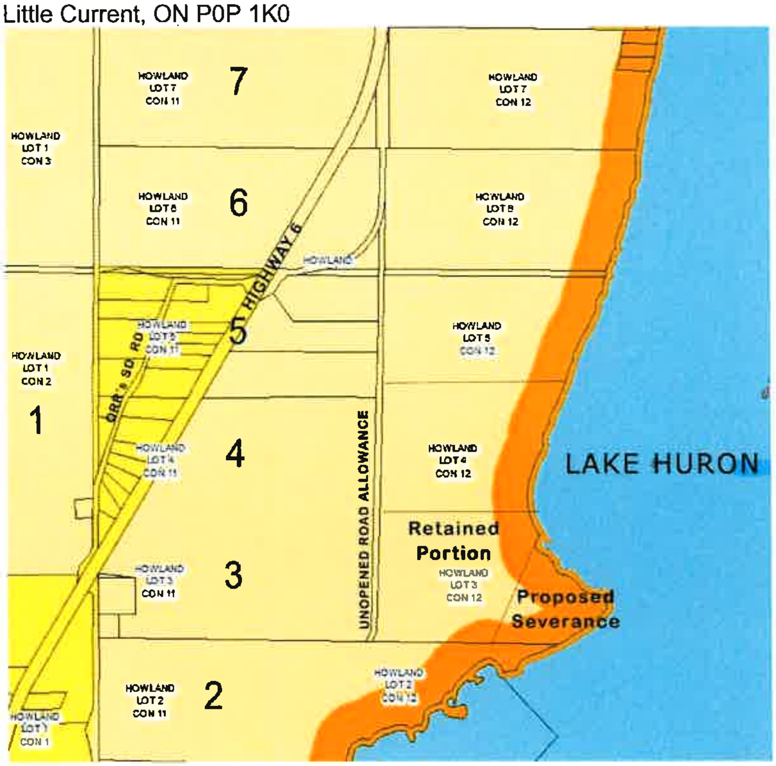
IF YOU WISH TO BE NOTIFIED of the Decision of the Planning Authority in respect of the proposed Consent, you must make a written request to the Secretary-Treasurer of the Planning Authority at the address shown below.

IF A PERSON OR PUBLIC BODY THAT FILES AN APPEAL against a decision of the Approval Authority in respect of the proposed consent has not made a written submission to the Approval Authority before it gives or refuses to give a provisional consent, the Ontario Land Tribunal may dismiss the appeal.

ADDITIONAL INFORMATION regarding this application is available to the public for viewing at the Municipal office between the hours of 8:30 a.m. and 4:30 p.m. Monday to Friday; or you may contact Ms. Pam Myers, Clerk and Secretary-Treasurer of the Planning Authority, at (705) 368-3500 ext. 228.

Dated: January 18, 2023

Town of Northeastern Manitoulin & the Islands
14 Water St. E.; P.O. Box 608
Little Current, ON P0P 1K0



NEMI
NORTHEASTERN MANITOULIN & THE ISLANDS

Box 608, Little Current, Ontario, P0P 1K0
705-368-3500

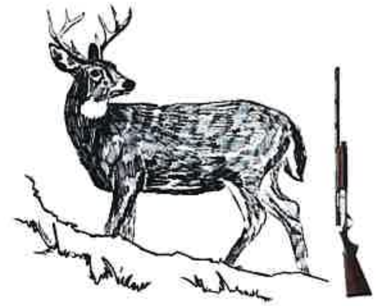
Tender Opening

Date of Opening Feb 6, 2023

Project Sand - Salt Shed

Present for Opening Wayne Williamson

Supplier	Price	HST	Total
Nixon	2 825 000.	325 000.	3 150 000.–
SCB	630 000.00 ~~650~~	81 900	711 900.–



Little Current & District Fish & Game Club

10659 Hwy 6

Sheguiandah, On

POP 1WO

January 28, 2023

Dear Supporter:

In 2022 we were very fortunate to once again host the grade 4 students from the area Public Schools. We hope this will happen again in 2023.

When the students visit us at the Walleye Hatchery in Sheguiandah, they will observe fish being removed from the trap net, bass nest building, aquatic life forms, fish and animal mounts, introduction to how the watershed works and Manitoulin fossils. There will also be a demonstration of Walleye egg extraction and fertilization if we are fortunate enough to have any Walleye spawners come into the creek. For the last few years there has been a serious decline in returning spawners.

There will be approximately 180 students this year and at the end of the field trip all students receive a rod and reel.

We also have the Walleye Hatchery and two raising ponds. We raise approximately 100,000 fingerlings each year and stock locally.

It would be appreciated if your organization or business could help financially support our programs.

Thanks you.

Sincerely

Lou Shortt, President

705-368-2446

Homelessness Resolution

A Call to the Provincial government to End Homelessness in Ontario

Please be advised that The Town of Northeastern Manitoulin and the Islands at its meeting held adopted the following:

WHEREAS the homeless crisis is taking a devastating toll on families and communities, undermining a healthy and prosperous Ontario;

WHEREAS the homelessness crisis is the result of the underinvestment and poor policy choices of successive provincial governments;

WHEREAS homelessness requires a range of housing, social service and health solutions from government;

WHEREAS homelessness is felt most at the level of local government and the residents that they serve;

WHEREAS municipalities and District Social Administration Boards are doing their part, but do not have the resources, capacity or tools to address this complex challenge; and,

WHEREAS leadership and urgent action is needed from the provincial government on an emergency basis to develop, resource, and implement a comprehensive plan to prevent, reduce and ultimately end homelessness in Ontario.

THEREFORE BE IT RESOLVED That The Town of Northeastern Manitoulin and the Islands calls on the Provincial Government to urgently:

a. Acknowledge that homelessness in Ontario is a social, economic, and health crisis;

b. Commit to ending homelessness in Ontario;

c. Work with AMO and a broad range of community, health, Indigenous and economic partners to develop, resource, and implement an action plan to achieve this goal.

AND FURTHER THAT a copy of this motion be sent to the Minister of Municipal Affairs and Housing; the Minister of Children, Community and Social Services; and the Minister of Health, the Association of Ontario (AMO) and the Federation of Northern Ontario Municipalities (FONOM).

Project Lifesaver
DONOR UPDATE

Manitoulin Northshore Victim Services and Manitoulin O.P.P. would like to thank you for your support of the Project Lifesaver initiative in the Manitoulin/Northshore area.

We are very excited to announce that Project Lifesaver is now in full swing in our region. In December, Manitoulin OPP officers as well as MNVS staff trained with Northshore Search & Rescue to learn how to utilize the devices and equipment to locate missing individuals.

We are pleased to say that there has been great interest in the project and the devices, and new clients are set to be provided with devices very soon. We continue to fundraise towards ongoing costs, including administrative and maintenance costs.

Over half of individuals living with cognitive conditions will wander at some point, and many will wander repeatedly. Thanks to your generosity, we will be able to assist these individuals and bring loved ones home in our community.

January 13th, 2023