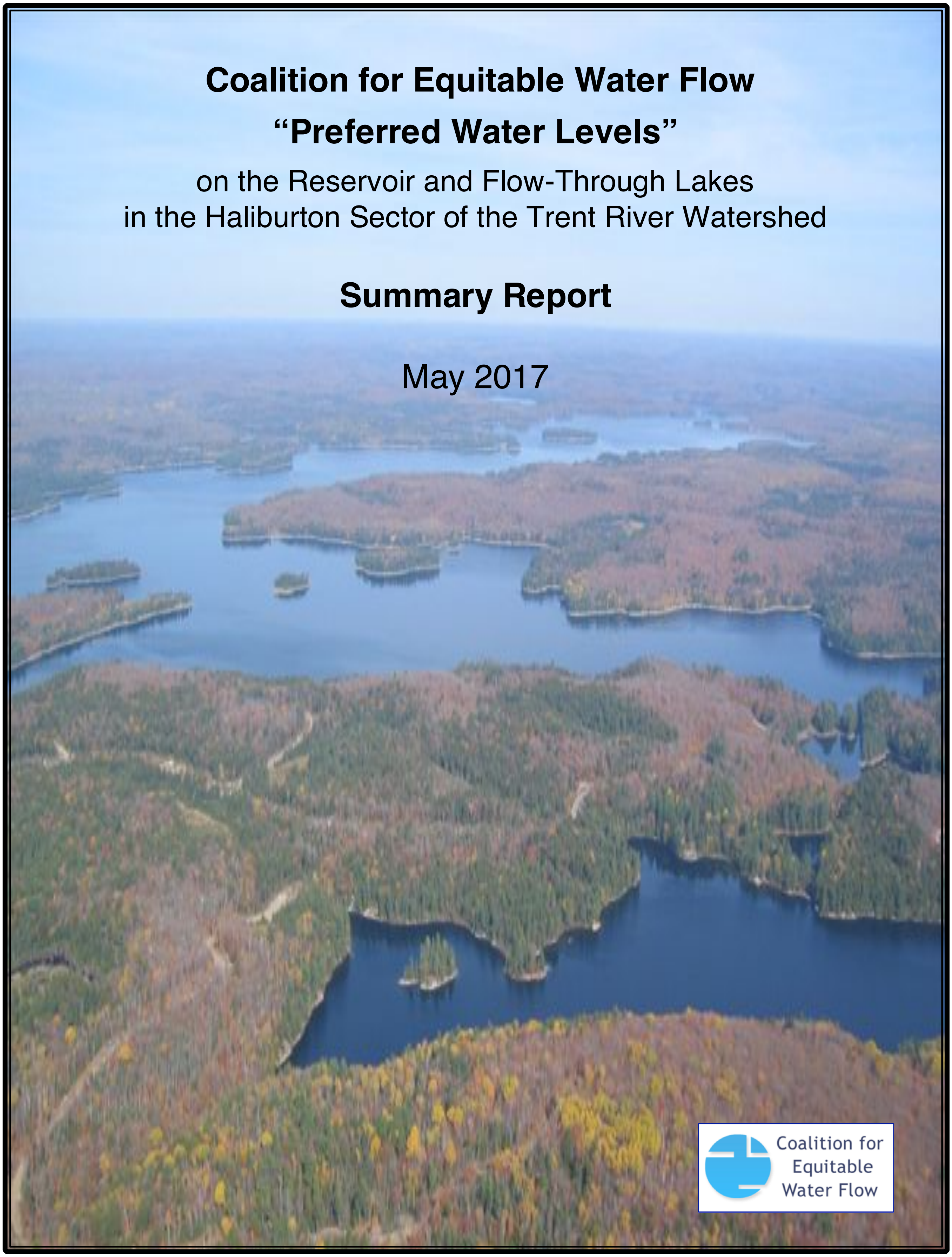

Coalition for Equitable Water Flow

"Preferred Water Levels"

on the Reservoir and Flow-Through Lakes in the Haliburton Sector of the Trent River Watershed

Summary Report

May 2017

Coalition for Equitable Water Flow

PREFACE

In 2011, the Coalition for Equitable Water Flow (CEWF or the Coalition) initiated a project to identify preferred water levels (PWLs) on the reservoir and flow-through (RaFT) lakes of the upper Trent River watershed during the navigation season with two main goals in mind:

- first, to engage member lake associations in an exercise to document local (lake-specific) water level issues using measurable criteria; and
- second, to compile this information for submission to the Trent Severn Waterway (TSW) as support for the inclusion of lake-specific constraints in a more sophisticated model for integrated water management at the watershed level.

The Coalition believes that the identification of preferred water level ranges based on lake-specific constraints will increase the TSW's understanding of the impact of their operations on waterfront property owners.

The inspiration for this initiative is to be found in a 1973 Acres International Ltd. report, which considered a number of drawdown policies for the reservoir lakes. One approach was termed 'equal percentage drawdown'; another was termed 'equal damage drawdown'. At the time, Acres concluded that while 'equal damage' was the most equitable approach, it would be better to adopt 'equal percentage drawdown' due to insufficient damage data. It was noted that *"eventually all the lakes may be able to be assessed individually for reaction to drawdown"* so that an 'equal damage' approach might become possible. The Coalition believes that, after 40 years, that time has come, and in fact is an inherent part of a 2011 AECOM Water Management Study for Parks Canada, which recommended a constraint-based water management model that includes lake-specific data.

ACKNOWLEDGEMENTS

This Summary Report would not have been possible without the active involvement of many people. The Executive Committee of the Coalition wishes to thank the volunteers in our member lake associations who took the time to document local constraints with quantitative data, design lake-specific surveys, and compile the results for inclusion in individual lake submissions.

Throughout the process the Coalition Executive has liaised with TSW management and with Parks Canada's Water Management Advisory Council (WMAC) to ensure that the water management concerns of the TSW could be taken into account. Particular thanks are due to Jewel Cunningham, Dawn Bronson, Colin Clarke and Dave Ness for their encouragement and insights during the course of this initiative.

CEWF EXECUTIVE COMMITTEE

Ted Spence, Chair	Catchacoma Lake
Bruce McClennan, Vice-Chair	Gull Lake
Roger Cunningham, Secretary-Treasurer	White Lake
Chris Riddle, Past-Co-Chair	Kennisis Lake
Martin Rist, Past Co-Chair	Drag Lake
Bill Cornfield	Horseshoe Lake
David Lean	Jack's Lake
Geoff Byford	Mountain Lake
Jim Wilson	Twelve Mile Lake

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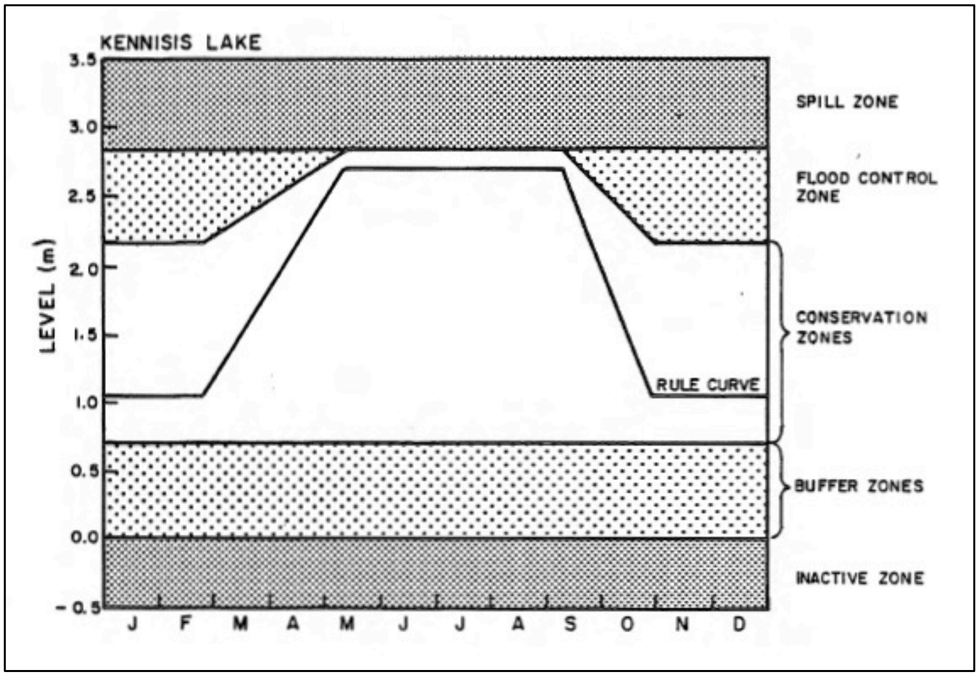
GUIDE TO ACRONYMS AND ABBREVIATIONS

CEWF	Coalition for Equitable Water Flow (aka 'the Coalition')
E%DD	Equal Percentage Drawdown
MNRF	(Ontario) Ministry of Natural Resources and Forestry
MSD	Maximum Storage Depth
PWL	Preferred Water Level
RaFT	Reservoir and Flow-Through (Lakes)
TSW	Trent Severn Waterway
WMAC	Water Management Advisory Council (of Parks Canada)



Of historic interest: A Rule Curve of 'desirable water levels' for Kennisis Lake from a 1988 Report for the TSW by Acres International Ltd. An early attempt to identify 'spill' and 'flood' zones as well as 'buffer' and 'inactive' zones on a typical reservoir lake.

EXECUTIVE SUMMARY

PURPOSE

In 2011 the Coalition for Equitable Water Flow initiated a project to identify preferred water levels on the reservoir and flow-through lakes of the upper Trent River watershed during the navigation season with two main goals in mind:

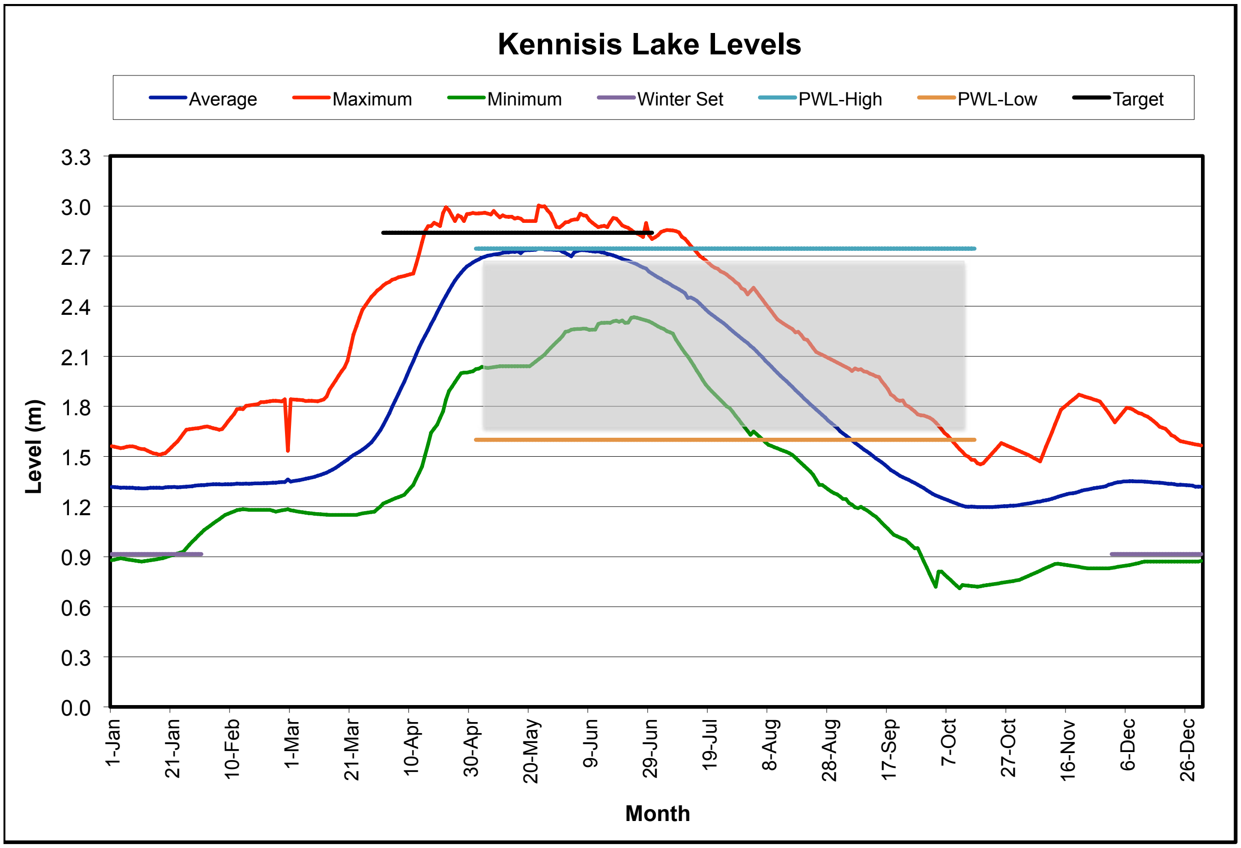
- first, to engage member lake associations in an exercise to document local (lake-specific) water level issues using measurable criteria; and
- second, to compile this information for submission to the Trent Severn Waterway (TSW) as support for the inclusion of lake-specific constraints in a more sophisticated model for integrated water management at the watershed level.

LEVEL OF PARTICIPATION

The participating lake associations represent approximately 81% of the TSW's reservoir storage capacity in the Haliburton Sector. Full representation is not possible as 11% of the storage capacity is from lakes without a cottage association, including some with no cottages.

TYPICAL LAKE ASSOCIATION INPUT

A summary chart for each participating lake association overlays the 'preferred water levels' during the navigation season on the TSW 30-year average and extreme levels data, along with the TSW's target full level and the winter log-set level, as per the example from Kennisis lake:



CEWF CONCLUSIONS

The Coalition's PWL initiative has proved a useful vehicle to engage Member lake associations both in terms of increasing their understanding of water management issues on their lake and for the watershed. The following general conclusions reflect the content of the individual lake association submissions. These are being submitted to the TSW for detailed discussion.

1. UPPER PREFERRED WATER LEVELS CORRESPOND TO THE AVERAGE HIGH WATER LEVELS

The upper preferred water level limits identified by participating associations generally correspond to the average high water levels attained by the current approach to water management. The variability (deviation from the average) of the annual high water is a concern and efforts to reduce this variation would benefit shoreline property owners by providing greater certainty regarding the risk of flooding and ice damage to shoreline infrastructure.

2. LOWER PREFERRED WATER LEVELS REQUIRE ATTENTION TO LAKE-SPECIFIC CONSTRAINTS.

The lower preferred water levels indicate that the ability to include lake-specific constraints in the water management model would result in a more equitable approach in terms of the hardship experienced by waterfront property owners. Again the variability (deviation from the average) of the annual low water level is a concern due to the resulting uncertainty regarding navigation, water-access and the usability of shoreline infrastructure (docks, water intakes etc.).

3. WATER CONSERVATION MEASURES ARE INCREASINGLY IMPORTANT DUE TO CLIMATE CHANGE

It is recognized that efforts to reduce the variability of water levels, while desirable, will meet with limited success given that the controls available to the TSW are not adequate to handle rapid changes in water levels and flows following extreme weather events. Nonetheless, the increasing frequency of extreme weather events, coupled with the projected long-term impact of climate change does suggest the need for an evolution of the current water management model, particularly in terms of water conservation during 'dry years'.

4. THE TSW NEEDS BETTER WATER MANAGEMENT MODELLING TOOLS

As the water management agency, the TSW needs a sophisticated, constraint-based water management modeling capability as recommended in the 2011 AECOM Water Management Study, one capable of considering lake-specific constraint data.

5. AN OPPORTUNITY EXISTS FOR IMMEDIATE INCREMENTAL WATER MANAGEMENT ENHANCEMENTS

Pending the acquisition of an enhanced water management modelling capability, and on an interim basis, the Coalition believes it would be appropriate for the TSW to:

i. review the 'extent' of the drawdown and the winter-set levels on each lake, given the projected reduction in the spring freshet based on climate change models;

ii. be prepared to make minor adjustments in an effort to mitigate lake-specific navigation and access issues based on the constraints identified by the participating lake communities;

iii. review the timing of the draw-down on a sub-watershed-basin basis, so that in wet years the drawdown could be designed to take only the water needed for the TSW to meet its mandate and to provide adequate flows through the flow-through lakes; whereas in dry years the drawdown could be designed to incorporate appropriate conservation measures throughout the system while maintaining adequate flows for the TSW to meet its mandate and to protect public health;

iv. consider their ability to protect smaller lakes from extreme draw-down when there is demonstrable hardship for residents and minimal benefit to the TSW; and

v. monitor reductions in leakage resulting from the replacement of dam #1 at Trenton and other TSW infrastructure upgrades that may allow for reduced flows throughout the system without compromising the various minimum flow constraints related to public health and safety.

6. THE TSW SHOULD CONSIDER MODIFYING THE CALCULATION OF EQUAL PERCENTAGE DRAWDOWN

While maintaining the underlying principle of equal percentage for the main period of the annual drawdown of the reservoir lakes (typically from June to early September), consideration should be given to the viability of the following phased approach using a more equitable calculation of ‘equal percentage’:

- initially drawdown all lakes with water levels above the TSW target full level in order to achieve the upper limit of the preferred range as evenly and as quickly as possible and to minimize local flooding and shoreline erosion;
- subsequently, rather than using the lower limit of the maximum storage depth in the denominator in the equal percentage drawdown calculation, instead use the lower limit of the PWL (or the mid-September average water level for those lakes who have not provided a PWL document) in the denominator to determine equal percentage for drawdown so that in a typical year all the reservoirs would reach the lower limit of their PWL at about the same time.

It is understood that some elements of such an approach might require modelling prior to implementation to avoid unintended negative consequences.

INTRODUCTION

There are 35 reservoir lakes with TSW-operated dams in the upper Trent watershed, an area referred to by the TSW as the Haliburton Sector. These dams control the water level of not only the lake in which they are located, but also the water levels of several adjacent lakes at essentially the same elevation. For water management purposes, the TSW typically considers these adjacent lakes as part of the total reservoir storage (e.g. Mountain linked to Horseshoe; Kashagawigamog to Canning; Boshkung to Twelve Mile). Twenty-eight of the lakes with dams have active lake associations and all but one are currently members of the Coalition. In addition, seven of the larger, adjacent or “flow through” lakes are also Coalition members.

In 2011 the Coalition launched an initiative whereby individual member lake associations were encouraged to document measurable constraints in an effort to define a **Preferred Water Level Range** during the normal navigation season. Typical constraints include limits to safe navigation or water access as well as environmental concerns relating to wetlands and wildlife habitat.

The Coalition believes that the TSW lacks sufficient lake-specific information on the impacts of high and low water levels during the navigation season for their water management plan to be able to reflect the unique characteristics of each of the reservoir and flow-through lakes.

The Coalition acknowledges that the TSW, as the overall water management agency for the entire Trent River watershed, has a challenging task that requires the consideration of multiple constraints across the watershed. Preferred water levels on the RaFT lakes may not be achievable if other constraints take precedence (e.g. flood control, maintaining minimum navigation levels on the canal, and meeting minimum flow requirements for public safety of drinking water and sewage treatment in municipalities downstream). However, the Coalition believes it is important that individual lake community parameters are documented so that they can be considered in a comprehensive water management model and accommodated when possible.

In particular, the Coalition recognizes that many reservoirs are lake trout lakes and that on many of these lakes the trout are shallow spawners. This requires that the water levels of these lakes need to be at their minimum, winter-set, level by mid-October, if not earlier, to protect the trout spawn. In order to achieve these levels in a timely manner, the TSW takes a ‘precautionary approach’ and draws down *all* the reservoir lakes in September, normally completing log operations by October 1st.

Initially, each participating member lake association was asked to provide a brief synopsis of their water level issues and to develop proposed ‘preferred water levels’ based on measurable criteria. The Coalition then compiled the results for transmission to the TSW and subsequent discussion once there was evidence of local community support from the relevant lake association. A list of common concerns regarding fluctuating water levels and flows (Appendix “A”) was provided to participants to stimulate discussion.

The Coalition emphasises that the PWL documents that form the foundation for the Summary Report are the result of community-based consultations and have been endorsed by the Boards, and generally the Members, of the individual lake associations as noted on the cover page of each of the attached PWL submissions (see Appendix “C”).

CONTEXT FOR RECOGNITION OF LAKE-SPECIFIC PREFERENCES

The Coalition PWL initiative benefitted from approaches to water management referenced in a number of studies, as well as information obtained in discussion with Parks Canada staff and members of Parks Canada's Water Management Advisory Council.

The 1973 Acres International Report

As noted in the Preface, the 1973 Acres International Report (Volume 2, page 21) considered a number of drawdown policies for the reservoir lakes and concluded that while **'equal damage'** was the most equitable approach it would be better to adopt **'equal percentage drawdown'**, at least until such time as it became possible to assess all the lakes individually for reaction to drawdown". The Coalition believes that after 40 years that time has come and that an 'equal damage' approach is implicit in the constraint-based water management model recommended in the 2011 AECOM Water Management Study.

The 2006 Muskoka River Water Management Plan

Local waterpower companies worked with the Ministry of Natural Resources to develop a water management plan for the Muskoka River watershed that takes an ecosystem-based approach by considering the interests and concerns of all water users within the watershed. Details can be found at: http://www.muskokawaterweb.ca/water-101/water-quantity/mrwmp

In Section 11 of the Muskoka River Plan a **'preferred strategy'** is outlined, based on an iterative process in which successive changes are made to the operating plan to address **identified concerns in each lake or river reach**. Rule curves were adjusted to address biological or social concerns documented for each. The magnitude of the resultant changes (in terms of seasonal lake levels and river flows) was then evaluated to determine the cumulative effect of the changes and the potential applicability of the overall strategy from a watershed scale perspective.

The 2011 AECOM Water Management Report

A **constraint-based approach** to water management is described in Section 7 of Part 4 of the AECOM Report *"Evaluation of the Current Approach to Water Management"* (starting on page 70). The Coalition believes that the "Preferred Water Level" constraints identified by individual lake associations could be integrated within such a model once adopted by the TSW. In the interim, it is believed that, once clearly identified, such constraint data could be taken into account informally under the current water management model.

The following select quotes from the extensive AECOM report are relevant to the PWL initiative:

> *The competition for the water of the Trent Severn Waterway has always been a condition of the system's operation. However, in recent decades, the stakeholders and variables at play as part of that competition have increased and subsequently so to have the demands and complexities of the operating environment. The following examples highlight some of the operational considerations within the Waterway:*
>
> - *The Haliburton Lakes have become one of the most significant cottage regions in the province; and more recently there has been a shift toward year round residency on these lakes;*
> - *Shoreline properties have increased in value, and with that the demands to maintain the levels of the reservoir lakes have increased;*

- *Cities and Towns have developed along the shorelines and have infrastructure demands to draw water from the system;*
- *The shores are home to thousands of businesses that rely on those that live in and visit the area;*
- *The societal awareness of and desire to protect the natural environment is increasing; and*
- *There are legitimate concerns about global warming and the potential impacts of climate change.*

The (TSW's) goal to optimize enjoyment of the water … (requires) … an understanding of each lake's needs and is anticipated to include the following considerations:

- *Locations and characteristics of properties that rely on water-based access (i.e., minimum water level required for access);*
- *Characteristics of lake-based recreation (i.e. seasonal timing, nature of activities, water requirements);*
- *Incremental impact to goal satisfaction from changes in water level (e.g. certain lakes may be affected by small changes in water level more than others, particularly those with a wide, shallow shoreline that can be easily exposed by low water levels); and*
- *Presence of significant cultural and tourism resources.*

The resultant Management Range is expected to reflect the optimal water requirements … for recreational, cultural and access purposes. Stakeholder surveys could potentially be used to determine the level of utility that users receive for certain water levels or flows, the results of which can be translated into a Management Range based on user satisfaction.

Lake-specific Constraints included in Current TSW Water Management Approach

In addition to the navigation ranges maintained for the lakes that form the Waterway itself, the current TSW water management plan does recognize a number of lake-specific constraints. For example, the minimum flow rate in Norland is designed to ensure a navigable water level on Shadow and Silver lakes even if the water is not required for canal operations. Similarly, a minimum flow is maintained from Drag Lake in the spring to support Walleye spawning.

INTERACTION BETWEEN CEWF AND PARKS CANADA (TSW AND WMAC)

Throughout the PWL process, the Coalition provided TSW management and the WMAC with regular updates and has appreciated the subsequent feedback.

A January 13, 2012 letter from Parks Canada's Superintendent responsible for the TSW, Dawn Bronson, recognized the Coalition's role as coordinator of the PWL project and requested that the Coalition include certain TSW priorities in the principles guiding the initiative (see below).

In an October 2013 presentation to the WMAC, the Coalition stressed that no reduction in the storage volume available to the TSW is being proposed, instead the Coalition is proposing that a more sophisticated water management model be developed that can be responsive to lake-specific constraints. (See AECOM Volume 4, section 7.5, page 85 re Integrated Management Ranges for Individual Representative Lakes).

UNDERLYING PRINCIPLES

Based on the approach taken in other studies and recognising the TSW's priorities, the Coalition adopted the following principles as part of the PWL initiative:

- acceptance of the need for integrated water management at the watershed level;
- recognition of the need to reduce threats to public safety and damage to public and private infrastructure;
- a focus on water conservation and the conservation of fish and wildlife habitat;
- recognition of the priority needed to be given to flood control, including protection of shorelines from erosion and lakes from silting;
- the maintenance of adequate water flows to sustain water quality and fish habitat;
- the importance of safe navigation and access to waterfront property on all navigable watercourses including the reservoir, flow-through and canal lakes;
- the need for an equitable approach whereby all stakeholders are required to share the burden of constraints on the system; and
- respect for the legislated mandate of the TSW.

THE PROCESS

As noted, the Coalition has provided support to individual lake associations so that they were able to engage their Boards and members in an exercise to identify lake-specific water level issues and preferred water level ranges based on measurable criteria.

The Coalition has coordinated this process, reviewed the results for consistency, and forwarded completed documents to the TSW once there was evidence of community support.

Summaries of the completed PWL documents have been an ongoing feature of the annual Coalition Member Communications meetings held each September and at the regular CEWF-TSW liaison meetings.

This Report is a comprehensive summary of the initiative as of Spring 2017, and includes the Coalition's overall analysis and conclusions to date.

THE RESULTS

LEVEL OF PARTICIPATION

Table 1 provides a summary of the degree of participation in the PWL initiative by Coalition Member RaFT lake associations. It lists all 35 reservoir lakes with TSW dams in the Haliburton Sector. The lake associations representing 25 of these lakes participated to varying degrees. In addition a number of flow-through lakes participated, typically in conjunction with a neighbouring reservoir lake (e.g. Mountain with Horseshoe; Soyers and Kashagawigamog with Canning).

Of the reservoir lakes that are not represented in the Coalition's PWL initiative:

- nine did not have an active association to engage (Nunikani, Sherborne/Trout, Red Pine, Little Bob, Eagle/Moose, Grace/Pusey, Farquhar, Gooderham, and Contau (although associations for Grace and Eagle/Moose are now active and may participate in the future));
- five chose not to participate, or had failed to complete their documentation as of May 2017 (Big Bob, Moore, Glamor, Koshlong, Twelve Mile/Little Boshkung);
- one is not a Coalition member (Boshkung Lake) and did not participate;

As noted in Table 1, the Sherborne Lake dam is not actively managed to the same extent as the other reservoir dams, and water levels on Sherborne Lake are not controlled according to equal percentage drawdown. It is understood that water typically flows from Sherborne Lake to Kushog Lake, but at high levels a channel to Big Hawk Lake is also active. Accordingly Sherborne Lake statistics are not included in the calculations presented in this Report.

The participating lake associations represent approximately 81% of the TSW's reservoir storage capacity in the Haliburton Sector. Full representation is not possible as 11% of the storage capacity is from lakes that had no cottage owners association when the PWL initiative was launched, including some with no cottages.

Further to Table 1, a more comprehensive list of lakes, alternate names, and inter-linked lakes is provided in Appendix "B".

Lakes and Dams Excluded from Consideration

There are several dams in the Haliburton Sector that are not owned and operated by the TSW. Some are privately owned, such as the dam on Minden Lake owned and operated by the Orillia Power Generation Corporation. Others are owned by the Ontario Ministry of Natural Resources and Forestry (MNRF). It is understood that the operation of the MNRF dam at Kinmount only has a minimum impact on downstream flows in the Burnt River, as there is very little storage of water immediately above the dam. Similarly the MNRF dam on Salerno Lake, which controls flow into the Irondale River, which in turn flows into the Burnt River upstream of Kinmount, has minimal impact due to the limited storage capacity of Salerno Lake.

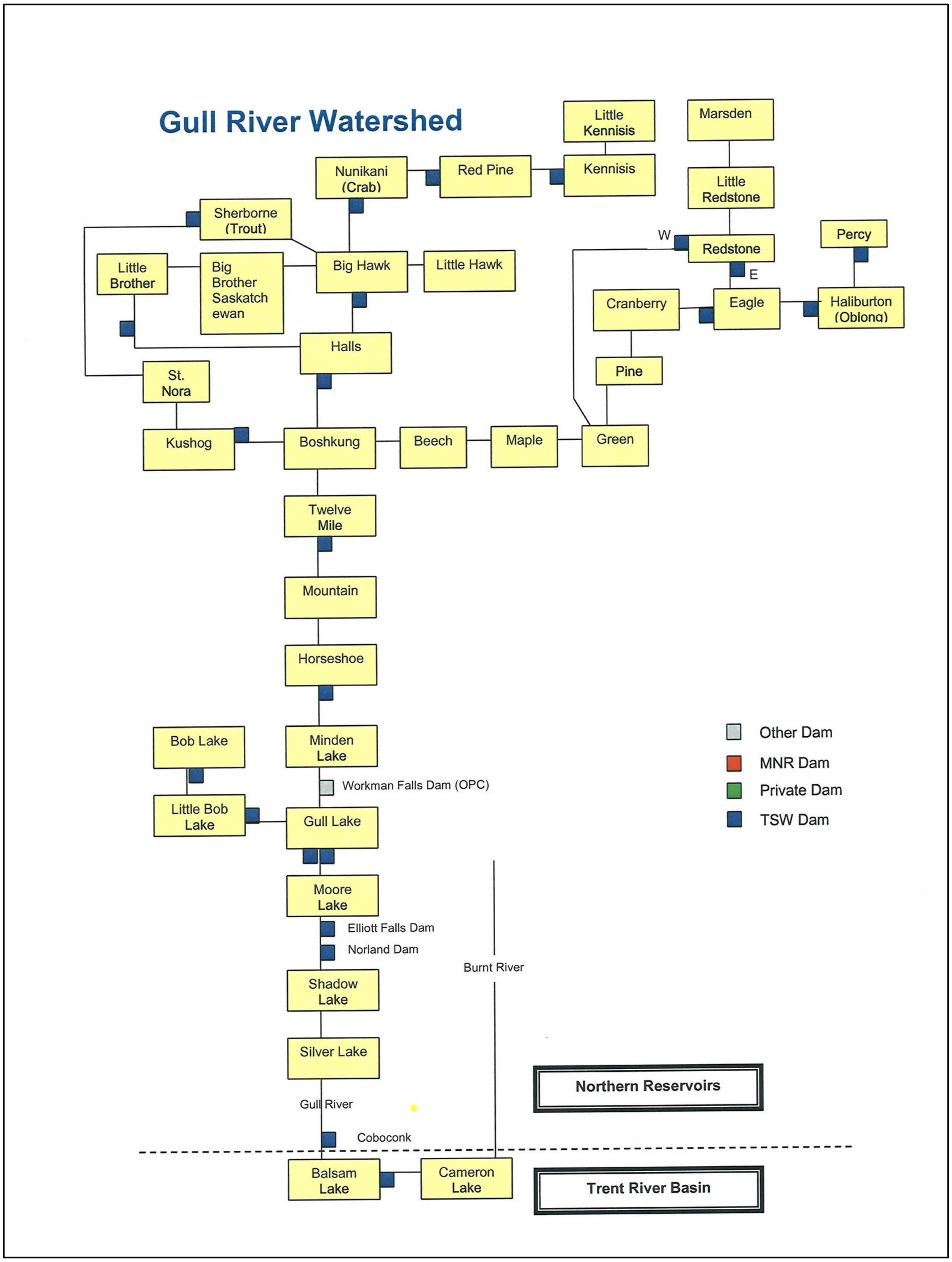
Agreements between the TSW and the owners of these other dams, and close cooperation on operational matters, ensures that the TSW retains overall water management control of the watershed, and the operation of these dams does not affect the TSW's water management operations with regard to long-term storage and flows. Thus, the operation of these non-TSW dams is not relevant to the analysis and conclusions developed in this Report.

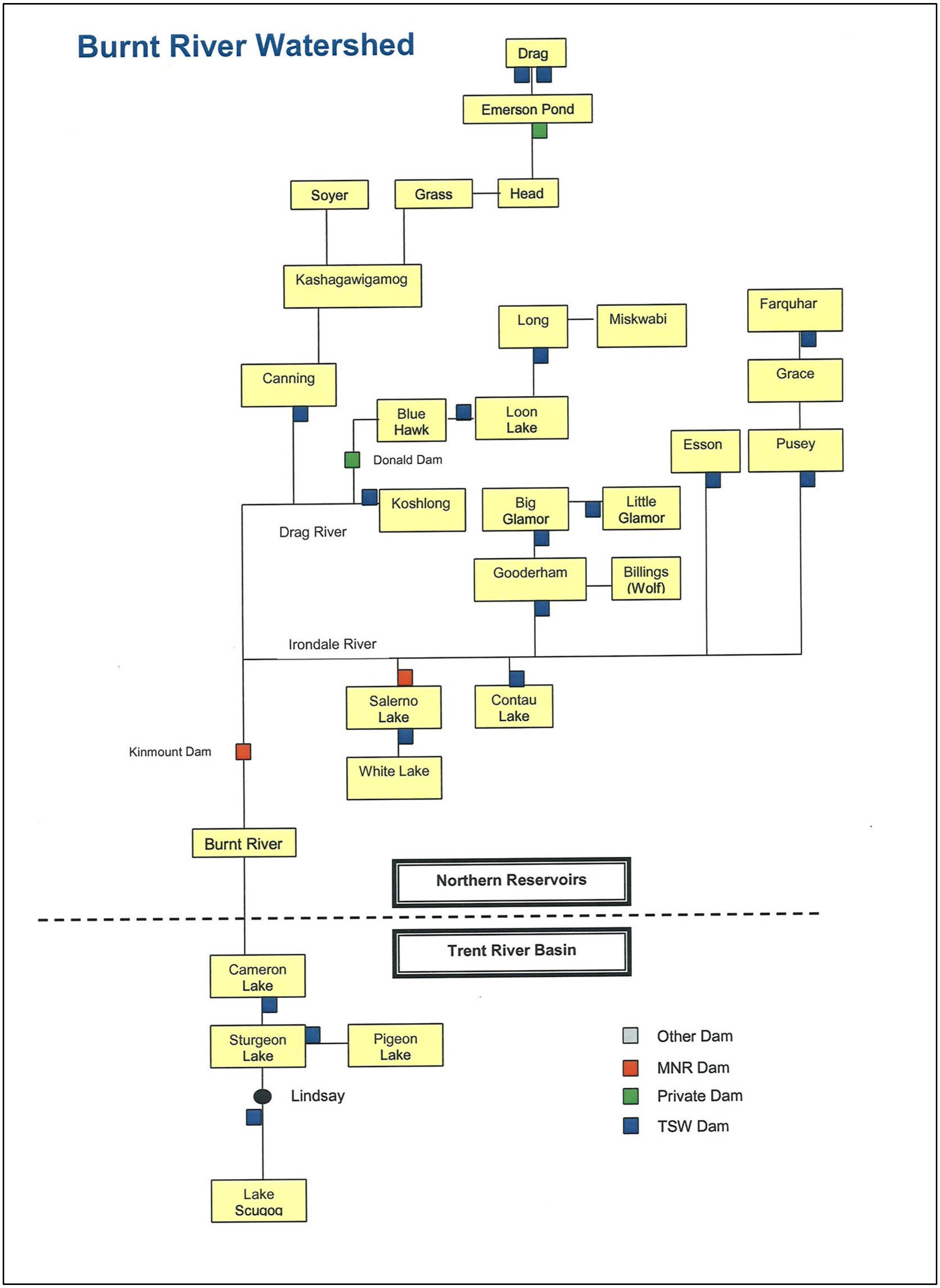
Table 1. Participation in the CEWF PWL Initiative by Lake Associations

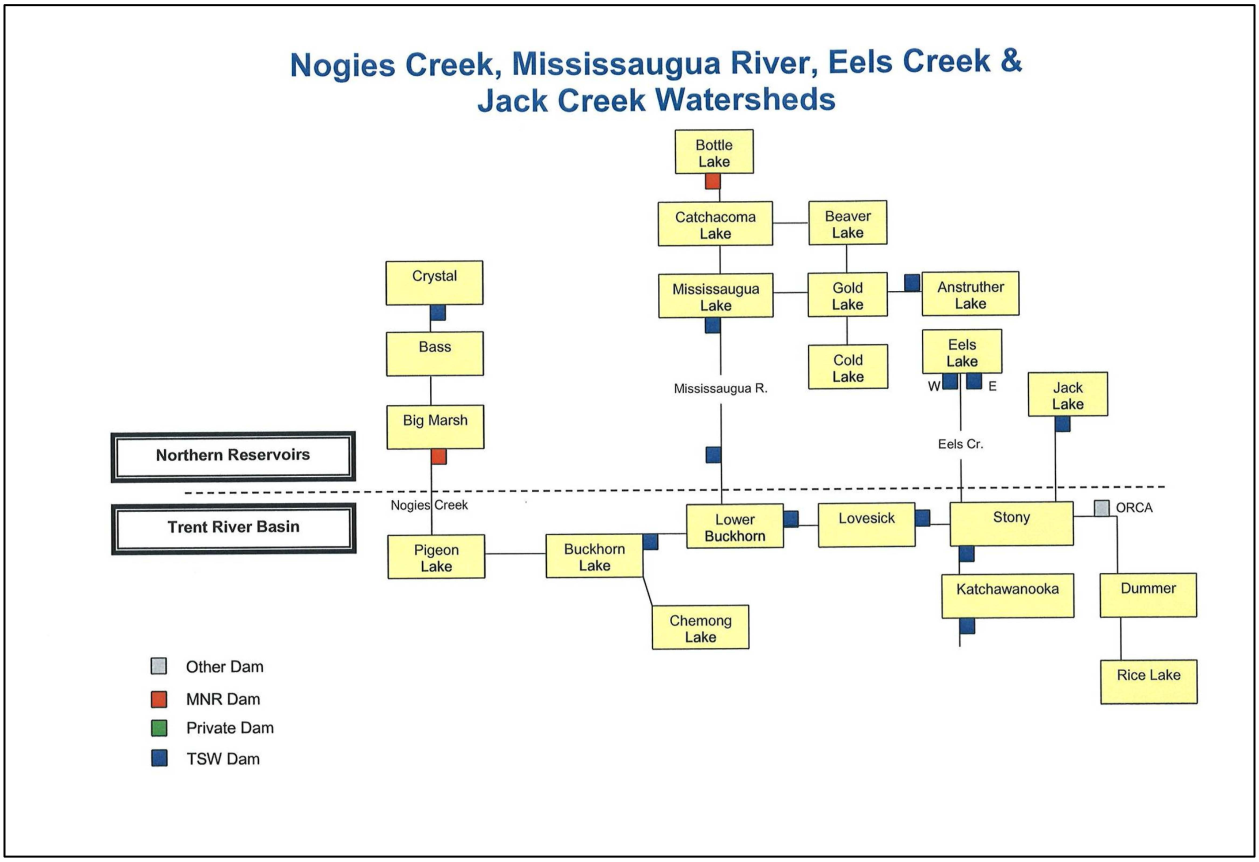
Gull Watershed Lake	**Storage (ha-m)**	**PWL Document**	**Notes**
Kennisis	4752	Yes	
Red Pine	469	No	No Association
Nunikani	299	No	No Association – No Cottages
Sherborne (Trout)	373	No	Not active part of system
Big /Little Hawk	2748	Yes	
Halls	819	Yes	
Kushog	1667	Yes	
Redstone	4118	Yes	
Percy	1115	Yes	
Haliburton/Oblong	2167	Yes	
Eagle/Moose	942	No	New Association (as of 2016) - not yet a CEWF Member
Boshkung	1666	No	Not a CEWF Member
Twelve Mile/Little Boshkung			Response not received as of deadline
Maple/Beech/Cameron	Flow thru	No	Not a Reservoir – but flow/level data exist at TSW
Mountain	833	Yes	Joint PWL Document
Horseshoe			
Big Bob	654	No	Multiple associations
Little Bob	111	No	No Association
Gull	913	Yes	
Moore	118	No	Response not received as of deadline
Burnt Watershed Lake			
Drag / Spruce	1890	Yes	
Soyers	262	Yes	Joint PWL Document
Kashagawigamog			
Canning			
Miskwabi (Long)	664	Yes	
Loon	338	Nominal	Accepted by LLA
Koshlong	679	No	Response not received as of deadline
Farquhar	810	No	No Association
Grace	482	No	New Association - only Joined CEWF in 2016
Pusey (aka Dark)		No	No Association
Esson	504	Nominal	Accepted by CEWF member road association executive
Little Glamor	115	Nominal	Accepted by Lake Association contact
Glamor	325	No	Response not received as of deadline
Gooderham	1041	No	No Association
Contau	145	No	No Association
Fortescue	293	Yes	Joint PWL Document with White
White			
Southern Reservoir Lake			
Crystal	958	Yes	
Mississagua/Catchacoma	5021	Yes	
Anstruther	1420	Yes	
Eel's	2981	Yes	
Jack's	2074	Yes	
Total Storage	**43,766.00**	**100%**	
Storage - PWL Lakes	**35,652.00**	**81%**	
Storage - No Association	**4,672.00**	**11%**	
Storage - Other Lakes	**3,442.00**	**8%**	

THE RESERVOIR LAKES OF THE UPPER TRENT SUB-WATERSHEDS

The following four figures provide insight into the complexity of the water management challenge facing the TSW and some of the differences between the various sub-watersheds. The map of the Haliburton Reservoir Lakes is from the 2011 AECOM Report prepared for Parks Canada. The sub-watershed schematics were produced by EcoPlans for the 2008 Panel on the future of the TSW.


Gull River Watershed
Little Kennisis
Marsden
Nunikani (Crab)
Red Pine
Kennisis
Little Redstone
Sherborne (Trout)
W
Redstone
Percy
E
Little Brother
Big Brother Saskatchewan
Big Hawk
Little Hawk
Cranberry
Eagle
Haliburton (Oblong)
Halls
Pine
St. Nora
Kushog
Boshkung
Beech
Maple
Green
Twelve Mile
Mountain
Horseshoe
Other Dam
MNR Dam
Private Dam
TSW Dam
Bob Lake
Minden Lake
Workman Falls Dam (OPC)
Little Bob Lake
Gull Lake
Moore Lake
Elliott Falls Dam
Norland Dam
Burnt River
Shadow Lake
Silver Lake
Northern Reservoirs
Gull River
Coboconk
Balsam Lake
Cameron Lake
Trent River Basin


Burnt River Watershed
Drag
Emerson Pond
Soyer
Grass
Head
Kashagawigamog
Long
Miskwabi
Farquhar
Canning
Grace
Blue Hawk
Loon Lake
Esson
Pusey
Donald Dam
Koshlong
Big Glamor
Little Glamor
Drag River
Gooderham
Billings (Wolf)
Irondale River
Salerno Lake
Contau Lake
Kinmount Dam
White Lake
Burnt River
Northern Reservoirs
Trent River Basin
Cameron Lake
Sturgeon Lake
Pigeon Lake
Lindsay
Lake Scugog
Other Dam
MNR Dam
Private Dam
TSW Dam



DOCUMENTATION & SUMMARY CHARTS

The individual PWL documents for each participating lake association are provided in Appendix “C”.

Table 2a provides an overview of the **storage available** on each reservoir along with the annual average and the 25-year extreme **fluctuation ranges** – all based on data available from the TSW.

Table 2b provides a summary of the **PWL ranges** and compares the (spring) High and (October 1st) Low PWLs with the historic average high and low water levels.

Table 2c focuses on **drawdown ranges as of October 1st** and compares the average with preferred drawdown ranges as a percentage of the maximum storage depths.

Brief interpretive notes are provided below each Table.

Caution: While it is convenient to use the ***25-year average*** *in discussing water levels, there is considerable variance from the average in terms of actual annual water levels and fluctuation ranges. This variance, typically reflecting ‘wet’ vs. ‘dry’ years, is an important consideration and presents a significant challenge for water management operations.*

Table 2a. Reservoir Lake Storage Volume & Annual Fluctuation Ranges

Lakes by Sub-watershed	TSW Data						Historic Ranges	
Parameter	Full Control Level	TSW Target Full Level	Sill or Deduction	Max. Storage Depth	Max. Storage Volume		Average Historic Range	Extreme Historic Range
Units	(m)	%	(m)	(m)	(ha-m)		(m)	(m)
Gull River Watershed								
Kennisis Lake	2.90	98	0.00	2.84	4,657		1.5	2.3
Red Pine	1.22	100	0.00	1.22	469		0.5	1.8
Nunikani Lake	3.05	100	0.31	2.74	299		1.8	2.8
Hawk Lake	4.42	100	0.38	4.04	2,748		2.2	3.3
Halls Lake	2.59	95	0.91	1.55	819		0.9	1.6
Trout Lake	1.52	100	0.00	1.52	373		1.2	1.8
Kushog Lake	3.20	95	1.22	1.82	1,667		1.6	2.3
Percy Lake	1.98	100	0.00	1.98	1,115		1.7	2.2
Oblong Lake	3.05	100	1.07	1.98	2,167		1.3	2.0
Redstone Lake (West)	3.66	100	0.76	2.90	4,118		1.9	2.7
Eagle Lake	2.29	100	0.46	1.83	942		1.1	1.7
Twelve Mile	1.98	100	0.46	1.52	1,666		0.8	2.0
Horseshoe Lake	2.44	100	0.46	1.98	833		0.8	2.1
Big Bob	2.90	100	0.00	2.90	654		2.1	2.5
Little Bob	1.52	100	0.00	1.52	111		1.3	1.7
Gull Lake	2.13	100	1.22	0.91	913		0.5	1.6
Moore Lake	1.52	100	0.91	0.61	118		0.4	1.6
Gull Watershed Total Storage Volume					23,669			
Burnt River Watershed								
Drag Lake	2.29	95	0.46	1.71	1,890		1.1	1.9
Canning Lake	1.52	95	0.46	0.99	1,262		0.6	1.0
Miskwabi (Long) Lake	2.29	100	0.31	1.98	664		1.1	1.6
Loon Lake	1.98	98	0.61	1.33	338		0.9	1.6
Koshlong Lake	2.29	100	0.61	1.68	679		1.1	1.6
Farquhar Lake	3.05	97	0.61	2.35	810		1.3	2.3
Pusey (Grace) Lake	2.13	98	0.46	1.63	482		1.2	2.3
Esson Lake	3.05	100	0.91	2.13	504		1.7	1.9
Little Glamor Lake	1.83	100	0.00	1.83	115		1.7	1.9
Big Glamor Lake	2.44	100	0.70	1.74	325		1.5	2.0
Gooderham Lake	1.83	100	0.61	1.22	104		0.7	1.3
Contau Lake	1.68	100	0.46	1.22	145		0.9	1.2
White Lake	1.83	100	0.00	1.83	293		1.4	1.9
Burnt Watershed Total Storage Volume					7,609			
Southern Reservoirs								
Crystal Lake	2.74	100	0.61	2.13	958		1.5	1.9
Anstruther Lake	2.29	100	0.00	2.29	1,420		1.2	2.2
Mississagua Lake	2.44	100	0.00	2.44	5,021		1.4	2.0
Eels Lake	3.66	100	0.00	3.66	2,981		1.9	2.7
Jack's Lake	1.93	100	0.38	1.55	2,008		0.8	1.3
Southern Reservoirs Total Storage Volume					12,387			
Reservoir Total Storage Volume					43,665			

Table 2a serves as a reference to the basic control parameters for the reservoir lakes of the Haliburton Sector. The Gull River watershed accounts for 54% of the total storage capacity available to the TSW. The Burnt River watershed accounts for 17%, and the Central or Southern reservoirs account for 28%.

Table 2b. Reservoir Lake Preferred Water Levels & Ranges plus Difference from Average High & Low Levels

Lakes by Sub-watershed	PWL Data							PWL vs. Average Spring High & Oct. 1st Low			
Parameter	PWL- High		PWL - Low		PWL Range			Average Max.	PWL(Hi) Difference from Ave.	Average Low	PWL(Low) Difference from Ave.
Date/Period	Spring		End of Season		Navigation Season			Spring	Spring	on Oct. 1	on Oct. 1
Units	(m)	as % Draw down	(m)	as % Draw down	(m)	as % MSD*		(m)	(m)	(m)	(m)
Gull River Watershed											
Kennisis Lake	2.75	5%	1.60	46%	1.15	41%		2.7	0.0	1.3	0.3
Red Pine								1.2		0.8	
Nunikani Lake								2.8		1.2	
Hawk Lake	4.25	4%	2.50	48%	1.75	43%		4.3	0.0	2.2	0.3
Halls Lake	2.35	16%	1.60	64%	0.75	48%		2.5	-0.2	1.7	-0.1
Trout Lake								1.4		0.3	
Kushog Lake	3.10	6%	1.35	102%	1.75	96%		3.1	0.0	1.5	-0.2
Percy Lake	1.92	3%	0.96	52%	0.96	48%		2.0	0.0	0.8	0.2
Oblong Lake	2.98	3%	2.14	46%	0.84	42%		3.0	0.0	1.9	0.2
Redstone Lake (West)	3.55	4%	1.87	62%	1.68	58%		3.6	0.0	2.0	-0.1
Eagle Lake								2.2		1.3	
Twelve Mile								2.0		1.3	
Horseshoe Lake	2.40	2%	1.50	47%	0.90	45%		2.4	0.0	1.6	-0.1
Big Bob								2.9		0.9	
Little Bob								1.5		0.5	
Gull Lake	2.13	0%	1.75	42%	0.38	42%		2.2	0.0	1.8	0.0
Moore Lake								1.5		1.3	
Burnt River Watershed											
Drag Lake	2.20	5%	1.40	52%	0.80	47%		2.2	0.0	1.2	0.2
Canning Lake	1.55	-3%	1.30	23%	0.25	25%		1.5	0.1	0.9	0.4
Miskwabi (Long) Lake	2.29	0%	1.53	38%	0.76	38%		2.3	0.0	1.2	0.4
Loon Lake	1.9	6%	1.00	74%	0.90	68%		1.9	0.0	1.2	-0.2
Koshlong Lake								2.2		1.3	
Farquhar Lake								2.9		1.7	
Pusey (Grace) Lake								2.0		1.0	
Esson Lake	3	2%	1.40	77%	1.60	75%		3.0	0.0	1.8	-0.4
Little Glamor Lake	1.8	2%	0.30	84%	1.50	82%		1.8	0.0	0.7	-0.4
Big Glamor Lake								2.4		1.3	
Gooderham Lake								1.8		1.2	
Contau Lake								1.6		0.9	
White Lake	1.83	0%	0.61	67%	1.22	67%		1.8	0.0	0.8	-0.1
Southern Reservoirs											
Crystal Lake	2.74	0%	1.20	72%	1.54	72%		2.7	0.1	1.5	-0.3
Anstruther Lake	2.29	0%	1.00	56%	1.29	56%		2.3	0.0	1.2	-0.2
Mississagua Lake	2.44	0%	1.62	34%	0.82	34%		2.5	0.0	1.3	0.3
Eels Lake	3.50	4%	2.10	43%	1.40	38%		3.5	0.0	1.9	0.2
Jack's Lake	1.90	2%	1.17	49%	0.73	47%		1.9	0.0	1.2	0.0

No PWL Document

* Maximum Storage Depth

Table 2b lists the preferred water levels provided to the Coalition by each of the participating lake associations.

The data columns in Table 2b, from left to right, contain:

- the Preferred Spring High Water Level in metres above the sill plate of the dam and as a percentage of the drawdown from full;
- the Preferred Low Water Level (at the end of the navigation season),in metres above the sill plate of the dam and as a percentage of the drawdown from full;
- the Preferred Water Level Range (high minus low) in metres and as a percentage of the maximum storage depth available to the TSW;
- the historic average spring high water level and the difference between the Preferred Spring High Water Level and the historic average spring high; and
- the historic average low water level at the end of the navigation season (chosen as October 1st for consistency) and the difference between the Preferred Low Water Level and the historic average on October 1st.

The Preferred Spring High Water Levels are typically the same as the multi-year spring average high. The Preferred Low Water Levels at the end of the navigation season are more variable but typically fall between zero and 0.4 metres above the multi-year average for October 1st.

This is reflected in the summary charts included with each of the PWL documents in Appendix “C” as exemplified by the chart for Kennisis Lake below.

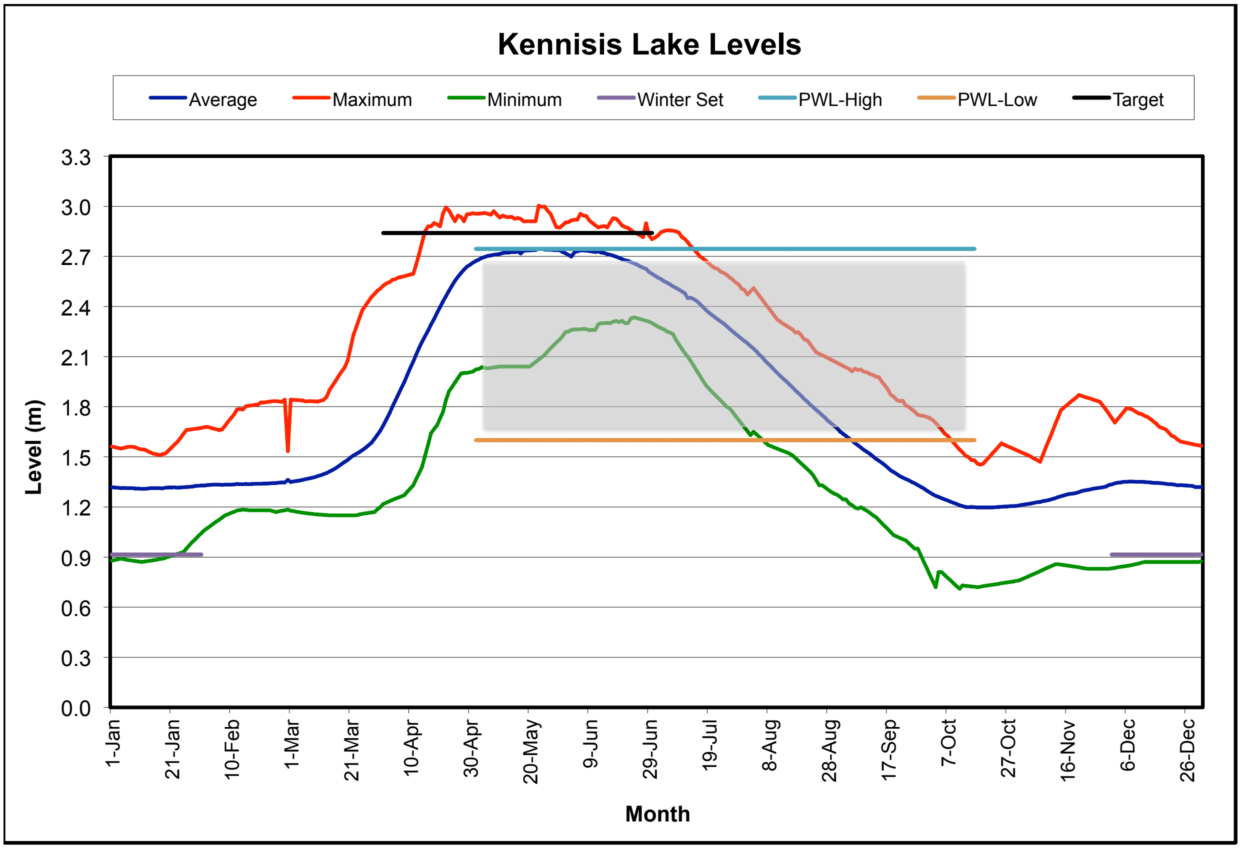


Table 2c. Average vs. Preferred Drawdown Range as of October 1st

Lakes by Sub-watershed	as of October 1st			
Parameter	Ave DD	Ave DD	Pref - Ave	Pref - Ave
Units	(m)	as % MSD	(m)	as % MSD
Gull River Watershed				
Kennisis Lake	1.61	57%	-0.46	-16%
Red Pine	0.42	34%		
Nunikani Lake	1.85	67%		
Hawk Lake	2.22	55%	-0.47	-12%
Halls Lake	0.91	59%	-0.16	-10%
Trout Lake	1.22	80%		
Kushog Lake	1.68	92%	0.07	4%
Percy Lake	1.23	62%	-0.27	-14%
Oblong Lake	1.15	58%	-0.31	-16%
Redstone Lake (West Dam)	1.66	57%	0.02	1%
Eagle Lake	1.03	56%		
Twelve Mile	0.73	48%		
Horseshoe Lake	0.82	41%	0.08	4%
Big Bob	2.00	69%		
Little Bob	1.02	67%		
Gull Lake	0.35	39%	0.03	3%
Moore Lake	0.22	37%		
Burnt River Watershed				
Drag Lake	1.09	63%	-0.29	-17%
Canning Lake	0.61	62%	-0.36	-37%
Miskwabi (Long) Lake	1.11	56%	-0.35	-17%
Loon Lake	0.83	62%	0.07	5%
Koshlong Lake	1.02	61%		
Farquhar Lake	1.37	58%		
Pusey (Grace) Lake	1.15	71%		
Esson Lake	1.29	60%	0.31	15%
Little Glamor Lake	1.18	64%	0.32	18%
Big Glamor Lake	1.11	64%		
Gooderham Lake	0.65	53%		
Contau Lake	0.78	64%		
White Lake	1.08	59%	0.14	8%
Southern Reservoirs				
Crystal Lake	1.22	57%	0.32	15%
Anstruther Lake	1.11	48%	0.18	8%
Mississagua (Catchacoma) Lake	1.14	47%	-0.32	-13%
Eels Lake	1.80	49%	-0.40	-11%
Jack's Lake	0.73	47%	0.00	0%
	NOTE: Data refer to Ranges not Levels			

No PWL Document

Table 2c is a compilation of water level ranges (fluctuations) as of October 1st. The data columns from left to right contain:

- the average drawdown range in metres (from the full control level);
- the average drawdown range as a percentage of the maximum storage depth;
- the difference between the preferred range (from Table 2b) and the average range in metres; and
- the difference between the preferred range and the average range as a percentage of the maximum storage depth.

It is noticeable that the preferred fluctuation is fairly evenly split between being significantly less (red highlight) and being slightly greater (green highlight) than the historic average..

THE NATURE OF THE CONSTRAINTS IDENTIFIED

The Coalition stressed to participating lake associations that the lake-specific *"Preferred Water Level Range"* during the navigation season should be based on measurable constraints.

While several constraints were common to many lakes, almost every participating association was able to identify unique constraints. These are detailed in the individual documents in Appendix "C".

In summary:

Common constraints include:

- flood risk for cottages and septic systems at high water levels;
- shoreline erosion at high water levels;
- flooding of Loon nests in June due to rising water levels;
- risk of ice damage to shoreline infrastructure when water levels rise close to full prior to breakup;
- inability to use boat launches safely at low water;
- unmarked navigation hazards due to fluctuating water levels;
- degradation of wetlands and loss of habitat at low water;
- failure of drinking water supply lines due to exposure or freezing at low water levels, especially a problem in shallow bays.

Unique constraints include:

- Anstruther Lake: inability to access boats in slips at the marina at low water levels;
- Canning, Kashagawigamog, Soyers, Grass, and Head lakes chain: access from Soyers Lake to the boat launch and marina becomes impossible when the water level drops below 1.3m; similarly the channel into Head Lake and water access to Haliburton Village, as well as travel between Canning and Kashagawigamog lakes is restricted at low water;
- Crystal Lake: ability to fill lake in spring and to protect water lines from freezing in winter suggests the winter log-set be increased by one log to 4 logs;
- Drag Lake & Spruce Lake: inability navigate and to access properties at low water levels as follows: throughout Outlet Bay; channel between Drag and Spruce lakes; channel between Drag Lake and Bonham's Bay; public boat ramps - Sandy Cove, Outlet Bay, Spruce Lake;
- Eel's Lake: removal of boats at the Eels Lake public access ramp is significantly hindered by the fact that the pier is totally out of the water by mid-August and becomes non-functional;
- Gull Lake: Low water level constraints include problems removing boats using the Deep Bay ramp; restricted access to island properties and docks left 'high and dry';

- Haliburton-Oblong lakes: inability to navigate under South Bay or Oblong bridges, inability to store boats at Fort Irwin Marina due to low water levels under bridges and channel leading to marina;
- Halls Lake: flooding of cottages on Old Mill Road, ice damage to fixed wharfs, severe erosion of banks on Kennisis River at high water levels, inability to access government boat launch from river at low water levels;
- Hawk lakes: clearance under bridge leading to marina limits access to Big Hawk Marina and to government boat launch (an issue when water levels too high or too low) – excessive current through narrows at bridge can make access to marina dangerous; inability to use the channel between Big and Little Hawk lakes, and to access to Big brother, Little Brother and Saskatchewan lakes at low water levels;
- Horseshoe Lake & Mountain Lake: severe flooding and inundation of septic systems at water levels over 2.7 metres; water level differentials resulting from the flow-constriction in the Mirror Lake narrows between Mountain and Horseshoe lakes;
- Jack’s Lake: high flow rates below the dam are a safety hazard and detrimental to the unique wetland ecology of the creek leading to Little Jack’s Lake;
- Kennisis Lake: navigation under the three bridges on the lake (leading to Little Kennisis Lake, Paddy’s Bay, and Kelly Lake) is restricted at water levels outside the preferred range due to lack of clearance at high water or lack of draught at low water;
- Kushog Lake: clearance under the Ox Narrows bridge at high water; inability to navigate between Kushog and St. Nora lakes at low water; navigational hazards in the channel leading to the Buckslide dam at low water;
- Miskwabi (Long) Lake: inability to navigate between Long and Miskwabi lakes at low water levels;
- Mississagua Lake, Catchacoma Lake, Beaver Lake, Gold Lake and Cold Lake: when the water level of the lakes drops below 1.62 metres it becomes impossible to navigate with a power boat between Catchacoma and McGinnis lakes; this level corresponds to approximately 0.9 m. depth in the McGinniss cut;
- Percy Lake: access to the boat launch is restricted at low water levels;
- Redstone Lake: low water levels result in navigational challenges on Pelaw Lake and in the narrows between Big and Little Redstone;
- White Lake and Fortescue Lake: navigation through the culvert under the municipal road between the two lakes is restricted at high and low water levels (clearance and draught issues respectively); access to the water at the White Lake dam virtually impossible at low water for boat launch/removal.

IMAGES OF SOME OF THE CONSTRAINTS

1. High water levels leading to overbank flooding (Horseshoe Lake April 2013)
2. Shoreline erosion due to wave action at high water levels
3. Low water level restricting navigation & access (Eel's Lake – late season 2012)
4. Ice damage due to high water levels in spring (Gull Lake – spring 2011)
5. Bridge on navigation channel limits access at both high and low water levels (Paddy's Bay, Kennisis Lake spring 2015)

ANALYSIS AND CONCLUSIONS

ASSUMPTIONS AND SCOPE

Consistent with the noted 'underlying principles' established for the Coalition's PWL initiative is an assumption that efforts should be made throughout the Trent River watershed to **conserve water** and **reduce the magnitude of water level fluctuations** to protect the natural environment and enhance the social and economic impact of water management operations.

The PWL initiative is focussed on **water levels** of reservoir and adjacent flow-through lakes. A detailed discussion of **water flows** and of water levels on other flow-through lakes is therefore beyond the scope of the initiative. However, the close link between water levels and flows is referenced in the analysis where relevant. A number of areas that lie beyond the scope of this initiative are identified for further study or consideration as components of integrated water management.

It is understood that significant operational changes in water management are likely to require simulation studies by TSW to ensure that the impact of any changes will provide a net benefit to the overall system and its stakeholders.

EQUAL PERCENTAGE DRAWDOWN

The current water management regime during the navigation season is based on a common two-phase approach for the reservoirs lakes, assuming that the lakes are close to their target full level at the start of the navigation season, which traditionally coincides with the Victoria Day holiday weekend in late May.

Initially the lakes are all drawn down by an equal percentage of their total available storage depth.

By mid-summer, the drawdown regime changes due to a need to achieve the 'winter-set' log condition by early October in order to protect the lake trout spawn. This requires a deviation from 'equal percentage' drawdown because the winter-set condition varies from lake to lake as shown in Table 3. The extremes of this variance in the percentage drawdown range are as follows:

- from 38% to 100% based on log settings (purple column)
- from 19% to 90% based on January 1st average winter water levels (cerise column)
- from 38% to 90% based on actual fall minimum water levels (blue column)

As noted, the equal percentage drawdown (E%DD) calculation is based on the maximum storage capacity of the reservoir lakes. However, the height of the dams varies considerably with the maximum storage depth varying from 0.6 to 4.0 metres (Table 2a). Similarly, the TSW's ability to refill a fully drawn-down lake varies according to the size of each lake's drainage basin. Most reservoir lakes are not fully drawn down in the fall because the water is not needed and because there is no guarantee that the lakes could be refilled in a typical spring. Table 4 shows that, based on log settings, six of the reservoir lakes are allowed to drop their full range, while three lakes retain a spare capacity of over 1 metre. All other lakes lie in between. Including this rarely used 'spare capacity' in the E%DD calculation introduces an arbitrary inequity in the E%DD protocol. While it would be more equitable to use the winter-set level as the basis for E%DD, rather than the maximum storage depth, this could have a significant negative impact on those lakes with no 'spare capacity' and whose shoreline infrastructure has been built based on an understanding of the current drawdown protocols. Such an approach would therefore need further study and modelling.

Table 3. Percentage Drawdown – Fall and Winter

Lake	Full Control Level	Max. Storage Depth	Max. Storage Capacity	Winter Log Set Level as % Drawdown	Average Winter Water Level on Jan 1st as % Drawdown	Average Fall Minimum as % Drawdown
Gull Watershed						
Kennisis	2.90	2.84	4657	68%	54%	58%
Redpine	1.22	1.22	469	75%	32%	38%
Nunikani	3.05	2.75	299	89%	70%	77%
Hawk	4.42	4.04	2748	72%	55%	58%
Halls	2.59	1.60	842	82%	42%	54%
Kushog	3.20	1.82	1722	100%	76%	91%
Percy	1.98	1.98	1115	100%	85%	83%
Haliburton/Oblong	3.05	1.98	2169	92%	73%	71%
Redstone	3.66	2.90	4121	95%	69%	69%
Eagle	2.29	1.83	944	92%	64%	62%
Twelve Mile	1.98	1.52	1666	70%	37%	51%
Horseshoe	2.44	1.98	833	61%	19%	40%
Big Bob	2.90	2.90	655	68%	62%	72%
Little Bob	1.52	1.52	111	100%	79%	85%
Gull	2.13	0.91	909	100%	38%	55%
Moore	1.52	0.61	118	50%	42%	46%
Burnt Watershed			**Gull Ave.**	**83%**	**58%**	**65%**
Drag	2.29	1.74	1919	62%	47%	58%
Canning	1.52	1.02	1287	86%	36%	56%
Miskwabi	2.29	1.99	665	38%	39%	55%
Loon	1.98	1.33	341	100%	61%	72%
Koshlong	2.29	1.68	680	82%	66%	68%
Farquhar	3.05	2.35	817	50%	44%	55%
Grace	2.06	1.56	463	91%	73%	79%
Esson	3.05	2.14	504	86%	75%	78%
Little Glamor	1.83	1.83	115	83%	90%	90%
Big Glamor	2.44	1.74	325	100%	86%	88%
Gooderham	1.83	1.22	104	75%	54%	58%
Contau	1.68	1.22	146	88%	78%	77%
White	1.83	1.83	293	83%	73%	79%
Nogies Creek Watershed			**Burnt Ave.**	**79%**	**63%**	**70%**
Crystal	2.74	2.13	956	100%	72%	73%
Mississagua Watershed						
Anstruther	2.29	2.29	1422	67%	49%	55%
Mississagua	2.44	2.44	5021	75%	48%	53%
Eel's Creek Watershed			**Mississagua Ave.**	**71%**	**49%**	**54%**
Eel's Lake	3.66	3.66	2983	67%	53%	56%
Jack Creek Watershed						
Jack's Lake	1.93	1.55	2008	86%	53%	54%
			Overall Ave.	**81%**	**59%**	**66%**
** Sherborne Lake excluded - not managed for E%DD						

🟩	Least Drawdown
🟥	Greatest Drawdown

Table 4. Extent of Typically Unused Storage Capacity

Reservoir Lake	Winter Log Setting	Storage Depth (m)*
Gull River Watershed		
Kennisis Lake	3	0.92
Red Pine	1	0.31
Nunikani Lake	2	0.31
Hawk Lake	5	1.14
Halls Lake	4	0.31
Kushog Lake	4	0.00
Percy Lake	1	0.31
Oblong Lake	4	0.15
Redstone West Lake	4	0.46
Eagle Lake	2	0.15
Twelve Mile	3	0.46
Horseshoe Lake	4	0.76
Big Bob	3	0.92
Little Bob	0	0.00
Gull Lake	2	0.00
Moore Lake	3	0.00
Burnt River Watershed		
Drag Lake	4	0.76
Canning Lake	2	0.15
Miskwabi Lake	5	1.22
Loon Lake	2	0.00
Koshlong Lake	3	0.31
Farquhar Lake	6	1.22
Grace Lake	2	0.15
Esson Lake	4	0.31
Little Glamor Lake	1	0.31
Big Glamor Lake	2	0.00
Gooderham Lake	3	0.31
Contau Lake	2	0.15
White Lake	1	0.31
Southern Reservoirs		
Crystal Lake	3	0.31
Anstruther Lake	2.5	0.76
Mississagua Lake	2	0.61
Eels Lake	4	1.22
Jack Lake	2	0.23
* Allowing for sill deduction per Table 2a	No spare capacity	
	>1 metre spare capacity	

A more realistic, but still 'common', approach would be to base a revised E%DD on the constraint-based preferred drawdown ranges identified by individual lake associations in this document, or on the actual average range rather than on the potential, but rarely used maximum range. This would modify the current E%DD to be closer to an 'Equal Pain Draw-Down'.

A phased approach based on the lake-specific information contained in this Summary Report would involve the following:

- initially drawdown all lakes with water levels above the TSW target full level in order to achieve the upper limit of the preferred range as evenly and as quickly as possible and to minimize local flooding and shoreline erosion;
- subsequently, rather than using the lower limit of the maximum storage depth in the denominator in the equal percentage drawdown calculation, instead use the lower limit of the PWL (or the mid-September average water level for those lakes who have not provided a PWL document) in the denominator to determine equal percentage for drawdown so that in a typical year all the reservoirs would reach the lower limit of their PWL at about the same time.

In most years, by the time the lower preferred water level has been attained it will be time to move away from E%DD in order to achieve the winter-set condition. In a very dry year however, and despite efforts to conserve water, the traditional approach to E%DD may need to be continued for a short period prior to establishing the winter-set condition.

The result of such a phased strategy would be to move closer to equalizing the impact of lower water levels on all the reservoirs by moving away from the current approach in which lakes with 'unused' bottom logs are drawn down faster than similar-sized lakes with shallower dams.

In recent years, the TSW's water control engineer has shown a willingness to depart from a rigid adherence to E%DD by adopting a number of pragmatic modifications, which typically have resulted in retaining water in some reservoirs when not required elsewhere in the watershed or for Waterway operations.

For example, between May and mid-August of 2016, a drought led the TSW to adopt water conservation measures basin-wide with local minimum flow constraints operating on the Gull and Burnt systems and over-riding E%DD. This resulted in higher % drawdown on the Burnt than the Gull due to the limited total storage in the Burnt system. At the same time, there was lower % drawdown of the Southern (Central) Reservoirs where water was being stored and the Coalition understands that there are no formal minimum flow constraints. (In the absence of extreme conservation situations, such as those experienced in 2016, the Coalition recognises the benefit of maintaining minimum flows on the creeks and rivers that drain the 5 Southern Reservoirs. Low flow issues as reported by Coalition Member associations include: stagnant water in Eel's Creek at Apsley; harm to endangered species on Jack's Creek; restricted access to cottages and provincial park campsites downstream of the Mississagua dam; and low water levels in Bass Lake downstream of the Crystal Lake dam.)

Another example. In late summer, assuming water is not needed to meet minimum levels downstream on the waterway, the TSW is able to vary the rate of drawdown for each sub-basin (the Gull, the Burnt and each of the southern/central reservoir sub-basins) because the complex system of reservoirs on the Gull and Burnt requires more time to bring down than is the case for the southern reservoir lakes which flow directly to the canal lakes. (The main limitation on the Gull system for example is the upper flow limit at Minden required to avoid local flooding). Thus while the goal is to get all lakes down by mid-October, the rates of drawdown can vary depending on the local lake and river characteristics for each sub-watershed. Whereas it takes up to 6 weeks to get the Gull system down, a southern reservoir lake like Mississagua can be lowered in much less time because it flows directly to the canal lakes.

Another possible modification to the final phase of the drawdown relates to some of the smaller lakes, such as Little Bob Lake for example, where the problems experienced by property owners at low water appear to be disproportionate to the benefit to the TSW of the small volume of water gained. Table 5 shows the proportion of the total storage provided by each of the reservoirs. In addition, it identifies the ten smallest reservoirs and shows that they comprise only 5% of the total storage volume.

Table 5. Proportion of Storage Volume for all Reservoirs and for 10 smallest

Parameter	Storage Volume as % of Total	Rank	Storage Volume as % of Total
Gull River Watershed			
Kennisis Lake	10.66%		
Red Pine	1.07%		
Nunikani Lake	0.68%	8	0.68%
Hawk Lake	6.29%		
Halls Lake	1.87%		
Trout Lake	0.86%	10	0.86%
Kushog Lake	3.82%		
Percy Lake	2.55%		
Oblong Lake	4.96%		
Redstone Lake (East Dam)	9.43%		
Eagle Lake	2.16%		
Twelve Mile	3.81%		
Horseshoe Lake	1.91%		
Big Bob	1.50%		
Little Bob	0.25%	2	0.25%
Gull Lake	2.09%		
Moore Lake	0.27%	4	0.27%
Gull Watershed Total	54.21%		
Burnt River Watershed			
Drag Lake	4.33%		
Canning Lake	2.89%		
Miskwabi (Long) Lake	1.52%		
Loon Lake	0.77%	9	0.77%
Koshlong Lake	1.55%		
Farquhar Lake	1.85%		
Pusey (Grace) Lake	1.10%		
Esson Lake	1.15%		
Little Glamor Lake	0.26%	3	0.26%
Big Glamor Lake	0.74%	7	0.74%
Gooderham Lake	0.24%	1	0.24%
Contau Lake	0.33%	5	0.33%
White Lake	0.67%	6	0.67%
Burnt Watershed Total	17.43%		
Southern Reservoirs			
Crystal Lake	2.19%		
Anstruther Lake	3.25%		
Mississagua (Catchacoma) Lake	11.50%		
Eels Lake	6.83%		
Jack's Lake	4.60%		
Southern Reservoirs Total	28.37%		
Reservoir Total	100.00%		5.08%

One more example of the TSW taking a more active approach is the decision in recent winters to actively manage the logs in several reservoir lake dams in response to their continuous monitoring of water levels and changing weather conditions.

UPPER PREFERRED WATER LEVEL LIMIT

For all participating reservoir lakes, there is a broad consensus that the preferred upper limit of the spring high water level is the same as the TSW's multi-year spring average high.

While this may appear to be an easily attained target, the challenge lies in the considerable annual variance from the 25-year average high water level. This is documented in the final two columns of Table 2a, and reflects the lack of control available to the TSW following the spring freshet and/or extreme precipitation events – something not well understood by the public.

It also highlights a number of conflicting priorities. For example, filling the reservoirs prior to the start of the navigation season increases the risk of flooding and shoreline erosion in the event of a heavy rain in May, whereas delaying the filling of the reservoirs increases the risk of rising water levels during Loon nesting season (late May thru early July) and the possibility of not being able to fill the reservoirs in a dry year.

This supports the need for a sophisticated water management modelling capability that can take into account the multiple constraints, including lake-specific constraints.

LOWER PREFERRED WATER LEVEL LIMIT

There is not the same consensus among the participating lake associations with regard to the lower preferred water level limit, although there are broadly consistent themes.

For one thing, the lakes are drawn down by different amounts depending on the height of the dam and current operational protocols (with drawdowns anywhere from 0.4 to 2.2m based on the average drawdown data in Table 2a). For another, the vertical profiles of the lakes vary: some have gently-sloping shorelines that continue out into shallow bays, while others have steep rocky shorelines resulting in deep water close to shore. An equal vertical drop in water level can result in very different shoreline exposure from one lake to another. Over the course of a full season the extent of exposed shoreline between the high and low water levels can vary significantly from one lake to another (or between different areas on the same lake), and this affects shoreline infrastructure such as docks, ramps, water intakes etc. to differing degrees.

In addition, as noted in Table 3, the winter-set condition varies between 38% and 90-100% (as measured by log settings or actual average fall water levels) from one lake to another, requiring a deviation from 'equal percentage' drawdown in late summer.

Navigation at the end of the boating season is the principal concern for almost all participating reservoir lakes and a consistent theme is that if the winter-set condition at each dam could be increased by one log, then in an average year the majority of navigational challenges would be resolved or greatly mitigated.

Several participating associations encouraged a review of the winter log-set and such a review may be further justified based on climate change projections.

Some participating associations specifically recognized the challenge of maintaining water levels within the preferred range given the need to achieve winter-set level prior to lake trout spawning in October. Accordingly the navigation season linked to the preferred water levels was deemed to end in early to mid-September in the documents provided for Eel's, Gull and Mississagua lakes – although there is general consensus that the navigation season runs at least until the Thanksgiving weekend on most lakes, just as on the Waterway itself. Nonetheless the constraint data provided for all lakes refer to measurable navigation constraints regardless of date.

As with the average high water level data, there is considerable annual variance from the 25-year average low water levels (documented in the final two columns of Table 2a): this reflects the difference between relatively 'dry' and 'wet' years. For example, a single extreme precipitation event in mid-August 2016 turned a 'very dry' year into a relatively normal year for fall navigation.

WINTER-SET LEVELS

As noted in the Introduction, the TSW aims to bring the reservoir lakes to their minimum, winter-set level by mid-October in order to protect the spawn of naturally reproducing shallow-spawning lake trout. The TSW's precautionary approach is applied to all the reservoirs as there is a lack of definitive information as to which lakes contain naturally reproducing (as opposed to stocked) lake trout, and which contain shallow-spawning lake trout. While commendable from an ecological point of view, access to more definitive data would allow the winter-set condition to be established later on lakes with no naturally reproducing lake trout (such as White Lake) or on lakes with deep-spawners (such as Kennisis Lake).

In addition to the timing of the draw-down, a September 2011 report prepared for MNRF proposed higher winter-set levels for Crystal, Catchacoma, Mississagua, and Percy lakes to support lake trout recruitment on spawning shoals that are currently exposed at low water.

Based on the data in Table 2b, the ability to increase the winter-set by one log would allow the lower limit of the PWLs to be met on most lakes in an 'average year'. As noted in Table 2c, based on data for October 1st, when the preferred drawdown ranges are compared to the average ranges, there are almost as many lakes whose preferred range is slightly greater than the average as there are lakes whose preferred range is significantly less that the average. This suggests that there may be room for minor adjustments to the current drawdown regime without significantly reducing the storage capacity available to the TSW. However, increases to any of the winter set levels will need to be based on an assessment by the TSW with regard to their ability to make subsequent log-setting adjustments during the winter in response to snowpack and precipitation measurements or flood control modelling data.

FLOW-THROUGH LAKES & MINIMUM FLOW RATES

Most of the larger flow-through lakes are treated by the TSW as an extension of the immediate downstream reservoir if they are at similar elevations (e.g. Little Boshkung and Twelve Mile, Canning and Kashagawigamog, Grace and Pusey/Dark, Mississagua and Catchacoma). However there are some flow-though lakes, the water levels of which are principally determined by the volume of water flow. The lakes downstream of the Eagle Lake dam on the Maple Lake chain are an example. For these lakes, the shutting-down of an upstream reservoir lake dam to conserve water results in a drop in flow and a concomitant drop in water level. This suggests a future need to understand and to communicate the correlation between flow rates and water levels, and where possible, to identify a minimum flow constraint in order to maintain water levels within a preferred range. While the maintenance of such flow rates may be impractical in a dry year when water conservation is a priority, nonetheless a better understanding and communication of the correlation between flow rates and water levels would be helpful to local residents. In this regard, the Coalition notes that in 2016 the TSW was to be commended for including Maple Lake in its weekly water level forecasts for the first time. Also, in recent years, the TSW has operated the two Redstone dams sequentially rather than simultaneously, which has helped to even out the flow through the Maple Lake chain.

The TSW has adopted minimum flow rates for several of the rivers in the upper Trent system, mainly for the maintenance of water quality and a healthy ecosystem. For example, the minimum flow rate at Norland/Coboconk on the Gull River is 12.7 cubic metres per second, while on the Burnt, north of Cameron Lake, it is 6 cubic metres per second. Flow is measured on the Irondale River at Furnace Falls before the river joins the Burnt River, but the Coalition is not aware that TSW has established a minimum flow rate here. Minimum flows are required at several downstream locations for navigation on the regulated portion of the Waterway, and for local infrastructure such as drinking water intakes (reflected in the minimum flow constraint of 17 cubic metres per second on the Otonabee River in Peterborough, and of 3 cubic metres per second downstream of Lock #31 in Buckhorn).

In some instances these minimum flows are sufficient to support navigation on a flow-through lake (e.g. Shadow Lake). In other instances, higher minimum flows would be required for navigation (e.g. Maple Lake and the river connecting Grace Lake with Pusey/Dark Lake).

Sound water management has to balance competing interests; in a dry year for example, it may be necessary to favour water conservation over increased flows for navigation.

This situation was addressed in a 1988 Post-Audit Report on the TSW by Acres International. The Report noted that the TSW aims to maintain a flow of 12.7 cubic metres per second at Norland during the navigation season in order to maintain reasonable water levels on Shadow and Silver lakes. It calculated that if the flow were reduced to 5.66 cubic metres per second, sufficient to meet the downstream demand, the lake level would drop by about 14 cm. Thus the minimum flow constraint at Norland was controlling the releases from upstream reservoirs to the extent of causing a greater drawdown on the Gull system than in the other sub-basins.

The Acres Report analysis indicated that reducing the minimum flow requirement would significantly increase water levels in some of the upstream reservoirs by the end of summer. For example, the improvement in Kennisis levels was 29 cm on average, but over 80 cm in dry years. Similarly for Hawk Lake the improvement in a dry year could be as much as 135 cm.

It was suggested that if a weir were to be constructed north of Coboconk to raise the level of Silver and Shadow lakes, summer water levels would be increased by about 0.64 metres at low flow rates – avoiding the negative impact on Shadow and Silver lakes (but causing obstruction to upstream boat traffic) and that the upper lakes on the Gull would experience significantly improved summer water levels.

Local interests have not supported a weir north of Coboconk, and a similar proposal for Maple Lake has failed to attract broad community support. As water conservation becomes increasingly important due to climate change, it is possible that such an approach may warrant further study in order to respond to demands for navigation on flow-through lakes. In the meantime no preferred water levels documents on flow-through lakes, other than those deemed part of adjacent reservoir lakes, are included in this report.

CONCLUSIONS

The Coalition's PWL initiative has proved a useful vehicle to engage Member lake associations both in terms of increasing their understanding of water management issues on their lake and for the watershed. The various surveys of lake association members identified a number of general concerns as well as providing information on lake-specific constraints. The following general conclusions reflect the content of the individual lake association submissions attached as Appendix "C".

1. UPPER PREFERRED WATER LEVELS CORRESPOND TO THE AVERAGE HIGH WATER LEVELS

The upper preferred water level limits identified by participating associations generally correspond to the average high water levels attained by the current approach to water management (see Table 2b). The variability (deviation from the average) of the annual high water levels (Table 2a) is a concern and efforts to reduce this variation would benefit shoreline property owners by providing greater certainty regarding the risk of flooding and ice damage to shoreline infrastructure.

2. LOWER PREFERRED WATER LEVELS REQUIRE ATTENTION TO LAKE-SPECIFIC CONSTRAINTS.

The lower preferred water levels indicate that the ability to include lake-specific constraints in the water management model would result in a more equitable approach in terms of the hardship experienced by waterfront property owners. Again the variability (deviation from the average) of the annual low water level is a concern due to the resulting uncertainty regarding navigation, water-access and the usability of shoreline infrastructure (docks, water intakes etc.). The provision of weekly water level forecasts by the TSW during the drawdown is greatly appreciated and helps to reduce some of the uncertainty.

3. WATER CONSERVATION MEASURES ARE INCREASINGLY IMPORTANT DUE TO CLIMATE CHANGE

It is recognized however that efforts to reduce the variability of water levels while desirable will meet with limited success given that the controls available to the TSW are not adequate to handle rapid changes in water levels and flows following extreme weather events. Nonetheless, the increasing frequency of extreme weather events, coupled with the projected long-term impact of climate change does suggest the need for an evolution of the current water management model, particularly in terms of water conservation during 'dry years'.

4. THE TSW NEEDS BETTER WATER MANAGEMENT MODELLING TOOLS

As the water management agency, the TSW needs a sophisticated, constraint-based water management modeling capability as recommended in the 2011 AECOM Water Management Study, one capable of considering lake-specific constraint data.

5. AN OPPORTUNITY EXISTS FOR IMMEDIATE INCREMENTAL WATER MANAGEMENT ENHANCEMENTS

Pending the acquisition of an enhanced water management modelling capability, and on an interim basis, the Coalition believes it would be appropriate for the TSW to:

i. review **the 'extent' of the drawdown** and the **winter-set levels** on each lake, given the projected reduction in the spring freshet based on climate change models;

ii. be prepared to make minor adjustments in an effort to mitigate lake-specific navigation and access issues based on the **constraints** identified by the participating lake communities;

iii. review the **timing of the draw-down on a sub-basin basis**, so that in **wet years** the drawdown could be designed to **take only the water needed** for the TSW to meet its mandate and to provide adequate flows through the flow-through lakes; whereas in **dry years** (such as 2016) the drawdown could be designed to incorporate appropriate **conservation measures throughout the system** while maintaining adequate flows for the TSW to meet its mandate and to protect public health;

iv. consider their ability to protect smaller lakes from extreme draw-down when there is demonstrable hardship for residents and minimal benefit to the TSW; and

v. monitor reductions in leakage resulting from the replacement of dam #1 at Trenton and other TSW infrastructure upgrades that may allow for reduced flows throughout the system without compromising the various minimum flow constraints related to public health and safety.

6. THE TSW SHOULD CONSIDER MODIFYING THE CALCULATION OF EQUAL PERCENTAGE DRAWDOWN

While maintaining the underlying principle of equal percentage for the main period of the annual drawdown of the reservoir lakes (typically from June to early September), consideration should be given to the viability of the following phased approach using a more equitable calculation of ‘equal percentage’:

- initially drawdown all lakes with water levels above the TSW target full level in order to achieve the upper limit of the preferred range as evenly and as quickly as possible and to minimize local flooding and shoreline erosion;
- subsequently, rather than using the lower limit of the maximum storage depth in the denominator in the equal percentage drawdown calculation, instead use the lower limit of the PWL (or the mid-September average water level for those lakes who have not provided a PWL document) in the denominator to determine equal percentage for drawdown so that in a typical year all the reservoirs would reach the lower limit of their PWL at about the same time.

In most years, by the time the lower preferred water level has been attained it will be time to move away from E%DD in order to achieve the winter-set condition. In a very dry year however, and despite efforts to conserve water, the traditional approach to E%DD may need to be continued for a short period prior to establishing the winter-set condition.

It is understood that some elements of such an approach might require modelling prior to implementation to avoid unintended negative consequences.

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The 2006 Muskoka River Water Management Plan. Developed by the Ontario Ministry of Natural Resources in conjunction with local waterpower companies and implemented in 2006. http://www.muskokawaterweb.ca/water-101/water-quantity/mrwmp

It's All About the Water: Report of the Panel on the Future of the Trent-Severn Waterway. Prepared for the Minister of the Environment. March 2008.

Trent Severn Waterway: Water Management Study: AECOM Canada Ltd. Prepared for Parks Canada. April 2011.

Trent-Severn Waterway Operations: Water Level Management to Assist Walleye and Lake Trout in Bancroft District of the Ministry of Natural Resources. A Background Report prepared for MNRF by James Castle. September 2011.

APPENDIX A: COMMON CONCERNS RE WATER LEVELS ON THE RAFT LAKES

The following list identifies some of the negative impacts experienced by property owners on the RaFT lakes when water levels or flow rates fluctuate, and especially when they fall outside the established normal seasonal range.

Water Levels "too high"

- Low-lying cottages flooded
- Shoreline erosion greatly increased
- Ice damage more likely
- Wetlands swamped – shoreline bird nests flooded, habitat degraded
- Clearance at bridges reduced
- Unmarked navigational hazards hidden
- Difficult to install and access certain styles of dock

Water Levels "too low"

- Access to 'water access' properties restricted
- Inability to navigate between some lakes
- Inability to remove boats from boat lifts
- Inability to trailer boats at boat launches
- Water intake lines prone to exposure and/or freezing in areas with shallow shorelines
- Unmarked navigational hazards created
- Wetlands dry out
- Damage to exposed shoreline vegetation, especially on shallow lakes, leading to barren zone between high and low water marks

Flow rates "too high"

- Boating becomes unsafe
- Shoreline erosion increases
- Degradation of habitat for wildlife
- Inability to navigate between lakes

Flow rates "too low"

- River and flow through lake depths decrease and navigation becomes difficult
- Shorelines on shallow and flow-through lakes become exposed
- Access to water and to 'water access' properties restricted
- Fish habitat is degraded e.g. for spring-spawning pickerel
- Stagnant water and algae blooms can occur
- Water quality degrades

Lake Levels rising in June (after normal seasonal high)

- Loon nest become inundated
- Wetland habitat degraded in prime breeding season for aquatic wildlife

Lake Levels falling in October (and any of the winter months)

- Trout spawning beds can dry out (applies to shallow- spawning trout lakes)

APPENDIX B: HALIBURTON SECTOR LAKES, ALTERNATE NAMES, AND INTER-LINKED LAKES.

The purpose of the following Table is to list the reservoir and flow-through lakes in the Haliburton Sector of the TSW according to which dam controls their water levels. The Table includes alternate names in common use for some lakes as well as details of lake association names and their Coalition Membership status.

The Table is in two sections: the first lists TSW dam-controlled lakes alphabetically using the name in use by the TSW and identifies the adjacent (upstream) lakes that contribute to the storage capacity of the dam; the second includes all adjacent and some other flow-through lakes alphabetically and cross-references them to the dammed lake in the first section.

Reservoir Lake (with TSW dam)	Alternate Names, Adjacent (Upstream) Lakes, Association & CEWF Membership Information
Anstruther Lake	Association: Anstruther Lake Cottagers Association CEWF Member: Yes
Big Hawk Lake	Adjacent Lakes: Little Hawk Lake Association: Halls and Hawk Lakes Property Owners Association CEWF Member: Yes
Bob Lake	Alternate Names: Big Bob Lake Association: South Bob Lake Association (one of several) CEWF Member: Yes (but only represents about 20% of whole lake; other associations on Bob Lake are not CEWF members)
Canning Lake	Adjacent Lakes: Kashagawigamog Lake, Soyers Lake, Grass Lake, Head Lake Association: Canning Lake Property Owners Association CEWF Member: Yes
Contau Lake	Association: No (inactive) CEWF Member: No
Crystal Lake	Adjacent Lakes: Swamp Lake Association: Crystal Lake Cottagers Association CEWF Member: Yes
Drag Lake	Adjacent Lakes: Spruce Lake Association: Drag and Spruce Lake Property Owners Association CEWF Member: Yes
Eagle Lake	Adjacent Lakes: Moose Lake Association: Formed in 2016 CEWF Member: No
Eels Lake	Alternate Names: Eel's Lake Association: Eel's Lake Cottagers Association CEWF Member: Yes
Esson Lake	Adjacent Lakes: Otter Lake Association: Rowbotham Lane Road Association CEWF Member: Yes (but does not represent whole lake)

Reservoir Lake (with TSW dam)	Alternate Names, Adjacent (Upstream) Lakes, Association & CEWF Membership Information
Farquhar Lake	Association: No CEWF Member: No
Glamor Lake	Association: Glamor Lake Cottagers Association CEWF Member: Yes
Gooderham Lake	Adjacent Lakes: Pine Lake Association: No CEWF Member: No
Gull Lake	Association: Gull Lake Cottagers Association CEWF Member: Yes
Halls Lake	Adjacent Lakes: Little Brother Lake Association: Halls and Hawk Lakes Property Owners Association CEWF Member: Yes
Horseshoe Lake	Adjacent Lakes: Mountain Lake Association: Horseshoe Lake Property Owners Association CEWF Member: Yes
Jack Lake	Alternate Names: Jack's Lake Association: Jack's Lake Association CEWF Member: Yes
Kennisis Lake	Adjacent Lakes: Little Kennisis Lake, Lipsy Lake, Kelly Lake Association: Kennisis Lake Cottage Owners Association CEWF Member: Yes
Koshlong Lake	Association: Koshlong Lake Association CEWF Member: Yes
Kushog Lake	Adjacent Lakes: St. Nora Lake Association: Kushog Lake Property Owners Association CEWF Member: Yes
Little Bob Lake	Association: No CEWF Member: No
Little Glamor Lake	Association: Little Glamor Lake Cottage Association CEWF Member: Yes
Long Lake	Adjacent Lakes: Miskwabi Lake Association: No (see under Miskwabi Lake) CEWF Member: No
Loon Lake	Adjacent Lakes: Dudman Lake Association: Loon Lake Property Owners Association CEWF Member: Yes
Mississagua Lake	Adjacent Lakes: Catchacoma Lake, Beaver Lake, Gold Lake, Cold Lake Association: Cavendish Community Ratepayers Association Inc. CEWF Member: Yes
Moore Lake	Association: Moore Lake Property Owners Association CEWF Member: Yes
Nunikani Lake	Adjacent Lakes: Crab Lake Association: No CEWF Member: No

Reservoir Lake (with TSW dam)	Alternate Names, Adjacent (Upstream) Lakes, Association & CEWF Membership Information
Oblong Lake	Adjacent Lakes: Haliburton Lake Association: No (see under Haliburton Lake) CEWF Member: No
Percy Lake	Association: Percy Lake Ratepayers Association CEWF Member: Yes
Pusey Lake	Alternate Names: Dark Lake Adjacent Lakes: Grace Lake Association: No (see under Grace Lake) CEWF Member: No
Red Pine Lake	Adjacent Lakes: Paint Lake Association: No CEWF Member: No
Redstone Lake	Adjacent Lakes: Little Redstone Lake Association: Redstone Lake Cottagers Association CEWF Member: Yes
Sherborne Lake	Adjacent Lakes: Trout Lake Association: No CEWF Member: No
Twelve Mile Lake	Adjacent Lakes: Little Boshkung Lake, Boshkung Lake Association: Twelve Mile Little Boshkung Lake Association CEWF Member: Yes
White Lake	Adjacent Lakes: Fortescue Lake Association: White Lake Cottagers Association CEWF Member: Yes

Adjacent and Other Lakes	Cross-Reference to Reservoir Lake, Alternate Names, Association & CEWF Membership Information
Beaver Lake	See Under: Mississagua Lake
Beech Lake	Not part of any reservoir, a member of the Maple Lake chain of flow-though lakes on the upper Gull system CEWF Member: Yes
Boshkung Lake	See Under: Twelve Mile Lake Association: Boshkung Lake Property Owners Association CEWF Member: No
Catchecoma Lake	See Under: Mississagua Lake
Cold Lake	See Under: Mississagua Lake
Crab Lake	See Under: Nunikani Lake
Dark Lake	See Under: Pusey Lake
Devil's Lake	See Under: Salerno Lake
Dudman Lake	See Under: Loon Lake
Gold Lake	See Under: Mississagua Lake
Grace Lake	See Under: Pusey Lake Association: CEWF Member: Yes – joined in 2016
Grass Lake	See Under: Canning Lake

Adjacent and Other Lakes	Cross-Reference to Reservoir Lake, Alternate Names, Association & CEWF Membership Information
Haliburton Lake	See Under: Oblong Lake Association: Haliburton Lake Cottagers Association CEWF Member: Yes
Head Lake	See Under: Canning Lake
Kashagawigamog Lake	See Under: Canning Lake Association: Lake Kashagawigamog Organization CEWF Member: Yes
Kelly Lake	See Under: Kennisis Lake
Lipsy Lake	See Under Kennisis Lake
Little Boshkung Lake	See Under: Twelve Mile Lake
Little Brother Lake	See Under: Halls Lake
Little Hawk Lake	See Under: Big Hawk Lake
Little Kennisis Lake	See Under: Kennisis Lake
Little Redstone Lake	See Under: Redstone Lake
Maple Lake	Not part of any reservoir, a member of the Maple Lake chain of flow-though lakes on the upper Gull system CEWF Member: Yes
Miskwabi Lake	See Under: Long Lake Association: Miskwabi Area Community Association CEWF Member: Yes
Moose Lake	See Under: Eagle Lake
Mountain Lake	See Under: Horseshoe Lake Association: Mountain Lake Property Owners Association CEWF Member: Yes
Otter Lake	See Under: Esson Lake
Paint Lake	See Under: Red Pine Lake
Pine Lake	See Under: Gooderham Lake
Salerno Lake	See Under: n/a (MNR dam – not TSW reservoir) Alternate Names: Devil’s Lake Association: Salerno Devil’s Lake Cottagers Association CEWF Member: No
Soyer Lake	See Under: Canning Lake Alternate Names: Soyers Lake Association: Soyers Lake Rate Payers Association CEWF Member: Yes
Spruce Lake	See Under: Drag Lake
St. Nora Lake	See Under: Kushog Lake
Trout Lake	See Under: Sherborne Lake

APPENDIX C: INDIVIDUAL LAKES PREFERRED WATER LEVELS DOCUMENTS:

(in order, by sub-watershed, starting with headwater lakes)

Individual Lakes One-Page Summary PWL Charts:

Coalition for
Equitable
Water Flow

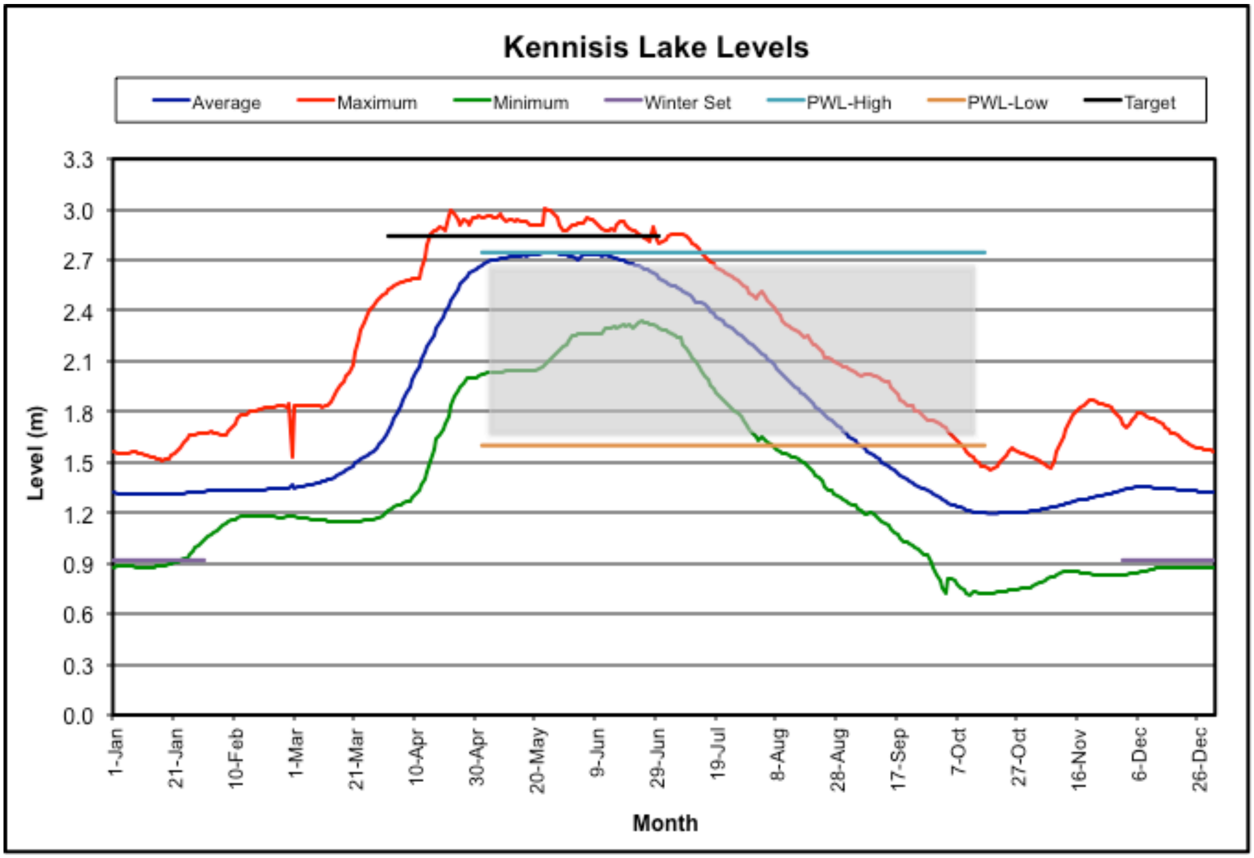
“Preferred Water Levels” During the Navigation Season for

Kennisis Lake

Contents

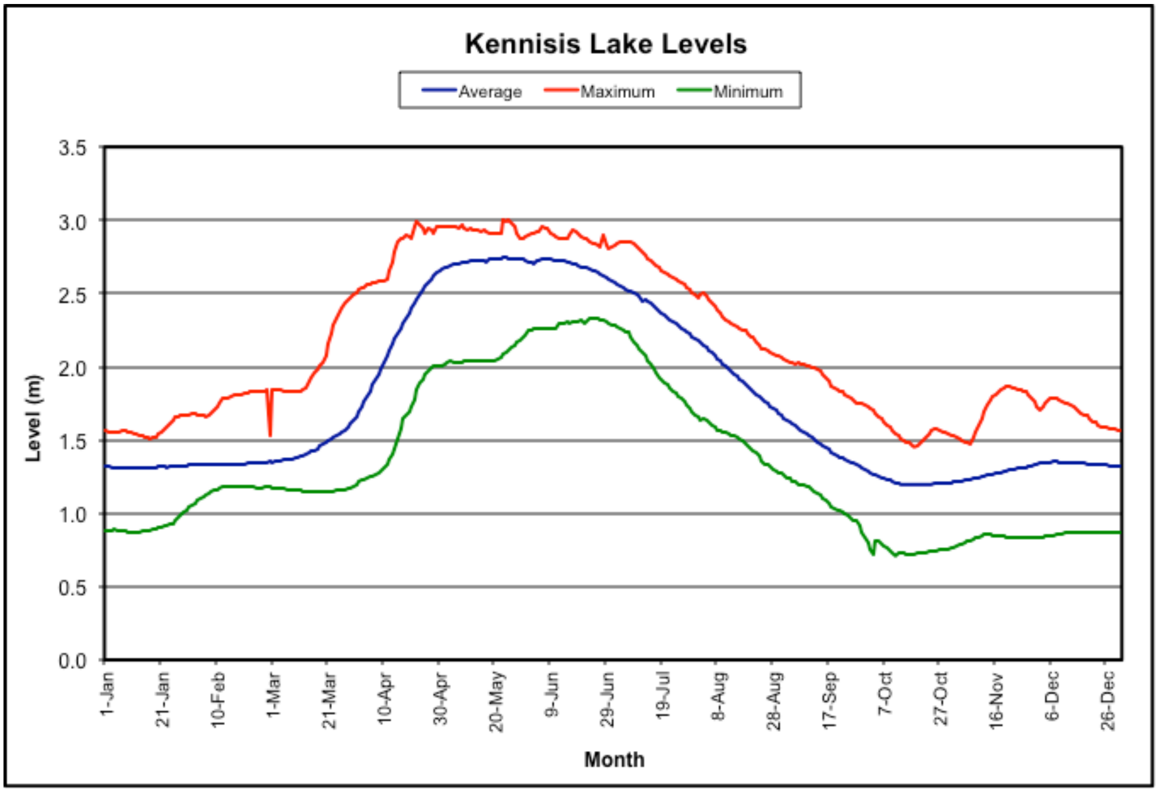
Approval and Endorsement

The preferred water levels identified in this document were approved by the Kennisis Lake Cottage Owners Association Board and endorsed unanimously by the Members at their Annual General Meeting on September 3, 2011.



Kennisis Lake: Historic Water Levels

The following chart records the multi-year average water level (blue line) on Kennisis Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Kennisis Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 9.5 logs in place	2.90m	100% full
TSW Target level in Spring	2.84m	98% full
TSW Winter set level - 3 logs in place	0.92m	32% full
Nominal water level fluctuation (per logs)	1.92m	66% of capacity
Historic average fluctuation (per chart)	1.54m	53% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Kennisis Lake – Preferred Water Levels

Key lake statistics:

Drainage area: 174 sq. km.
Lake area: 1641 ha.
Maximum storage volume: 4,657 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Low-lying cottages flooded
- Shoreline erosion greatly increased
- Ice damage more likely
- Clearance at bridges reduced

Water Levels "too low"

- Access to 'water access' properties restricted
- Inability to navigate between lakes due to low water
- Inability to trailer boats at boat launches
- Water intakes lines prone to freezing in areas with shallow shorelines
- Unmarked navigational hazards created
- Wetlands dry out

Lake Levels rising in June (after normal seasonal high)

- Wetland habitat degraded in prime breeding season for aquatic wildlife

Lake Levels falling in October

- Shallow Trout spawning beds may dry out (known beds are deep on Kennisis)

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 2.75 metres above the sill plate is proposed. This is equal to the multi-year average for early June and represents 95% of the full range available for control by the TSW. This water level is 6" below the top of the dam with all logs in place as compared to the TSW 'target' of 98% full, equal to 2" below the top of the dam.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 1.60 metres and become severe at 1.20 metres above the sill plate. The 1.60 metre level is equal to the multi-year average for September 1st and represents 55% of the full range available for control by the TSW. This water level is 51" below the top of the dam.

KLCOA thus supports a preferred water level range of 1.60 – 2.75metres during the navigation season.

Winter-set Level

KLCOA understand that the traditional winter-set level at the Kennisis dam is 0.9 m (3 logs in). To achieve this level before mid-October trout spawning season typically requires the lake to be drawn down below the lower preferred water level limit during the navigation season. A review of the winter-set level may therefore be appropriate.

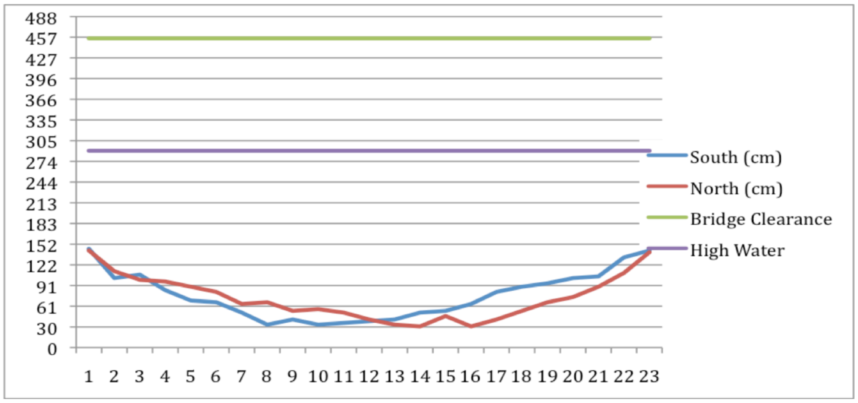
Worked example: Navigation under the Bridge between Big and Little Kennisis Lakes

(This is provided as one example of a constraint that supports the KLCOA position)

Of the 1047 waterfront properties on the Kennisis lakes, 286 are located on Little Kennisis Lake. Navigation between the only marina on the lake and Little Kennisis Lake requires passage under a road bridge. The channel is shallow and there is limited clearance under the bridge. If the water level is too high, some boats do not have sufficient clearance. If the water level is too low there is inadequate draft.

An analysis of the channel profile plus an evaluation of boat characteristics has been conducted. The following is a summary of the findings:

- the bottom of the centre of the channel is 0.3 m above the sill plate
- the channel profile is a regular 'shallow-saucer' shape
- assuming the navigational channel occupies 60% of the overall width of the channel there are high-spots that are 0.8 m above the sill plate.
- The underside of the bridge roadbed is 4.6 m above the sill plate
- Most boats could pass under the bridge if there was a minimum clearance of 1.8 m
- There is thus sufficient clearance at a water level of 2.8 m (close to TSW's full condition)
- Most boats require a draft of less than 0.8 m
- There should therefore be sufficient draft if the water level is greater than 1.6 m
- This allows TSW an operating range of 1.2 m (1.6 to 2.8 m) during the navigation season.



An environmentally acceptable approach to dredging the channel to remove 'erratic' rocks would be desirable and would allow for greater fluctuation in water level without impacting navigation.

<u>Paddy's Bay Bridge</u>

A second bridge providing access from the main lake to Paddy's bay has been profiled as well. Although the channel is about 1.0 m above the sill plate and the underside of the roadbed is 4.2 m above the sill plate, it is typically smaller boats that use this channel. No additional water level constraints are therefore deemed essential. Although dredging of the channel would certainly improve access.

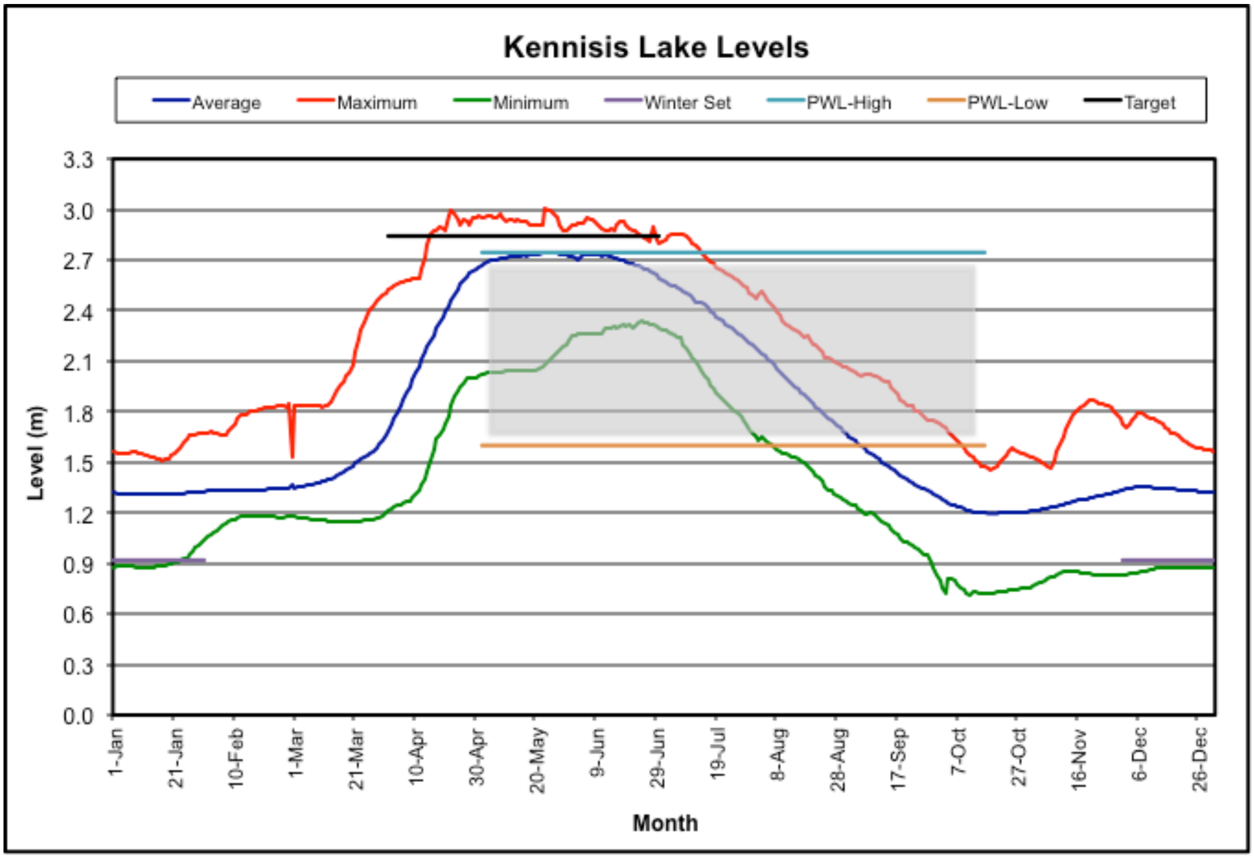
Kennisis Lake: Comparison of Historic and Preferred Water Levels

The following chart superimposes the KLCOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 3 logs in the dam;
- the preferred **upper limit** of 2.75 m for the water level during the navigation season, equivalent to 9 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.6 m for the water level during the navigation season, equivalent to 5 logs in the dam, is typically breached in September, or as early as August in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 4 logs instead of 3.



Coalition for
Equitable
Water Flow

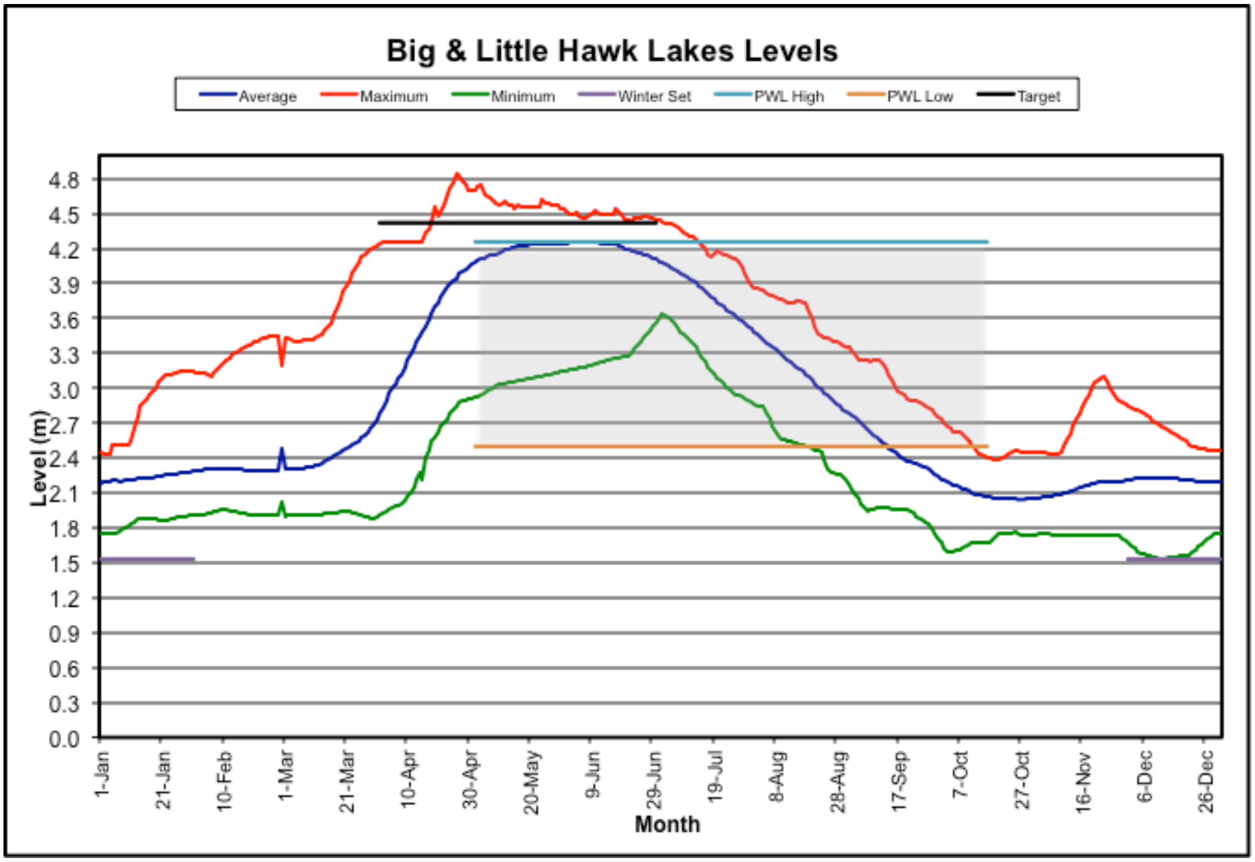
"Preferred Water Levels" During the Navigation Season for

Big & Little Hawk Lakes

Contents

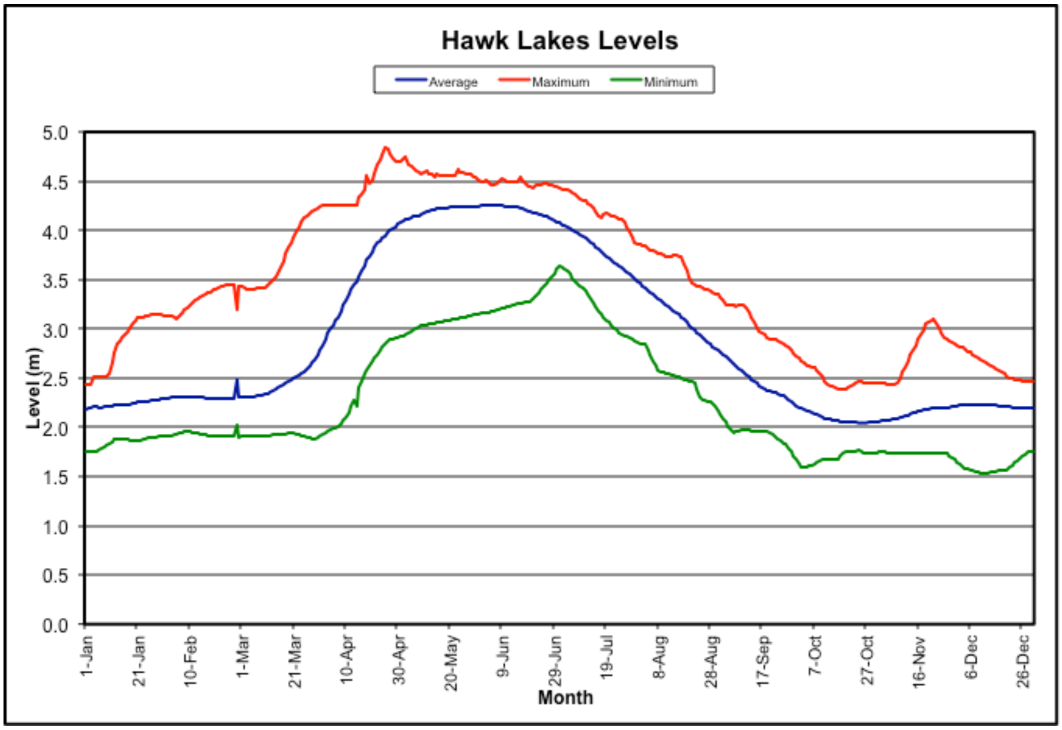
Approval and Endorsement

The preferred water levels identified in this document were approved by the Halls and Hawk Lakes Property Owners Association Board on March 16, 2017 and will be tabled for endorsement by the (Hawk lakes) Members at their AGM on July 2, 2017.



Big Hawk and Little Hawk Lakes: Historic Water Levels

The following chart records the multi-year average water level (blue line) on the Hawk lakes since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Big Hawk Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	
Sill plate deduction	0.38m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 14.5 logs in place	4.42m	100% full
TSW Target level in Spring	4.42m	100% full
Maximum Available Storage Depth (per logs)	4.04m	
TSW Winter set level - 5 logs in place	1.53m	28% full
Nominal water level fluctuation (per logs)	2.89m	72% of capacity
Historic average fluctuation (per chart)	2.20m	54% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Big Hawk & Little Hawk Lakes – Preferred Water Levels

Key lake statistics:

Drainage area: 62.5 sq. km.
Lake area: 842 ha.
Maximum storage volume: 2,748 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels “too high”

- Low-lying cottages flooded
- Old logs and deadheads dislodged from their locations and float causing navigation hazards and damage to docks and moored boats
- Dock mooring points on shore under water so they cannot be attached properly.
- Shoreline erosion greatly increased
- Ice damage more likely
- Clearance at bridges reduced - Big Hawk Marina and government boat launch cut off from the rest of the lake to larger boats due to low clearance.

Water Levels “too low”

- Access to ‘water access’ properties restricted
- Inability to navigate between lakes or access marina due to low water
- Inability to trailer boats at boat launches
- Water intakes lines prone to freezing in areas with shallow shorelines
- Waterway to Big Brother, Little Brother, and Saskatchewan Lakes becomes hazardous to navigate.
- Unmarked navigational hazards created
- Current under bridge at Big Hawk Marina becomes strong and dangerous to navigate
- Waterway through the Narrows becomes impassable.
- Water recedes to far from shore making it impossible to keep docks attached.
- Wetlands dry out
    - - Little Brother Lake – large areas become dried out
    - - Little Hawk Lake – Large wetland to the north dries out completely.

Lake Levels rising in June (after normal seasonal high)

- Wetland habitat degraded in prime breeding season for aquatic wildlife
- Water fowl who nest close to the shoreline have their nests flooded preventing them from reproducing

Lake Levels falling in October

- Docks and boats may become dislodged from their moorings
- Shallow trout spawning beds may dry out

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 4.25 metres above the sill plate is proposed. This is equal to the multi-year average for early June and represents 96% of the full range available for control by the TSW. This water level is 0.17m (7”) below the top of the dam with all logs in place as compared to the TSW ‘target’ of 100% full.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 2.5 metres and become severe at 2.0 metres above the sill plate. The 2.5 metre level is equivalent to the multi-year average for mid-September and represents 48% of the full range available for control by the TSW. This water level is 1.9m (74”) below the top of the dam.

HHLPOA thus supports a preferred water level range of 2.50 – 4.25 metres during the navigation season.

Winter-set Level

HHLPOA understands that the traditional winter-set level at the Big Hawk dam is 1.53 m (5 logs in). To achieve this level before mid-October trout spawning season typically requires the lake to be drawn down below the lower preferred water level limit during the navigation season. A review of the winter-set level may therefore be appropriate.

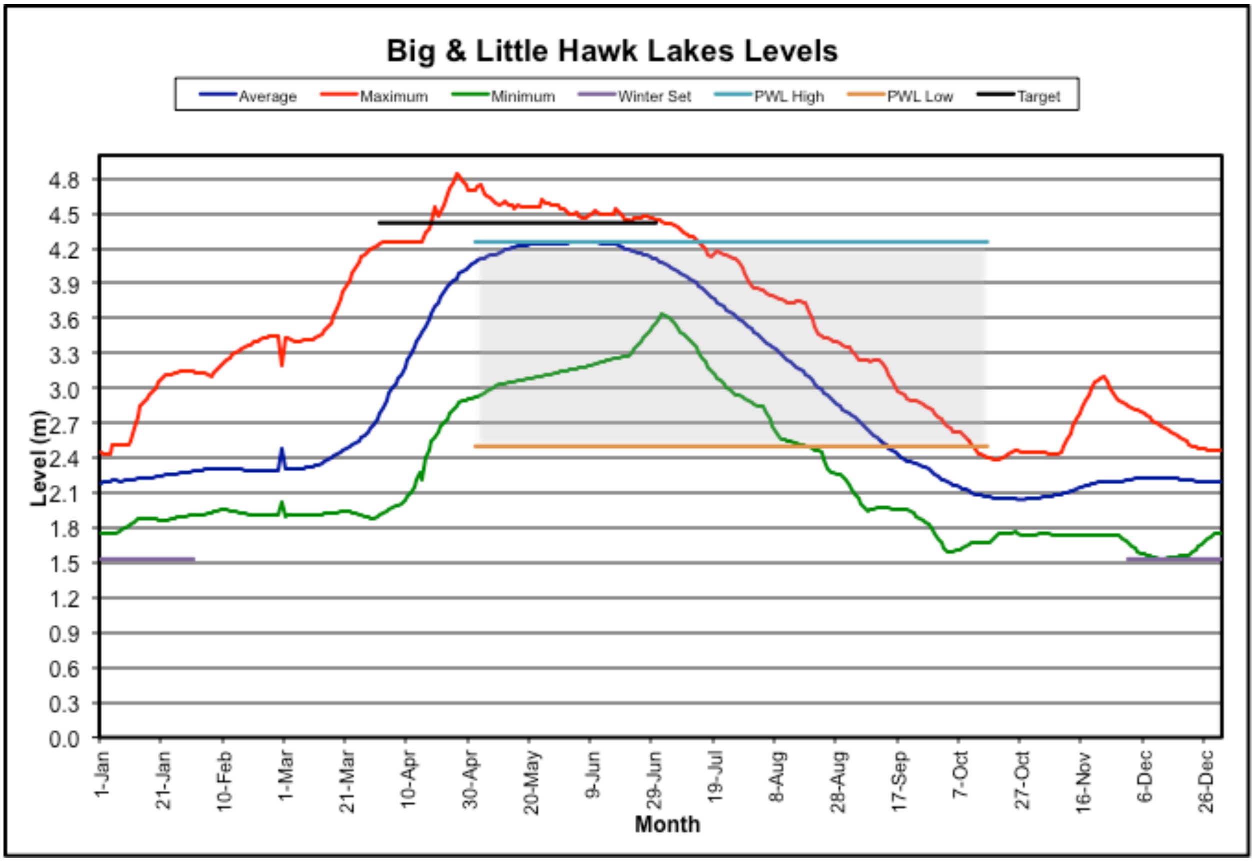
Big Hawk & Little Hawk Lakes: Comparison of Historic and Preferred Water Levels

The following chart superimposes the HHLPOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted ‘full’ level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 5 logs in the dam;
- the preferred **upper limit** of 4.25 m for the water level during the navigation season corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 2.50m for the water level during the navigation season, equivalent to 5 logs in the dam, is typically breached in late September, or as early as late August in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 6 logs instead of 5.



Coalition for
Equitable
Water Flow

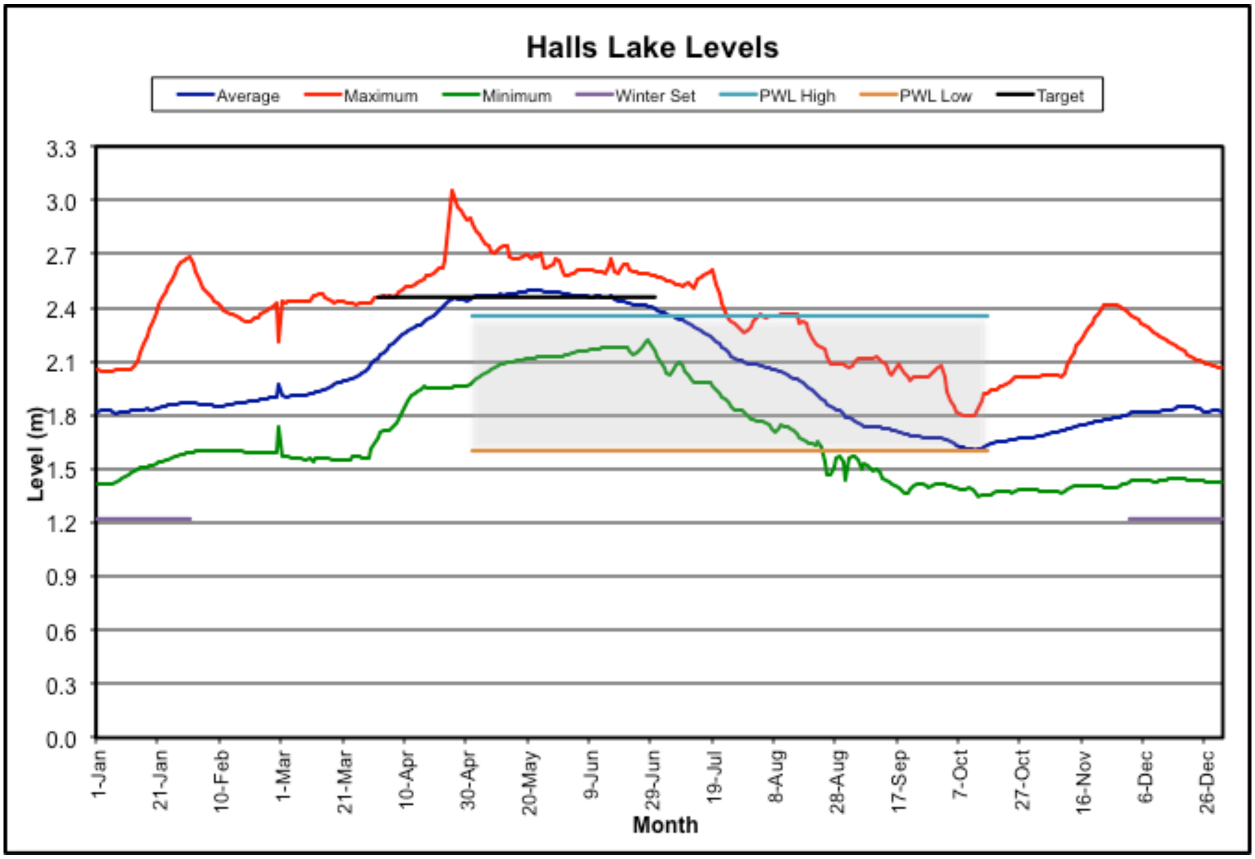
"Preferred Water Levels" During the Navigation Season
for
Halls Lake

Contents

1. Historic water level data: average, high and low
2. Preferred water levels during the navigation season
3. Comparison of Historic and Preferred water levels
4. Composite Preferred Water Level chart

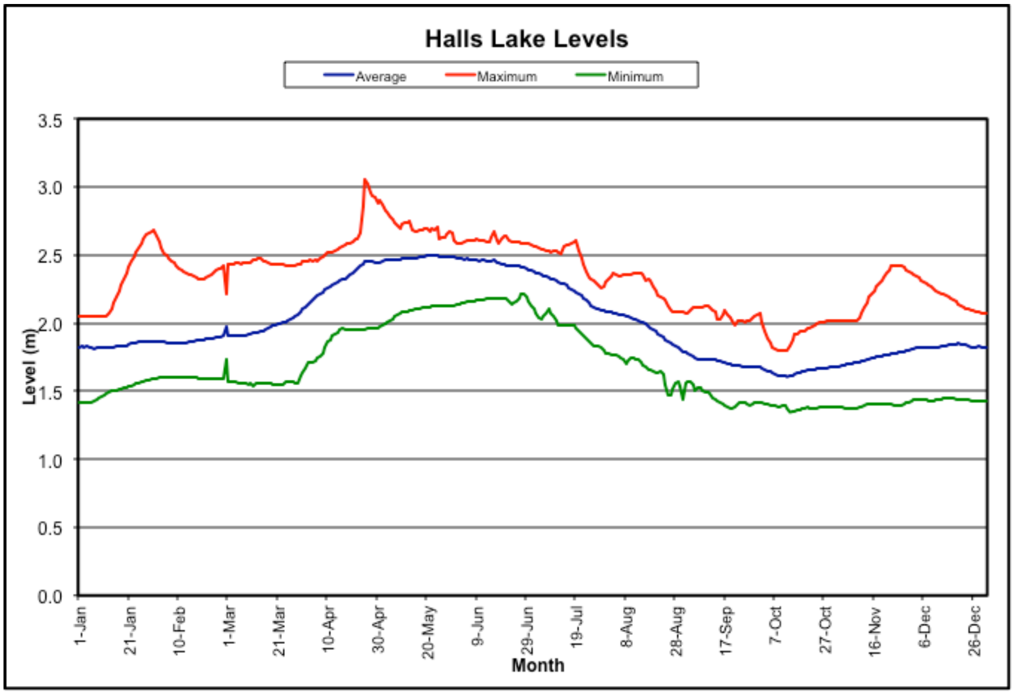
Approval and Endorsement

The preferred water levels identified in this document were approved by the Halls and Hawk Lakes Property Owners Association Board on March 16, 2017 and will be tabled for endorsement by the (Halls lake) Members at their AGM on July 2, 2017.



Halls Lake: Historic Water Levels

The following chart records the multi-year average water level (blue line) on Halls Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Halls Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	
Sill plate deduction	0.91m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 8.5 logs in place	2.59m	100% full
TSW Target level in Spring	2.46m	95% full
Maximum Available Storage Depth (per logs)	1.68m	
TSW Winter set level - 4 logs in place	1.22m	18% full
Nominal water level fluctuation (per logs)	1.68m	82% of capacity
Historic average fluctuation (per chart)	0.90m	56% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Halls Lake – Preferred Water Levels

Key lake statistics:

Drainage area:	21.5 sq. km.
Lake area:	529 ha.
Maximum storage volume:	819 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels “too high”

- Deadheads and logs can be dislodged and float to where they can be a navigation hazard and or cause damage to docks boats and boat houses
- Low-lying cottages flooded: there are several cottages on Old Mill Rd. that are within 2 feet of the high water mark; they are at great risk of flooding
- Shoreline erosion greatly increased; e.g. on the Kennisis River there is heavy erosion on the outer banks of the river bends: this causes significant property damage
- Ice damage more likely: - cottages with fixed wharfs and older boat houses are at risk when the water levels come up before the ice is out

Water Levels “too low”

- Inability to trailer boats at boat launches: boat launch at Old Mill is short and is difficult to use in the fall as trailers must drive off the end under water
- Unmarked navigational hazards created
- Wetlands dry out
- Mouth of the River becomes too shallow to navigate causing river bound boat owners to not have access to the government boat launch

Lake Levels rising in June (after normal seasonal high)

- Wetland habitat degraded in prime breeding season for aquatic wildlife
- Cottagers who have installed their temporary docks may have them washed away

Lake Levels falling in October

- Waterlines become exposed or moved because of the water fluctuation
- Shallow Trout spawning beds may dry out

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 2.35 metres above the sill plate is proposed. This is equal to 0.15m (6”) below the multi-year average of 2.50m for early June, which corresponds to the TSW’s 95% target full level of 2.46m.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 1.6 metres, equal to the multi-year average for early October. This being said there are fewer navigational hazards on Halls Lake than the typical reservoir lake due to its shape and depth. It would be less of an impact on cottagers to have a lower water level at the end of the navigational season than a too high water level at the beginning.

HHLPOA thus supports a preferred water level range of 1.60 – 2.35 metres during the navigation season.

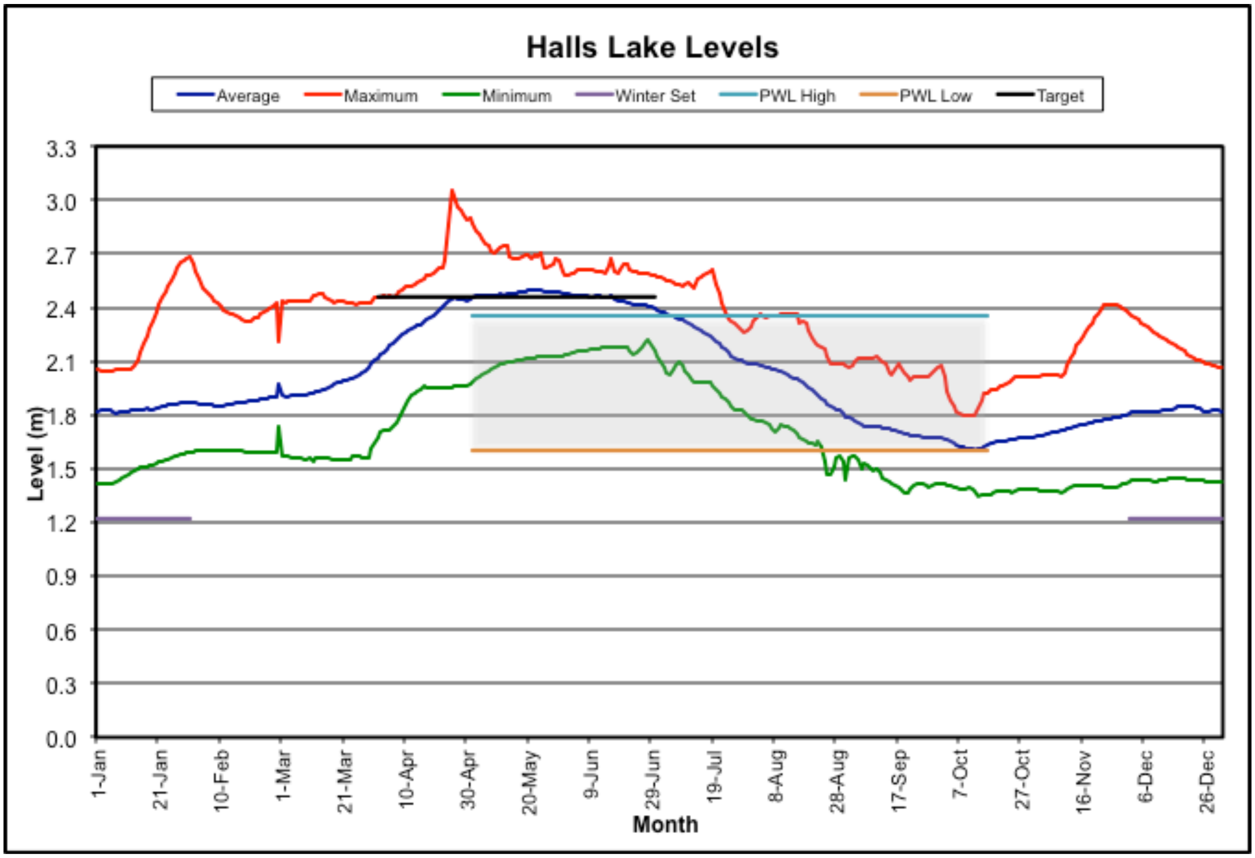
Halls Lake: Comparison of Historic and Preferred Water Levels

The following chart superimposes the HHLPOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 4 logs in the dam;
- the preferred **upper limit** of 2.35 m for the water level during the navigation season corresponds to 0.155m (6") below the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.60m for the water level during the navigation season, is typically maintained into October, except in a dry year when this level can be breached by September 1st



"Preferred Water Levels" During the Navigation Season for

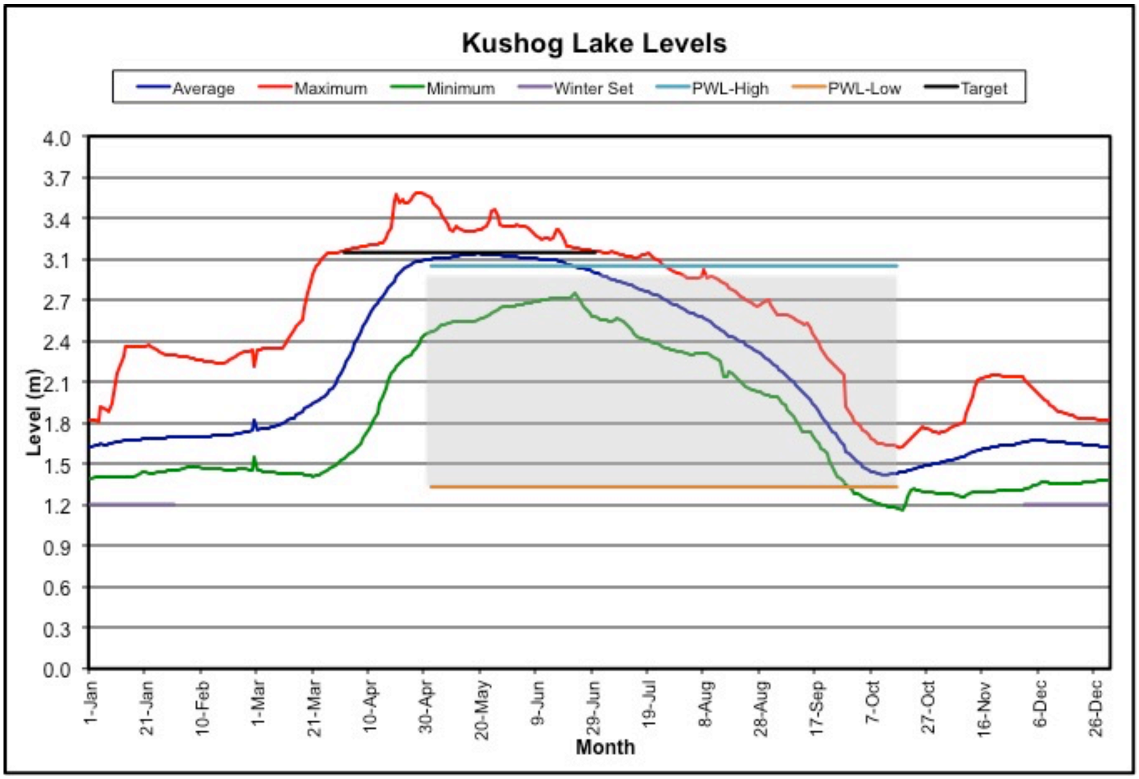
Kushog Lake

Contents

1. Historic water level data: average, high and low
2. Preferred water levels during the navigation season
3. Comparison of Historic and Preferred water levels
4. Composite Preferred Water Level chart

Approval and Endorsement

The preferred water levels identified in this document were approved by members of the Kushog Lake Property Owners Association (KLPOA) based on a newsletter article and follow-up survey conducted by the Association in Spring 2015.[1]



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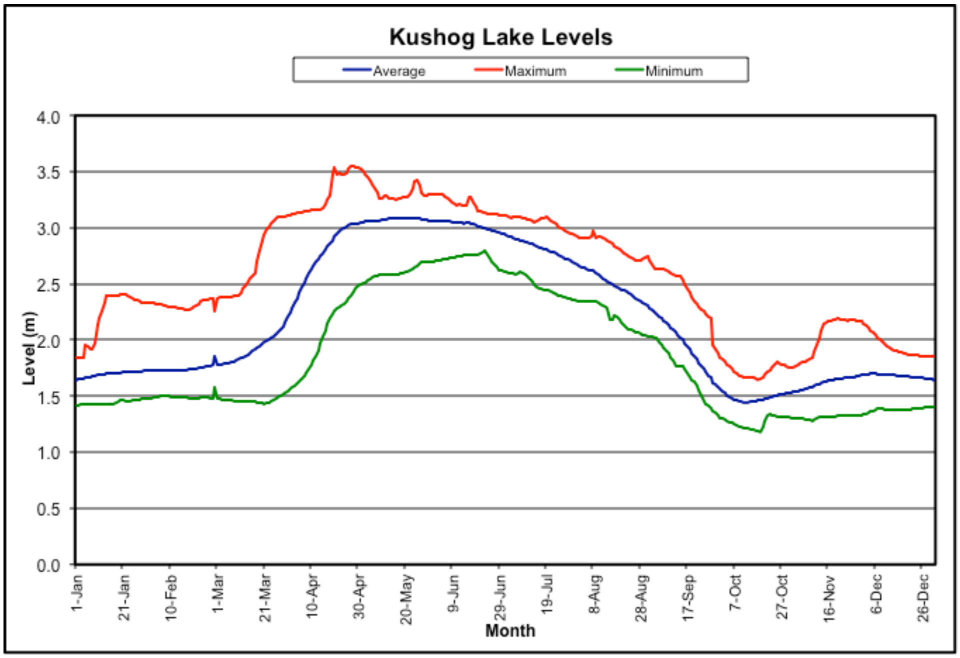
[1] . The survey was part of the annual membership form and went to 501 property owners on the lake; 62 out of 201 members (31%) specifically endorsed the document, 1 member did not endorse the proposal, 2 had comments, and the remainder provided no response.

Kushog Lake: Historic Water Levels

The following chart records the multi-year average water level (blue line) on Kushog Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Kushog Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	
Sill Plate Deduction[2]	1.22m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 10.5 logs in place	3.20m	100% full
TSW Target level in Spring	3.10m	95% full
Maximum Storage Depth (per logs)	1.98m	
Maximum Storage Depth (w. 95% constraint)	1.88m	
TSW Winter set level - 4 logs in place	1.22m	0% full
Nominal water level fluctuation (per logs)	1.98m	100% of capacity
Historic average fluctuation (per chart)	1.63m	82% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

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[2] Deduction typically due to obstruction upstream of the dam that limits extent of possible drawdown.

Kushog Lake – Preferred Water Levels

Key lake statistics:

Drainage area:	111 sq. km.
Lake area:	915 ha.
Maximum storage volume:	1,667 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Low-lying properties flooded; foundations weakened, basements flooded
- Shoreline erosion greatly increased; Boat wakes run further up shoreline
- Ice damage more likely
- Wetlands swamped – nests flooded, habitat degraded
- Clearance at Ox Narrows bridge reduced, even restricted
- Unmarked navigational hazards hidden, e.g. large rock at Shangri La
- Shoreline debris floats away and may present boating hazard
- Docks become detached from shore

Water Levels "too low"

- Difficulty navigating between Kushog and St. Nora Lakes
- Water intake lines may not be long enough to provide water; prone to freezing and/or 'suck air' – especially in areas with shallow shorelines
- Unmarked navigational hazards created e.g. rocks in channel leading to Buckslide Dam
- Wetlands dry out
- Boats and docks may become marooned on dry shore-land

Lake Levels rising in June (after normal seasonal high)

- Loon nests become inundated
- Wetland habitat degraded in prime breeding season for aquatic wildlife

Lake Levels falling in October

- Shallow Trout spawning beds at Ox Narrows may dry out exposing eggs

Kushog Lake Specific Concerns:

Loon Nesting:

KLPOA participates in the Canadian Loon Survey and is very concerned about the decline in the loon population on Kushog Lake. Loons return as soon as the ice is out – mid April. Usually one or two eggs are laid in late May or June, and incubation of eggs generally lasts 26-28 days (through July). If the water level rises after the eggs are laid, the nest may become flooded; if the water level drops, the loons may not be able to 'walk' to the nest and the eggs are more vulnerable to predators. To mitigate the unstable water levels on Kushog Lake, a number of loon nesting platforms have been installed.

Lake Trout Spawning:

Lake Trout spawn at Ox Narrows, a protected area. KLPOA is very concerned about the health of our lake trout population and has observed and recorded spawn activity almost daily during spawning season for the past 6 years. Flow affects the build-up of silt – KLPOA has twice cleaned silt off the spawning beds. We recognize that TSW and MNR work together to ensure an appropriate water level over the spawning beds during this time and encourage this continued cooperation.

Upper preferred water level limit
We have had a recognized agreement with TSW that Kushog Lake only be filled to 95% (3.1 meters), which we would like to maintain. This is essentially equal to the multi-year average for all of May. A rapid water level increase during April and May (from the winter set level to 95% full) would get the water level up before the loons nest and before property owners position their docks.

Kushog Lake Specific Seasonal Adjustments & Lower preferred limit of water level
A gradual drawdown from 95% (3.1 meters) to 2.3 meters during the months of July and August would provide a relatively stable shoreline during the navigation season. A subsequent rapid drawdown to a low of 1.35 meters during September and early October would prepare the spawning beds at Ox Narrows for the trout to spawn. Spawning season is mid-October to mid-November. After the spawn is finished, a slight increase in water levels to protect the eggs would prepare for winter. Thus a lowest level of 1.35 meters is suggested.

KLPOA thus supports a preferred water level range of 1.35 – 3.10metres during the navigation season.

Winter Set Level: TSW reference is 4 logs in place, 1.22 meters, 0% full. The average level from December 1st to January 31st has been 1.7 meters. What happens next has been very dependent on the weather.

Conclusion:
KLPOA has enjoyed a respectful and cooperative relationship with TSW over many years. KLPOA recognizes the challenges that TSW faces in satisfying the needs and demands of its many competing constituents. We appreciate that we are now being notified of forecasted changes in water level – this is critical to our being able to notify our property owners when they need to plan to protect their property. The installation of a new automated water level measuring gauge at Buckslide Dam may assist the TSW with making more timely adjustments. Our wish is that Kushog Lake not be filled over 95%, that the level remain relatively stable during the summer months, that the level not drop after the lake trout spawn, and that we be kept informed when rapid changes are anticipated.

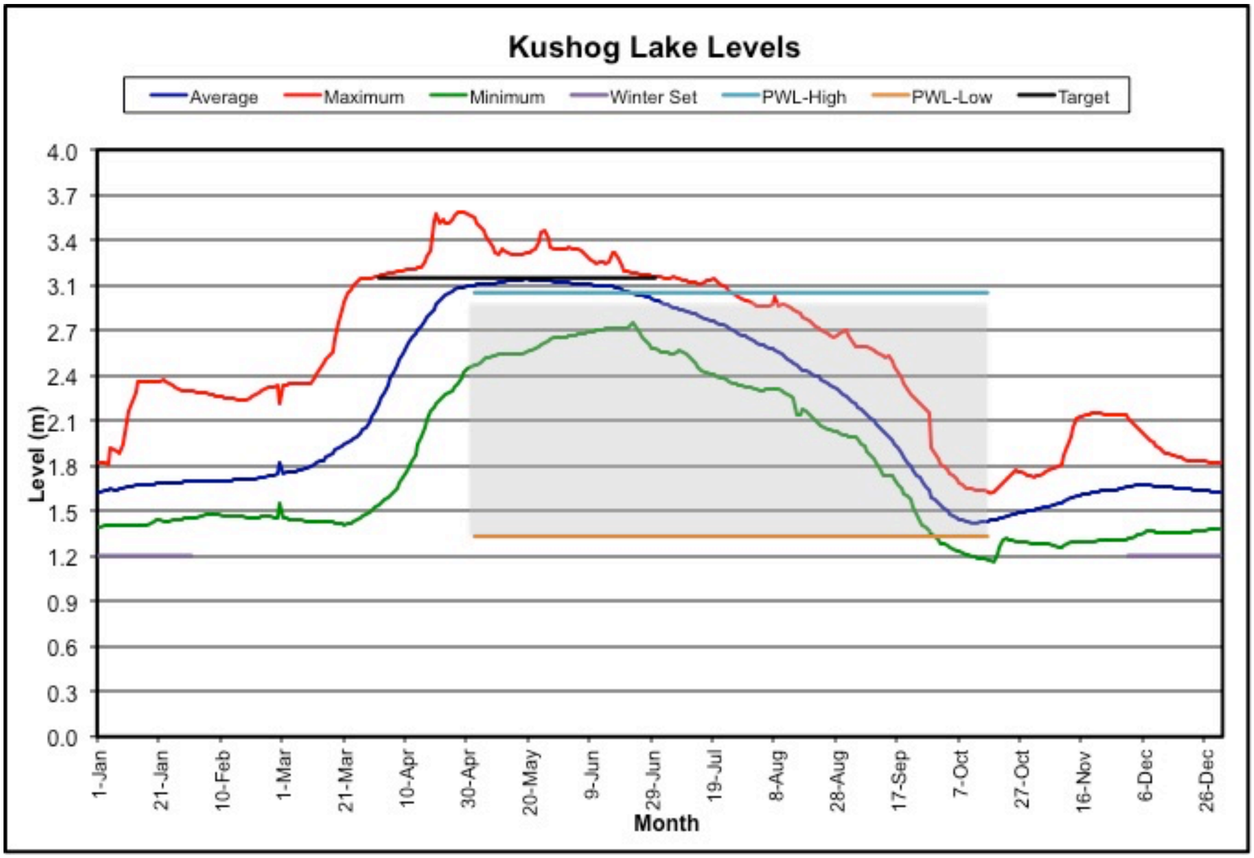
Kushog Lake: Comparison of Historic and Preferred Water Levels

The following chart superimposes the KLPOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 4 logs in the dam;
- the preferred **<u>upper limit</u>** of 3.10 m for the water level during the navigation season, equivalent to 95% full, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **<u>lower limit</u>** of 2.3 m up to August 31st and 1.35 m by mid-October is typically maintained in an average year.



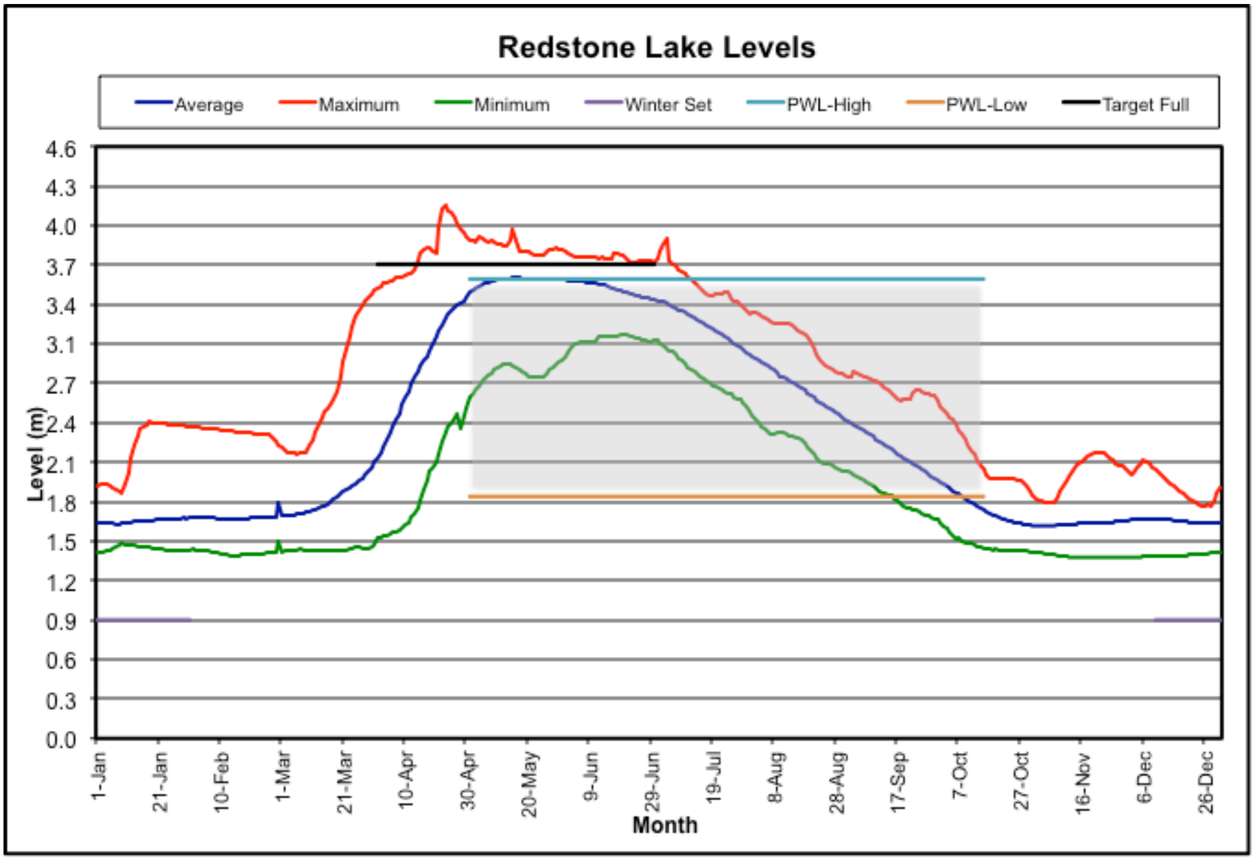
Coalition for
Equitable
Water Flow

"Preferred Water Levels" During the Navigation Season
for
Redstone Lake

Contents

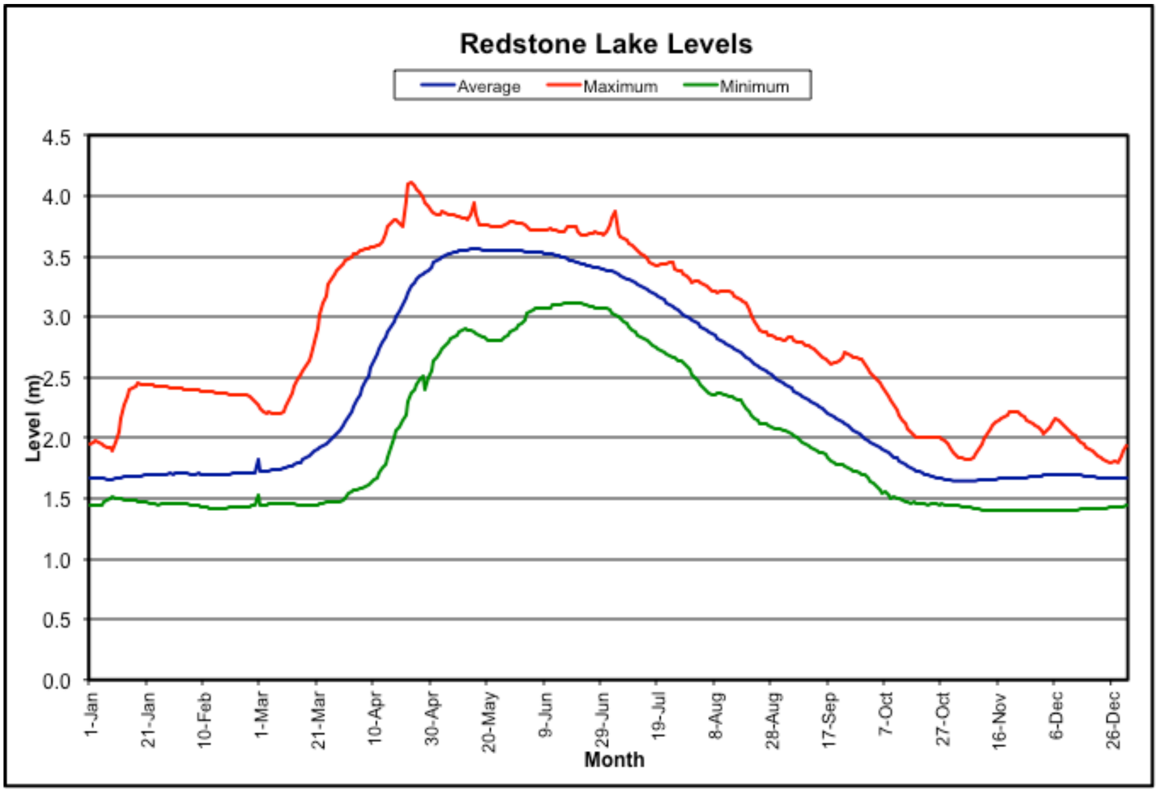
Approval and Endorsement

The preferred water levels identified in this document were ratified by the Redstone Lake Cottagers Association (RLCA) Board of Directors in 2011 with minor revisions endorsed in February 2013 following discussions with CEWF.



Redstone Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Redstone Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using gauges located at the Redstone Lake (East & West) dams. The water level is measured in metres (m) above the sill plate of each dam. Data for the West dam are reported below.

Key reference points:

Sill plate level (adjusted)	0.76m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 12 logs in place	3.66m	100% full
TSW Target level in Spring	3.66m	100% full
TSW Winter set level - 4 logs in place	1.22m	16% full
Nominal water level fluctuation (per logs)	2.44m	84% of capacity
Historic average fluctuation (per chart)	1.91m	66% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Redstone Lakes – Preferred Water Levels (Revised February 2013)

Key lake and Dam statistics:

Drainage area: .... 169 sq. km.
Lake area: .... 1442 ha.
Maximum storage volume: .. 4,118 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Shoreline erosion greatly increased
- Ice damage more likely

Water Levels "too low"

- Access to 'water access' properties restricted
- Inability to navigate between lakes due to low water
- Water intakes lines prone to freezing in areas with shallow shorelines
- Unmarked navigational hazards created
- Wetlands dry out

Lake Levels rising in June (after normal seasonal high)

- Wetland habitat degraded in prime breeding season for aquatic wildlife

Lake Levels falling in October

- Shallow Trout spawning beds would dry out

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 3.35 metres is preferred. Recognizing that this may unduly reduce the storage capacity available to the TSW, the RLCA is willing to adjust the upper preferred level to the multi-year average of 3.55 metres. This equates to one half-log lower than the current TSW practice which is the full 3.66 m control level.

Lower preferred limit of water level

Navigational hazards and challenges become severe when the water level of the lake drops below 1.87 metres. This equates to one log higher than current TSW practice).

RLCA thus supports a preferred water level range of 1.87 – 3.55 metres during the navigation season resulting in a water level fluctuation of five and a half feet rather than the current TSW practice of a seven-foot water level fluctuation. However, the RCLA notes that they would accept an increased upper limit resulting in a water level fluctuation of 6 feet if that were deemed necessary by the TSW in order not to breach the preferred lower limit during the navigation season.

Winter-set Level

RLCA understand that the traditional winter-set level at the East Redstone dam is 0.9 m (3 logs in) and at the West Redstone dam is 1.2 m (4 logs in). To achieve this level before mid-October trout spawning season typically requires the lake to be drawn down below the lower preferred water level limit during the navigation season. A review of the winter-set level may therefore be appropriate.

Background Information

The RCLA position reflects the Association's position from 2007 when an EcoPlans report, which informed the work of the Panel on the Future of the Trent Severn Waterway (TSW), cited Redstone's concerns about erosion, navigation and trout spawning, and included the suggestion that the high water level be set one foot lower than in recent years, and likewise the low water level be set one foot higher. It was noted that this would result in a water level fluctuation of five feet rather than the present seven feet.

In developing this position the RCLA noted that property owners constantly face issues such as erosion related to high water levels in the Spring in some parts of Redstone and low water levels overall in the Fall, and we also face navigational challenges on Pelaw, and in the narrows between Big and Little Redstone.

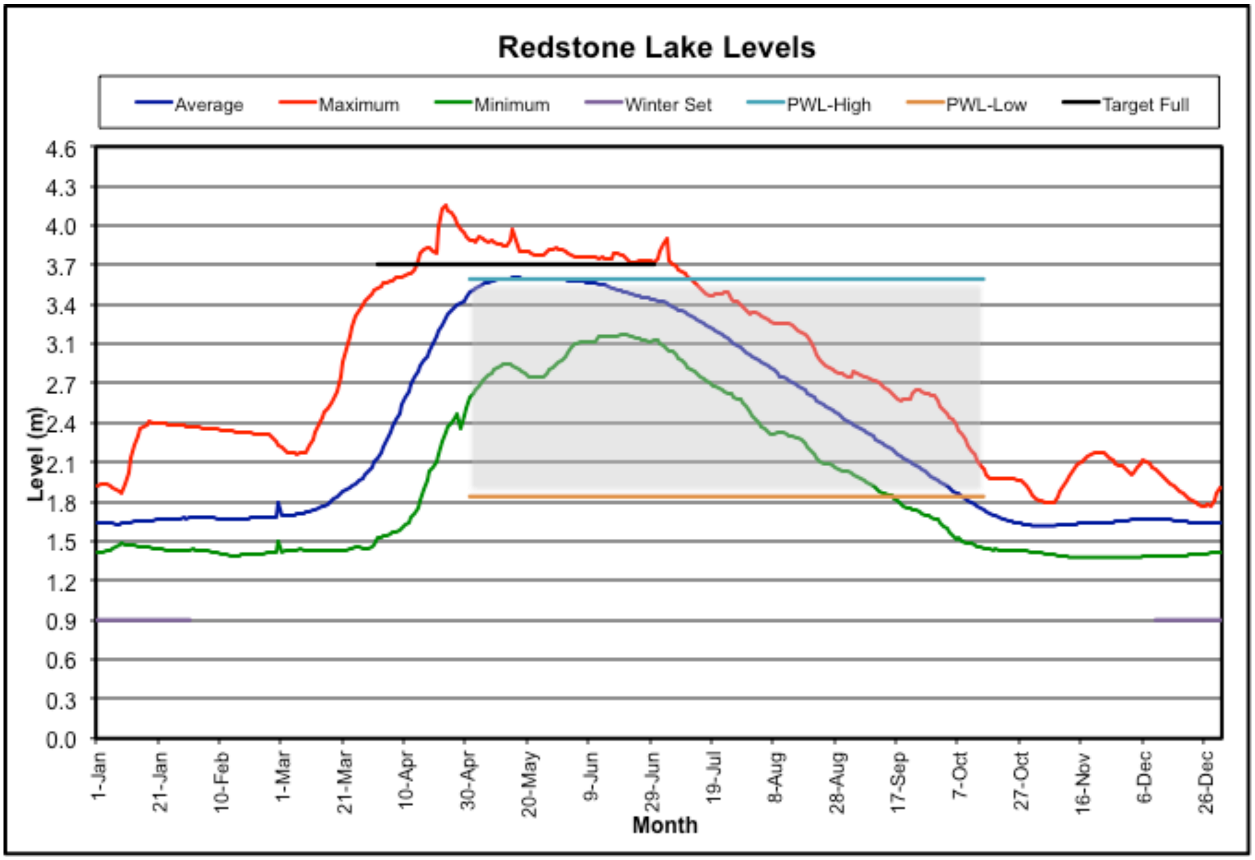
Redstone Lake Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the RLCA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the West dam: the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dams.

From the chart it can be seen that:

- the **winter-set** condition is 4 logs in the West dam (3 logs in the East dam);
- the preferred **upper limit** of 3. 55 m for the water level during the navigation season, equivalent to 11½ logs in the West dam, comparable to the multi-year average high water level.
- the preferred **lower limit** of 1.87 m for the water level during the navigation season, equivalent to 6 logs in the West dam, is typically maintained in an average year but is breached in September of a dry year. However this level has been maintained in the past as shown by the historic average and maximum. It would appear that this condition could be satisfied most years if the winter-set condition were increased by one log at each dam.



Coalition for Equitable Water Flow

“Preferred Water Levels” During the Navigation Season for

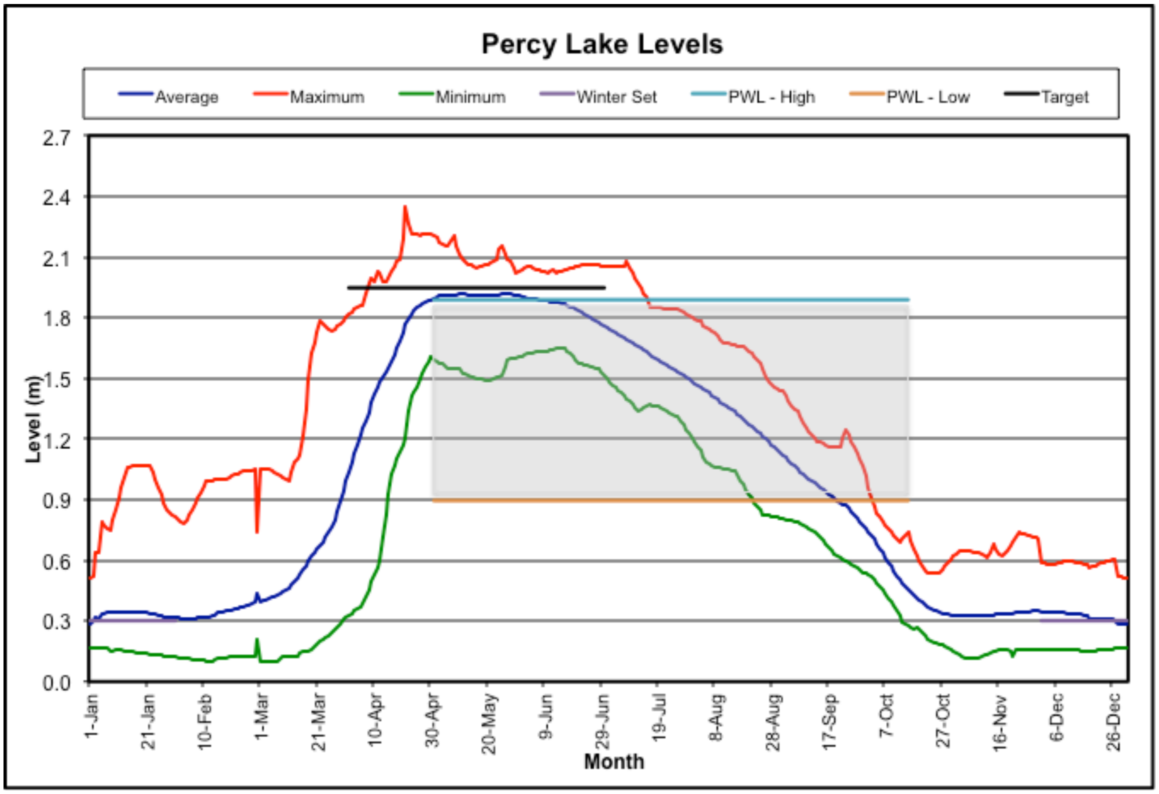
Percy Lake

Contents

1. Historic water level data: average, high and low
2. Preferred water levels during the navigation season
3. Comparison of Historic and Preferred water levels
4. Composite Preferred Water Level chart

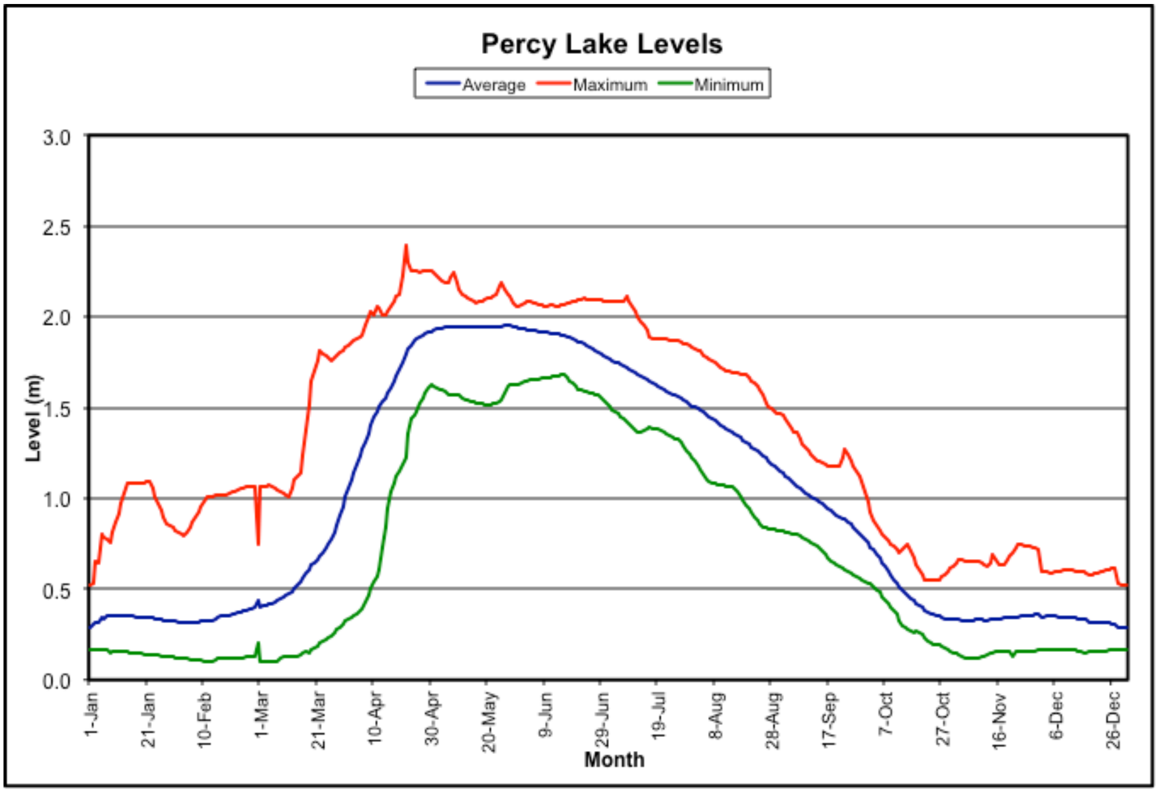
Approval and Endorsement

The preferred water levels identified in this document were approved by the Board and by the Members at the 2013 Percy Lake Ratepayers Association (PLRA) AGM.



Percy Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Percy Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Percy Lake dam. The water level is measured in metres (m) above the sill plate of the dam. Note that in about 2007 the winter-set condition was changed from 0 to 1 logs at the request of MNR to better protect trout spawning. The average and minimum data shown on the chart for winter months are therefore lower than currently experienced.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 6.5 logs in place	1.98m	100% full
TSW Target level in Spring	1.98m	100% full
TSW Winter set level - 1 log in place	0.31m	15% full
Nominal water level fluctuation (per logs)	1.67m	85% of capacity
Historic average fluctuation (per chart)	1.65m	83% of capacity

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Percy Lake – Preferred Water Levels

Key Lake and Dam statistics:

Drainage area: .... 74 sq. km.
Lake area:.................................. 563 ha.
Maximum storage volume:.. 1,115 ha-m
Log number & dimension:.... 6 @ 0.305m plus one metal 'half-log' 0.15m
Normal winter-set:................. 1 log left in (recently increased from zero at request of MNR for reasons related to trout spawning)

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- shoreline property damage if the lake is filled before the ice is out

Water Levels "too low"

- unmarked navigational hazards created with related safety concerns

Lake Levels falling in October

- Trout spawning beds can dry out

Preferred water levels 'Rule Curve'

The 2007 Percy Lake Ratepayers Association (PLRA) Watershed Plan noted that:
We are concerned about the water levels at Percy Lake. The majority of property owners would like the lake level fluctuations to be moderated. The lake level is too high in the spring, which causes erosion of the shoreline. The lake level is too low too early in the fall, which exposes the fish spawning grounds, and makes it very difficult to use the boat launch to take boats out of the lake for the winter.
See http://www.plra.net/index.cfm?page=TrentServern and also http://www.plra.net/docs/plrawp.pdf

A survey carried out for the PLRA Watershed Plan led to production of a preferred water levels chart (see below) that is the basis for the following preferred water level limits which were approved by the Board and by the Members at the 2013 PLRA AGM.

The PLRA Board noted that there is a preference for letting the downstream lakes fill before adding logs to the Percy Lake dam prior to April 1st. The rationale is that if there is a lack of snow-pack the downstream lakes would need the water and so it should not be trapped at the head of the chain of lakes.

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 1.92 metres is proposed. This corresponds with there being 6 logs in the dam plus a small head of water flowing over the dam. It also corresponds to the multi-year average high water level experienced in May.

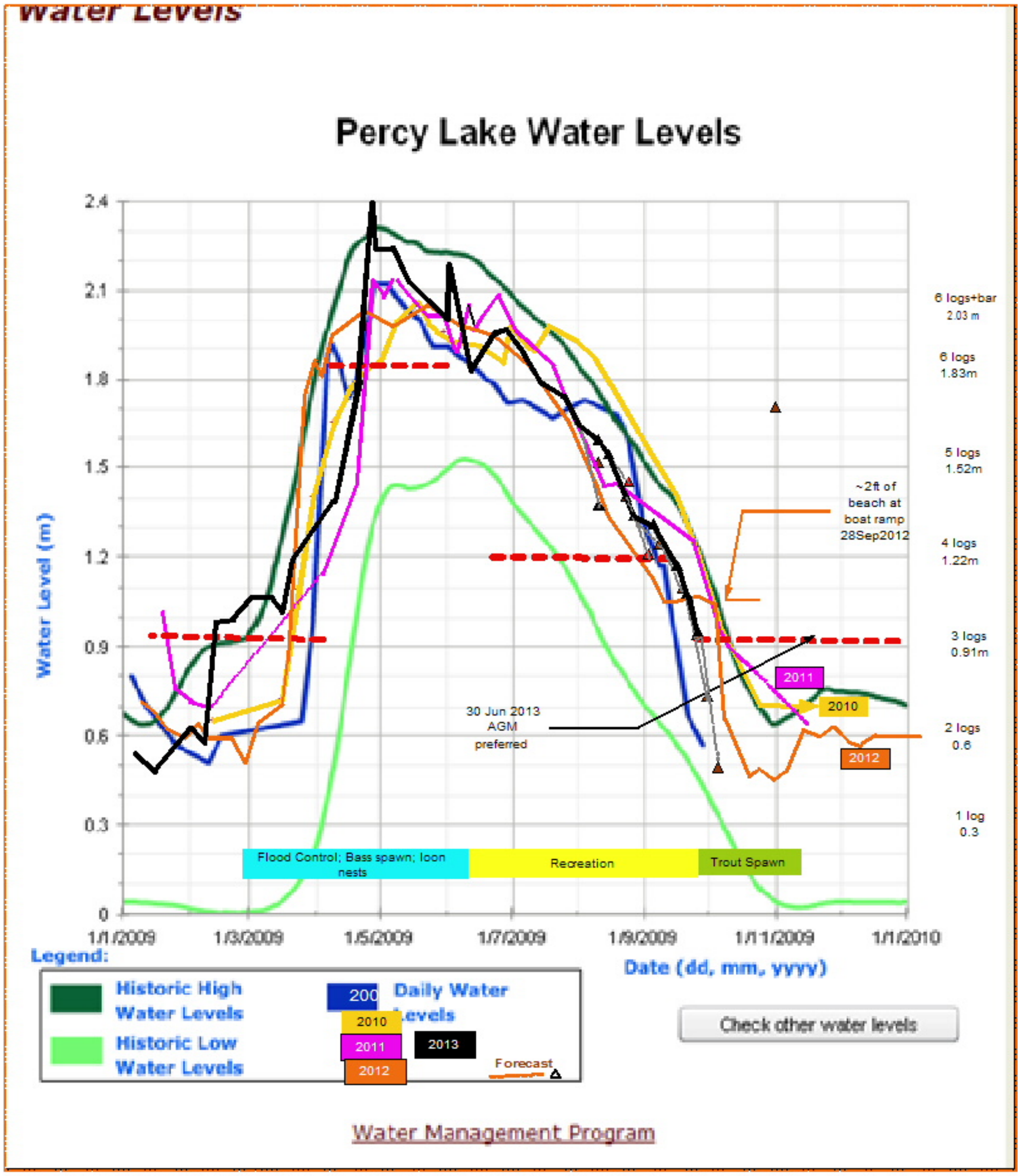
Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below0.96 metres. This corresponds to 2-3 logs in the dam. Below this level there are concerns due to exposure of trout spawning beds and it becomes extremely difficult to use the boat launch to remove boats for the winter.

The PLRA thus supports a preferred water level range of between 0.96 and 1.92 metres during the navigation season (equivalent to the number of logs left in the dam being between '3' and '6' logs).

Winter-set Level

PLRA understands that the traditional winter-set level at the Percy Lake dam is 0.31metres (1 log in). To achieve this level typically requires the lake to be drawn down below the lower preferred water level limit during the navigation season. A review of the winter-set level may therefore be appropriate. Regardless, the PLRA Board notes that the winter-set should be achieved soon after Labour Day to ensure stable levels for trout spawning.



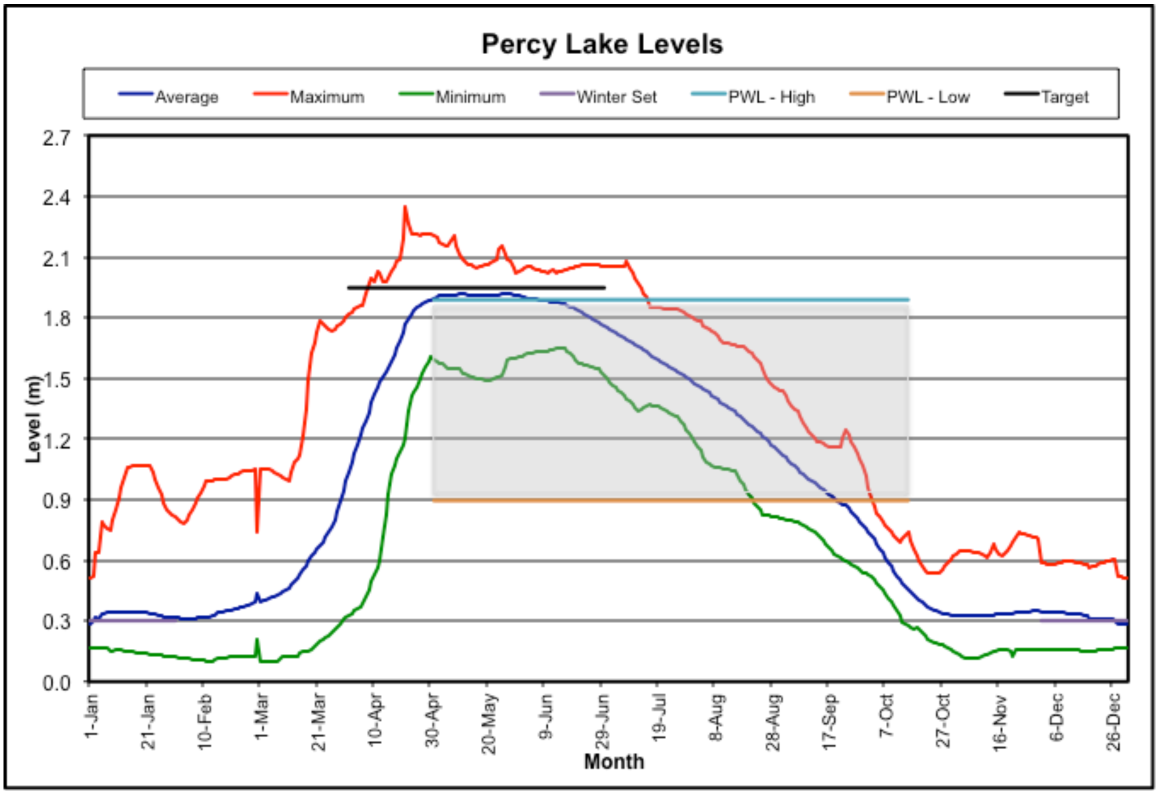
Percy Lake Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the PLRA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 1 log in the dam;
- the preferred **upper limits** of 1.92 m for the water level during the navigation season, equivalent to 6 logs in the dam, corresponds to the multi-year average high water level and so should be attainable;
- the preferred **lower limits and winter set** of 0.96m for the water level during the navigation season, equivalent to 3 logs in the dam, is typically breached in late September. It would appear that this level could be better assured if the winter-set condition were 2 or 3 logs instead of 1.



Coalition for Equitable Water Flow

"Preferred Water Levels" During the Navigation Season for

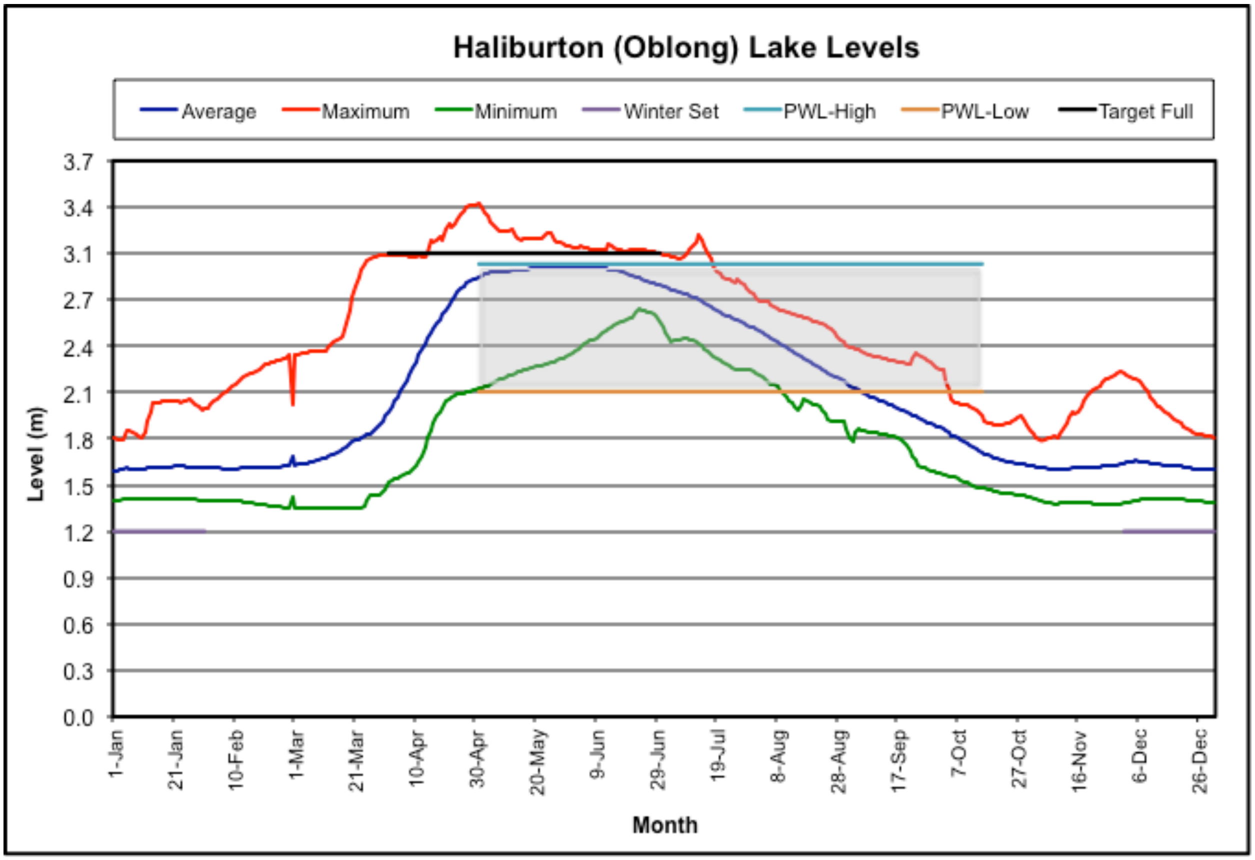
Haliburton - Oblong Lakes

Contents

1. Historic water level data: average, high and low
2. Preferred water levels during the navigation season
3. Comparison of Historic and Preferred water levels
4. Composite Preferred Water Level chart

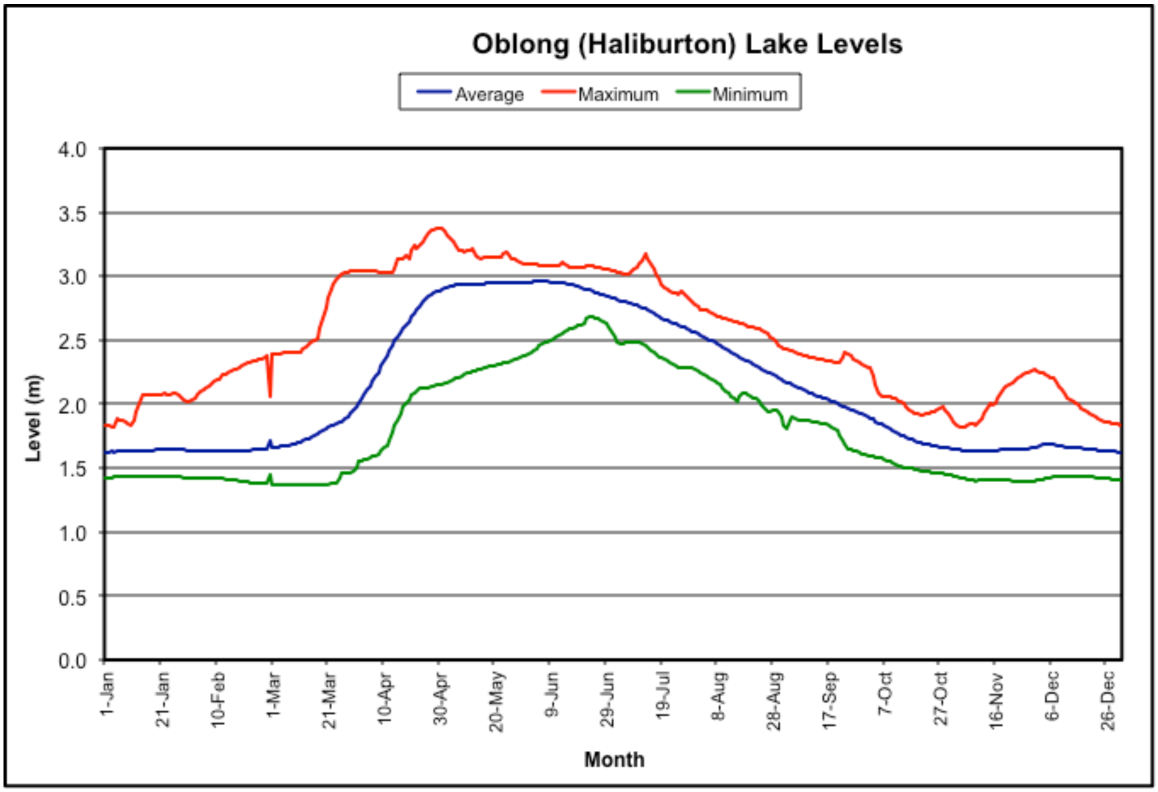
Approval and Endorsement

The preferred water levels identified in this document were provided to the Coalition by the Haliburton Lake Cottagers Association (HLCA) on October 10, 2012.



Haliburton - Oblong Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Oblong Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Oblong Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level (adjusted)	1.07m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 10 logs in place	3.05m	100% full
TSW Target level in Spring	3.05m	100% full
TSW Winter set level - 4 logs in place	1.22m	8% full
Nominal water level fluctuation (per logs)	1.83m	92% of capacity
Historic average fluctuation (per chart)	1.33m	67% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Haliburton & Oblong Lakes – Preferred Water Levels

Key Lake and Dam statistics:

Drainage area: .... 77 sq. km.
Lake area: .... 1094 ha.
Maximum storage volume: .. 2167 ha-m
Log number & dimension:.... 10 wood logs @ 0.305 metres for full control level plus a steel half-log @ 0.15m for incremental adjustments

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Flooding to low-lying properties.
- Insufficient clearance at South Bay / Oblong bridges.
- Ice damage severe during Spring thaw.

Water Levels "too low"

- Docks beached on shores rendering them unmovable and susceptible to spring ice damage.
- Access to the eleven Haliburton Lake "water access only" properties becomes restricted and navigation unsafe.
- Water intake lines prone to freezing and/or 'suck air' – especially in areas with shallow shorelines.
- Unsafe navigation, inability to navigate under South Bay or Oblong bridges, inability to store boats at Fort Irwin Marina due to low water levels under bridges and channel leading to marina.
- Inability or unsafe removal of boats at public launches.

Lake Levels falling in October

- Shallow Trout spawning beds could dry out

Fish Habitat and Spawning observations:

Haliburton Lake supports a native population of lake trout that reproduces naturally in the lake. Supplemental stocking is not needed to support this population.

In October 1986 a Community Fisheries Involvement Program resulted in the mapping and identification of 11 sites where lake trout were observed along the shore or on shallow rock shoals. Spawning occurred between Oct 11 and 25 with peak numbers observed between Oct 15 and 21.

During this survey and subsequent observations in 1987, no water level information for the lake or actual measurements at these sites was taken. Observations and comments were primarily focused on quantifying how silty the substrate was, how much substrate was available for spawning and how many fish were observed at these locations.

In response to the field work completed in these years a habitat rehabilitation project was completed in 1987 and 1988 and at least one known site was enhanced with the addition of rock rubble. Again this was a community effort supported by the Haliburton Lake Association.

The impact to lake trout beds associated with lake level fluctuations, although it has not been directly measured or studied on Haliburton Lake, suggests that lake level fluctuations especially during early to mid October is critical to maintaining a Lake supports which supports a native population of lake trout that reproduces naturally without a need for fishery stocking.

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages a spring log setting of no more than 9½ logs and an upper preferred water level limit of 2.98 m is proposed. This is comparable to the multi-year average high water level. However, it is noted that the clearance at the two bridges on the lake becomes a problem for larger boats at a water level equivalent to a 9-log setting.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 2.14 m and become severe at 1.83 m. These levels are equivalent to a log-setting of 7 or 6 logs respectively, without any head of water over the dam.

Haliburton Lake Cottage Association (HLCA) thus supports a preferred water level range of 2.14 – 2.98 metres during the navigation season (equivalent to between 7 and 9½ logs left in the dam).

Winter-set Level

Haliburton Lake Cottage Association (HLCA) understands that the traditional winter-set level at the Oblong Lake dam is 1.22 m (4 logs in). To achieve this level typically requires the lake to be drawn down below the lower preferred water level limit during the navigation season. A review of the winter-set level may therefore be appropriate.

Worked example:

Navigation under the South Bay and Oblong Bridges to Haliburton Lake

Of the approximate 500 waterfront properties on Haliburton and Oblong lakes, roughly 35% are located on South Bay and Oblong Lake. Navigation between the only marina on the lake (Fort Irwin Marina) and South Bay & Oblong Lake requires passage under a road bridge. The channel is shallow and there is limited clearance under the bridge. If the water level is too high, some boats do not have sufficient clearance. If the water level is too low, there is inadequate draft and navigation becomes unsafe.

An analysis of the channel profile plus an evaluation of boat characteristics has been conducted. The following is a summary of the findings:

- the bottom of the centre of the channel under the two bridges is approx. 1.1 m above the sill plate of the dam (not including an allowance of 8-9" for irregularities and erratic rocks);
- the channel profile is a regular 'shallow-saucer' shape;
- assuming the navigational channel occupies 60% of the overall width of the channel there are high-spots and obstructions (rocks / logs) that reduce the effective channel depth by 8-9" (0.2 m) to yield an effective level that is 1.3 m above the sill plate of the dam;
- The underside of the South Bay bridge roadbed is 4.6 m above the sill plate;
- The underside of the Oblong bridge roadbed is 4.5 m above the sill plate;
- Most boats could pass under the bridge if there was a minimum clearance of 1.8 m;
- There is thus sufficient clearance for most boats at a water level of 2.7 m (one log lower than TSW's full condition) , which is a water level equivalent to the top of 9 logs in the dam.
- Most boats require a draft of no less than 0.8 m;
- There should therefore be sufficient draft if the water level is greater than 2.1 m which is a water level equivalent to the top of 7 logs in the dam;
- This allows TSW an operating range during navigation season of 0.6 m (2.1 to 2.7 m or between 7 & 9 logs in).

An environmentally acceptable approach to dredging the channel to remove 'erratic' rocks would be desirable and would allow for greater fluctuation in water level without impacting navigation. Dredging under the Haliburton Lake bridges and channel to the Marina was investigated in 2010 however deemed to be cost prohibitive by the Municipal authorities. There are also concerns that dredging would destabilize the cribs used to support the bridge superstructure.

Utilizing a metal half-log by TSW would be desirable for HLCA in minimizing water fluctuations while at the same time allowing 0.14 m water flow to TSW system when conditions warrant nominal draw-down.

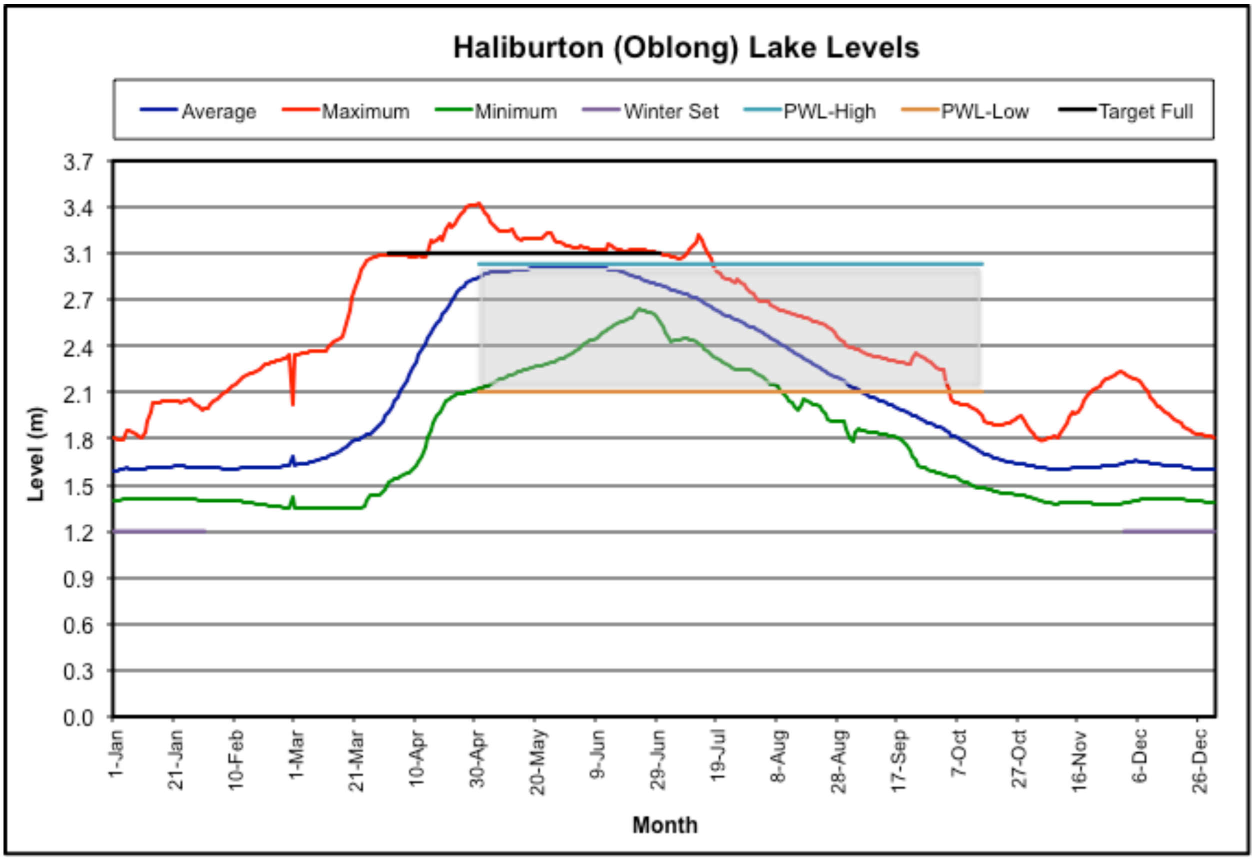
Haliburton & Oblong Lakes Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the KLCOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 4 logs in the dam;
- the preferred **<u>upper limit</u>** of 2.98 m for the water level during the navigation season, equivalent to 9½ logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **<u>lower limit</u>** of 2.14 m for the water level during the navigation season, equivalent to 7 logs in the dam, is typically breached in September, or as early as August in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 5 logs instead of 4.



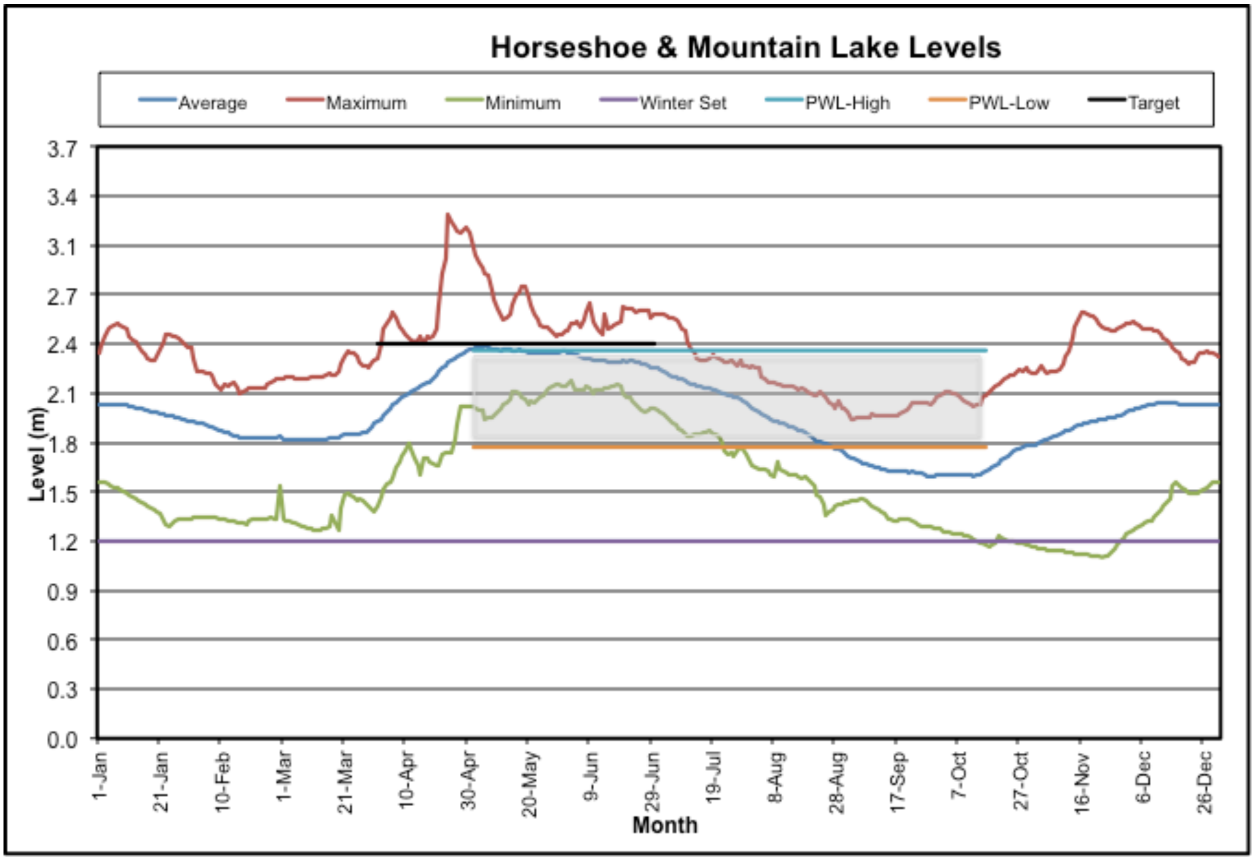
Coalition for
Equitable
Water Flow

"Preferred Water Levels" During the Navigation Season
for
Horseshoe & Mountain Lakes

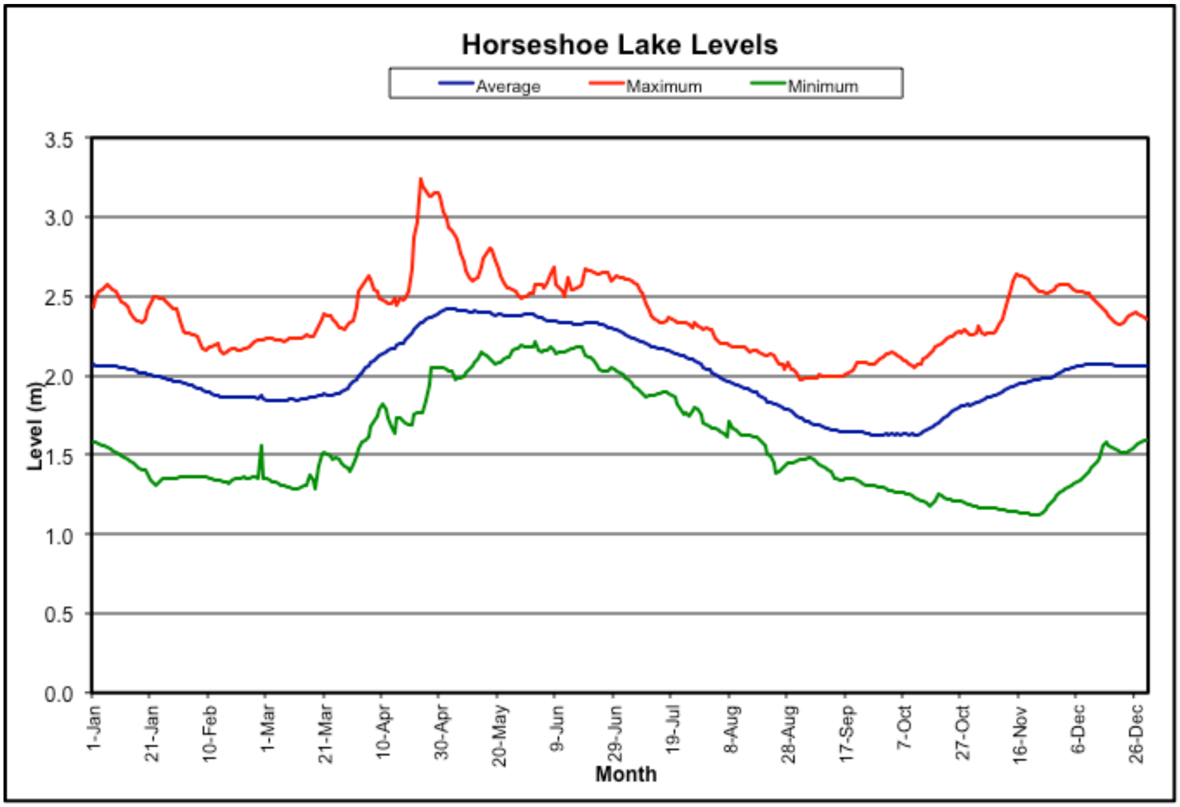
Contents

Approval and Endorsement

The preferred water levels identified in this document were separately endorsed by both the Horseshoe Lake property Owners' Association (HLPOA) and the Mountain Lake property Owners' Association (MLPOA) in April 2014 and October 2013 respectively.



Horseshoe Lake Average Water Levels



Data provided by the Trent Severn Waterway

The following chart records the multi-year average water level (blue line) on Horseshoe Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.

<u>How to Read the Chart</u>

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Horseshoe Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level (adjusted)	0.46m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 8 logs in place	2.44m	100% full
TSW Target level in Spring	2.44m	100% full
TSW Winter set level – 4 logs in place	1.22m	39% full
(Note: winter set may vary: in a 'wet' year such as 2014 it was 3 logs)		
Nominal water level fluctuation (per logs)	1.22m	61% of capacity
Historic average fluctuation (per chart)	0.80m	40% of capacity

NOTE 1: Due to the Mirror Lake narrows between Mountain and Horseshoe lakes there can be a differential between the levels of the two lakes, Mountain being higher. MLPOA and HLPOA endorse the Parks Canada initiative to place an automated water level gauge on Mountain Lake to provide additional water management data.

NOTE 2: While the water level of the lakes is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Horseshoe & Mountain Lakes – Preferred Water Levels

Key lake statistics:

Drainage area:	46.6 sq. km.
Lake area:	556 ha.
Maximum storage volume:	833 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Low-lying cottages and homes flooded, roads impassable
- Ice damage and shoreline erosion greatly increased
- Wetlands become swamped, nests flooded, habitat degraded

Water Levels "too low"

- Navigational hazards emerge; inability to navigate between HL and ML;
- Dry frontages, useless docks and water lines, inability to remove boats;
- Wetlands dry out.

Lake Levels falling in October

- The traditional autumn lake level drawdown often compromises trout spawn on Mountain Lake, an MNR-designated cold-water ("at capacity") trout lake.

Mirror Lake Narrows:

- The Mirror Lake narrows between Mountain Lake and Horseshoe Lake is a significant constriction that affects the Mountain Lake water levels depending on the flow rate passing over the Twelve Mile Lake dam through Mountain and Horseshoe Lakes and over the Horseshoe Lake dam. This natural constriction is not likely fully characterized by present TSW water flow control models.
- Flood conditions during the spring of 2013 and near flood conditions during the spring of 2016 have confirmed that Horseshoe Lake dam readings underestimate freshet high water levels on Mountain Lake. These high water levels can persist into the first month of the navigation season, confounding the upper preferred water level for Mountain Lake compared to Horseshoe Lake.

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages an upper preferred water level limit of 2.4 metres above the sill plate is proposed. This is equal to the multi-year average for early June as well as the TSW's targeted 'full' level. Above this level significant issues begin to be experienced and above 2.7 metres they are severe.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 1.80 metres and become severe at 1.50 metres above the sill plate. The 1.80 metre level is equal to the multi-year average for late August as well as for late October. However there is a dip in the lake level between these dates.

HLPOA & MLPOA thus supports a preferred water level range of 1.8 – 2.4metres during the navigation season. However the PWL range for Mountain Lake should, at a future date, be identified separately based upon data from a water level gauge situated on Mountain Lake. This would require that the water levels on Mountain Lake be plotted separately by TSW on the graph of data associated with the Horseshoe Lake dam.

Winter-set Level

A review of the winter set level is requested primarily to protect trout spawning beds on Mountain Lake. Other significant low water impacts on both lakes are noted above.

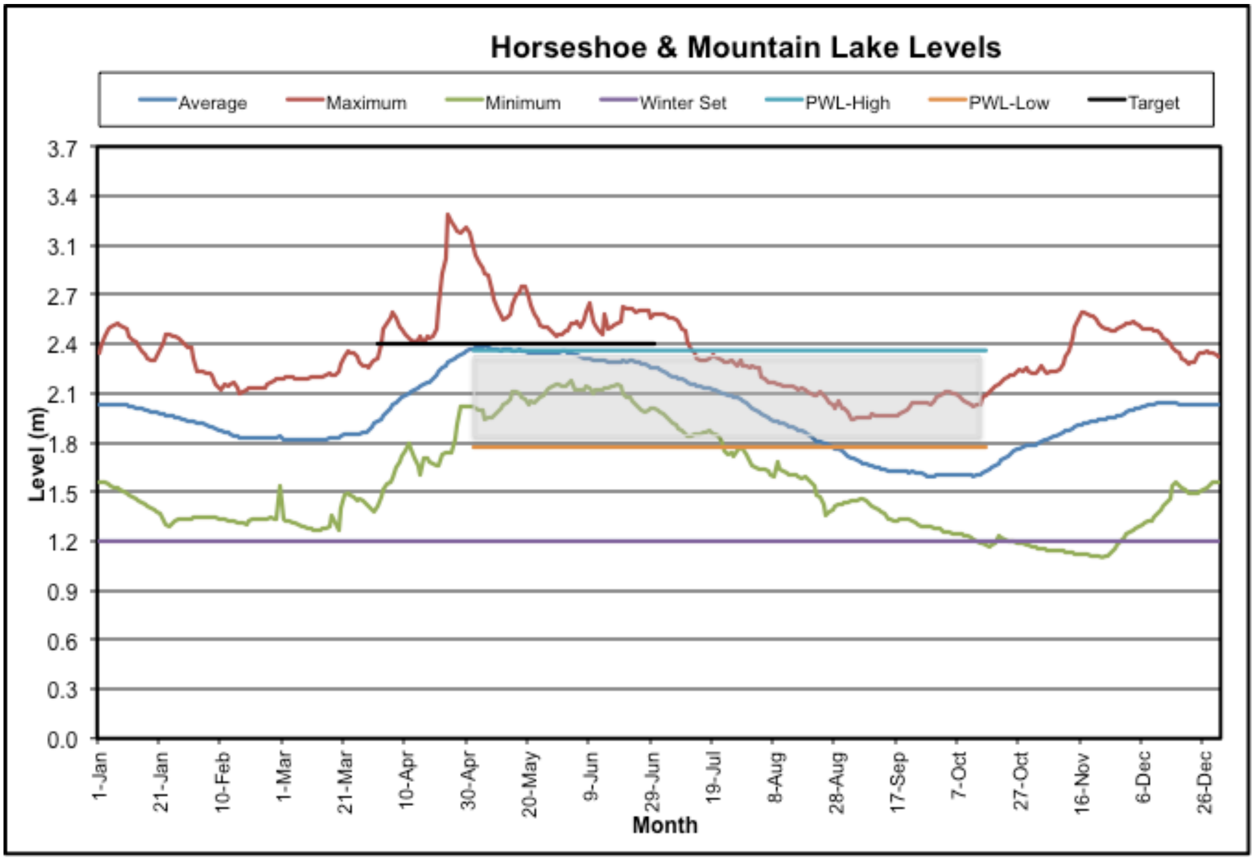
Horseshoe & Mountain Lakes: Comparison of Historic and Preferred Water Levels

The following chart superimposes the HLPOA & MLPOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the typical **winter-set** condition is equal to 4 logs in the dam;
- the preferred **upper limit** of 2.4 m for the water level during the navigation season, equivalent to 8 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.;
- the preferred **lower limit** of 1.8 m for the water level during the navigation season, equivalent to 5-6 logs in the dam, is typically breached in late August, or in late July in a dry year, but regained by late October on average. The solution would appear to be an ability to reduce the dip in water levels experience in September & October.



Coalition for
Equitable
Water Flow

"Preferred Water Levels" During the Navigation Season for

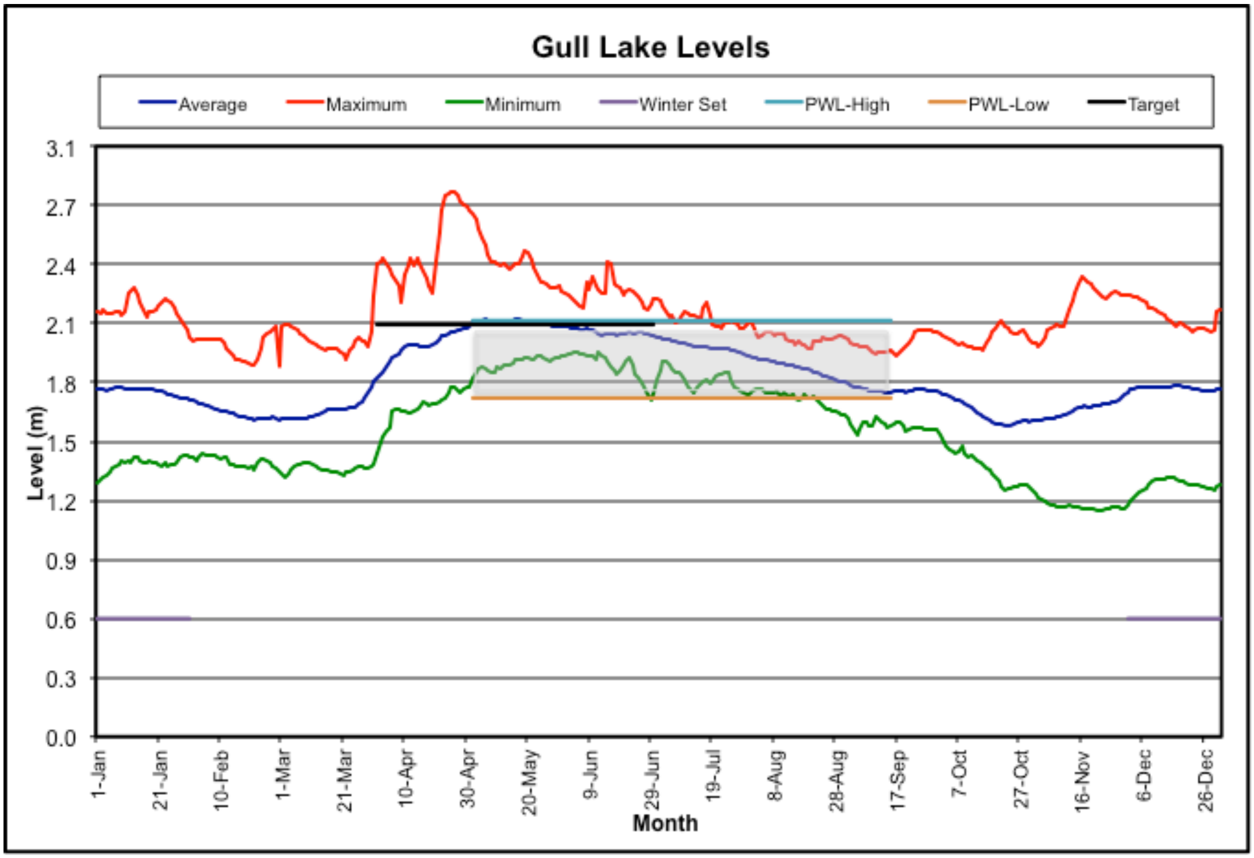
Gull Lake

Contents

1. Historic water level data: average, high and low
2. Preferred water levels during the navigation season
3. Comparison of Historic and Preferred water levels
4. Composite Preferred Water Level chart

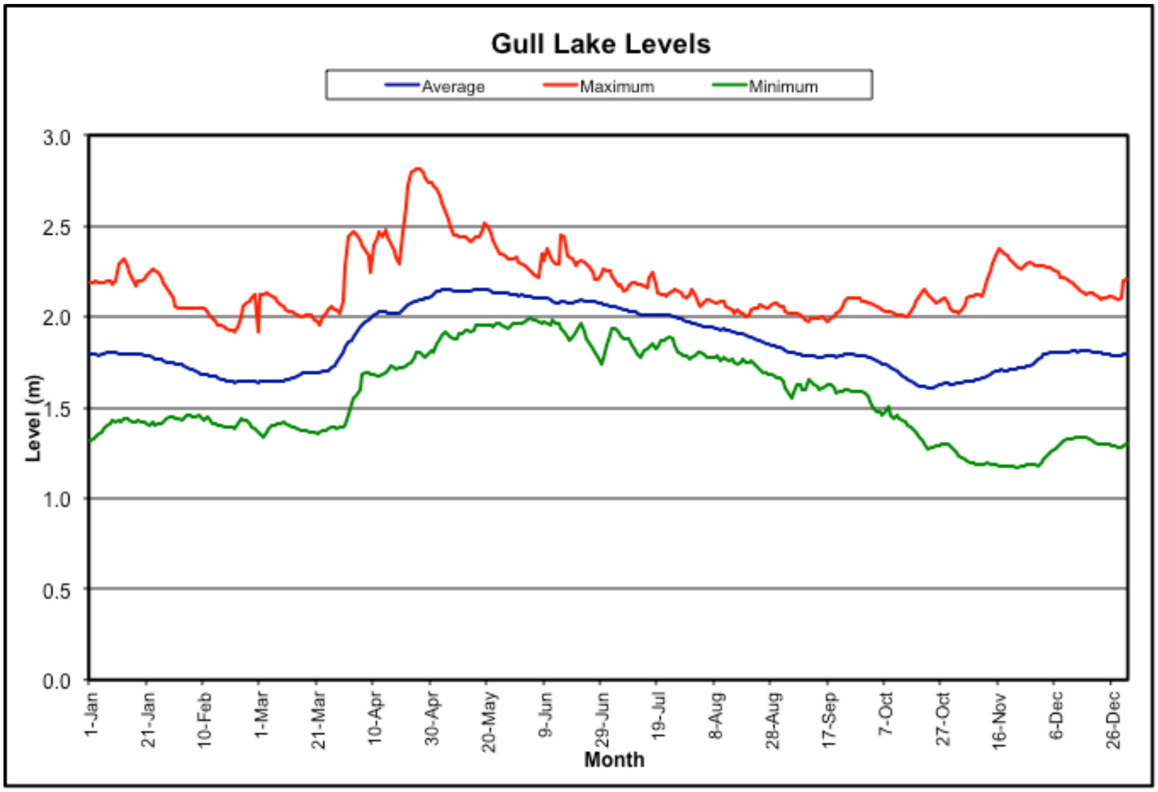
Approval and Endorsement

The preferred water levels identified in this document were approved by the members of the GLCA at their 2013 AGM following the presentation of an analysis of written survey responses (on file with the Association and CEWF).



Gull Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Gull Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

<u>How to Read the Chart</u>

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Gull Lake dam (Moore Falls). The water level is measured in metres (m) above the sill plate of the dam (#1 spillway).

Key reference points:

Sill plate level (adjusted)	1.22m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 7 logs in place	2.13m	100% full
TSW Target level in Spring	2.13m	100% full
TSW Winter set level – 2 logs in place	0.61m	0% full
Nominal water level fluctuation (per logs)	0.91m	100% of capacity
Historic average fluctuation (per chart)	0.54m	59% of capacity

NOTE 1: The sill or deduction is equivalent to 4 logs, yet the winter-set condition is identified by TSW as 2 logs and recently has varied from 4 (January 2013) to zero (April 2013) logs.

NOTE 2: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Gull Lake– Preferred Water Levels

Key lake and Dam statistics:

Drainage area: .... 167 sq. km.
Lake area: .... 998 ha.
Maximum storage volume: .. 913 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Structural damage to boathouses, docks and electrical systems
- Dock installation not possible
- Access to island properties difficult

Water Levels "too low"

- Boats must be removed or are not accessible from docks
- Water supply problems
- Property access problems on the islands
- Boat removal problems at Deep Bay ramp

Lake Levels rising in June (after normal seasonal high)

- Dock losses as decks float off

Lake Levels falling in October

- Same as water levels too low

Upper preferred water level limit

An upper preferred water level limit of 2.13 metres above the sill plate is proposed as of early June. This is equal to the multi-year average high water level (in May) and is equal to the 'full control level' of the dam. Knowing that some flood storage may be necessary in the Spring, the GLCA requests that TSW recognize that levels above 2.13 m cause inconvenience, and above 2.4 m cause infrastructure damage.

Lower preferred limit of water level

Navigational hazards and challenges increase when the water level of the lake drops below 1.75 metres above the sill plate. This is equal to the multi-year average for mid-late September as well as the multi-year average at the end of December. Levels below 1.75 m in the fall cause boat and property access problems and water supply problems. At levels below 1.65 m, these problems become substantially more severe.

GLCA thus supports a preferred water level range of 1.75 – 2.13 metres during the navigation season.

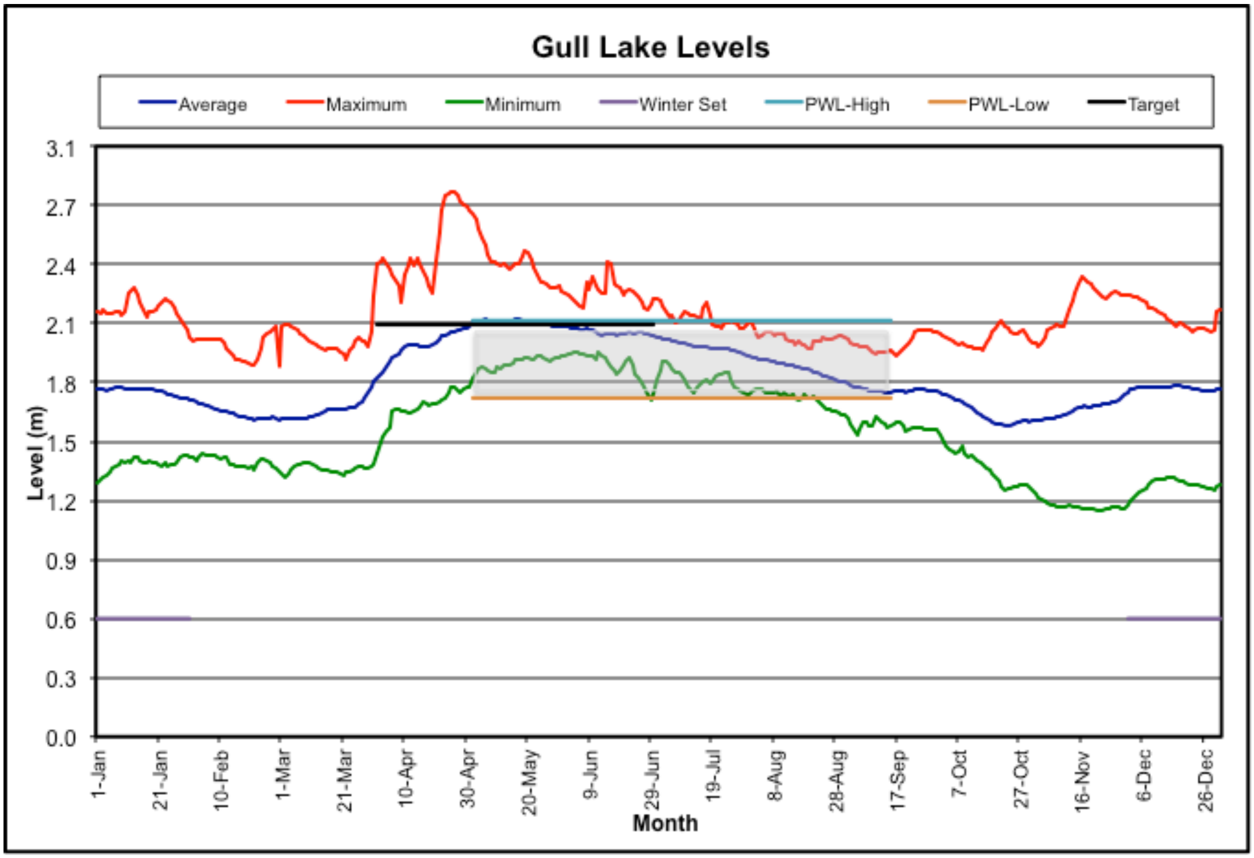
Gull Lake: Comparison of Historic and Preferred Water Levels

The following chart superimposes the GLCA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 2 logs in the dam;
- the preferred **<u>upper limit</u>** of 2.13 m for the water level during the navigation season, equivalent to 7 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **<u>lower limit</u>** of 1.75 m for the water level during the navigation season, equivalent to 5.5 logs in the dam, is typically maintained through to October on average and so should be attainable except in very dry years.



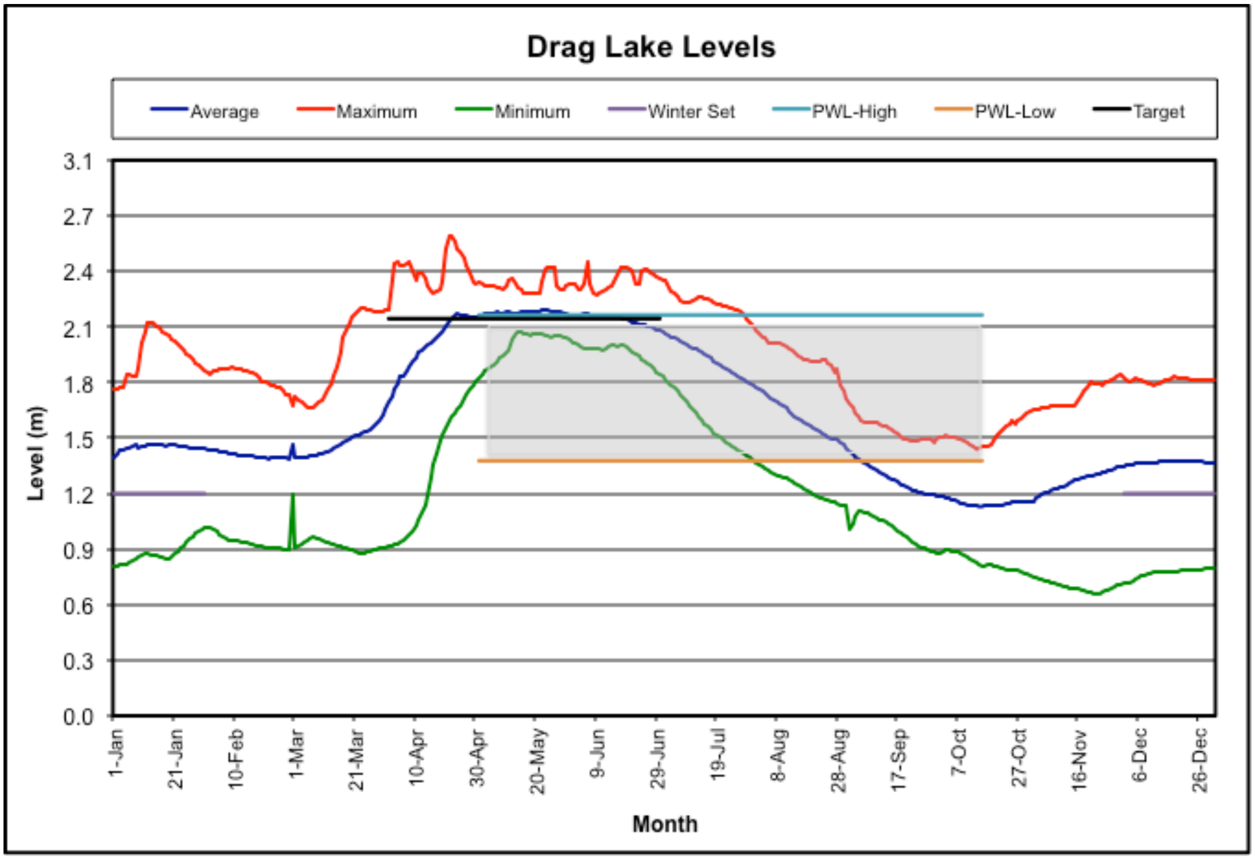
Coalition for
Equitable
Water Flow

“Preferred Water Levels” During the Navigation Season
for
Drag and Spruce Lakes

Contents

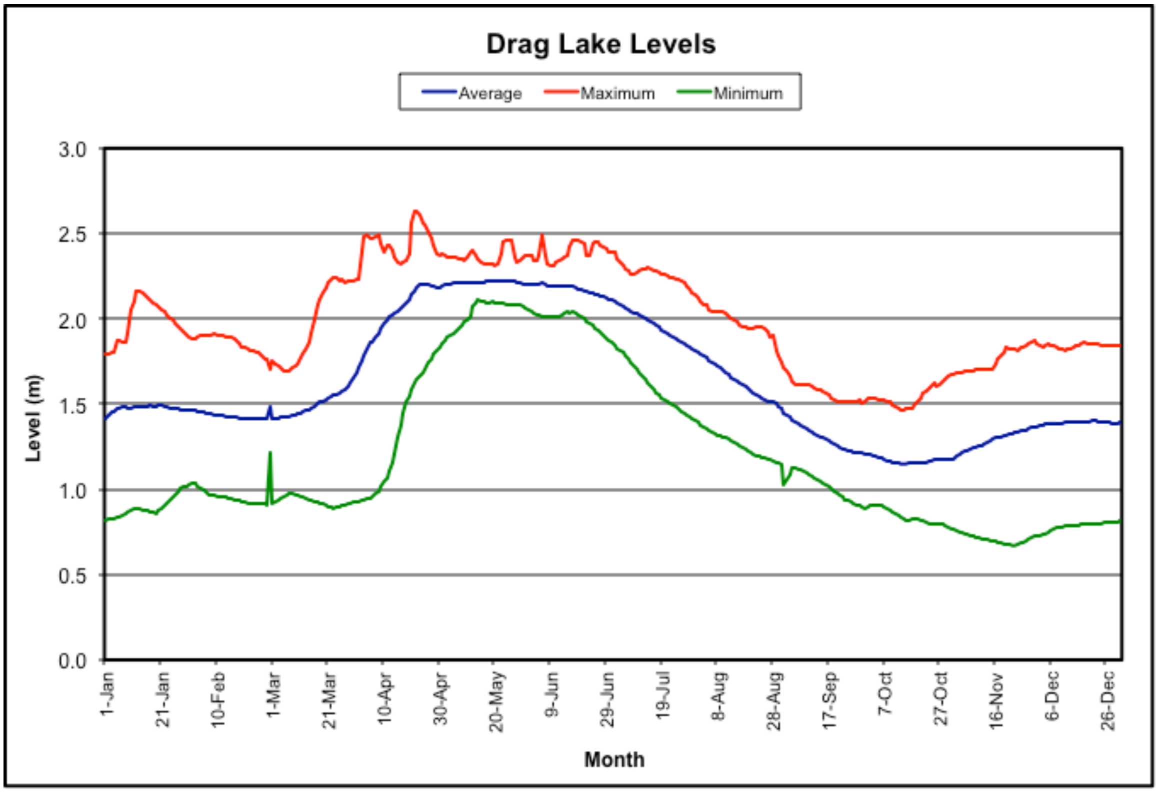
Approval and Endorsement

The preferred water levels identified in this document were approved by the Drag and Spruce Lakes Property Owner Association in November 2012 .



Drag Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Drag Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

<u>How to Read the Chart</u>

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Drag Lake dam. The water level is measured in metres (m) above the sill plate.

Key reference points:

Sill plate level (adjusted)	0.46m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 7.5 logs in place	2.29m	100% full
TSW Target level in Spring	2.18m	95% full
TSW Winter set level – 4 logs in place*	1.22m	42% full
Nominal water level fluctuation (per logs)	0.96m	52% of capacity
Historic average fluctuation (per chart)	1.07m	58% of capacity

** The TSW sets the dam at 5 logs for winter but allows the adjacent hydro dam to maintain the lake at a level equivalent to there being 4 logs in the dam with the additional 'head' of water being used for hydro generation.*

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Drag and Spruce Lakes – Preferred Water Levels

Key lake statistics:

Drainage area: .... 121 sq. km.
Lake area:.................................... 1102 ha.
Maximum storage volume: .. 1890 ha-m

Objective

- To define the preferred maximum and minimum water levels for Drag/Spruce Lakes in order to optimize: Boating safety; Property accessibility; and Ecological health of the lakes
- It is understood that Drag/Spruce Lakes are part of the Trent-Severn Waterway reservoir lakes system, and there may be at times demands for water that would result in levels outside of the preferred range. However the DSLPOA recommends that the current operating procedures be adjusted such that maintaining these preferred levels becomes a prime TSW objective.

Key Considerations for Drag/Spruce Lakes

- There are several areas of the lakes, impacting a large number of property owners, where the lake levels experienced in the latter part of the boating season create serious navigational problems due to inadequate water depths. The prime areas of concern:
    - Throughout Outlet Bay
    - Channel between Drag and Spruce Lakes
    - Channel between Drag Lake and Bonham's Bay
    - Public boat ramps - Sandy Cove, Outlet Bay, Spruce Lake
- This results in a denial of boat access to properties, inability to access boat ramps, and damage to property.
- Also, the greater the rise and fall of water levels, the greater the number of unmarked boating hazards throughout the lakes. Large submerged rocks represent a serious risk at high speeds.
- Large changes in water levels put a stress on the entire lake ecosystem – fish habitat, waterfowl nesting, wetlands, and shoreline dead zones.

Position of Drag and Spruce Lakes Property Owners Association

Preferred Maximum lake level:	no change from current practice (i.e. 95% full or 2.18m above sill plate of dam)
Preferred Minimum lake level:	increase 1 foot (0.3 m) from historical average (i.e. 1.4m above sill plate of dam)*

The DSLPOA thus supports a preferred water level range of 1.4 – 2.2 metres during the navigation season resulting in a water level fluctuation of no more than 0.8m (2' 7").

Background Data

Historical average high water level (occurs May 19)	2.2 m (7' 3")
Historical average low water level (occurs Oct 15)	1.1 m (3' 8")

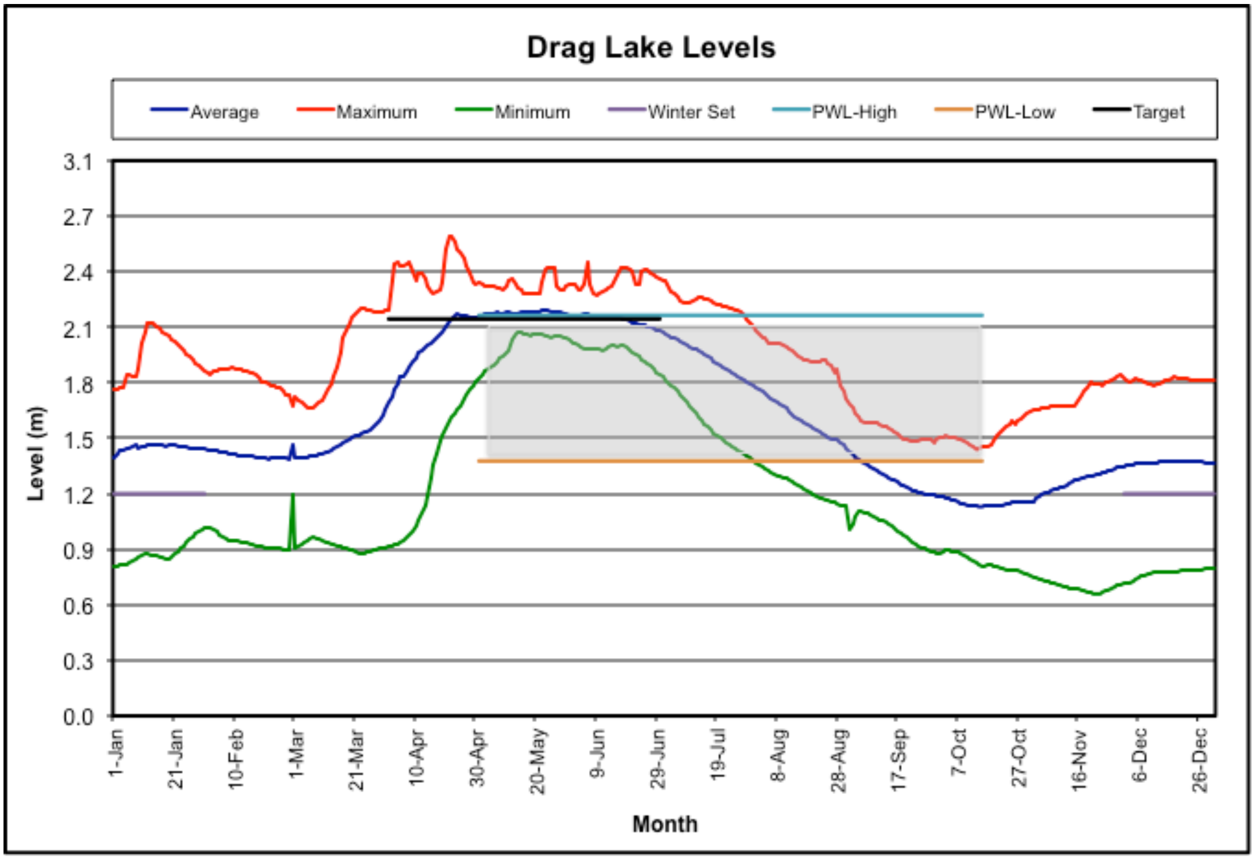
Drag Lake Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the DSLPOA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 4 logs in the dam;
- the preferred **upper limit** of 2.2 m for the water level during the navigation season, equivalent to 7 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.4 m for the water level during the navigation season, equivalent to 4 logs in the dam, is typically breached in September, or as early as August in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 5 logs instead of 4.



Coalition for
Equitable
Water Flow

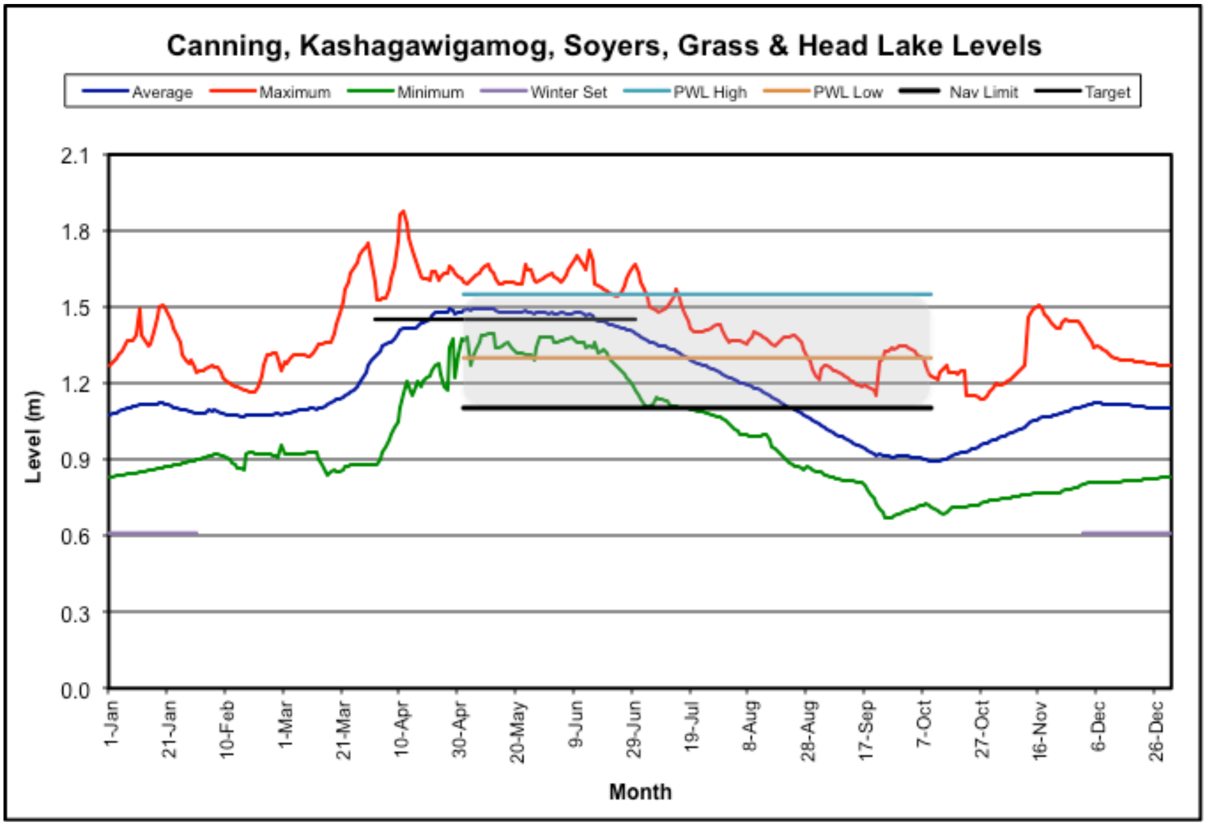
“Preferred Water Levels” During the Navigation Season for

Canning, Kashagawigamog, Soyers, Grass, and Head Lakes

Contents

Approval and Endorsement

The preferred water levels identified in this document were endorsed in October 2016 by the boards of directors of the Soyers Lake Rate Payers Association, the Lake Kashagawigamog Organization, and the Canning Lake Property Owners Association.

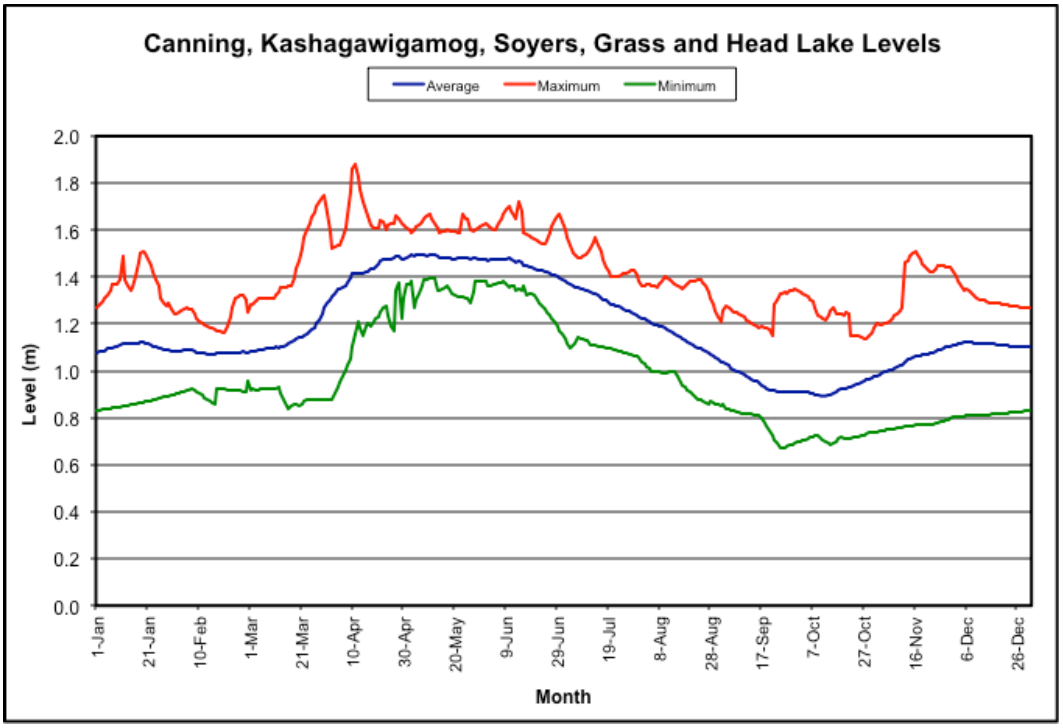


Preamble

The Parks Canada dam at the outflow of the Burnt River from Canning Lake also controls the water levels on a chain of upstream lakes stretching back to Haliburton Village. These lakes include Canning, Kashagawigamog, Soyers, Grass and Head lakes. The first three of these lakes have lake associations that are members of the CEWF and that have collaborated to develop a common 'preferred water levels' document for transmission to the Trent-Severn Waterway (TSW) by CEWF. The reference data quoted in the document come from Parks Canada as posted for the Canning Lake chain.

1. Canning's 5 Lake Chain: Historic Water Levels

The following chart records the multi-year average water level (blue line) on the Canning Lake chain for the period 1988 - 2013. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



(Source: data provided by the Trent Severn Waterway)

<u>How to Read the Chart</u>

Water levels are measured by the TSW using a gauge located at the Canning Lake dam. The water level is measured in metres (m) above the sill plate of the dam. There is an upstream obstruction that prevents the lake being drawn down more than 0.46m above the sill plate.

Key reference points:

Sill plate level (adjusted)	0.46m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 5 logs in place	1.53m	100% full
Net Operating Range (1.53 – 0.46)	1.07m	allowing for sill deduction
TSW Target level in Spring	1.45m	95% full
TSW Winter set level - 2 logs in place	0.61m	14% full
Nominal water level fluctuation (per logs)	0.92m	86% drawdown of capacity
Historic average fluctuation (per chart)	0.6m	56% of drawdown capacity

Current Water Level Data

To check the current water level on a reservoir lake you can visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Although the Canning Lake dam effectively controls the water levels on the upstream chain of lakes, flow constrictions at the bridges and in the channels between lakes typically result in the upstream lakes responding more slowly to dam adjustments than is the case on Canning Lake. Accordingly the water level reading at the Canning dam may not reflect the actual water level on the inter-connected lakes at any given time.

2. Canning Lake Chain – Preferred Water Levels

Key statistics for the 5 lakes on the Canning Lake chain:

Drainage area:	168 sq. km.
Lake area:	1274 ha.
Maximum storage volume:	1,287 ha-m

The Canning chain of lakes is the twelfth largest of the 35 Haliburton Sector reservoirs by storage volume, however it is the second largest reservoir on the Burnt River system. Whereas the chain of five lakes provides only 2.9% of the TSW's total reservoir storage capacity, it provides 16.8% of the total Burnt River storage capacity.

Most significant Impacts of fluctuating Water Levels on the lakes:

Water Levels "too high" on the lakes

- Increased risk of ice damage
- Significant increase in shoreline erosion
- Unmarked navigation hazards hidden
- Cribs and fixed docks flooded.
- Adverse effects on fish spawning in fall

Water Levels "too low" on the lakes

- Inability to navigate between lakes due to low water
- Access to and movement of floating docks restricted
- Unmarked navigational hazards created
- Problems with use of boat launch ramps
- Narrowing channel widths for boat traffic
- Lake water Lines and intake valves exposed
- Shoreline erosion and low water levels resulting in ice undermining break walls
- Wetlands turn into mud flats displacing fish and wildlife habitat

In addition members identified the following significant issues on the lakes:

- Rising water levels in June threaten nesting waterfowl particularly loons.
- When winter levels fall below mid-October levels there is a risk that the lake trout spawn will be dried out or frozen.

Local considerations identified by residents on one or more of the inter-connected lakes:

- Soyers Lake does not have a boat launch; to access the marina and a boat launch requires travel from Soyers through a narrow channel with a number of obstacles (rocks, shoals, and logs) which require a certain minimum depth (1.3 metres as measured at the dam gauge) to prevent damage to boats;
- The Soyers Lake Safety Directors (SLSD) researched the preferred water levels through to Thanksgiving weekend 2016, knowing that the Trent Severn Waterway (TSW) is still in operation, drawing water from the reservoir lakes until the system is shut down. This parallels the operating timeline of the system.
- The SLSD took depth soundings regularly in the navigation channel (between Kashagawigamog and Soyers) to identify and determine the deepest water levels and safest passage, recognizing the height of the hazards in the channel. For instance, a safe water level of 1.3 metres (as measured at the dam gauge) for the 5 lakes in the chain, does not mean that there is 1.3 metres of water in the channel at the entrance to Soyers Lake. As of October 8th, 2016 (last weekend of TSW operation) the water depth at the Canning Dam was 0.88 m (35”). A variety of depth soundings were undertaken on this weekend. Individual rocks and logs in the navigable channel in some areas allowed only 0.37 - 0.50 m (15 “ – 24”) draught which creates damaging effects as can be seen from the many marks on the rocks and logs in the channel. Travel through this channel is unsafe at this low water level.
- Water depths below 1.3 meters (as measured by the dam gauge) to winter set levels at Canning Dam transitions Soyers Lake wetlands into mud flat environments. The mud flat environments have become subject to growth from local and foreign vegetation and displacement of wetland’s wildlife, fish and spawning grounds. Precipitation, particularly during heavy periods of moisture, disturbs exposed mud lands soil and vegetation and transfers it into the navigable waterway channel areas (silting in).
- In addition, the decreasing water levels from early September through October, dropping from 1.2 m - 0.85 m (47.25 “ – 33.6 “), affect many individual cottagers and year round residents of Soyers Lake, in respect to the quality of their intake lake water, the exposing of normally submerged rocks and shoals at their docks and waterfront environment, and the shoreline passageways that become hazards. If the temporary ‘dip’ in water levels could be avoided, maintaining the water level at 1.1m it would be most helpful.
- the channel into Head Lake can be challenging as you get later in the boating season: this might be an issue from a tourism perspective as the town of Haliburton promotes the fact that it is on a 5 lake chain and if you can't get into the town by boat without damaging your lower unit it won't be helpful for cottagers to venture into town later in the season;
- Canning Lake residents have two areas of concern just to be able to get boats into Lake Kashagawigamog, which at the very least is necessary to get boats to a ramp for the season end: one area is a sand shoal build up area while coming into Canning from the narrows where it widens out and the other is a rocky area passing under the bridge at Ingoldsby;
- Canning Lake would prefer the yellow 1.3 level as a minimum for as much of the boating season as possible while reserving the orange dashed 1.1 level as a navigable minimum (per the PWL chart).

Preferred Water Level Recommendations

Upper preferred water level limit for the Lakes after May 24th

To minimize shoreline erosion and other damage an upper preferred water level limit of 1.55 metres above the sill plate is proposed. This is just above the multi-year average for early June and represents the 100% full condition with 5 logs in place. It suggests no change in spring operating procedures by the TSW. However, it is important that this level not be reached until after the ice is off the lake.

Lower preferred limit of water level before Thanksgiving

When the water level of the lakes drops below 1.3 metres navigation boats are not able to navigate from Canning to Kashagawigamog to access the boat ramp/marina. Further navigation challenges appear when the water level falls below 1.1 metres.

Because our Lakes are known to have shallow spawning lake trout it is important that drawdown to winter levels occurs by Oct 15 and therefore it is unlikely that this preferred level can be maintained much past Thanksgiving.

Preferred River Flow Rates

While we understand that the TSW priority in the spring is to bring the reservoirs to full and over the summer to provide needed flow to the canal lakes, we would suggest that the impacts of drastic flow changes on the river need to be recognized.

Whenever possible a modest flow is required in the river throughout the summer season to support the river ecosystem and recreation uses

Whenever possible log operations should be limited to no more than one full log at a time in order to avoid unexpected changes in flow rates downstream in the river.

The Canning Lake Property Owners Association, the Soyers Lake Rate Payers Association, and the Lake Kashagawigamog Organization thus support a preferred water level range for Canning Lake chain of 1.55 to 1.3 metres during the navigation season from May 24th until Thanksgiving.

It is further noted that for the Canning to Head lake chain, excluding Soyers Lake, navigation through several areas becomes challenging below 1.3 metres and that if the fall 'dip' could be reduced or eliminated this would significantly enhance late season navigation.

3. Canning Lake Chain: Comparison of Historic and Preferred Water Levels

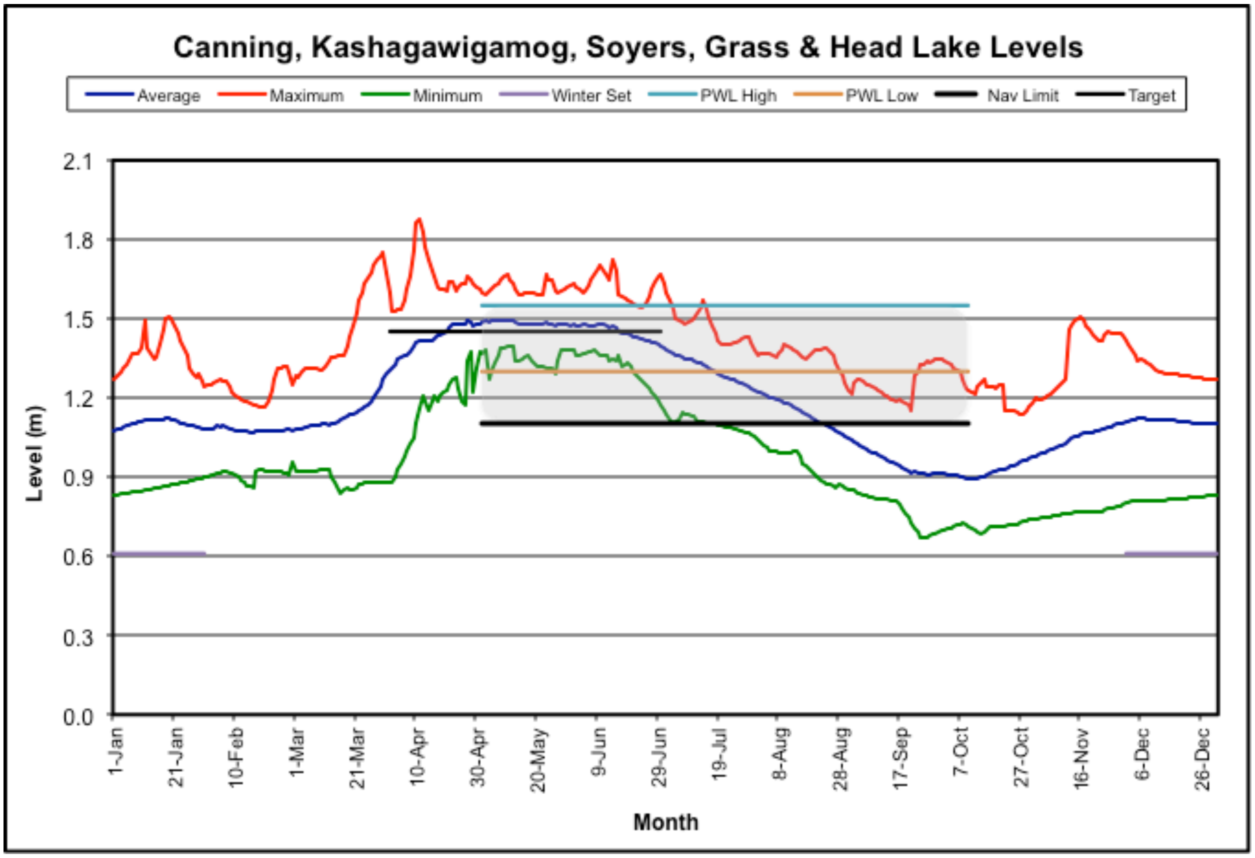
The following chart superimposes the Canning Lake chain Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 2 logs in the dam;
- the preferred **upper limit** of 1.55 m for the water level during the navigation season, equivalent to 5 logs in the dam, corresponds to above the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.3 m for the water level during the navigation season is breached by early August in an average year, and the absolute lower minimum for navigation of 1.1m is breached by early September in an average year. It would appear that leaving one additional log in the dam would significantly mitigate the negative impact of the current operating regime by raising the average minimum water level to about 1.2m. Alternatively, if water management operations could prevent the 'dip' below 1.1m in September and October that would serve to mitigate the navigation challenge at the end of the season.

4. Composite Preferred Water Level chart



Coalition for Equitable Water Flow

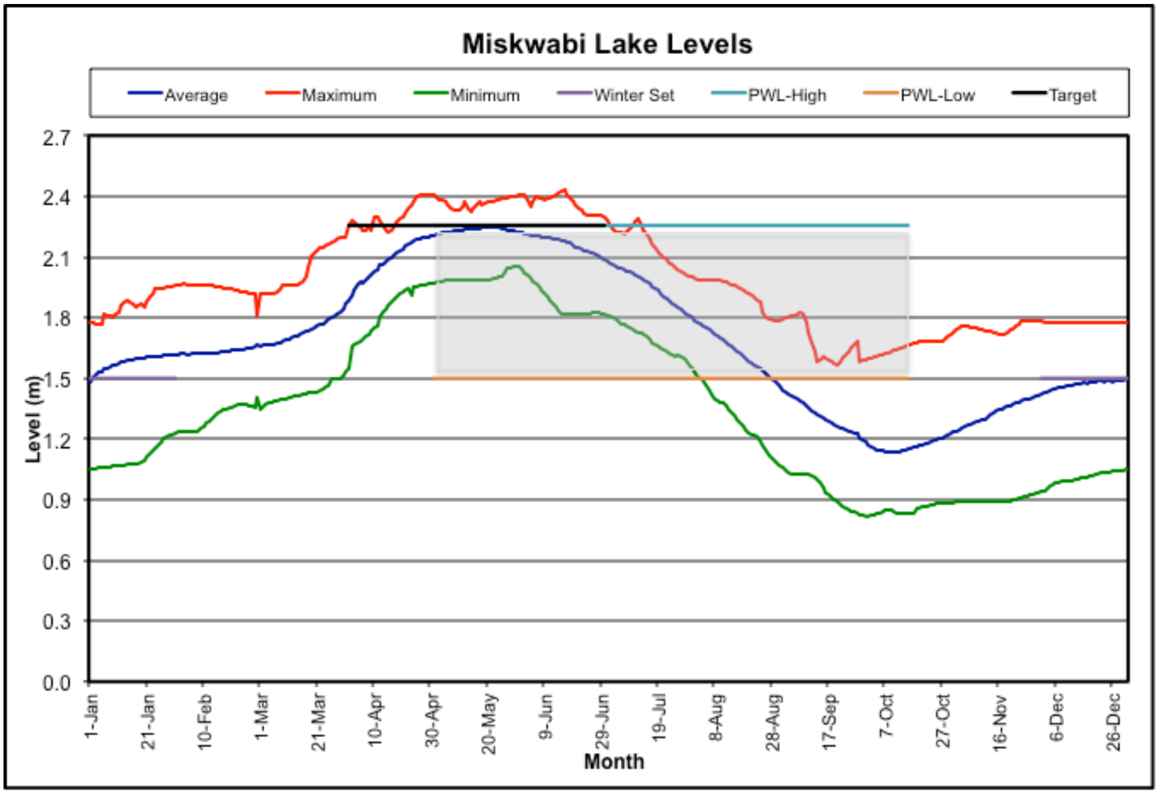
"Preferred Water Levels" During the Navigation Season for

Miskwabi (Long) Lake

Contents

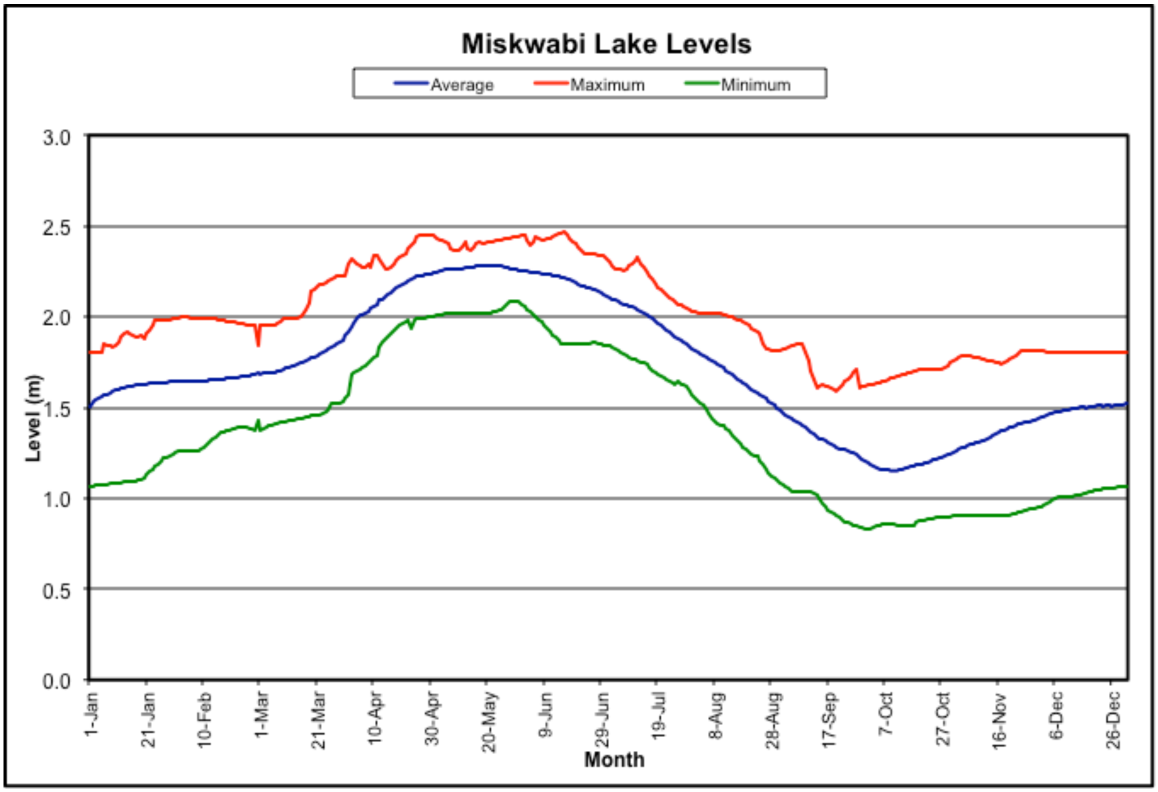
Approval and Endorsement

The preferred water levels identified in this document were approved by the Miskwabi Area Cottagers' Association (MACA) members at their 2012 AGM and endorsed by resolution of the Board of Directors on August 25, 2012 – with a clarification added by CEWF in November 2012.



Miskwabi (Long) Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Miskwabi Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

<u>How to Read the Chart</u>

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Miskwabi Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level (adjusted)	0.31m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 7.5 logs in place	2.29m	100% full
TSW Target level in Spring	2.29m	100% full
TSW Winter set level – 5 logs in place	1.52m	62% full
Nominal water level fluctuation	0.77m	38% of capacity
Historic average fluctuation (per chart)	1.13m	57% of capacity

<u>Current Water Level Data</u>

To check the current water level on a reservoir lake you can use visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Miskwabi – Long Lakes – Preferred Water Levels

Key lake and Dam statistics:

Drainage area: .... 20.2 sq. km.
Lake area: .... 335 ha.
Maximum storage volume: .. 664 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- shoreline erosion

Water Levels "too low"

- difficulty navigating between Long and Miskwabi Lakes
- unmarked navigational hazards created
- difficulties in removing boats and docks from lake
- difficulty in accessing some bays in the lakes
- water intake problems

Lake Levels rising in June

- breeding difficulties for aquatic birds

Lake Levels falling in October

- possible negative effect on lake trout spawning beds

Upper preferred water level limit:

- to reduce shoreline erosion, there should be no more than 7 logs in the dam in Spring and the upper preferred water level should be no greater than the multi-year average of 2.29 m.

Lower preferred water level limit:

- water level of 1.53 m to maintain adequate water levels for safe navigation: equivalent to 5 logs.

Miskwabi Area Cottagers' Association supports a range between 1.53 and 2.29m based on there being between 5 and 7 logs in the dam during the navigational season.

Winter-set Level:

Miskwabi Area Cottagers' Association understands that the traditional winter set level at the Long Lake dam is 5 logs (1.07 m).

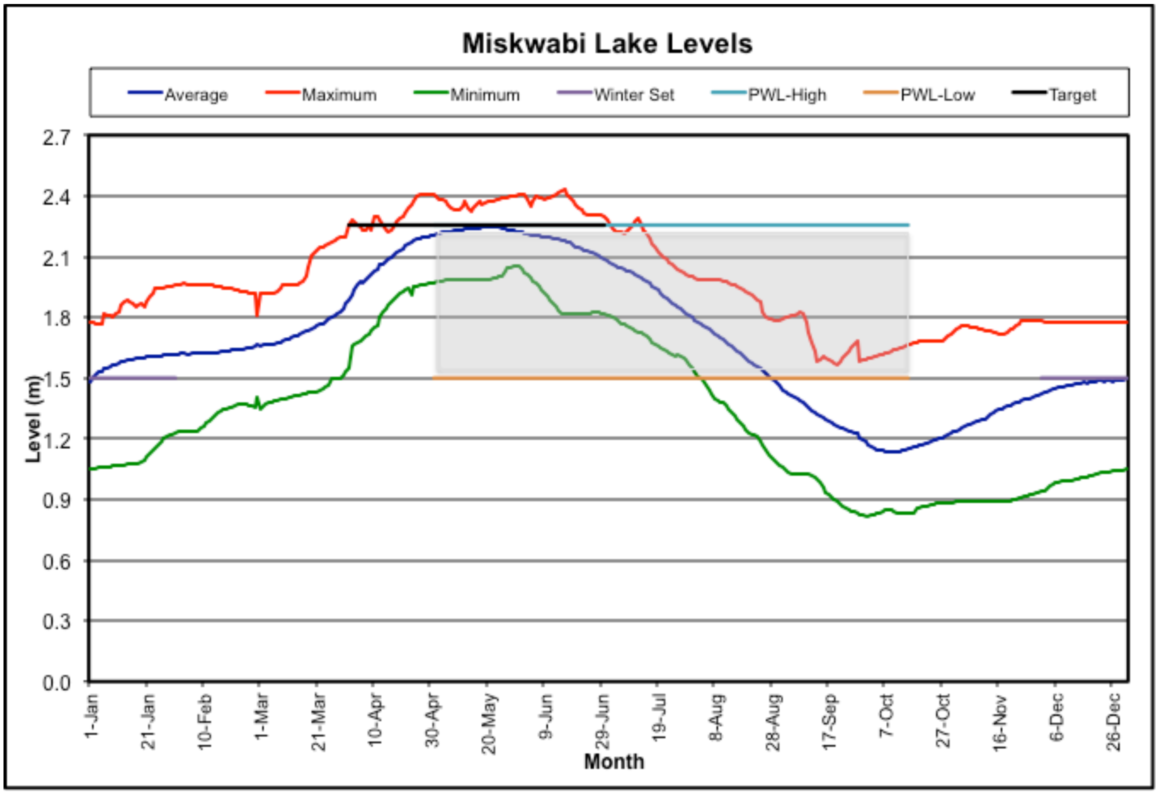
Miskwabi - Long Lakes Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the MACA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 5 logs in the dam;
- the preferred **upper limit** of 2.29 m for the water level during the navigation season, equivalent to 7 logs in the dam plus a slight head of water, is comparable to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.53 m for the water level during the navigation season, equivalent to 5 logs in the dam, is typically breached in September, or as early as August in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were not breached in September.



"Preferred Water Levels" During the Navigation Season for

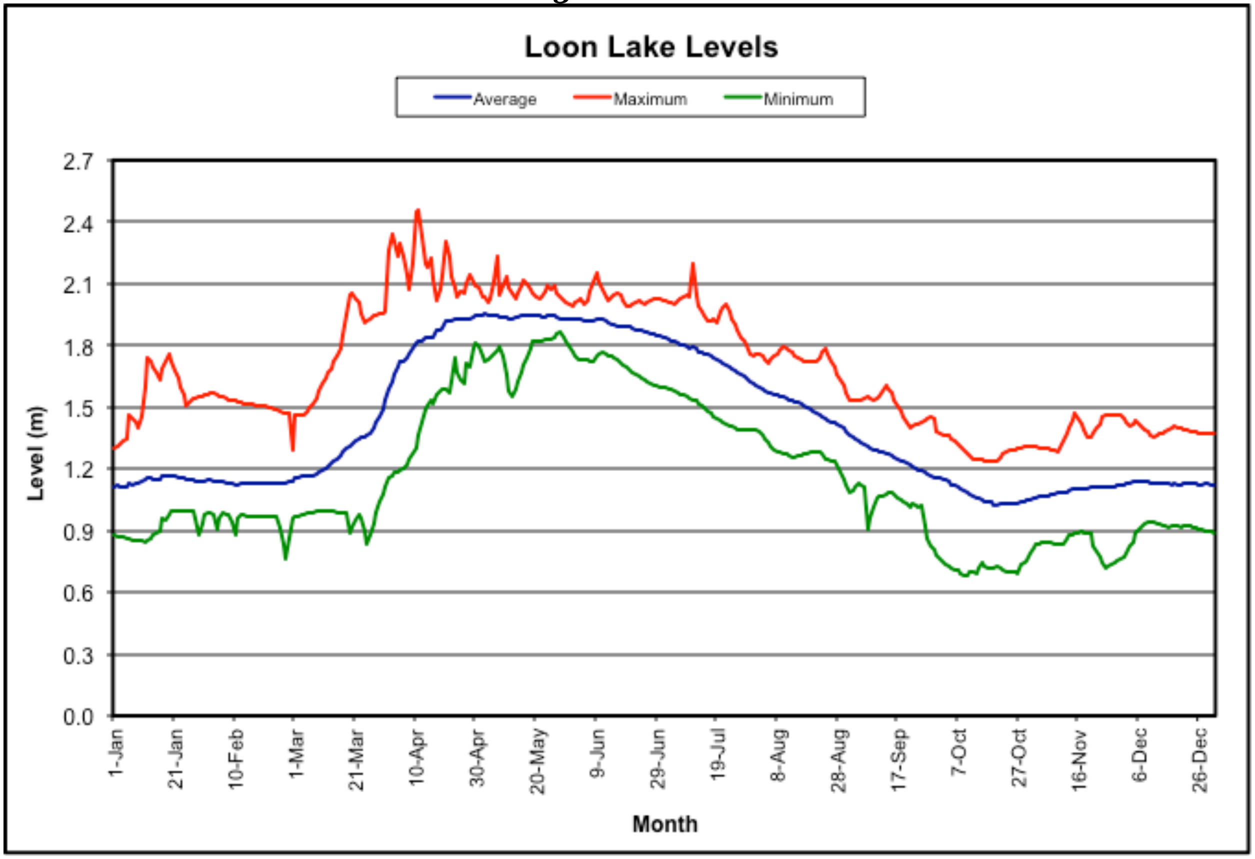
Loon Lake

Summary

When contacted by CEWF in April 2016, the President of the Loon Lake Property Owners Association (LLPOA), Joe Harwood, indicated that while the Association supports CEWF's overall approach, they believe the current water management protocols of the TSW are appropriate and so there is no need for them to complete a preferred water levels report for CEWF.

Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels as the TSW's published current average levels during the navigation season.

The nominal preferred water level range for Loon Lake is 1.0 – 1.9 metres during the navigation season.



Data provided by the Trent Severn Waterway

Loon Lake: Historic Water Levels

Key lake statistics:

Drainage area:	46 sq. km.
Lake area:	254 ha.
Maximum storage volume:	338 ha-m

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Stump Lake Dam. The water level is measured in metres (m) above the sill plate of the dam. There is a 'sill plate adjustment' of 0.61m reflecting an upstream obstruction that means the water level cannot be brought down to the sill plate level. Due to a flow constriction through the Gregory Lane culvert that lies between the dam and Loon Lake, water levels on the main lake can vary from those recorded by the gauge, especially due periods of high flow.

The chart on page 1 records the multi-year average water level (blue line) on Loon Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.

Key reference points:

Sill plate level	0.00m	
Adjusted Sill Plate Level	0.61m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 6.5 logs in place	1.98m	100% full
TSW Target level in Spring	1.94m	98% full
TSW Winter set level - 2 logs in place	0.61m	0% full
Nominal water level fluctuation (per logs)	1.37m	100% of capacity
Historic average fluctuation (per chart)	0.90m	66% of capacity

Current Water Level Data
To check the current water level on a reservoir lake you can use visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Preferred Water Levels

When contacted by CEWF in April 2016, the President of the Loon Lake Property Owners Association (LLPOA), Joe Harwood, indicated that while the Association supports CEWF's overall approach, they believe the current water management protocols of the TSW are appropriate and so there is no need for them to complete a preferred water levels report for CEWF.

This position was developed on the basis of consultation with the Lake Partner Program administrator (Mike Grinnell) and the chair of the LLPOA Water Committee (Pete Sibley).

They did note a concern related to flood mitigation efforts during spring freshets or extreme rainfall events. While it is agreed that the TSW does an excellent job of preventing bad flooding, it is suggested that they establish, as a reference, a gauge point at the dam that represents the water level at the mouth of the Burnt River, several centimetres just before embankment over topping occurs. The gauge point would be a specific head of water over the sill of the dam at any given number of stop logs. It would then function as an alarm point for potential flooding of the majority of the lowlands on Loon Lake. In addition it was suggested that the TSW would benefit from the installation of a new measuring stick on the downstream side of the box culvert under Highway 118 at Shanty Creek.

The LLPOA requested that CEWF ensure that lakes not participating in the PWL initiative not be adversely affected due to changes in water management protocols resulting from lakes that do participate.

Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels on Loon Lake as the TSW's published current average levels during the navigation season.

The nominal preferred water level range for Loon Lake is 1.0 – 1.9 metres during the navigation season.

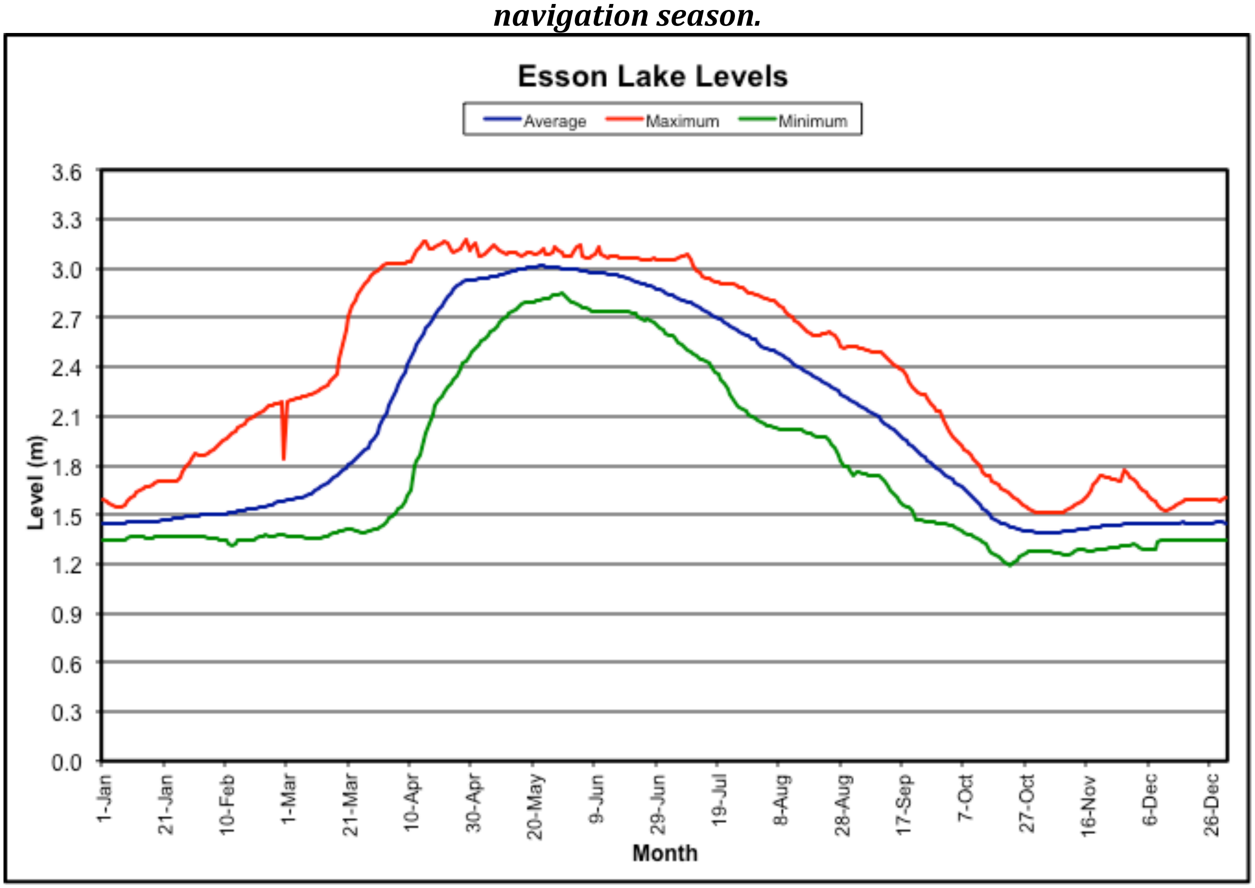
"Preferred Water Levels" During the Navigation Season
for
Esson Lake

Summary

CEWF is not aware of a lake association representing all of Esson Lake, however the lake is represented at CEWF by the Rowbotham Road Association. When contacted by CEWF in April 2016, the Association indicated that they did not intend to participate in the CEWF PWL initiative.

Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels as the TSW's published current average levels during the navigation season.

The nominal preferred water level range for Esson Lake is 1.4 – 3.0 metres during the navigation season.



Data provided by the Trent Severn Waterway

Esson Lake: Historic Water Levels

Key lake statistics:

Drainage area:	20 sq. km.
Lake area:	236 ha.
Maximum storage volume:	504 ha-m

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Esson Lake dam. The water level is measured in metres (m) above the sill plate of the dam. There is a 'sill plate adjustment' of 0.91m reflecting an upstream obstruction that means the water level cannot be brought down to the sill plate level.

The chart on page 1 records the multi-year average water level (blue line) on Esson Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.

Key reference points:

Sill plate level	0.00m	
Adjusted Sill Plate Level	0.91m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 10 logs in place	3.05m	100% full
TSW Target level in Spring	3.05m	100% full
Maximum Storage Depth	2.13m	
TSW Winter set level - 4 logs in place	1.22m	14% full
Nominal water level fluctuation (per logs)	1.83m	86% of capacity
Historic average fluctuation (per chart)	1.6m	75% of capacity

Current Water Level Data
To check the current water level on a reservoir lake you can use visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Preferred Water Levels

CEWF is not aware of a lake association representing all of Esson Lake, however the lake is represented at CEWF by the Rowbotham Road Association. When contacted by CEWF in April 2016, the Association indicated that they did not intend to participate in the CEWF PWL initiative.

Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels as the TSW's published current average levels during the navigation season.

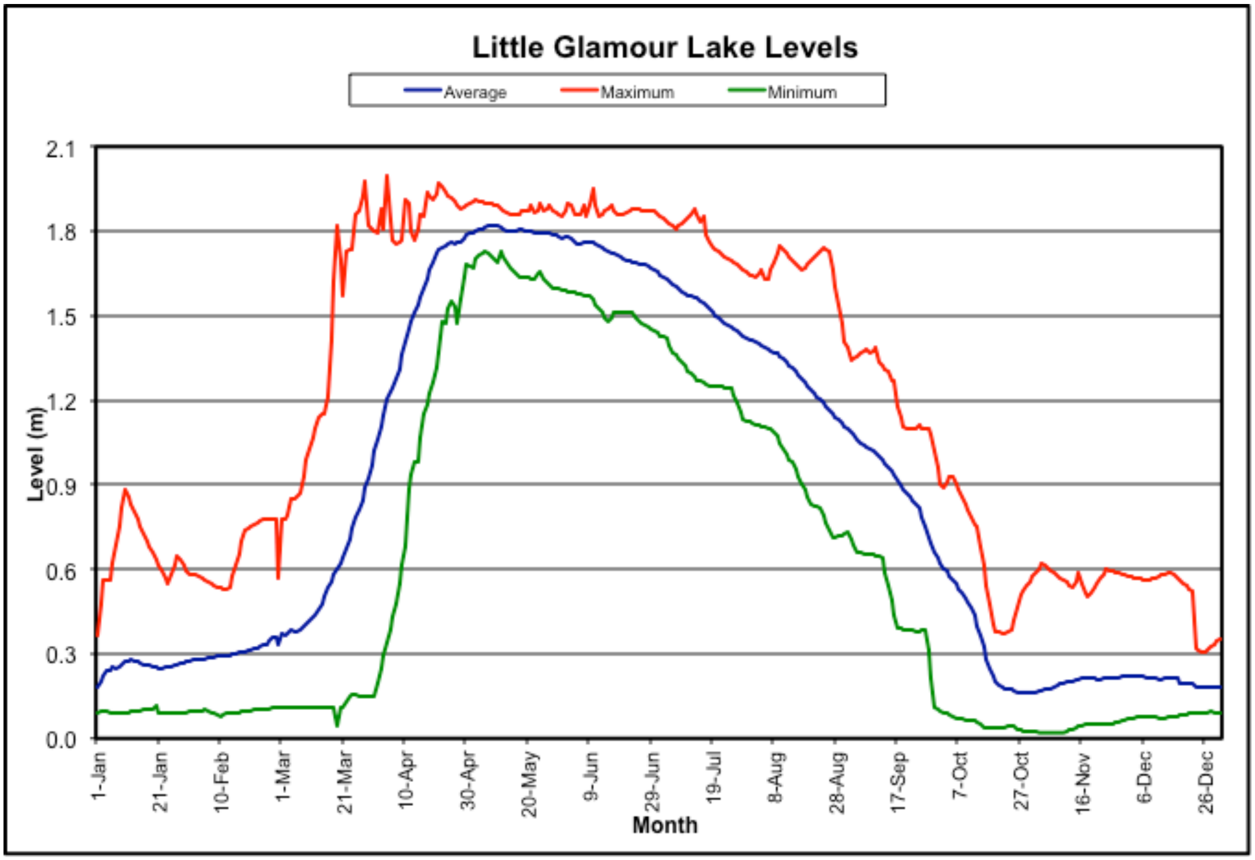
The nominal preferred water level range for Esson Lake is 1.4 – 3.0 metres during the navigation season.

"Preferred Water Levels" During the Navigation Season
for
Little Glamor Lake

Summary

When contacted by CEWF in April 2016, the President of the Little Glamor Lake Cottage Association (LGLCA), Steve Consentino, responded that fluctuating water levels "has never really been an issue on our lake. CEWF confirmed that the LGLCA accepts the current water level management regime and has no specific issues with regard to water levels. Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels as the TSW's published current average levels during the navigation season.

The nominal preferred water level range for Little Glamor Lake is 0.3 – 1.8 metres during the navigation season.



Data provided by the Trent Severn Waterway

Little Glamor Lake: Historic Water Levels

Key lake statistics:

Drainage area:	27 sq. km.
Lake area:	63 ha.
Maximum storage volume:	115 ha-m

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Little Glamor Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

The chart on page 1 records the multi-year average water level (blue line) on Little Glamor Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 6 logs in place	1.83m	100% full
TSW Target level in Spring	1.83m	100% full
TSW Winter set level - 1 log in place	0.305m	17% full
Nominal water level fluctuation (per logs)	1.53m	83% of capacity
Historic average fluctuation (per chart)	1.63m	89% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Preferred Water Levels

When contacted by CEWF in April 2016, the President of the Little Glamor Lake Cottage Association (LGLCA), Steve Consentino, responded that fluctuating water levels "has never really been an issue on our lake. The 'no-go' areas on our lake for motorboats remain the same at high and low water levels. The channel to and from the boat launch is not impacted, as long as you know where the navigable part of the channel is. We are a small lake and during the summer unusual fluctuations are pretty much determined by the odd heavy rain or a beaver dam letting go as we are not really fed by any other lake."

CEWF confirmed that the LGLCA accepts the current water level management regime and has no specific issues to raise with regard to water levels on Little Glamor Lake. Accordingly, for statistical purposes, CEWF has nominally defined the preferred water levels as the TSW's published current average levels during the navigation season.

The nominal preferred water level range for Little Glamor Lake is 0.3 – 1.8 metres during the navigation season.

Coalition for
Equitable
Water Flow

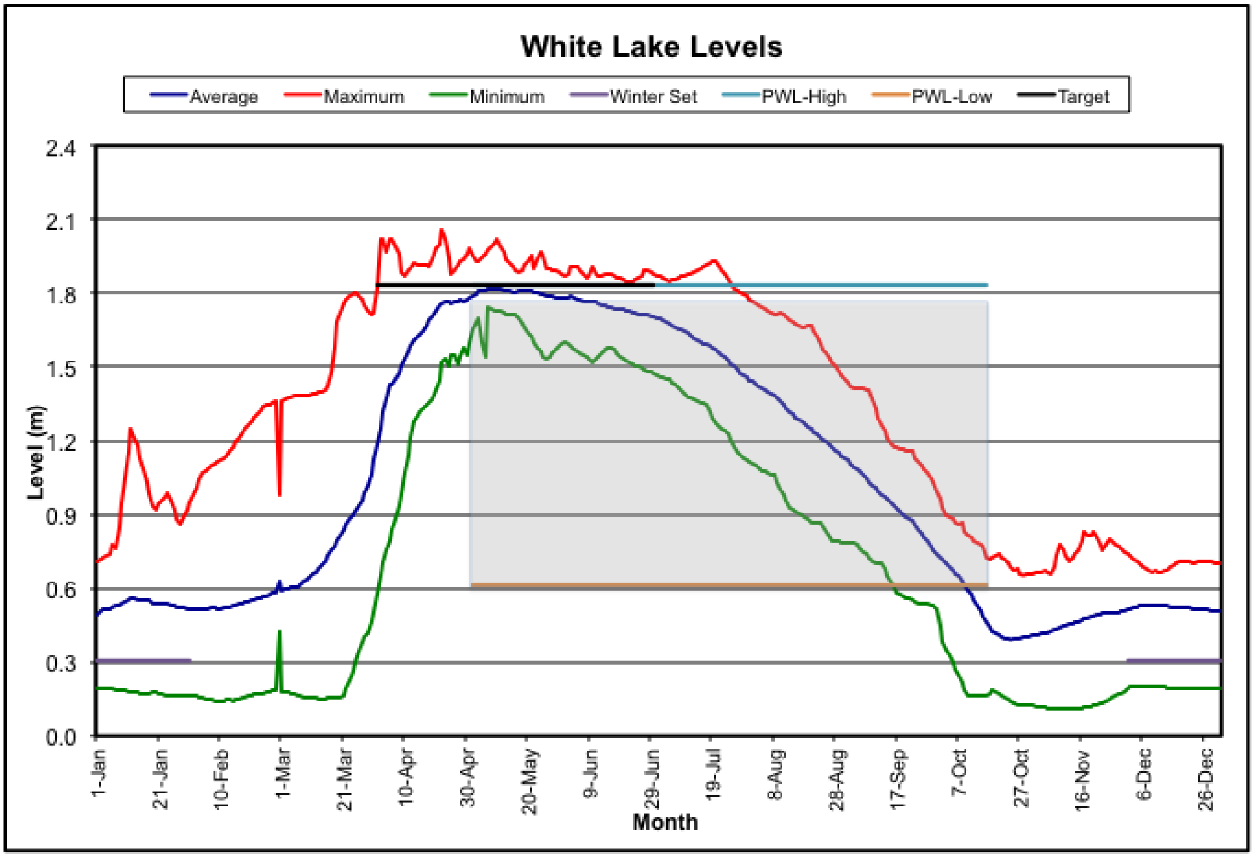
"Preferred Water Levels" During the Navigation Season for

White & Fortescue Lakes

Contents

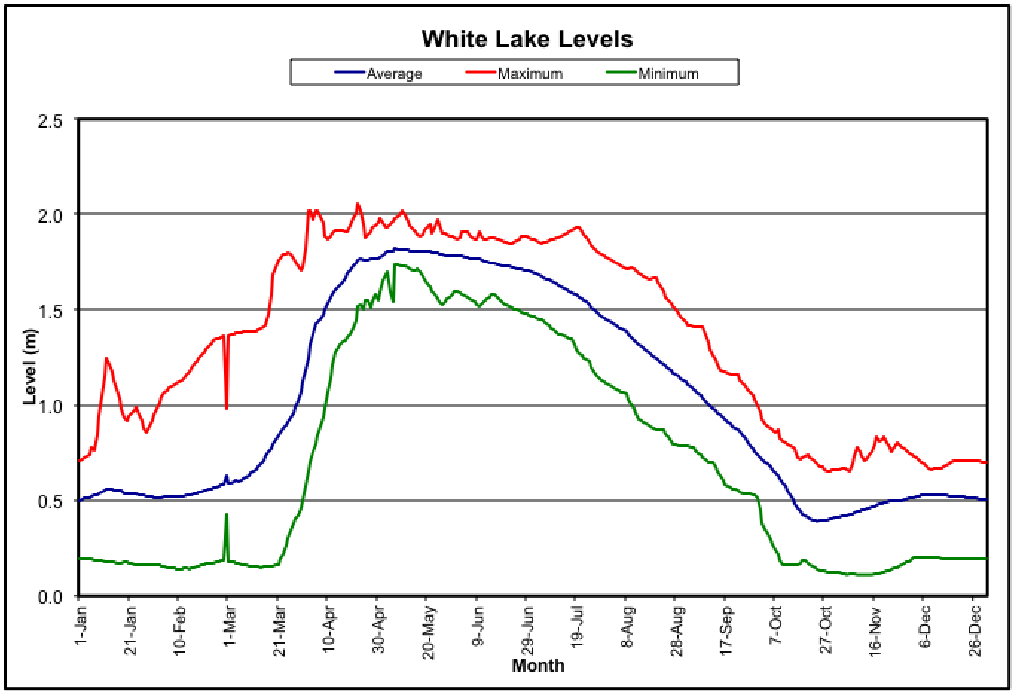
Approval and Endorsement

The preferred water levels identified in this document were approved by both the White Lake and Fortescue Lake Cottage Owners Association Boards and endorsed unanimously by the Members at their Annual General Meetings on July 4th and July 25th, 2015, respectively.



White (and Fortescue) Lakes: Historic Water Levels

The following chart records the multi-year average water level (blue line) as measured at the White Lake dam since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period. Fortescue Lake has the exact same water level as White Lake at all times, with a free flow of the water through a culvert on the North Salmon Lake Road. Fortescue Lake levels are therefore not referred in Trent Severn Waterway data.



How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a wall marked gauge located on the White Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 6 logs in place	1.83m	100% full
TSW Target level in Spring	1.83m	100% full
TSW Winter set level - 1 log in place	0.31m	17% full
Nominal water level fluctuation (per logs)	1.53m	83% of capacity
Historic average fluctuation (per chart)	1.43m	78% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

White & Fortescue Lakes – Preferred Water Levels

Key lake statistics for the two lakes combined as provided by the TSW:

Drainage area: 54 sq. km.
Lake area: 160 ha.
Maximum storage volume: 293 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Shoreline erosion
- No boat access between the two lakes
- Flooding of low-lying cottages
- Ice damage most likely
- Beach areas quite restricted

Water Levels "too low"

- Access of non-lake front property owner boats to the water (and removal) at the White Lake dam (no public landing site on the lake) virtually impossible, as well as considerable difficulty at other cottage fronts
- Damage to boats due to navigational hazards, (rocks, sunken tree stumps and logs, deadheads)
- Costs for building extensions to docks for water access
- Accessibility by boat to many shallow bays and docks due to extensive weed growth
- Wells drying up, and lake water in-take issues
- Need to move floating docks for the winter during the navigational season
- No boat passage between the 2 lakes
- Fortescue Lake trout spawning beds exposed
- Wetlands dry out, or remain moist with foul smell
- Pleasurable swimming curtailed too early

Lake Levels rising in June (after normal seasonal high)

- Wetland habitat degraded in prime breeding season for aquatic wildlife

Lake Levels falling in October

- Shallow Trout spawning beds may dry out

Upper preferred water level limit

To minimize shoreline erosion and local flooding of low-lying cottages the current upper preferred water level limit of 1.83 metres above the sill plate is proposed. This is equal to the multi-year average for early June and represents 100% of the full range available for control by the TSW. This water level is equal to the top of the dam with all logs in place, which is the TSW 'target' level.

Lower preferred limit of water level

Navigational hazards and challenges increase significantly when the water level of the lake drops below 0.61 metres. This is equal to the multi-year average for October 9th and represents 33% of the full range available for control by the TSW.

The White Lake and Fortescue Lake Cottage Associations thus support a preferred water level range of 0.61 – 1.83 metres during the navigation season.

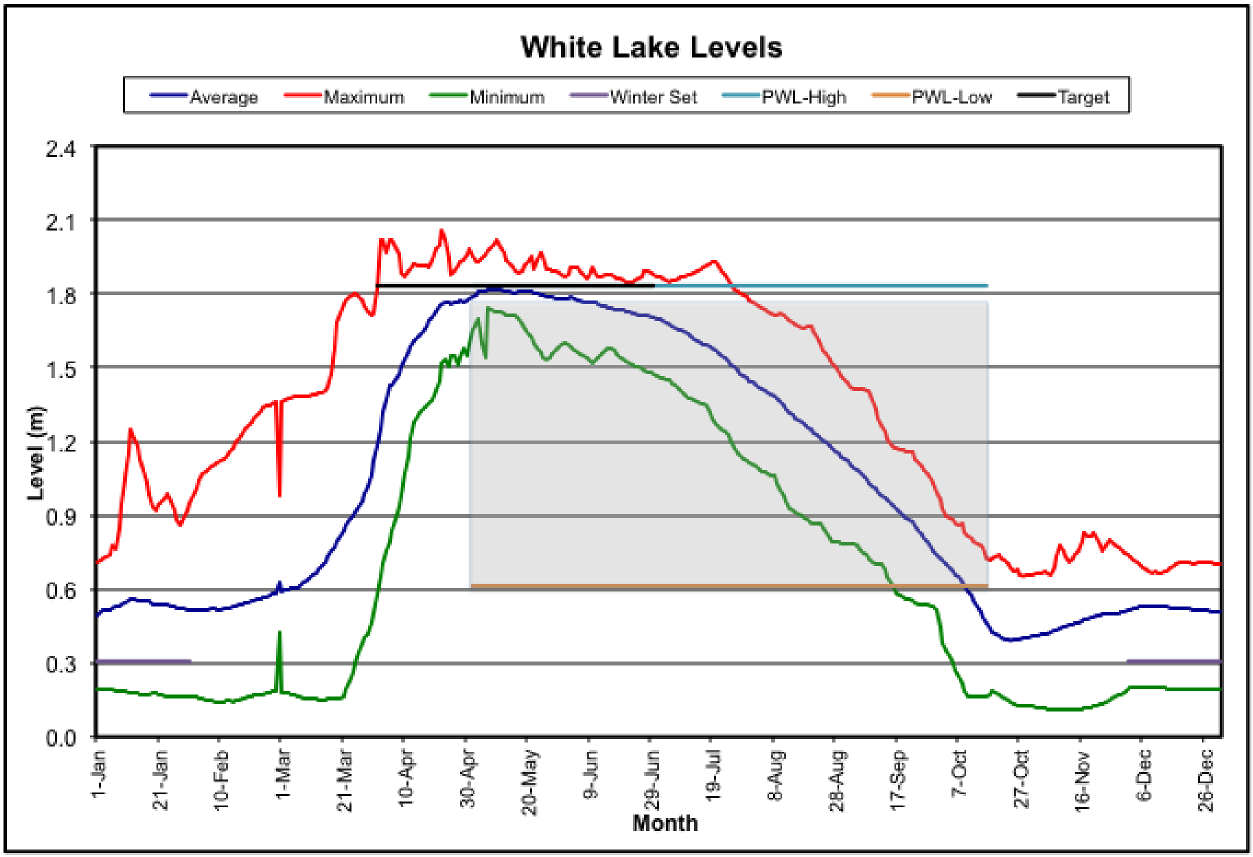
White and Fortescue Lakes: Comparison of Historic and Preferred Water Levels

The following chart superimposes the Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the current **winter-set** condition is equal to 1 log in the dam;
- the preferred **upper limit** of 1.83 m for the water level during the navigation season, equivalent to 6 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 0.61 m for the water level during the navigation season, equivalent to 2 logs in the dam, is typically maintained into early October, but can be breached as early as mid-September in a dry year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 1.5 logs instead of 1. However, the lake associations are requesting a winter-set of 2 logs to ensure that the preferred lower limit is maintained even in a dry year.



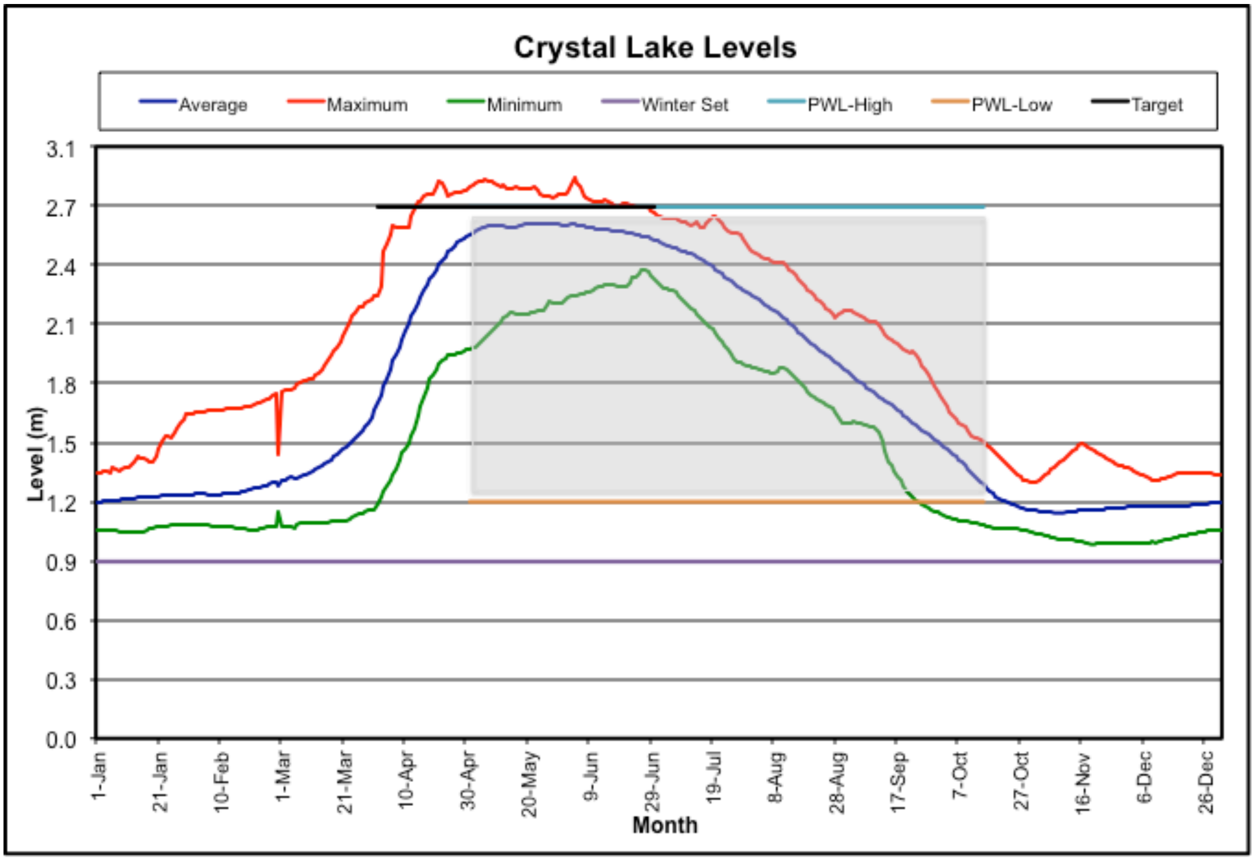
Coalition for
Equitable
Water Flow

“Preferred Water Levels” During the Navigation Season
for
Crystal Lake

Contents

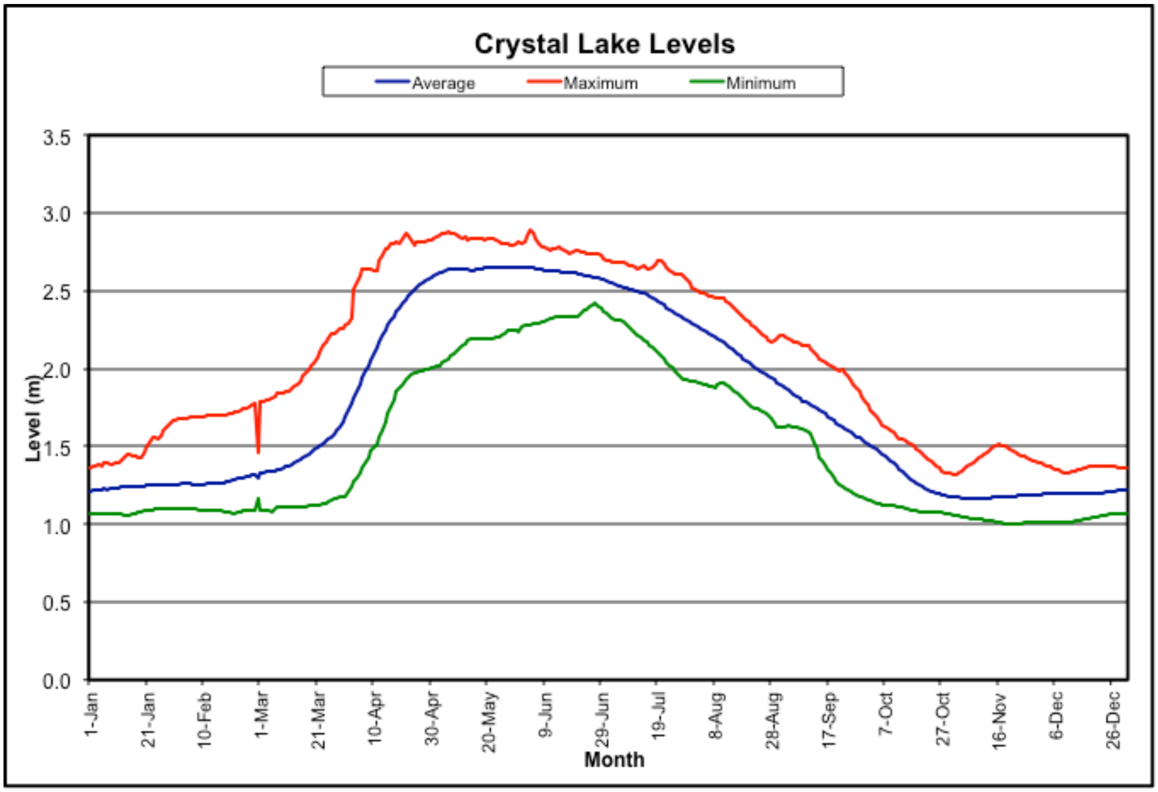
Approval and Endorsement

The preferred water levels identified in this document were endorsed by the Crystal Lake Cottagers Association (CLCA) Executive, Board and Membership (as of September 3, 2012).



Crystal Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Crystal Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Crystal Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level (adjusted)	0.61m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 9 logs in place	2.74m	100% full
TSW Target level in Spring	2.74m	100% full
TSW Winter set level – 3 logs in place	0.91m	14% full
Nominal water level fluctuation (per logs)	1.83m	86% of capacity
Historic average fluctuation (per chart)	1.49m	70% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Crystal Lake - Preferred Water Levels

Key Lake and Dam statistics:

Drainage area:	50 sq. km.
Lake area:	449 ha.
Maximum storage volume: ..	958 ha-m

Most significant Impacts of fluctuating Water Levels**:**

Water levels "too high" in spring (i.e. water is over-flowing the dam):

- low-lying properties may experience flooding;
- affects of shoreline erosion increased;
- ice damage likely if water levels rise too early.

Water Levels "too low" during the navigation season:

- floating docks become stranded;
- damage to boats can occur when more than one log is removed at a time i.e. people are unprepared for significant draw downs in a short time frame;
- -lake temperatures increase and may cause unwanted vegetation and "blooms"

Lake levels rising in June (after normal seasonal high):

- wetland wildlife habitat may be affected e.g. flooding of loon nests

Lake Levels falling in October:

- it is important that winter set is obtained prior to trout spawning season to ensure that eggs are not left dry;
- low lake levels in the fall have a significant affect on shore land wildlife including invertebrates and reptiles.

The levels identified below are submitted on the assumption that the reservoir lakes will continue to supply the TSW in the "traditional" fashion and the TSW intends to maintain the draught requirements in the canal lakes. Should the TSW change their fundamental operating program and mandate, including the "draught" requirements in the canal lakes, the position of Crystal Lake with regard to water level preferences may change. It should be noted that it is the preference of the Crystal Lake Cottagers that the highest possible water levels be maintained through out the recreational season.

Upper preferred water level limit

The preferred upper water level limit for Crystal Lake is 2.74 m, equivalent to the level of the dam when all 9 logs are in place.

Lower preferred water level limit during the navigation season

The preferred lower water level limit for Crystal Lake during the navigation season, which lasts until the Thanksgiving weekend, is 1.2 m, equivalent to the level of the dam when 4 logs are in place. Having the water level go below 4 logs prior to Thanksgiving greatly increases navigational hazards.

CLCA thus supports a preferred water level range of 1.20 – 2.74metres during the navigation season.

Winter-set level

CLCA understands that the traditional winter-set level at the Crystal Lake dam is 3 logs in. In order to ensure the protection of trout spawning habitat and that Crystal Lake has an adequate opportunity to fill in the spring, we are suggesting that a 4 log winter set is more appropriate.

It is suggested that this winter set should be achieved after the Thanksgiving weekend and prior to Trout spawning. It is important that a minimum winter set of 4 logs be maintained on Crystal Lake to protect against water lines freezing.

Installation of logs in the spring

While the number one concern of the CLCA is the ecological integrity of the watershed and the need to fill the lake basin for the recreational season (as predicted by moisture content and anticipated spring freshet), it is suggested that this be done in an incremental fashion to the extent possible in order to minimize potential property damage caused by rising and shifting ice adjacent to the shore.

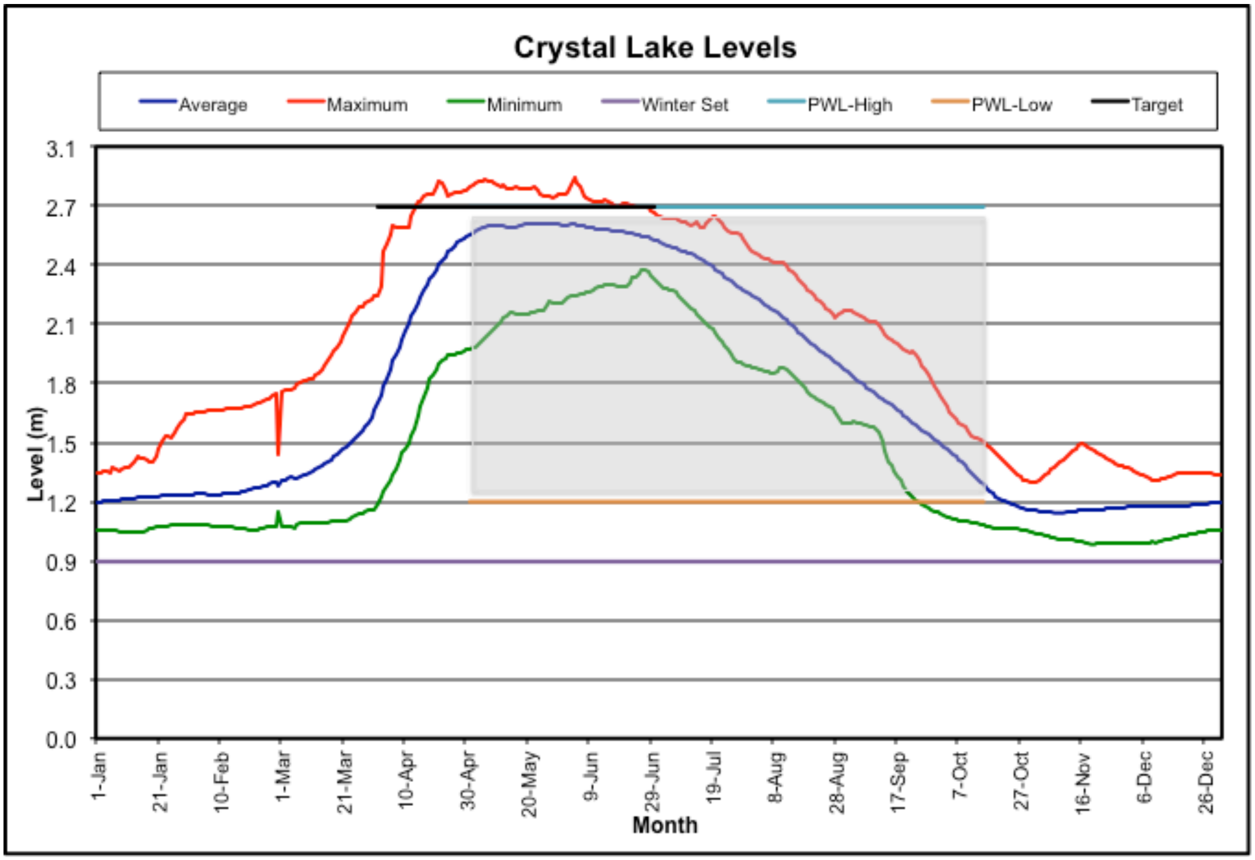
Crystal Lake Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the CLCA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 3 logs in the dam;
- the preferred **upper limit** of 2.74 m for the water level during the navigation season, equivalent to 9 logs in the dam, corresponds to a level slightly higher than the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.2 m for the water level during the navigation season, equivalent to 4 logs in the dam, is typically maintained in all but the driest of years and should be attainable. It would appear that this condition could better be assured if the winter-set condition were 4 logs instead of 3.

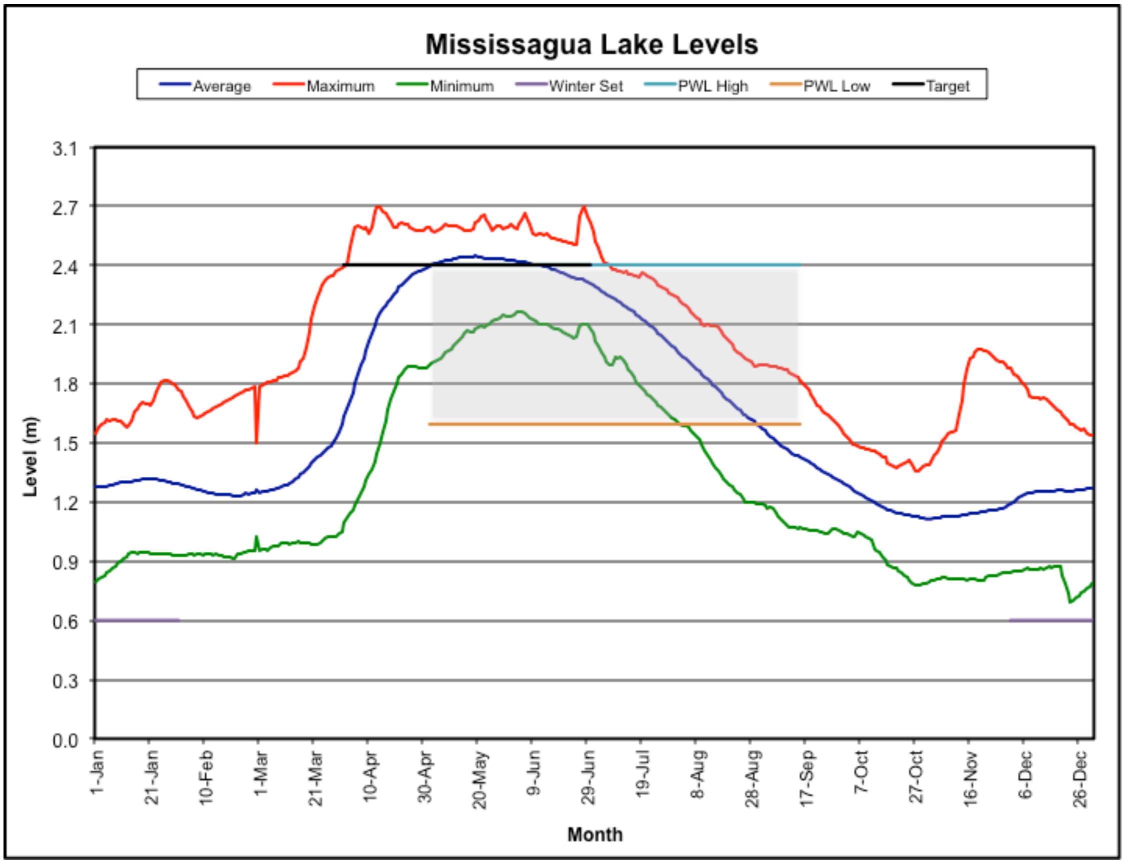


"Preferred Water Levels" During the Navigation Season
for
Mississagua Lake

Contents

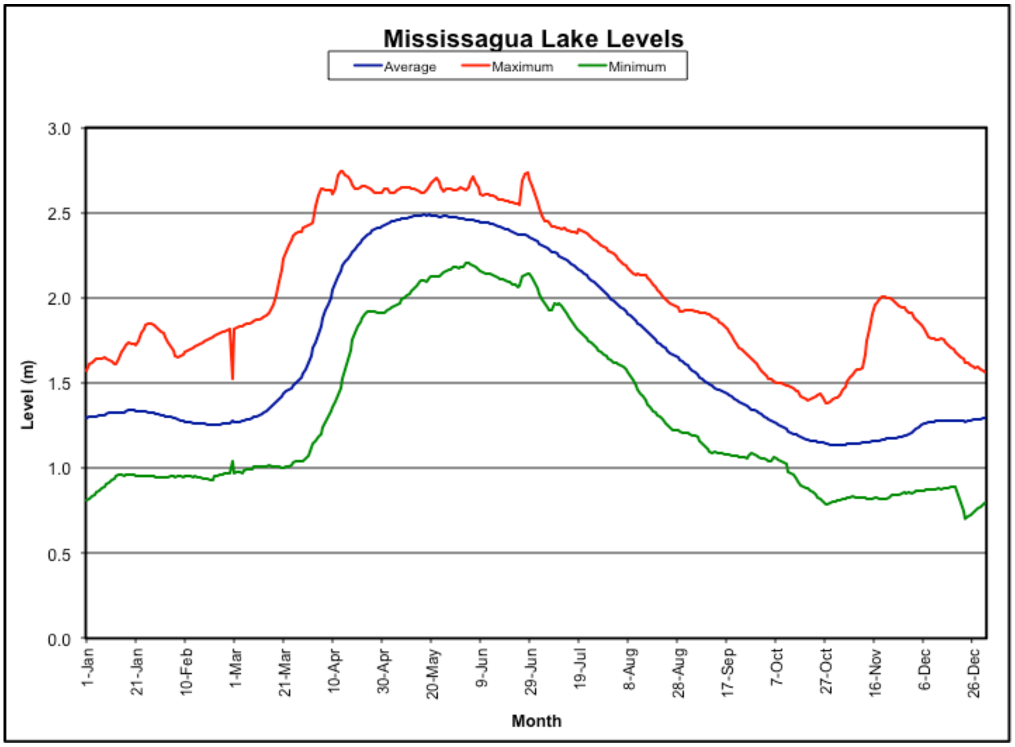
Approval and Endorsement

The preferred water levels identified in this document have been approved by the Board of the Cavendish Community ratepayers Association (CCRAI) and endorsed by the CCRAI Members at their Annual General Meeting on, Aug 15, 2015.



1. Mississagua Lake: Historic Water Levels

The following chart records the multi-year average water level (blue line) on Mississagua Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period. (Source: data provided by the Trent Severn Waterway)



How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Mississagua Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 8 logs in place	2.44m	100% full
TSW Target level in Spring	2.44m	100% full
TSW Winter set level - 2 logs in place	0.61m	25% full
Nominal water level fluctuation (per logs)	1.83m	75% of capacity
Historic average fluctuation (per chart)	1.36m	56% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

The Mississagua Dam controls the level of five major lakes, Mississagua, Catchacoma, Beaver, Gold and McGinniss, as well as the connecting channels and smaller lakes. The flow constrictions at the bridges and between lakes normally result in the upstream lakes responding more slowly to dam adjustments than is the case on Mississagua Lake.

The rate of flow over the dam and downstream in the Mississagua River varies considerably over the year as a result of dam operations and seasonal effects and impacts residents and cottagers on the river as well as facilities in the Kawartha Highlands Signature Site Provincial Park.

2. Mississagua Lake – Preferred Water Levels

Key lake statistics:

Drainage area:	218 sq. km.
Lake area:	2061 ha.
Maximum storage volume:	5,021 ha-m

The Mississagua lakes are the largest single reservoir by storage volume in the TSW system.

CCRAI Survey of Water Level Impacts 2014

In summer and fall 2014 CCRAI conducted a survey of impacts of fluctuating water levels. The Survey was presented to the CCRAI meeting in August 2014 and distributed to the CCRAI membership as well as through the two marinas on the lakes, and the Cottager Associations. A draft of this proposal was presented to the CCRAI public meeting in June 2015.

Most significant Impacts of fluctuating Water Levels on the lakes:

Water Levels "too high" on the lakes

- Increased risk of Ice damage
- Significant increase in shoreline erosion
- Unmarked navigation hazards hidden
- Cribs and fixed docks flooded.
- Adverse effects on fish spawning in fall

Water Levels "too low" on the lakes

- Inability to navigate between lakes due to low water
- Access to and movement of floating docks restricted
- Unmarked navigational hazards created
- Problems with use of boat launch ramps

In addition members identified the following significant issues on the lakes:

- Serious damage resulted in a recent year when water levels spiked in November and early December after docks had been set for winter storage.
- Rising water levels in June threaten nesting waterfowl particularly loons.
- When winter levels fall below mid-October levels there is a serious risk that the lake trout spawn will be dried out or frozen.

Most significant impacts of fluctuating Water Levels on the Mississagua River:

Water Flow "too high" on the River

- Increased risk of Ice damage
- Severe erosion associated with high flows after multiple log pulls at dam
- Flooding of and damage to cribs and docks
- Sudden significant changes in flow associated with the removal of more than one log result in damage to docks and ramps, which cannot be adjusted quickly enough.

Water Flow "too low" on the River

- Significant ecological impacts reported from extreme low flows (2014 recent example) weed growth, silt build up, high water temperatures, and wetlands drying out.
- Recreational use of river restricted at extreme low flows as in summer 2014 and spring 2015.

- Access to park campsites restricted when no flow as in spring 2015 when some sites were temporarily closed.

Preferred Water Level Recommendations

Upper preferred water level limit for the Lakes after May 24th

To minimize shoreline erosion and other damage an upper preferred water level limit of 2.44 metres above the sill plate is proposed. This is just below the multi-year average for early June and represents 100% of the full range available for control by the TSW. This water level is equivalent to the top of the dam with all logs in place and meets the TSW 'target' of 100% full. In order to achieve this level in most years it will probably be necessary for TSW to remove a half log from the dam by early June.

It is extremely important that this level not be reached until after the ice is off the lake. In our survey damage from ice at high water levels was the most frequently identified impact of high water. In recent years we have appreciated that TSW has tried to manage the reservoir filling to prevent high lake levels before the ice is off the lakes.

Lower preferred limit of water level before Labour Day

When the water level of the lakes drops below 1.62 metres it becomes impossible to navigate between Catchacoma and McGinnis lakes with a power-boat and other navigation hazards come into play. A level of 1.62 metres corresponds to approximately a 36 inches or 0.91 m. depth in the McGinniss cut. The 1.62 metre level is equal to the multi-year average for August 31st and represents 66% of the full range available for control by the TSW. This water level is 0.82 m. below the top of the dam with all 8 logs in place.

Because our Lakes are known to have shallow spawning lake trout it is important that drawdown to winter levels occurs by Oct 15 and therefore it is unlikely that this preferred level can be maintained much past Labour Day.

Preferred River Flow Rates

While we understand that the TSW priority in the spring is to bring the reservoirs to full and over the summer to provide needed flow to the canal lakes, we would suggest that the impacts of drastic flow changes on the river need to be recognized.

Whenever possible a modest flow is required in the river throughout the summer season to support the river ecosystem and recreation uses including access to the KHSS Provincial Park campsites on the River.

Whenever possible log operations should be limited to no more than one full log at a time in order to avoid unexpected and potentially dangerous and damaging changes in flow rates downstream in the river.

The Cavendish Community Ratepayers Association (CCRAI) thus supports a preferred water level range for Mississagua lakes of 2.44 to 1.62 metres during the navigation season from May 24th until after Labour Day.

CCRAI further suggests that every effort be made to maintain a minimum summer flow in the river and avoid multiple log pulls, which cause unexpected and potentially dangerous and damaging flow rates.

3. Mississagua Lake: Comparison of Historic and Preferred Water Levels

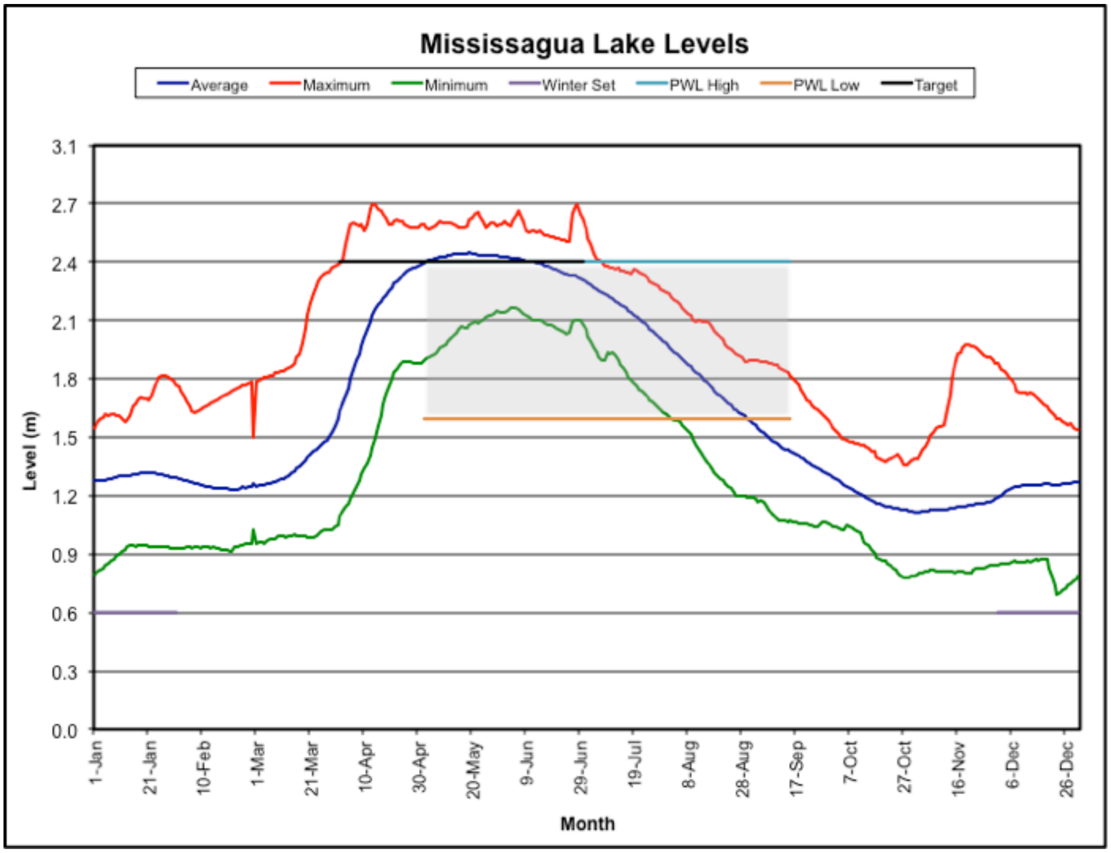
The following chart superimposes the [Mississagua] Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted ‘full’ level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 2 logs in the dam;
- the preferred **upper limit** of 2.44 m for the water level during the navigation season, equivalent to 8 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.62 m for the water level during the navigation season, equivalent to 4 or 4.5 logs in the dam plus overflow, is breached in late August in an average year, or as early as the end of July in a dry year: however this level has been maintained in the past as shown by the historic records. It would appear that this condition could be satisfied most years.

4. Composite Preferred Water Level chart



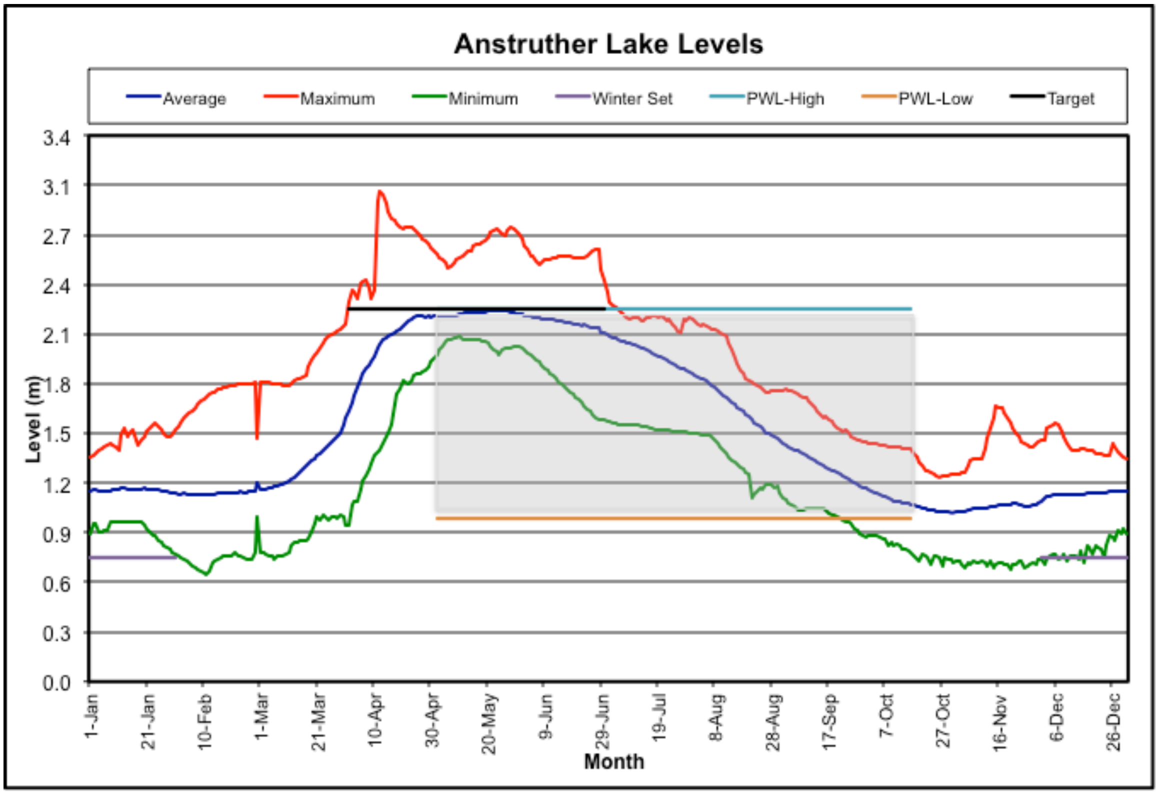
Coalition for
Equitable
Water Flow

"Preferred Water Levels" During the Navigation Season
for
Anstruther Lake

Contents

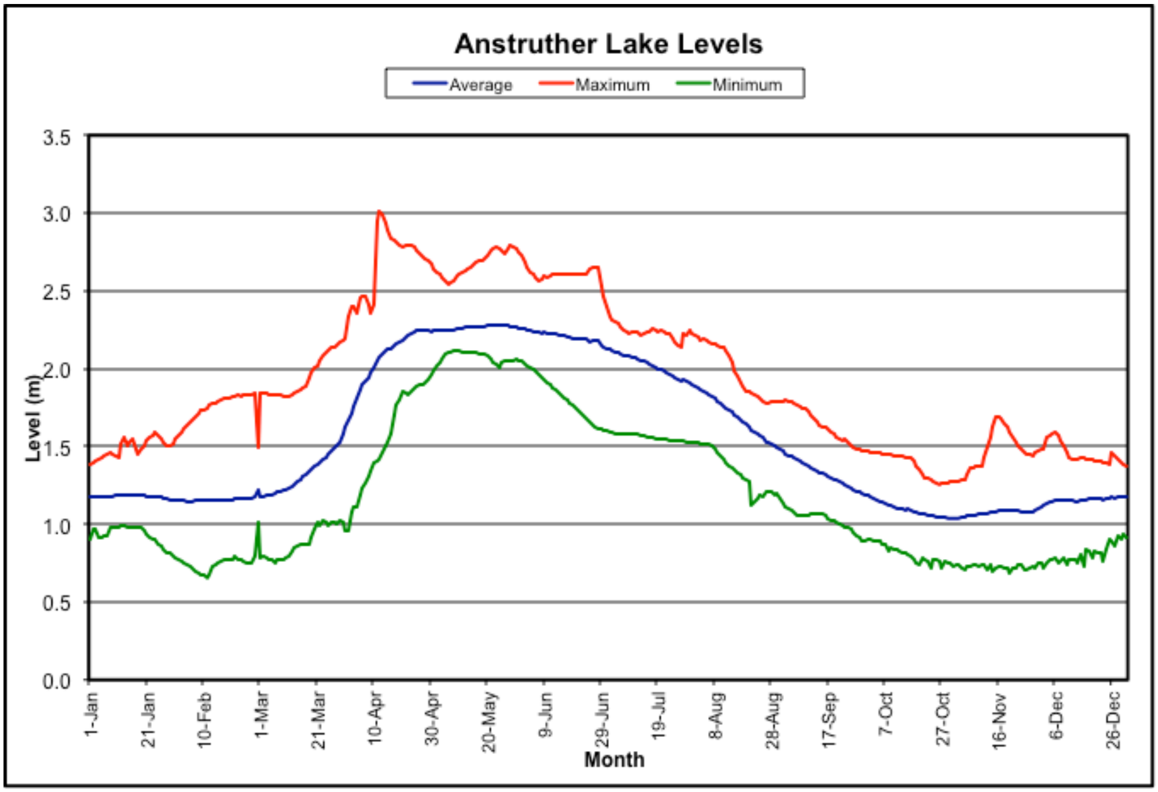
Approval and Endorsement

The preferred water levels identified in this document are based on a survey of members of the Anstruther Lake Cottagers Association (ALCA) as communicated to the Coalition by ALCA President Paul Beamish on January 28, 2014. Seventy-six percent of those responding to the survey supported maintaining the current system of controlling the water levels on the lake.



Anstruther Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Anstruther Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Anstruther Lake dam. The water level is measured in metres (m) above the sill plate of the dam.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 7.5 logs in place	2.29m	100% full
TSW Target level in Spring	2.29m	100% full
TSW Winter set level – 2.5 logs in place	0.76m	33% full
Nominal water level fluctuation (per logs)	1.53m	67% of capacity
Historic average fluctuation (per chart)	1.24m	54% of capacity

Current Water Level Data

To check the current water level on a reservoir lake you can use visit the TSW web site http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Anstruther Lake– Preferred Water Levels

Key lake and Dam statistics:

Drainage area: .... 93 sq. km.
Lake area: .... 621 ha.
Maximum storage volume: .. 1420 ha-m

Most significant Impacts of fluctuating Water Levels:

Water Levels "too high"

- Shoreline erosion and loss of trees

Water Levels "too low"

- Unable to access boats in slips at the marina
- Damage to boats due to navigational hazards
- Cost of building extended docks to access water
- Hazards to young children on exposed rocky shoreline
-

Upper preferred water level limit

An upper preferred water level limit of 2.29 metres above the sill plate is acceptable. This is equal to the multi-year average high water level (in May) and to the 'full control level' of the dam with 7.5 logs installed.

Lower preferred limit of water level

The ALCA recognizes the need to provide water to the TSW and is not looking for any change in the current operating procedure. The current winter-set of 2.5 logs results in the average water level on the lake dropping to 1.0 metres above the sill plate of the dam.

ALCA thus supports a preferred water level range of 1.00 – 2.29 metres during the navigation season.

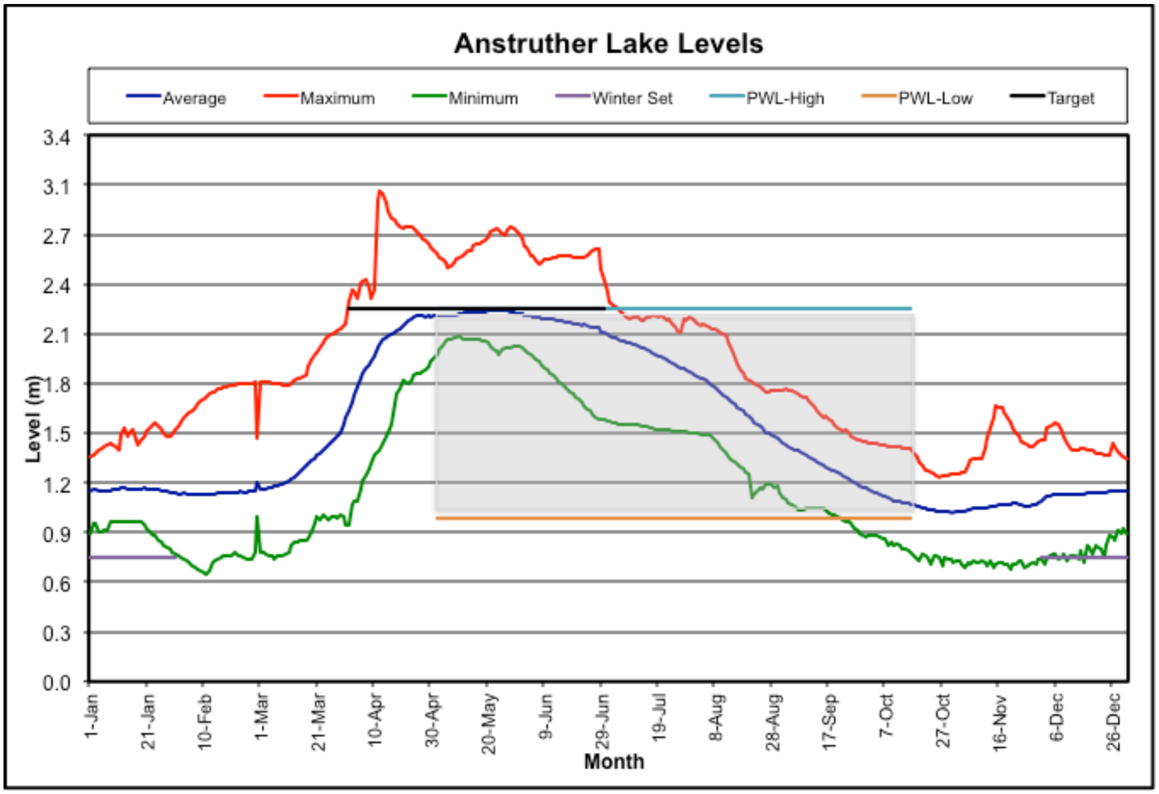
Anstruther Lake: Comparison of Historic and Preferred Water Levels

The following chart superimposes the ALCA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

Note: the left scale is still in metres above the sill plate of the dam: however the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dam.

From the chart it can be seen that:

- the **winter-set** condition is equal to 2.5 logs in the dam;
- the preferred **upper limit** of 2.29 m for the water level during the navigation season, equivalent to 7.5 logs in the dam, corresponds to the multi-year average high water level and so should be attainable.
- the preferred **lower limit** of 1.0 m for the water level during the navigation season, is the average water level experienced with 2.5 logs in the dam and so should be attainable in all but a very dry year.



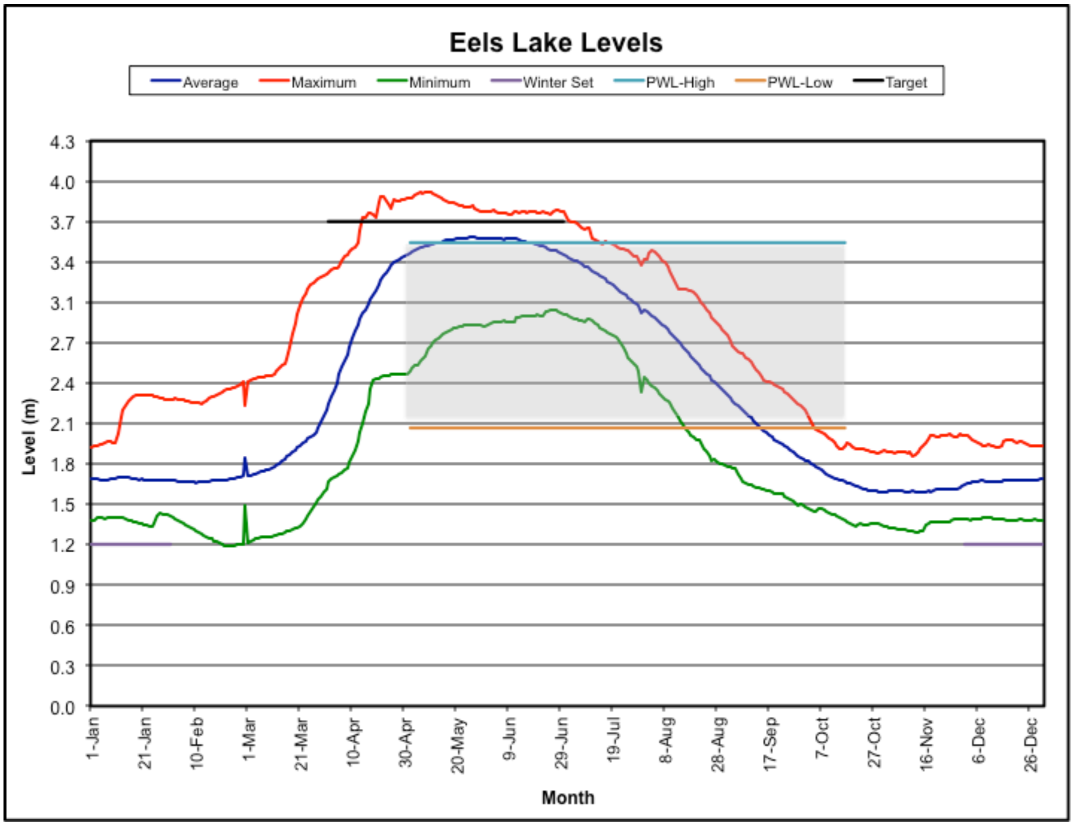
Coalition for
Equitable
Water Flow

"Preferred Water Levels" During the Navigation Season
for
Eel's Lake

Contents

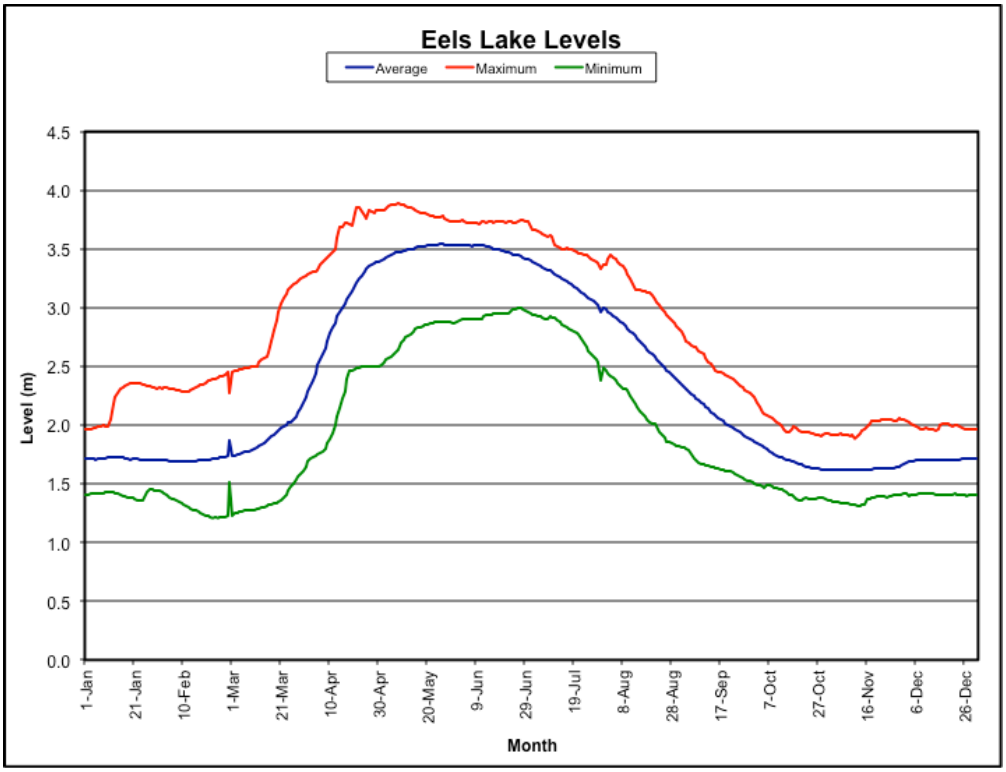
Approval and Endorsement

The preferred water levels identified in this document were ratified by the Eel's Lake Cottagers Association (ELCA) on April 29, 2015 at their Annual Meeting



Eel's Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Eels Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

How to Read the Chart

Water levels are measured by the Trent Severn Waterway (TSW) using an automatic recording gauge located at the Eels Lake Marina. The water level is measured in metres (m) above the sill plate.

Key reference points:

Sill plate level	0.00m	0% full
Height of standard stop-log	0.305m	
Height of dam with all 12 logs in place	3.66m	100% full
TSW Target level in Spring	3.66m	100% full
TSW Winter set level – 4 logs in place	1.22m	33% full
Nominal water level fluctuation (per logs)	2.44m	67% of capacity
Historic average fluctuation (per chart)	1.92m	52% of capacity

Current Water Level Data

To check the current water level on a reservoir lake, you can visit the TSW web site
http://www.pc.gc.ca/lhn-nhs/on/trentsevern/visit/ne-wl/trent_e.asp

NOTE: While the water level of the lake is 'controlled' by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a 'head' of water of several centimeters above the top of the logs; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Key lake and Dam statistics:

Drainage area: .... 104 sq. km.
Lake area:.................................... 815 ha.
Maximum storage volume: .. 2,981 ha-m

Characteristics: Eels Lake is a rocky lake which has many deep areas that allow Eels Lake to maintain a Lake Trout population, but the lake also has many shallow bays and channels that were created with the construction of the TSW dam and the resulting flooding of low lying forests.

To maintain the Lake Trout population, stocking has been carried out periodically by the MNR. Natural spawning of Lake Trout has been less successful. Although the underlying reasons for this are complex, silting of spawning areas caused by water level changes are suspected contributors.

Most Significant Detrimental Effects of Fluctuating Water Levels:

High Water Levels in Spring and Early Summer

- Shoreline erosion greatly increased, depositing silt and sand on bottom of lake
- Ice damage more likely
- Unmarked navigation hazards
- Rising Water Levels during June and July results in Loon nests being washed away.

Low Water Levels during the May 15 to September 15 Eels Lake Navigation Season

- Unmarked navigational hazards created (Note: Eels Lake has an unusually high number of submerged rocky shoals and boulders). Use of "run-about" boats (40HP and larger) becomes too hazardous after August 15 (Water level = 2.1 m =7 logs in) even during average lake levels (blue line on graph). Attempts to remove boats at the Eels Lake Public Access Ramp are significantly hindered by the fact that the pier is totally out of the water by mid August and becomes non-functional.
- The drawdown after August 15 (Water level = 2.1 m =7 logs in) results in excessive water-weed growth in shallow bays. This, besides being an Environmental concern, also affects the cottagers' use of their waterfront for swimming and boating.
- If logs are ever drawn below the current "Winter Set" of 4 logs in the dam (< 1.2m lake water level, considered a possibility by TSW in dry years, the lake water level drops to such a low level that the "Water Access Only" cottagers in 12 bays and channels can not access their cottages at all and non "Water Access Only" cottagers are restricted in the access to other parts of the lake.

Low Water Levels at 4-log Winter Set Conditions (Oct 1 to April 30) = 1.7m on average, with a range of 1.4 – 1.9m

When the water level falls below the average 1.7m there are the following concerns:

- in shallow bays of Eels Lake, foot valves of water systems out of water - sucking air and dirt.
- navigation impossible even with small fishing boats and motors.
- Lake Levels Falling From Intended Winter Set Levels - due to leak in dam; this could have a strong adverse effect on spawning fish, especially Lake Trout.

Eel’s Lake – Preferred Water Levels

Upper preferred water level limit
To minimize shoreline erosion and local flooding of low-lying cottages an upper water level limit of 3.5 metres is preferred. This equates to the multi-year average level in late May.

Lower preferred limit of water level
Navigational hazards and challenges become severe when the water level of the lake drops below 2.1 metres (which is typically seen in mid-September on average).

ELCA thus supports a preferred water level range of 2.1 – 3.5 metres during the May to Sept 15 Eels Lake navigation season resulting in a water level fluctuation of 1.4 metres rather than the current TSW practice of a 1.9 metre water level fluctuation.

In terms of water management practices, ELCA supports the principle that the TSW remove no more than one log at a time so that the short-term water level changes are reduced in severity*.*

Winter-set Level
ELCA understand that the traditional winter-set at the Eel’s Lake dam has been 1.2 m (4 logs in). To achieve this setting before mid-October trout spawning season typically requires the lake to be drawn down below the lower preferred water level limit of 2.1m after mid-September. However, it should be noted that the drawdown of Eels Lake is very rapid whenever a log is removed in the dam (about 3-4 days for the 30 cm level drop of one log removal). It is therefore requested for the TSW to review the feasibility of postponing the onset date of achieving winter-set level to approximately Oct 1 and of maintaining the winter-set level at a 5-log level. The feasibility of 5 logs in could be tested by the TSW for 1-2 years to study the impact on the rest of the system before making any final commitment.

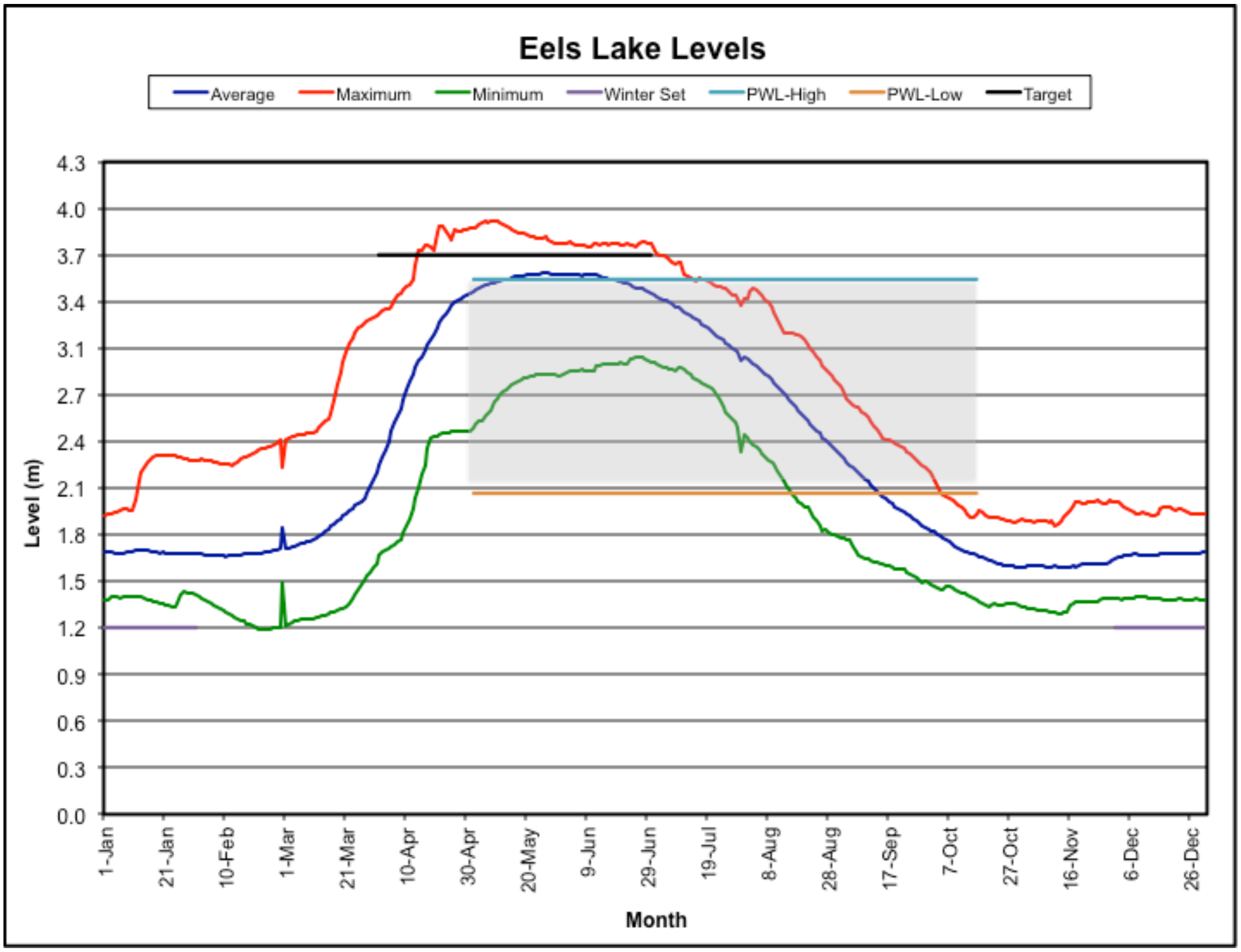
Eel’s Lake Preferred Water Levels compared to Historic Water Level Data

The following chart superimposes the ELCA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted ‘full’ level.

Note: the left scale is still in metres above the sill plate of the dam: the scale increments by 0.3 metres, equivalent to the depth of one of the control logs used to adjust the height of the dams.

From the chart it can be seen that:

- the current winter-set condition is 4 logs in the dam;
- the preferred upper limit of 3. 5 m for the water level during the navigation season, equivalent to 11½ logs in the dam, comparable to the multi-year average high water level.
- the preferred lower limit of 2.1m for the water level during the navigation season, equivalent to 7 logs in the dam, is typically maintained until mid-September in an average year but is breached as early as mid-August in a dry year. However it would appear that the preferred lower level condition could be satisfied most years if the winter-set condition were increased from 4 to 5 logs in the dam.


Eels Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
4.3
4.0
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

Coalition for
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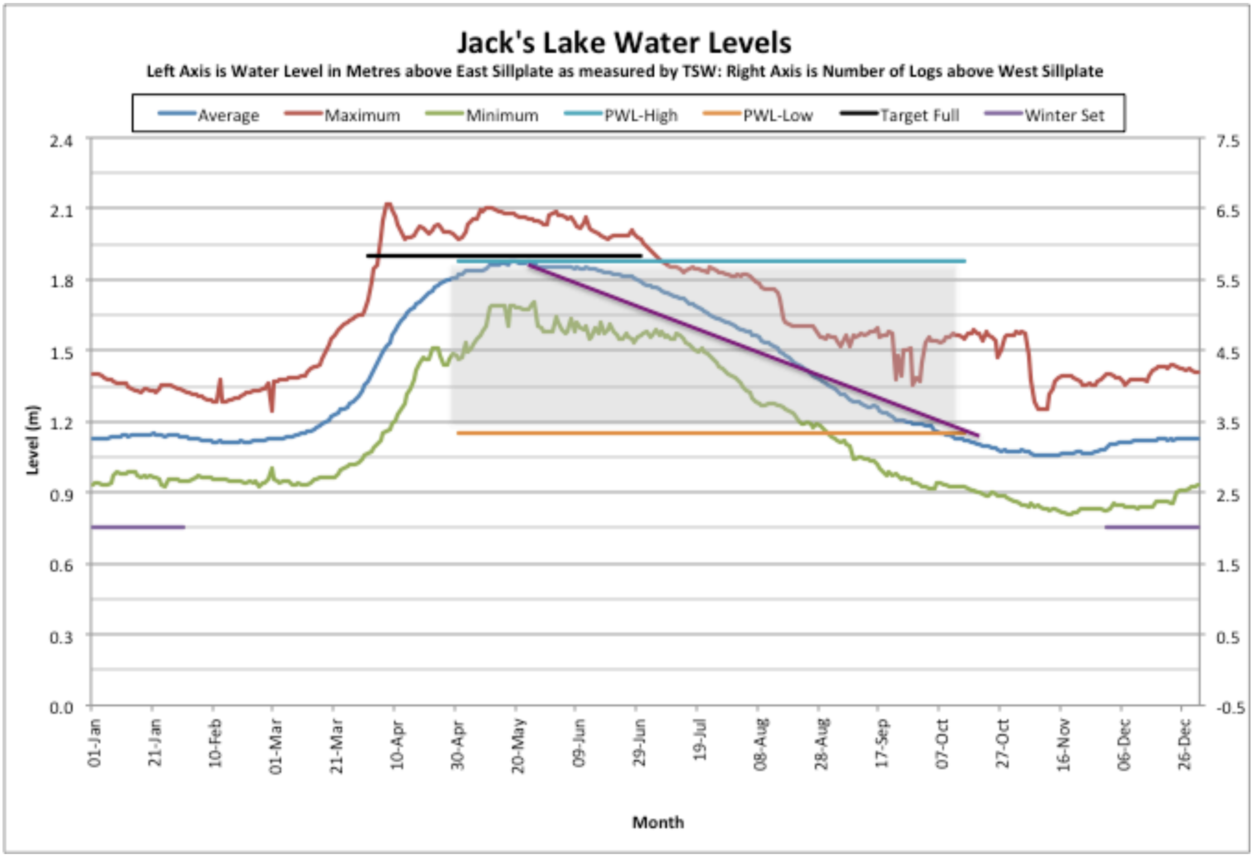
“Preferred Water Levels” During the Navigation Season
for
Jack’s Lake

Contents

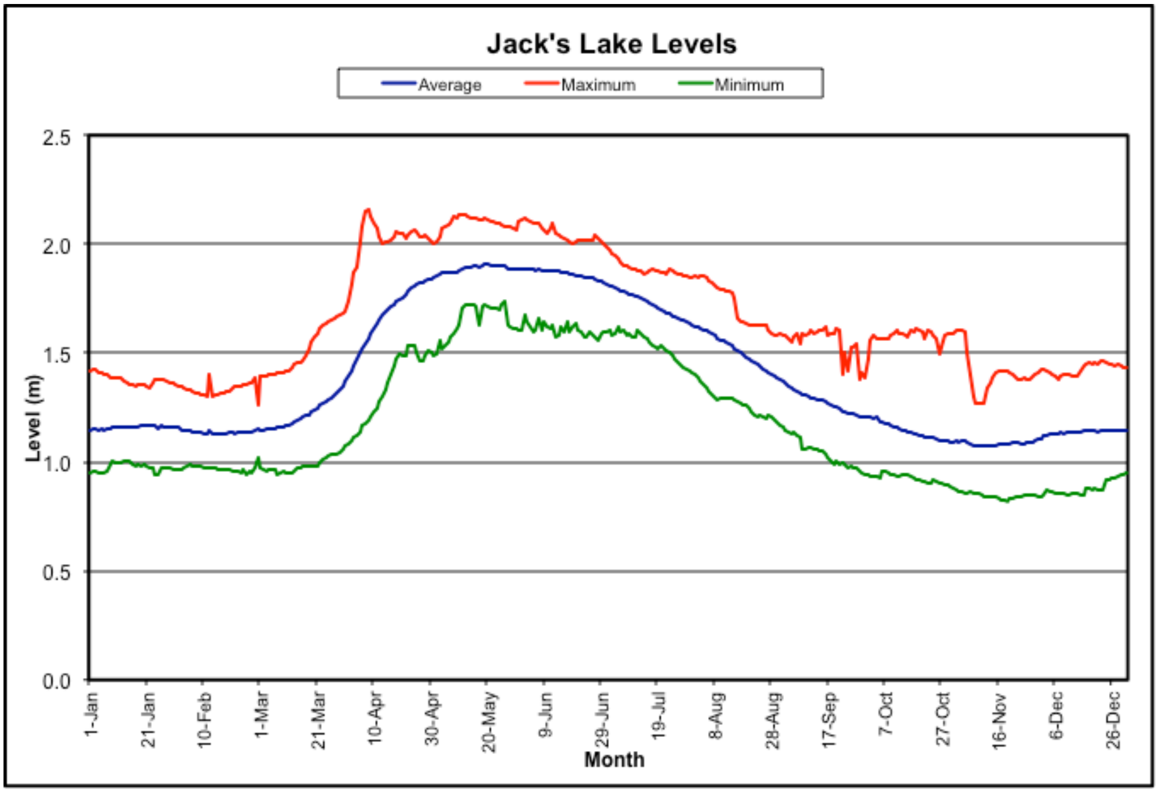
Approval and Endorsement

The preferred water levels identified in this document were approved by the Jack’s Lake Association (JLA) Board (December 12, 2012) - Robert C. DuBois, JLA Dam Coordinator.



Jack’s Lake Average Water Levels

The following chart records the multi-year average water level (blue line) on Jack’s Lake since 1988. An indication of the potential variability of water levels is provided by the maximum (red line) and minimum (green line) water levels recorded over the same period.



Data provided by the Trent Severn Waterway

<u>How to Read the Chart</u>

Water levels are measured by the Trent Severn Waterway (TSW) using a gauge located at the Jack’s Lake dam. The water level is measured in metres (m) above the sill plate of the unused east spillway of the dam. It is the west spillway that is used for log adjustments. The west spillway is 6” higher than that of the east spillway.

Key reference points:

Sill plate level (adjusted)	0.38m	0% full
TSW Target level in Spring	1.93m	100% full
Height of standard (12”) stop-log	0.305m	
(Target level is 2” below the top of the dam with 6 logs in the west spillway)		
TSW Winter set level – 2 logs in place	0.76m	25% full
Nominal water level fluctuation (per logs)	1.17m	75% of capacity
Historic average fluctuation (per chart)	0.83m	54% of capacity

NOTE: While the water level of the lake is ‘controlled’ by the number of logs in the dam, it will rarely be exactly equal to the level of the topmost log in the dam. It is usual for there to be a ‘head’ of water of several centimeters above the top of the dam; it is also possible for the water level of the lake to drop below the level of the topmost log in the dam due to evaporation or the recent addition of a stop-log.

Jack's Lake – Preferred Water Levels

Key lake and Dam statistics per TSW.

Drainage area:	83 sq km
Lake area:	1296 ha
Maximum storage volume:	2008 ha- m(storage depth x lake area)
Log number & dimension:	East spillway (unused): 7 wooden logs @ 12" West spillway (active): 6 wooden logs @ 12" plus one metal "half log" @ 6" (15.2 cm) that is not part of the total count but is used for fine-tuning draw-down.

NOTE: The TSW uses the sill plate of the East spillway as its reference point for water level data, but controls water levels by manipulation of logs in the West spillway. Because the West sill plate is 15cm. (6") higher than the East sill plate this can be confusing. In addition there is a common 'sill deduction' (typically an upstream obstacle that needs to be applied to both spillways. So please note that:

1. *The sill deduction is 0.38 m (15") as applied to the East sill - equivalent to 9" when applied to the West sill;*
2. *The "full level" is 1.93m (76") above the East spillway sill;*
3. *The same full level is therefore 76" - 6" = 70" above the West spillway sill.*
4. *The maximum storage depth is (76"-15") = 61" at the East spillway or (70" - 9") = 61" as measured at the West spillway;*
5. *With six standard 12" logs installed in the West spillway, the top of the top log will be 72" above the sill plate therefore 2" above what TSW considers 'full level"*

In summary - with 6 logs in the West spillway, the 'full level' of the lake is achieved when the water levels is 2" below the top of the top log.

Most significant Impacts of fluctuating Water Levels:

Water levels "too high" *(at or above a level equivalent to 5½-log set on the West spillway)*

- Shoreline erosion greatly increased from boat wakes
- Ice damage from lake levels rising while ice is still on the lake
- Loon nesting if water levels are rising during nesting season of May and June

Water levels "too low*" (at or below a level equivalent to a 3-log set on the West spillway)*

- Launch and recovery of watercraft is greatly affected
- Placing docks for winter storage
- Dock parking at Marinas, slips too shallow
- Navigational hazards both marked and unmarked
- Water access to properties restricted
- Shallow bays become unusable for power-boat traffic
- Weed growth occurs in areas where growth would not occur at normal water levels
- Lake Trout spawning occurs in late October and early November so dropping our lake in early September is not needed. The Lake Trout spawning beds are in deeper water and are covered even when the lake is at its winter set level.
- Dropping Jack's Lake to 50% by mid-September is not beneficial and reduces the season.

Navigational season on Jack's Lake

Our season runs from 1 May through 15 October (after Canada's Thanksgiving). However the ***navigation season effectively ends when the water level is at or below the equivalent of a 3 log set at the dam.***

Lake level reduction rate

Major concern has been high rate of discharge from Jack' Lake down to Little Jack's Lake. Rates exceeding 18" or 46 cm of over flow become dangerous for people hiking to Little Jack's Lake. This also floods wetlands along Jack's creek, which totally changes the ecology of this entire waterway. Recommend TSW plan on taking water at a constant rate with a 'head of water' not exceeding 30.5 cm (12") over the spillway.

Our season is 1 May through 15 October or 24 weeks long. There are 4 more weeks to get to mid-November, which is good for the winter set point (28 weeks). The discharge of our lake needs to be spread out over the entire season.

Upper preferred water level limit: 5½ -log set

To minimize shoreline erosion caused by boat wakes the water level should not exceed 190 cm (75"). The water level would be at the top of a 5½-log set on the West spillway.

Lower preferred limit of water level: 3-log set

To allow safe boating and use of most docks the lowest level the water should be is 117 cm (46"). The water level would be 4" above the top of a 3-log set on the West spillway.

The JLA thus supports a preferred water level range of 1.17 –1.90 metres during the navigation season.

Winter Set Level 2-log set

The 2-log set in the West spillway is equivalent to 76 cm (30") on the Parks Canada water level graph. We have to close our season when the water level is equivalent to the top of a 3-log set level.

Robert C. DuBois, JLA Dam Coordinator.
duboisr@earthlink.net 705-656-2430

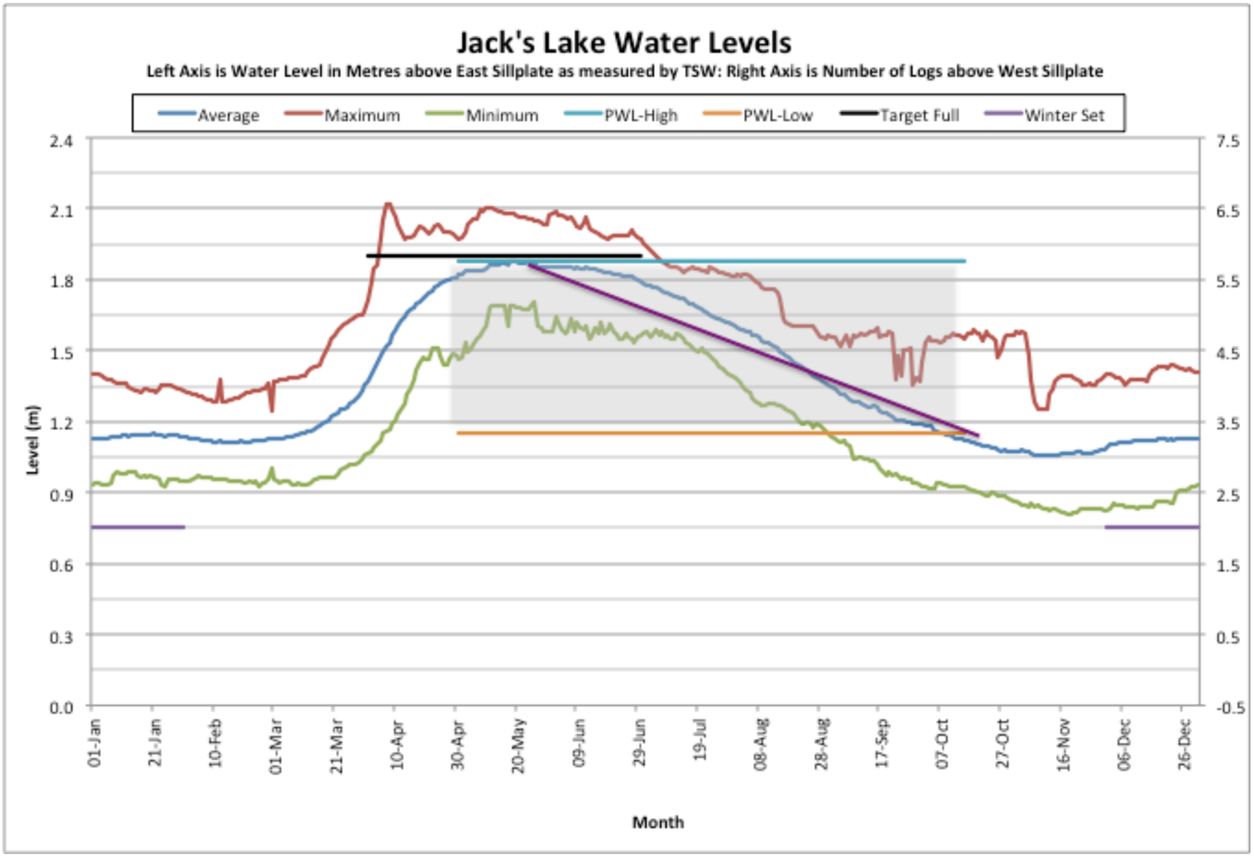
Jack's Lake Preferred Water Levels compared to Historic Water Level Data

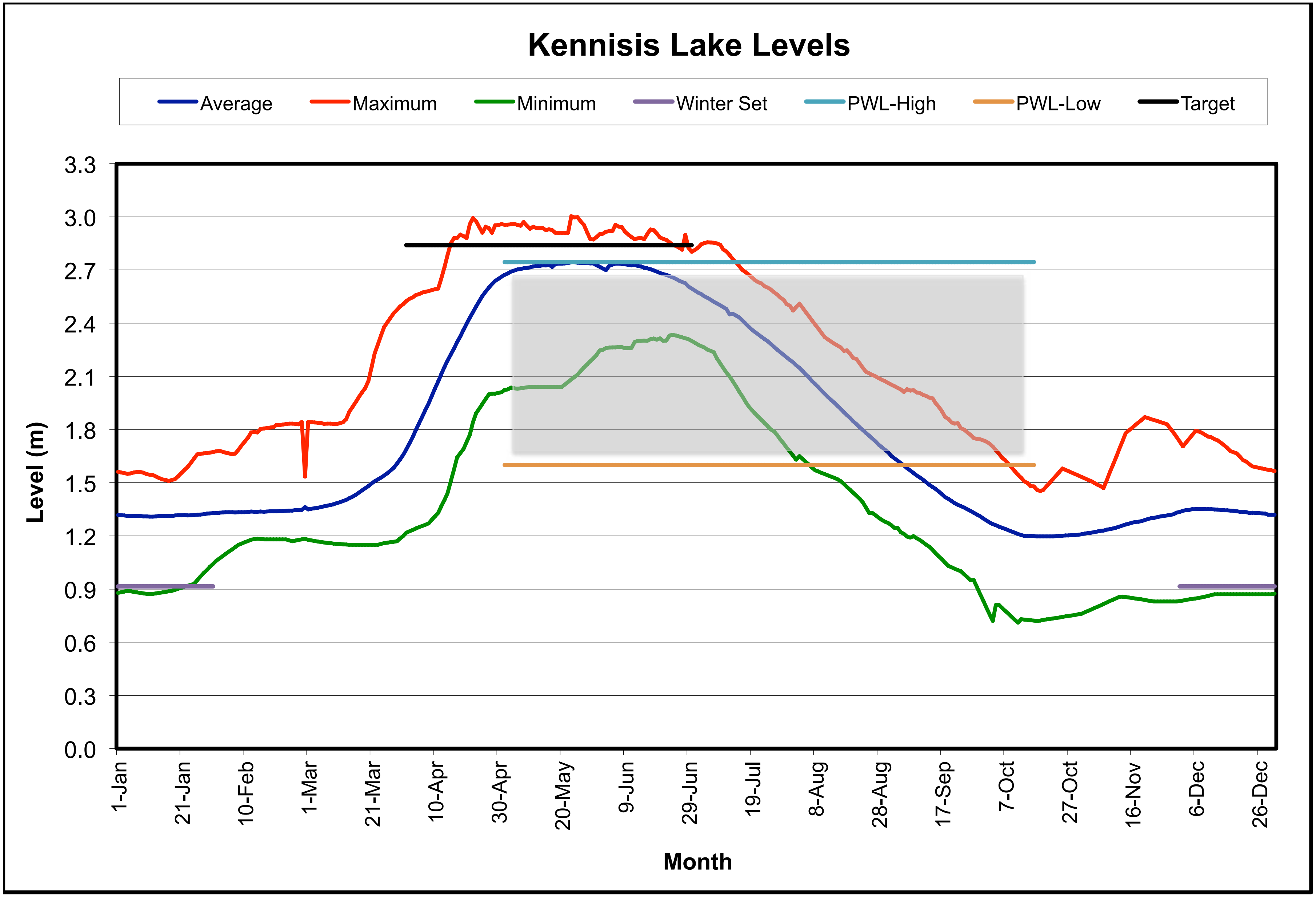
The following chart superimposes the JLA Preferred Water Level range during the navigation season (shaded area between upper and lower preferred limits) on the historic water level chart and includes information on the winter log-set level and the TSW targeted 'full' level.

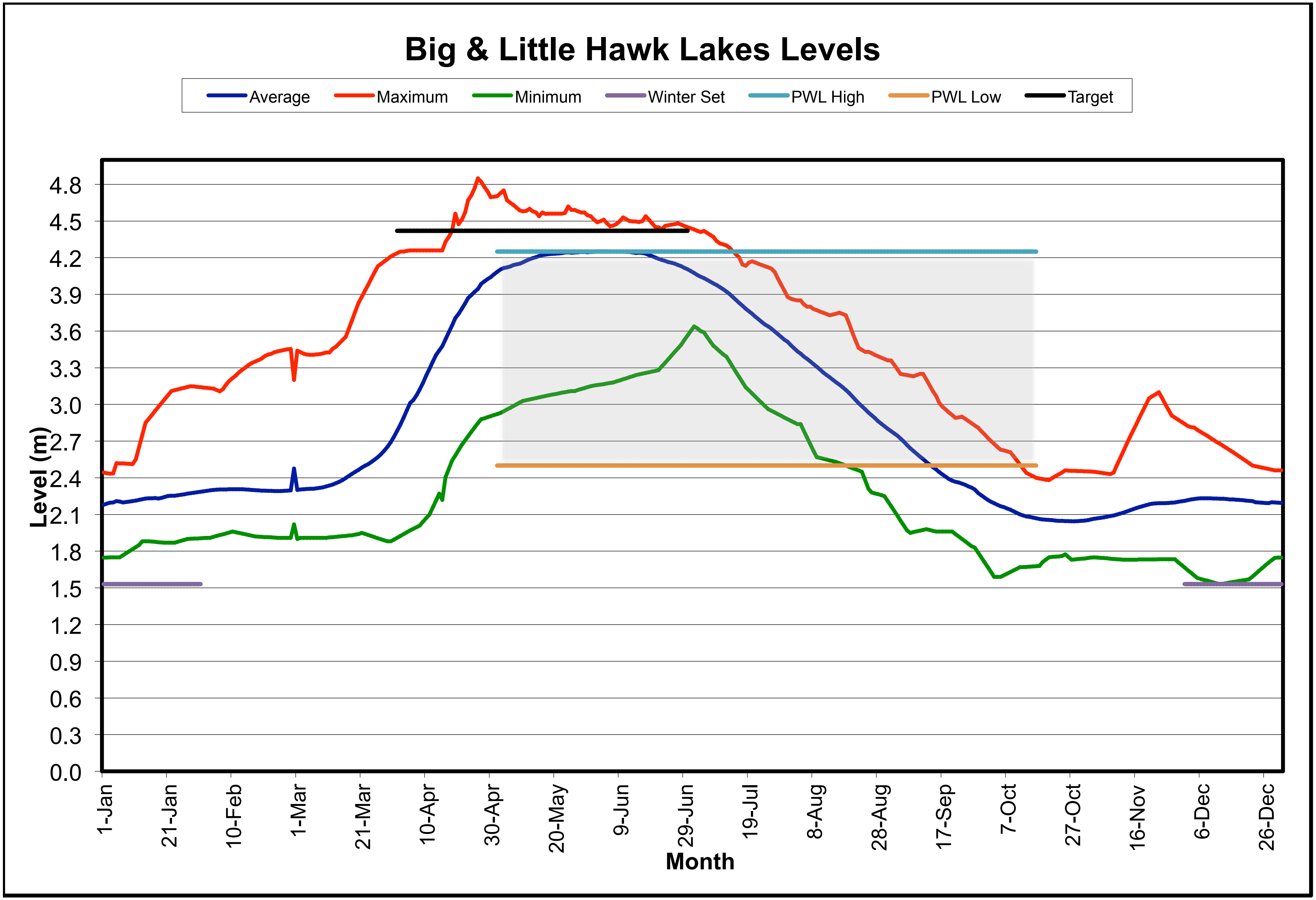
Note: the left scale is still in metres above the sill plate of the dam's East spillway: the scale increments by 0.3 metres (12"), equivalent to the depth of one of the control logs used to adjust the height of the dam. However the sill plate of the active West spillway is 6" higher than that of the East spillway and accordingly the logs on the West Spillway are 6" higher than implied by the scale.

From the chart it can be seen that:

- the **winter-set** condition is equal to 2 logs in the dam (west spillway);
- the preferred **<u>upper limit</u>** of 1.90 m for the water level during the navigation season, equivalent to 5½ logs in the dam, is equal to the average spring high water level.
- the preferred **<u>lower limit</u>** of 1.17 m for the water level during the navigation season, equivalent to 3 logs in the dam (west spillway), is typically only breached in September of a below average (dry) year: however this level has been maintained in the past as shown by the historic maximum. It would appear that this condition could be satisfied most years if the winter-set condition were 3 logs instead of 2 on the west spillway.




Kennisis Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month


Big & Little Hawk Lakes Levels
Average
Maximum
Minimum
Winter Set
PWL High
PWL Low
Target
Level (m)
4.8
4.5
4.2
3.9
3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
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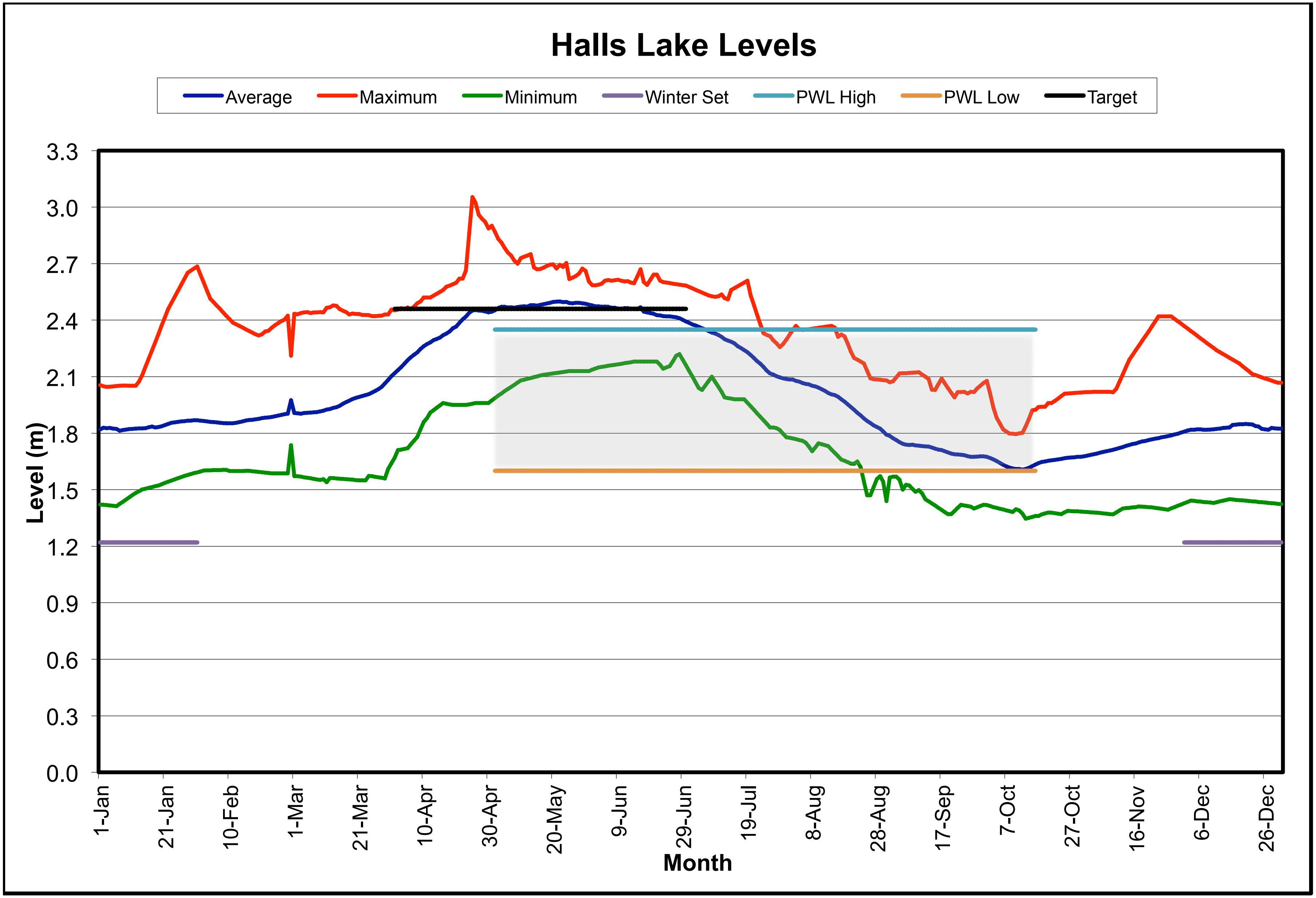
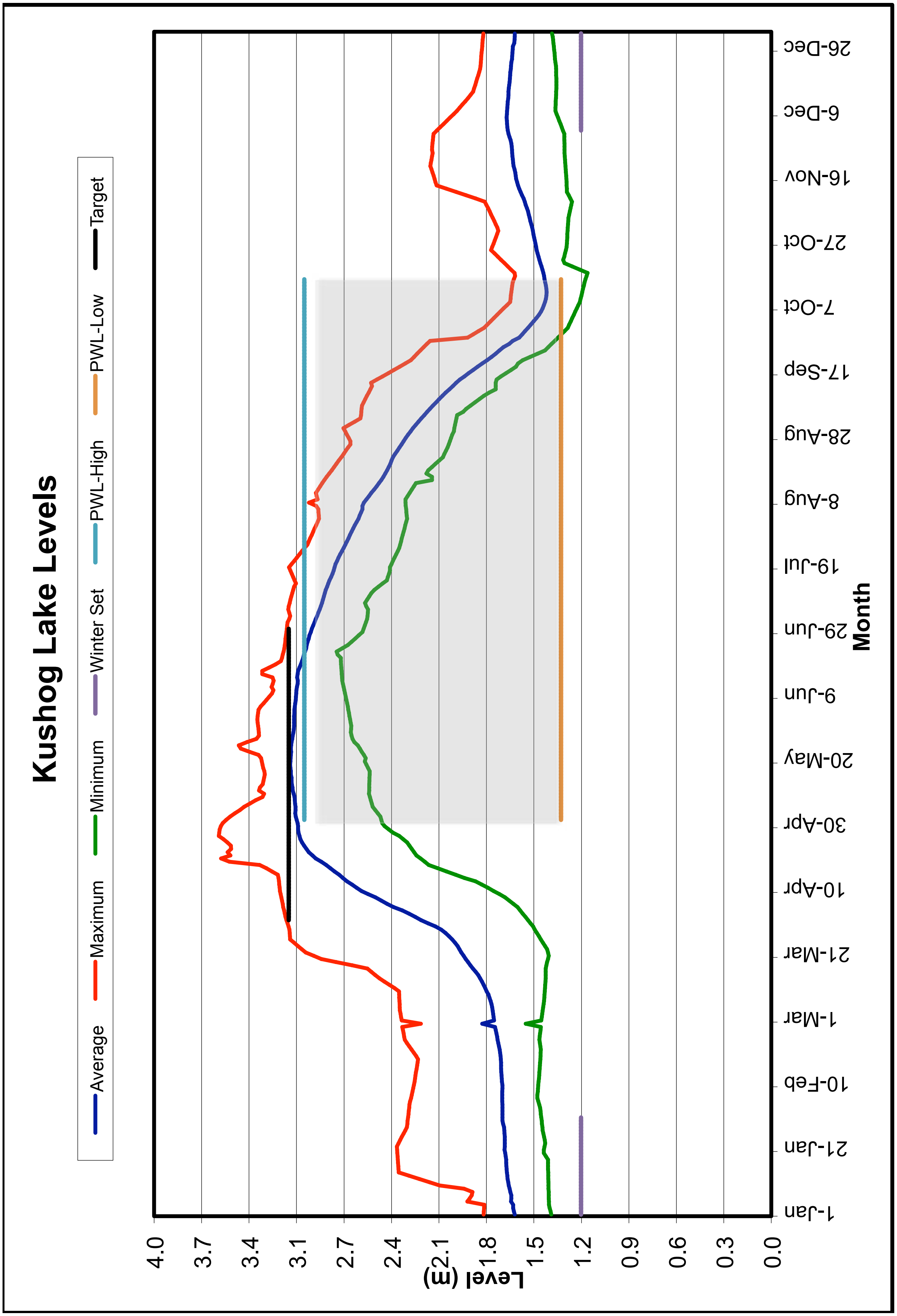
27-Oct
16-Nov
6-Dec
26-Dec
Month


Halls Lake Levels
Average
Maximum
Minimum
Winter Set
PWL High
PWL Low
Target
Level (m)
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month


Kushog Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
4.0
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
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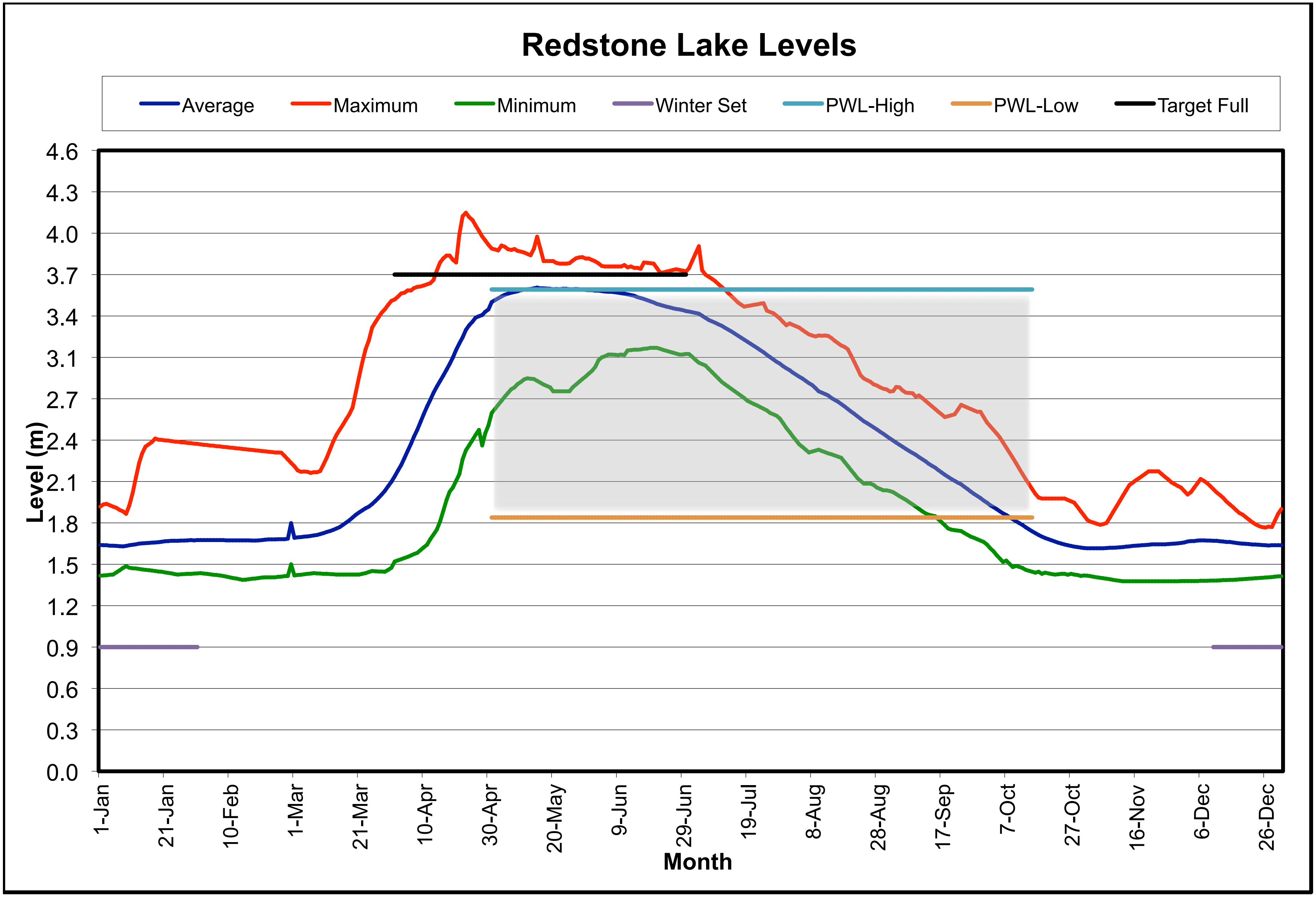
27-Oct
16-Nov
6-Dec
26-Dec
Month


Redstone Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target Full
Level (m)
4.6
4.3
4.0
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
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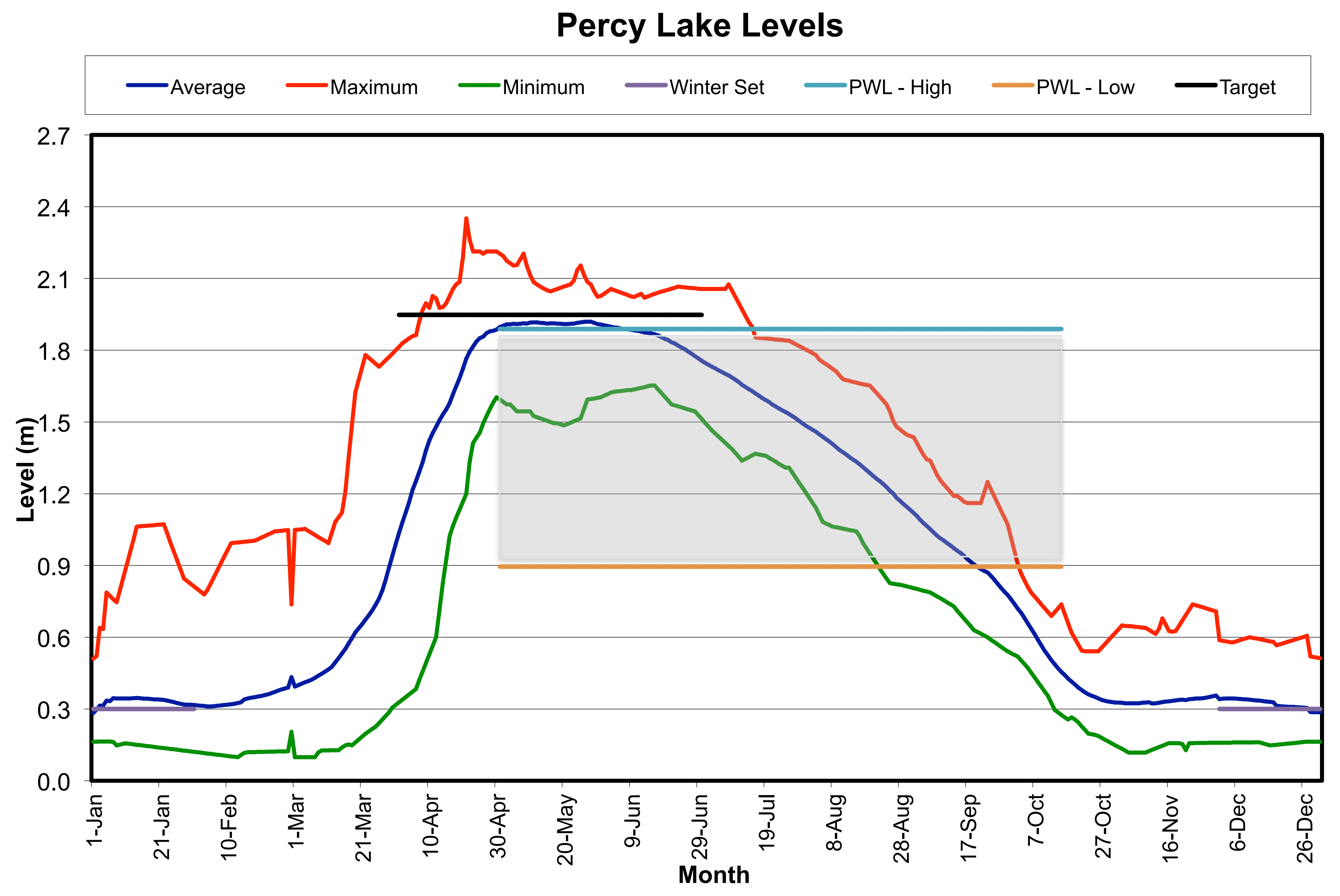
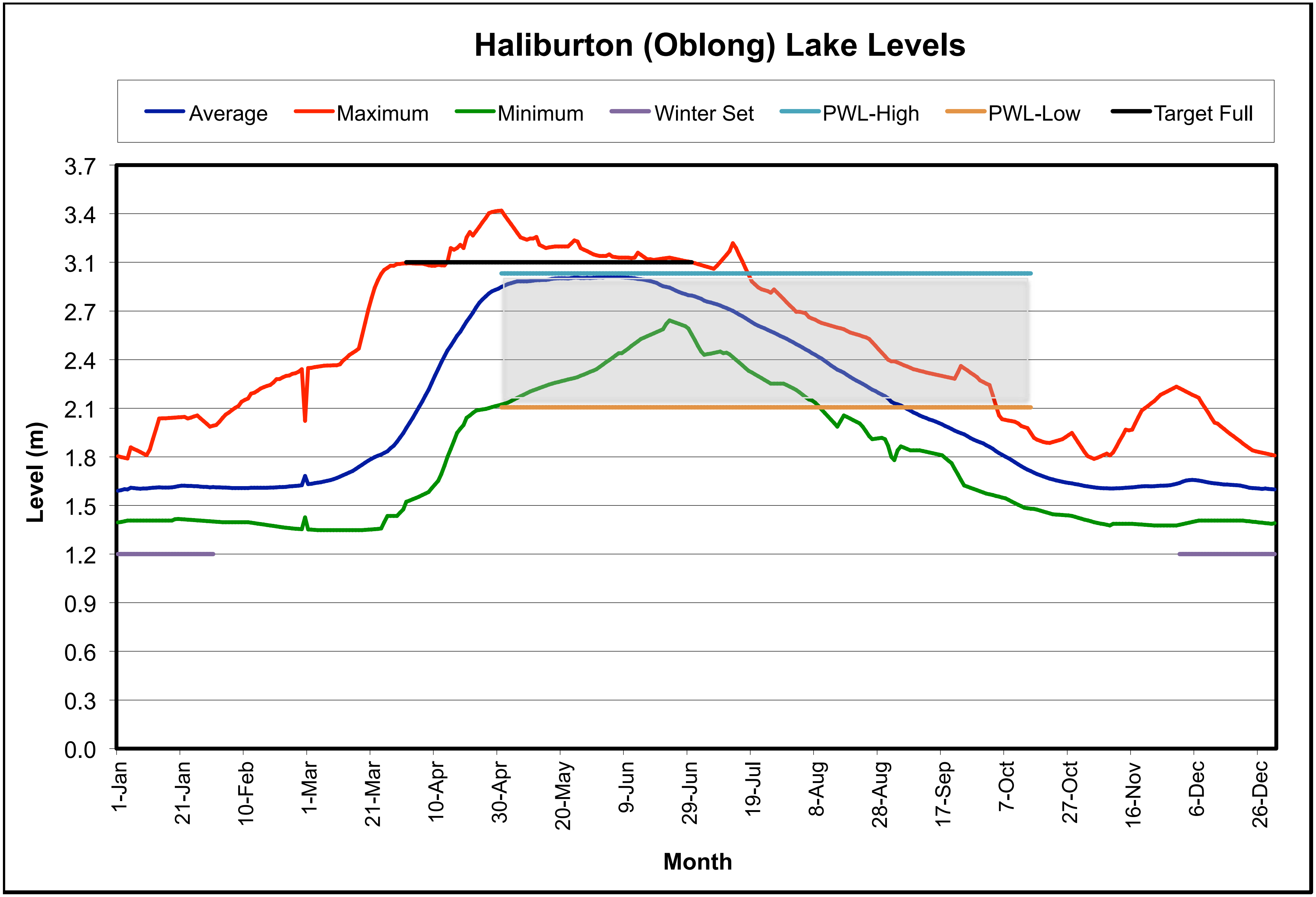
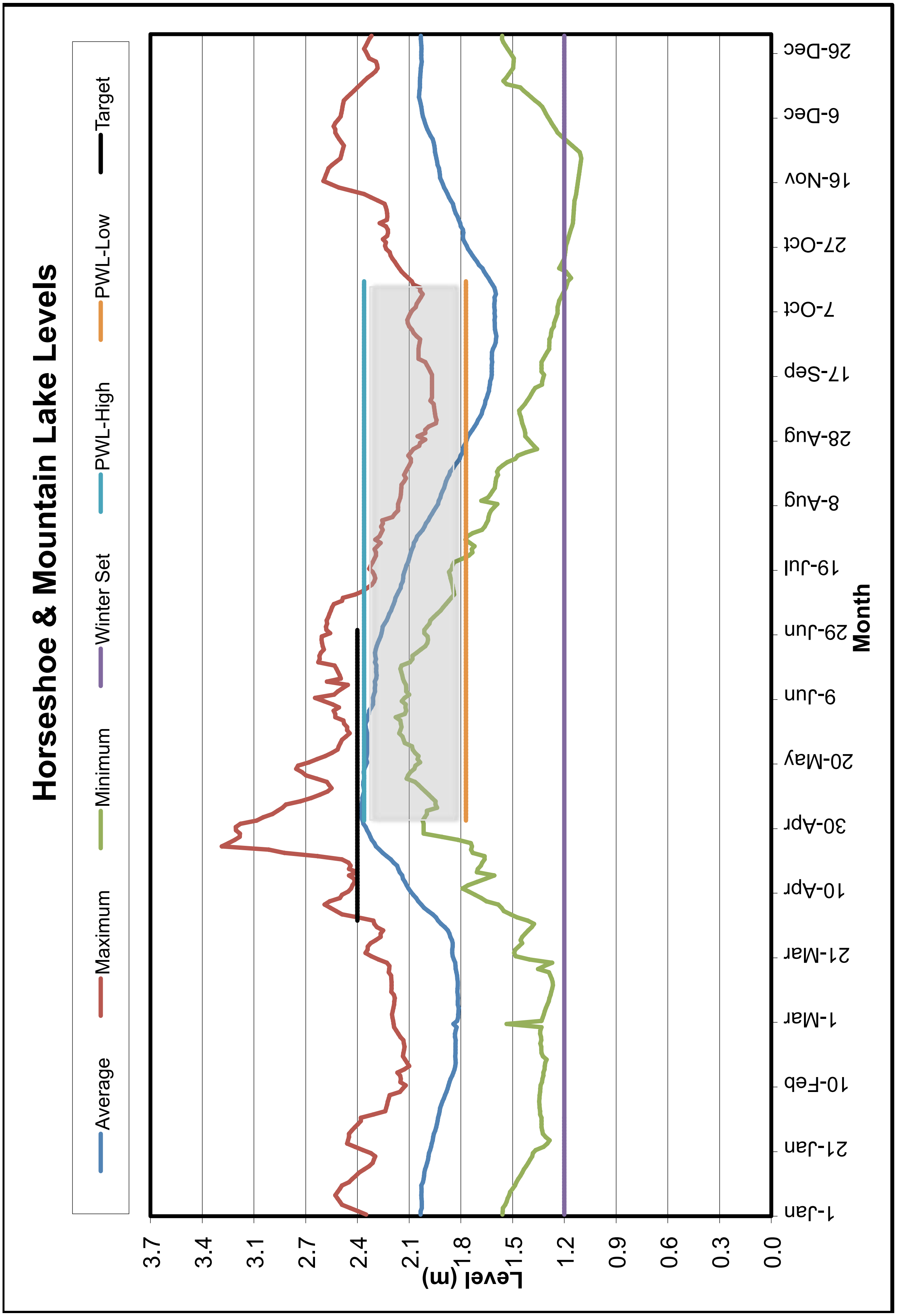
16-Nov
6-Dec
26-Dec
Month



Percy Lake Levels


Haliburton (Oblong) Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target Full
Level (m)
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month


Horseshoe & Mountain Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
Month
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
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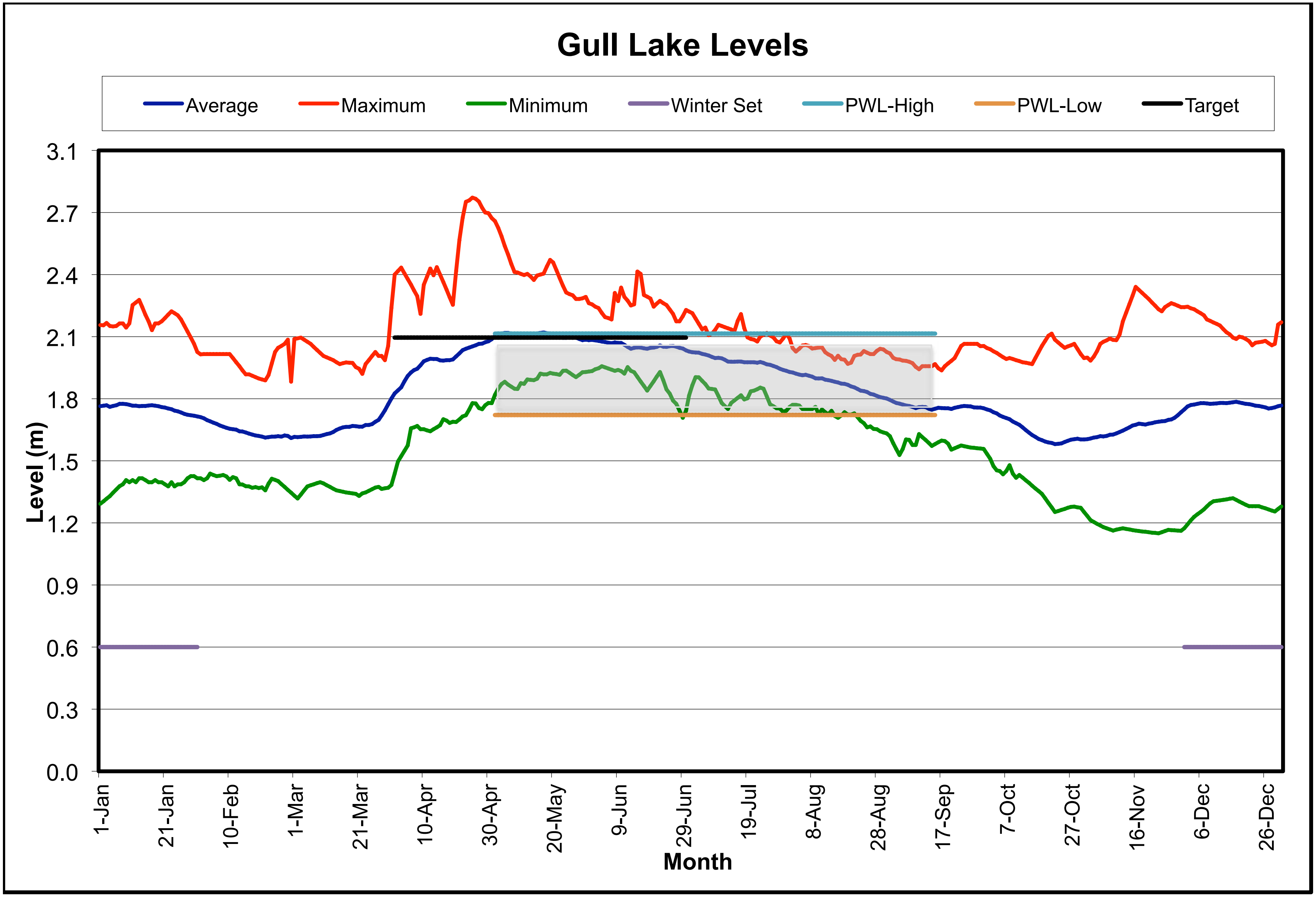
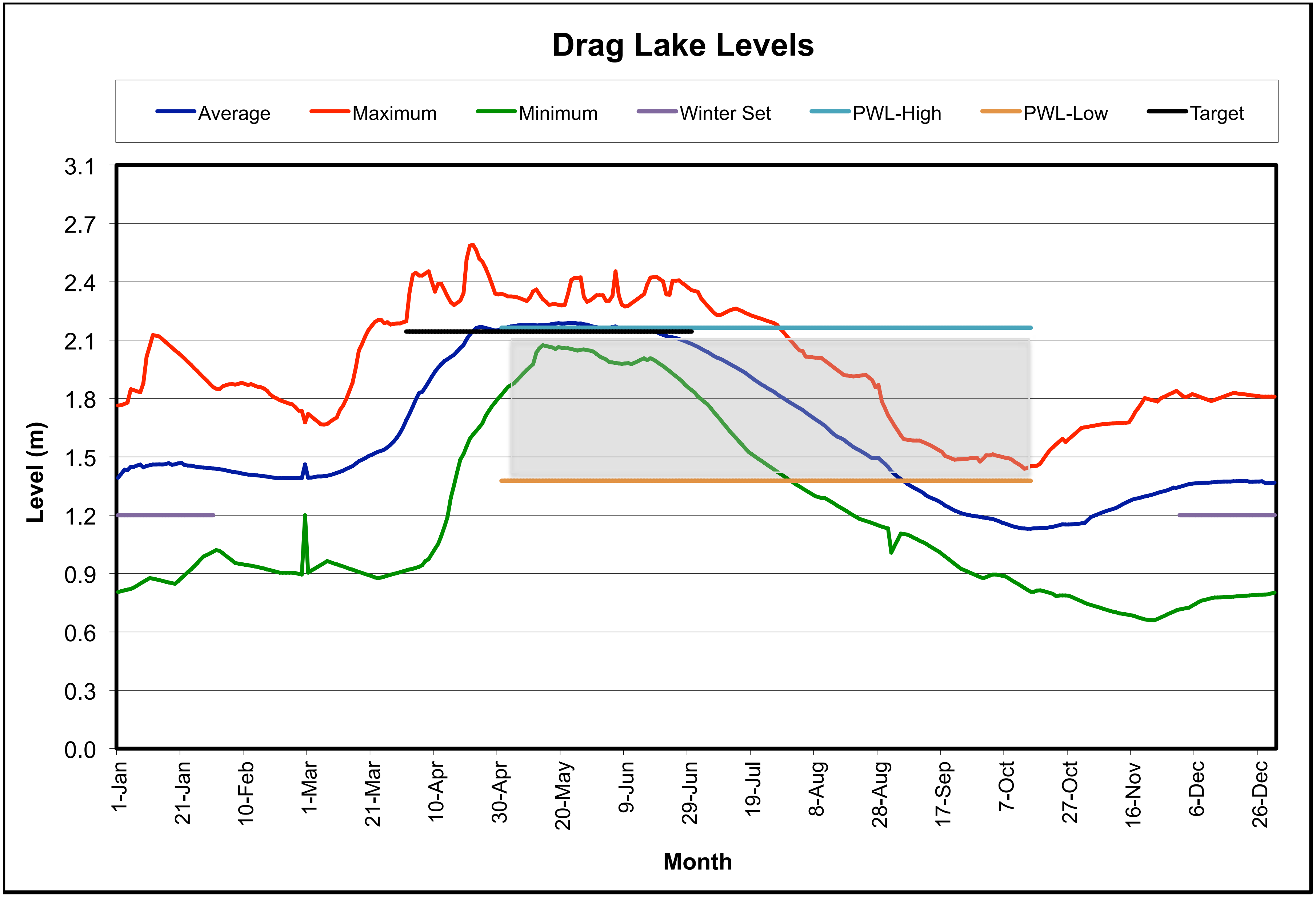
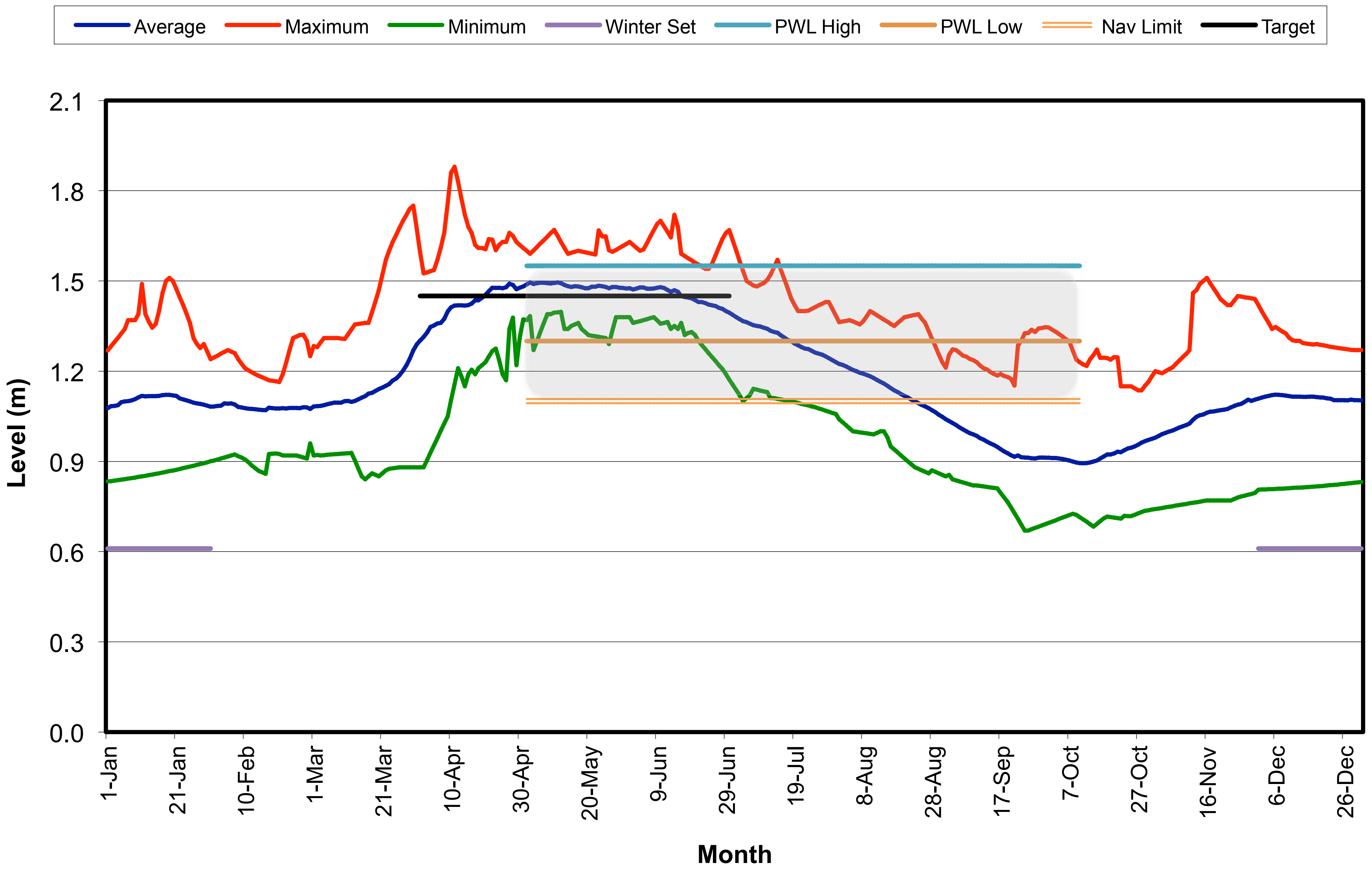
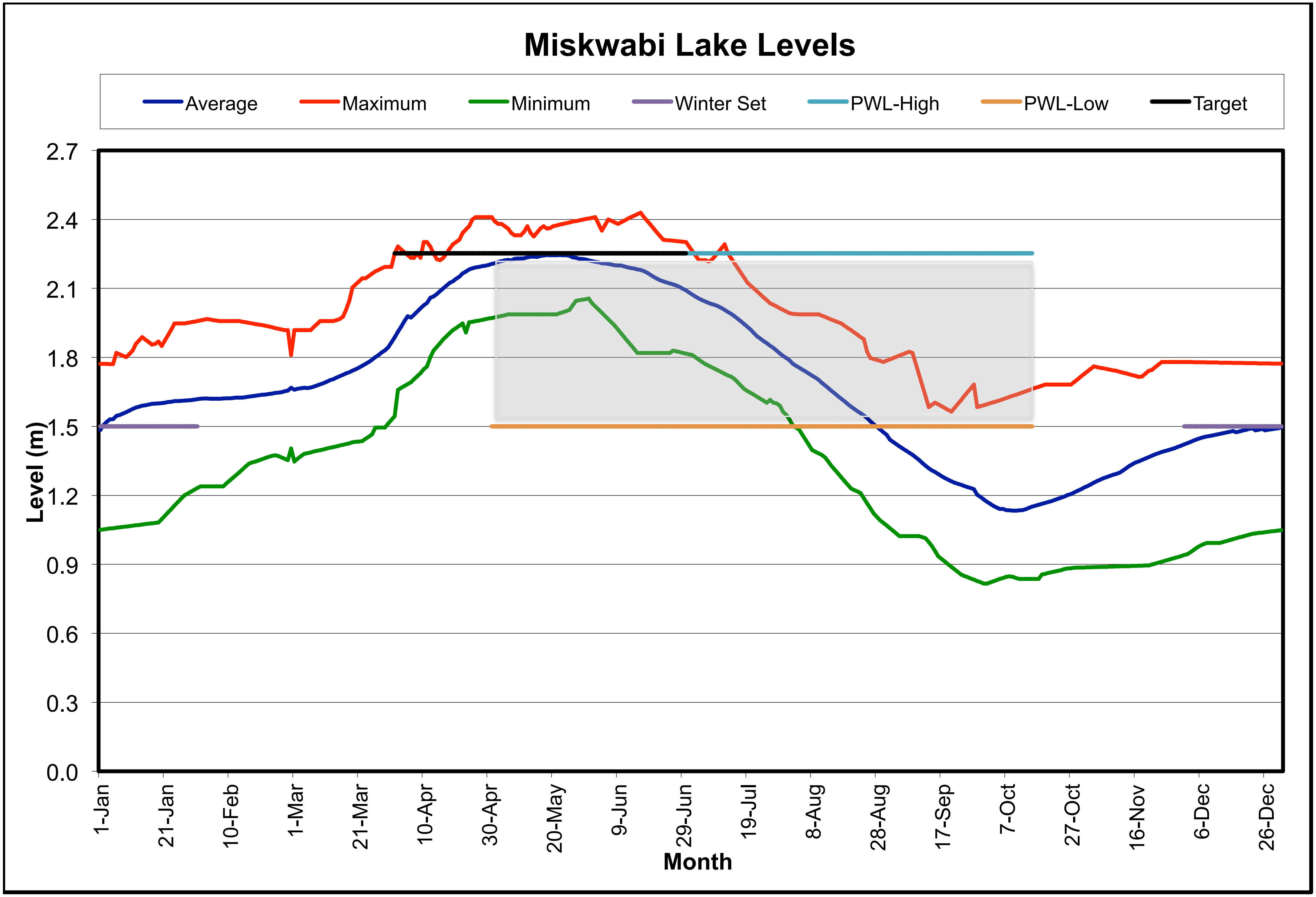
27-Oct
16-Nov
6-Dec
26-Dec

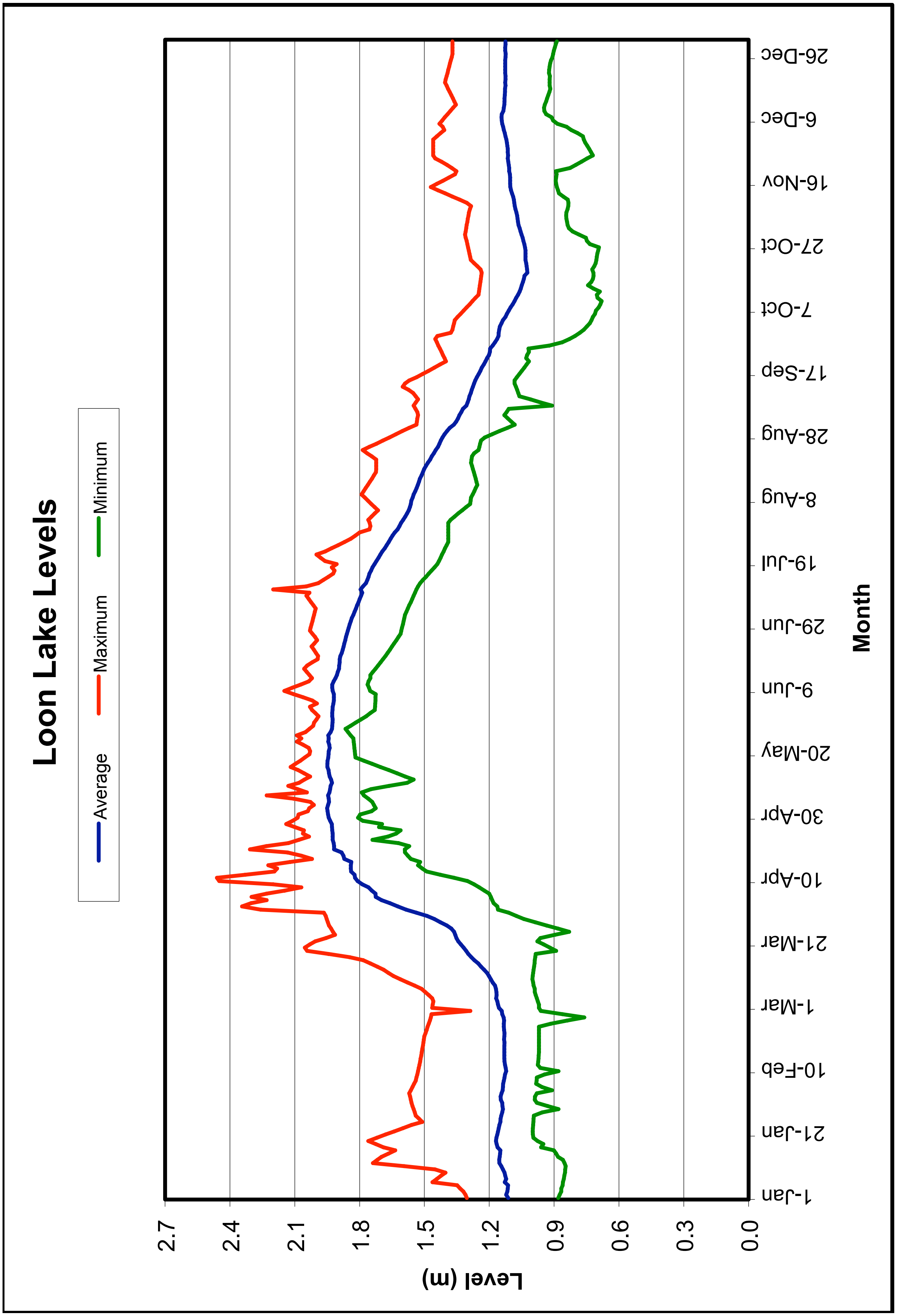

Gull Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

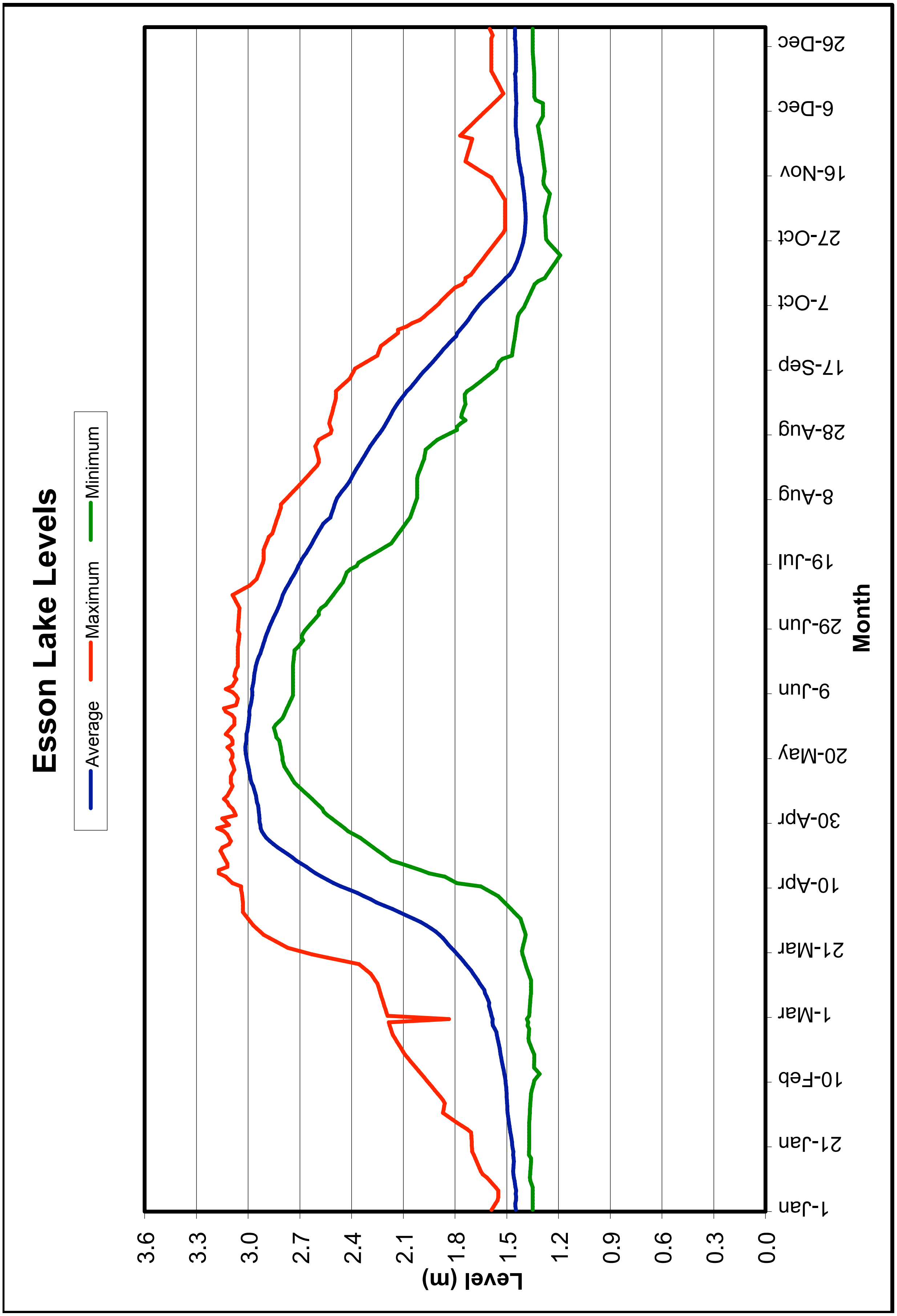

Drag Lake Levels

Canning, Kashagawigamog, Soyers, Grass & Head Lake Levels

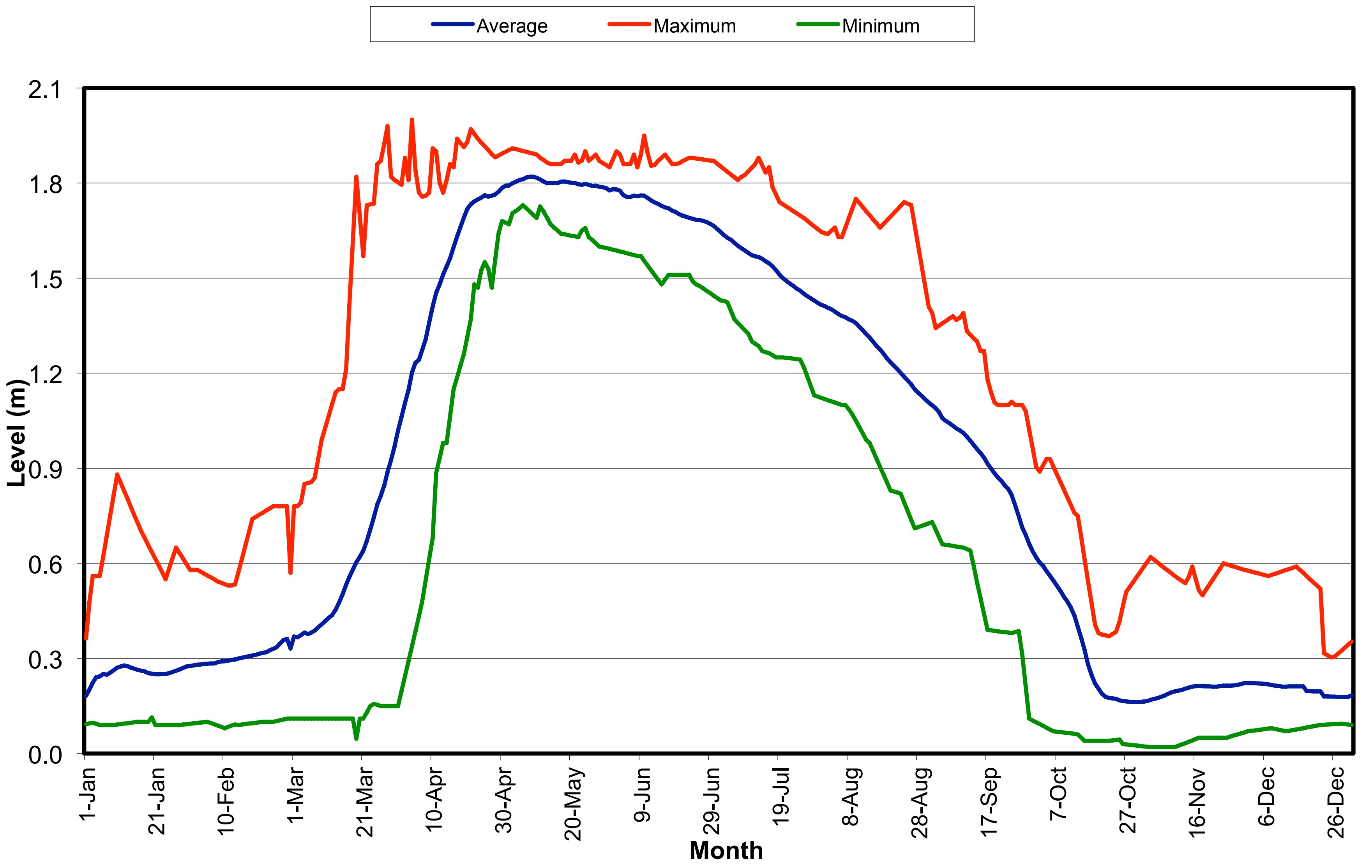


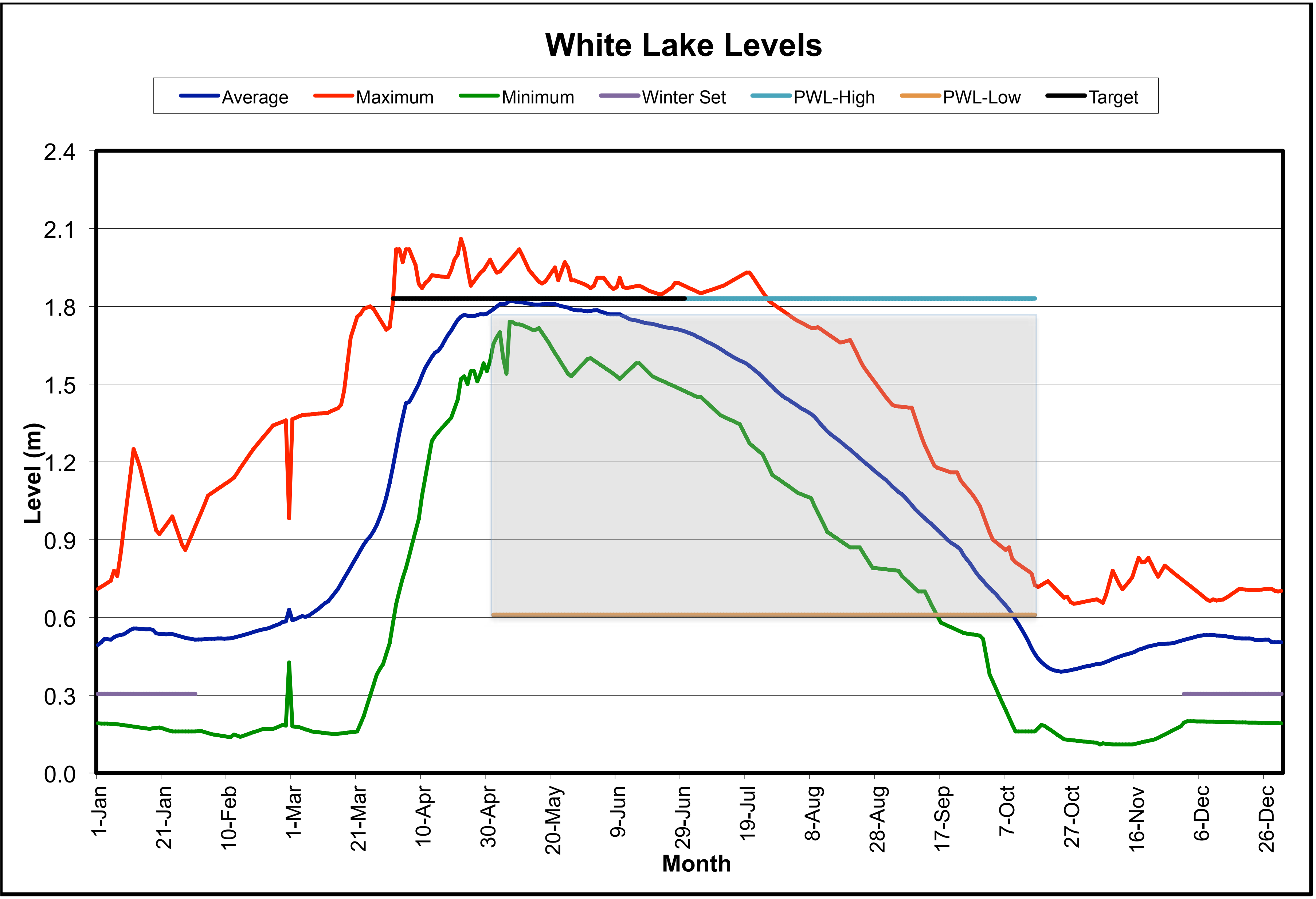

Miskwabi Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

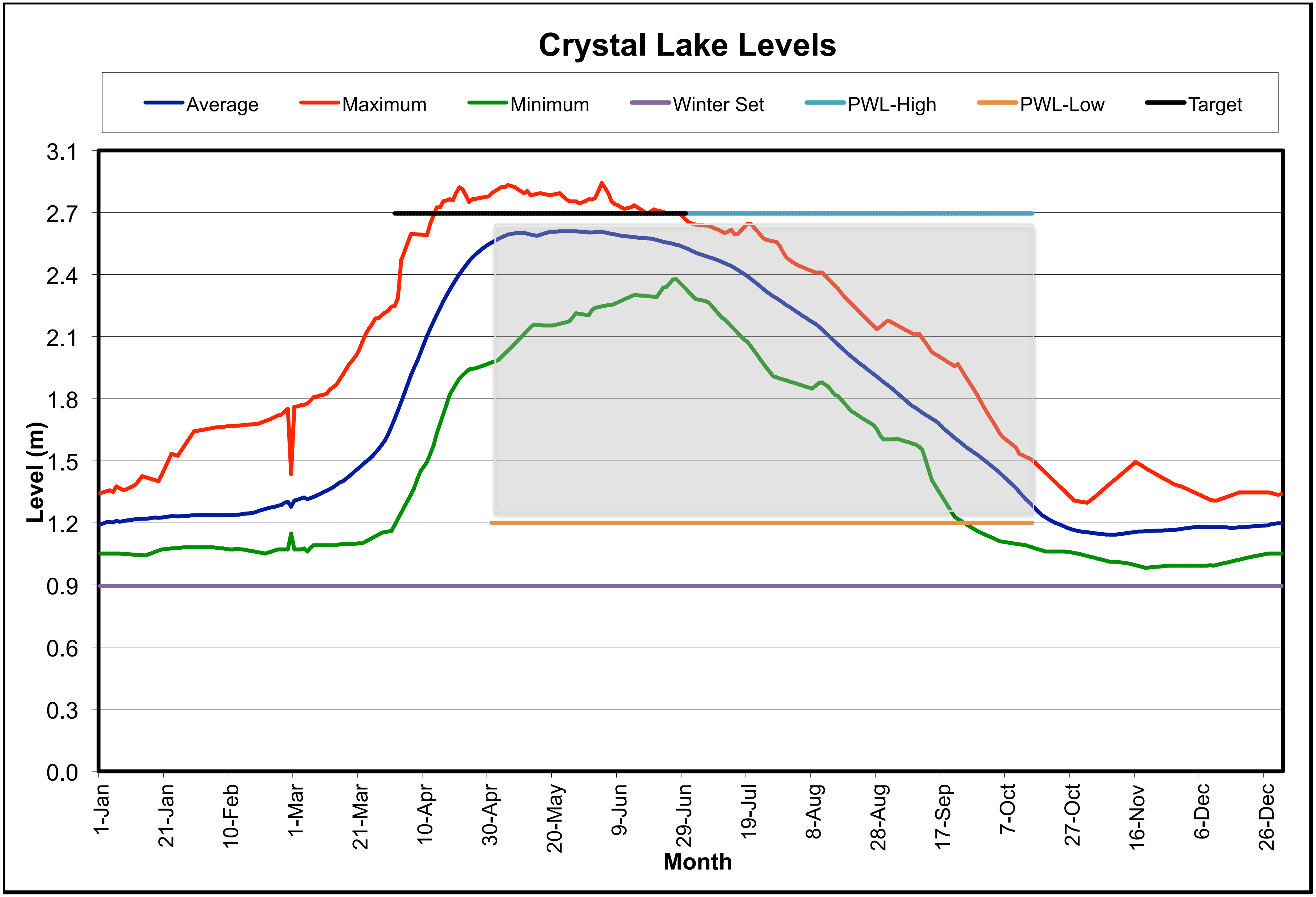

Loon Lake Levels
Average
Maximum
Minimum
Level (m)
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

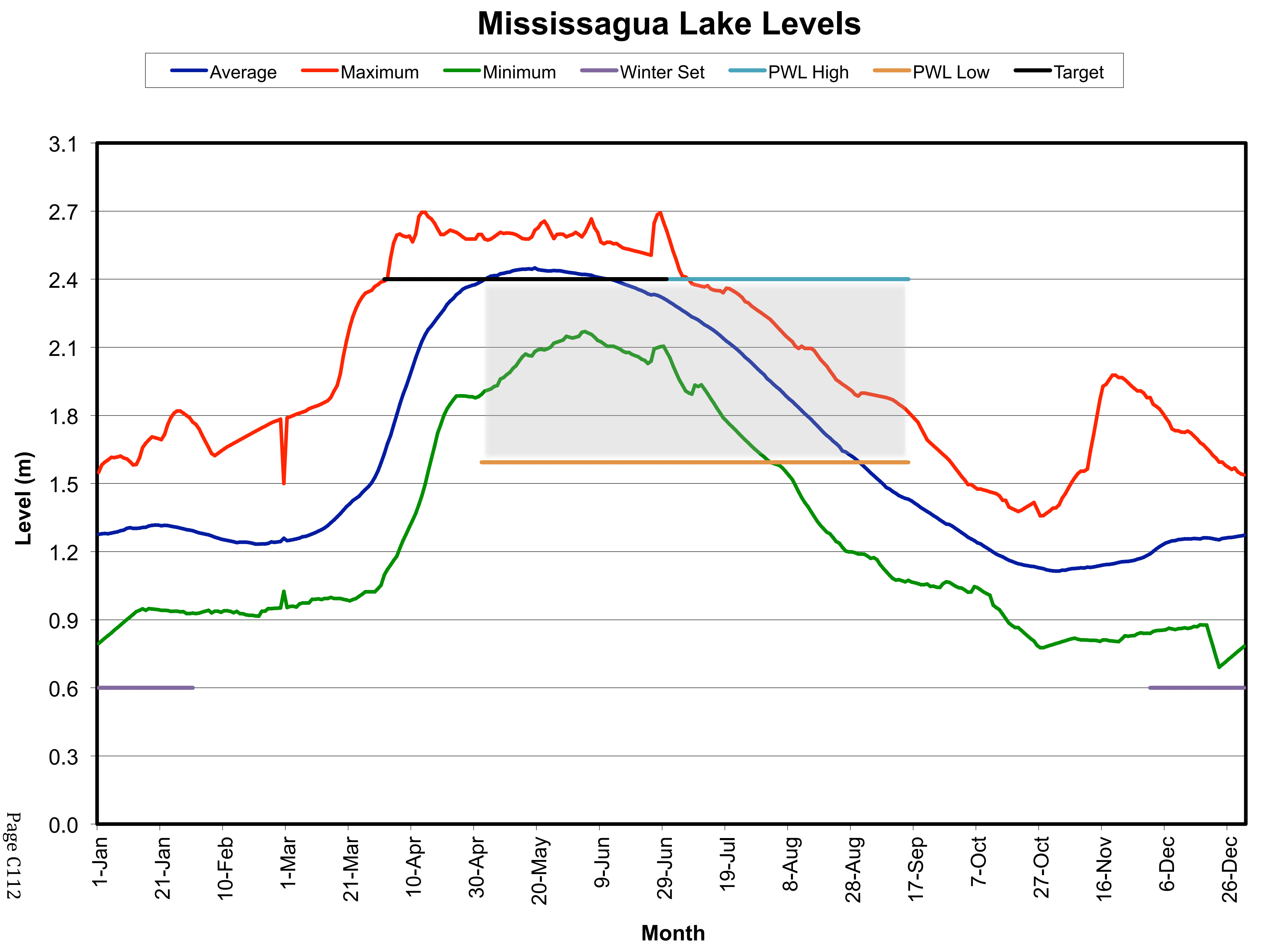

Esson Lake Levels
Average
Maximum
Minimum
Level (m)
3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

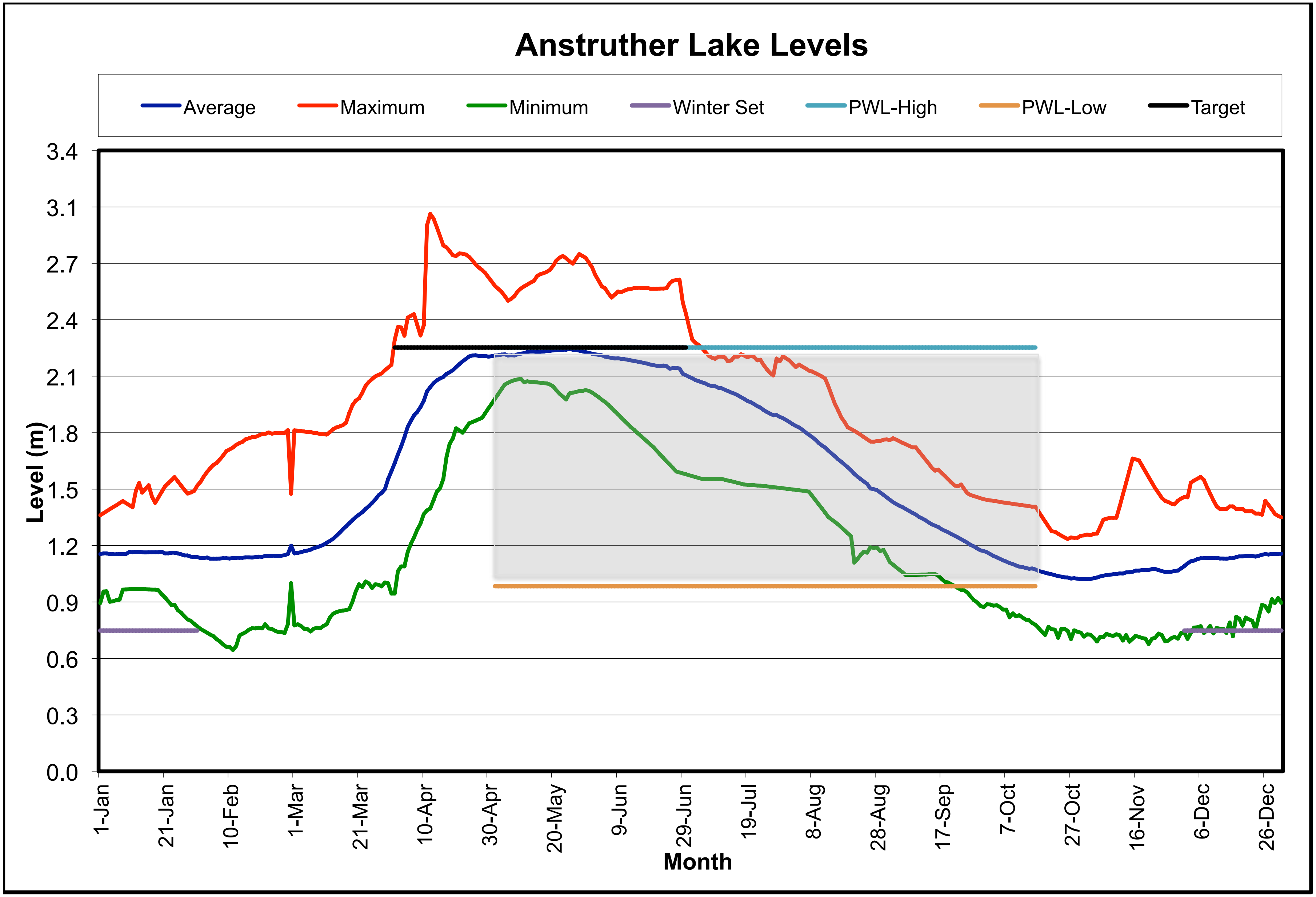
Little Glamour Lake Levels



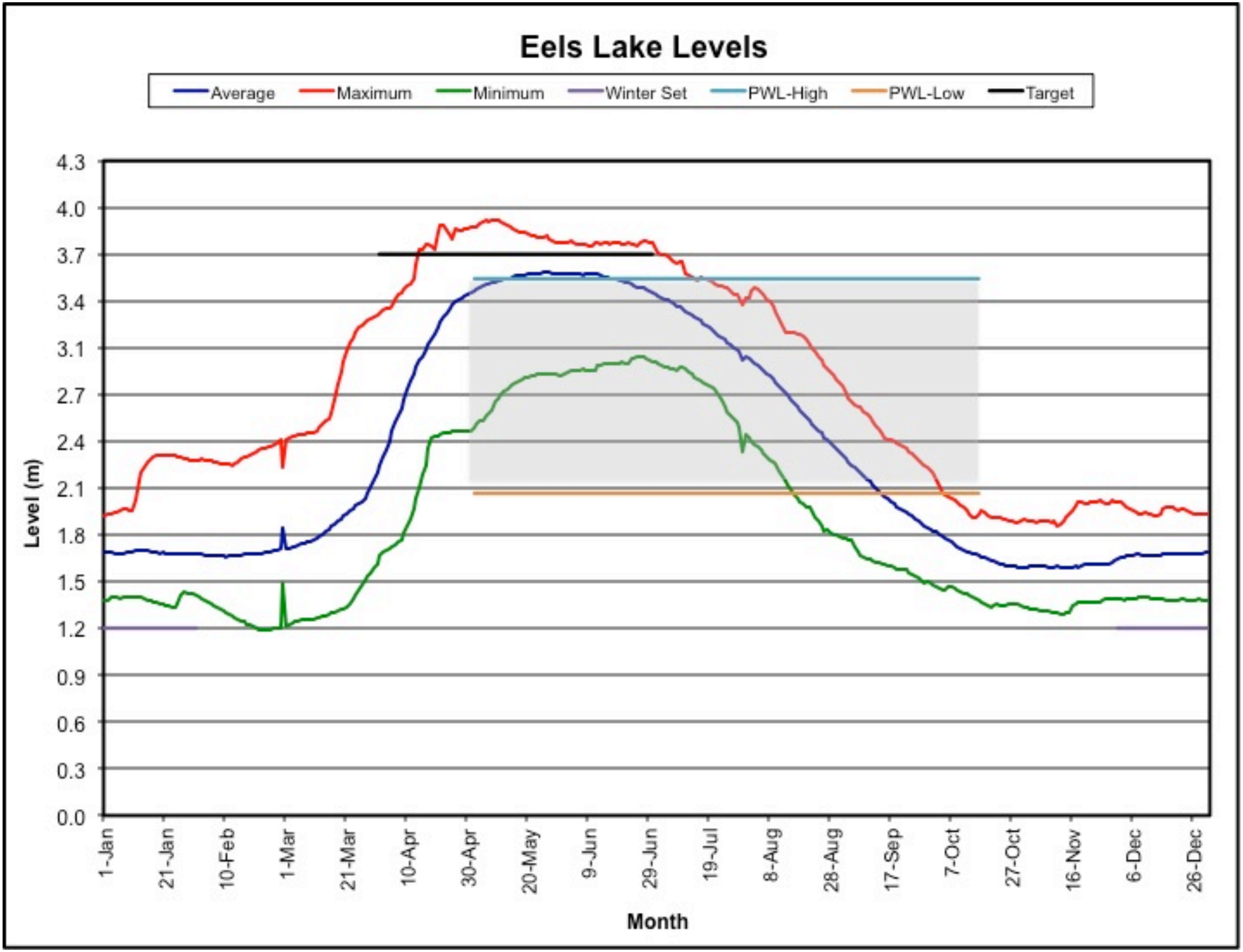

White Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month


Crystal Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month


Mississagua Lake Levels
Average
Maximum
Minimum
Winter Set
PWL High
PWL Low
Target
Level (m)
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month



Anstruther Lake Levels


Eels Lake Levels
Average
Maximum
Minimum
Winter Set
PWL-High
PWL-Low
Target
Level (m)
4.3
4.0
3.7
3.4
3.1
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1-Jan
21-Jan
10-Feb
1-Mar
21-Mar
10-Apr
30-Apr
20-May
9-Jun
29-Jun
19-Jul
8-Aug
28-Aug
17-Sep
7-Oct
27-Oct
16-Nov
6-Dec
26-Dec
Month

Jack's Lake Water Levels

Left Axis is Water Level in Metres above East Sillplate as measured by TSW: Right Axis is Number of Logs above West Sillplate