

Emergency Repairs at the Lake Major Dam Fish Ladder

ARC2016

November 9, 2016

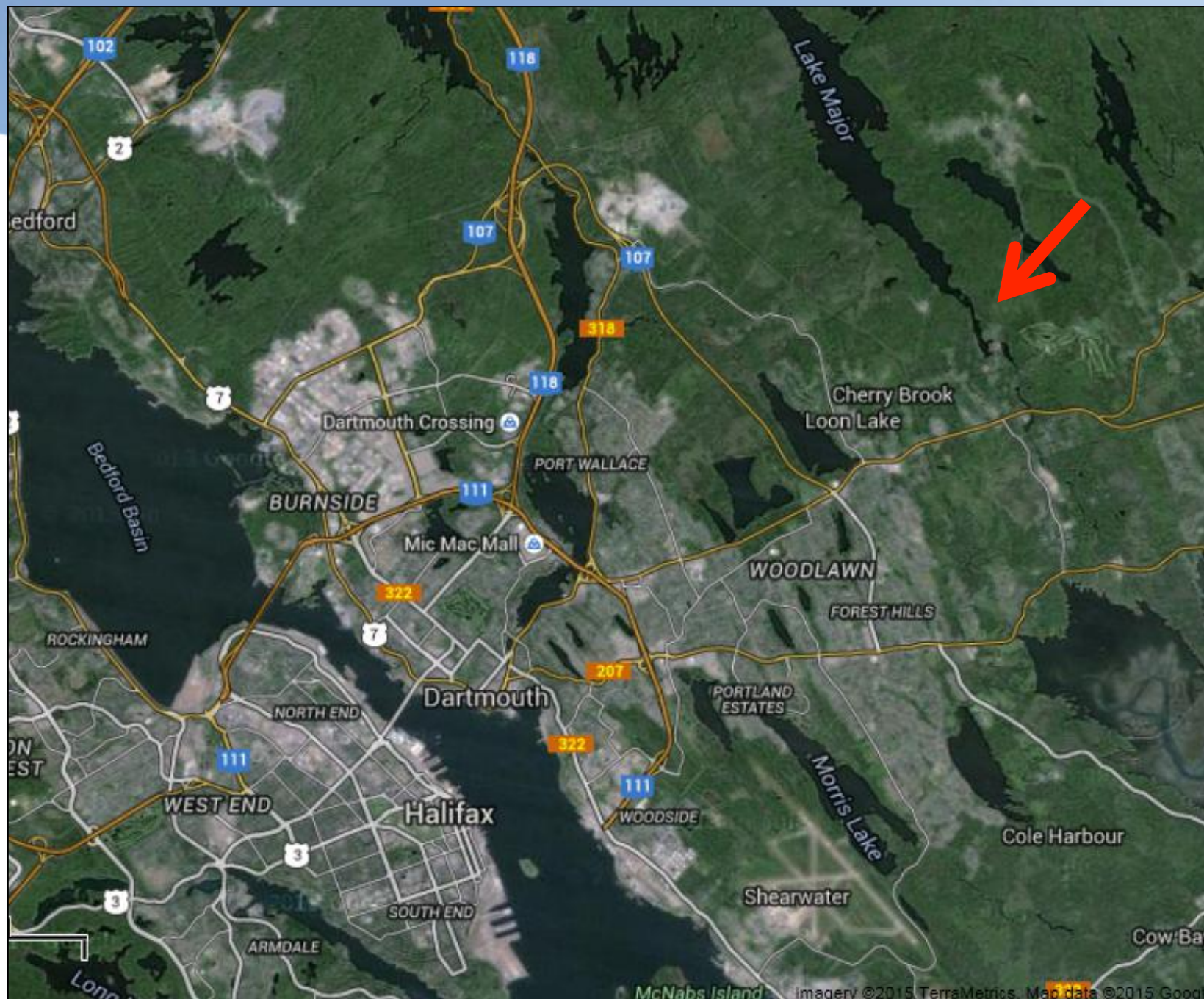
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Operations Engineer, Water Services Department



Dam Management at Halifax Water

- **Halifax Water owns and operates six dams as part of the water supply system**
- **Follow Canadian Dam Association's (CDA) *Dam Safety Guidelines***
 - Complete dam safety reviews (DSR) every seven years
 - Routine dam inspection program
 - Emergency Preparedness Plans and Inundation Mapping





September 1, 2011



September 1, 2011



Flood Inundation Map

Lake Major Dam Flood Inundation Study



Legend
 F10 - Flood Supply Level
 F20 - Flood Supply Level
 F30 - Flood Supply Level
 F40 - Flood Supply Level
 F50 - Flood Supply Level

- Notes**
1. Lake Major Dam is a roller into structure located on Lake Major East near North Point, BC. The dam is approximately 100 m long and 2.5 m high. The dam structure is owned and operated by the British Columbia Government and is located on the British Columbia Water Supply for the City of Vancouver. Eastern Slopes, Lake Major and Westside.
 2. Lake Major reservoir has a potential area of 10.1 km². At the F10, of 10 m, the reservoir area is 1.75 km² and the average of 10 m. Lake levels are controlled by weirs and an overflow spillway. Spillway flow is through a natural submergence.
 3. For Lake Major Dam is the commercial to F10 with an average of 10 m.
 4. Flood wave modeling was performed using National Institute of Standards and Technology version 1.0 (July 11, 2005).
 5. Cross section data developed from 1:10,000 mapping with the section lines.
 6. Bridge data extracted from a field survey conducted on May 17, 2005.
 7. Manning's "n" values extracted from British Columbia's "n" values with a field survey conducted on May 17, 2005.
 8. Reservoir water surface elevation was assumed to be at the top of spillway of the spillway of the spillway.
 9. Three sections modeled:
 a. Section 1: Lake Major Dam
 b. Section 2: Lake Major Dam
 c. Section 3: Lake Major Dam
 10. Section 1: Lake Major Dam
 a. Section 1: Lake Major Dam
 b. Section 2: Lake Major Dam
 c. Section 3: Lake Major Dam
 11. Section 2: Lake Major Dam
 a. Section 1: Lake Major Dam
 b. Section 2: Lake Major Dam
 c. Section 3: Lake Major Dam
 12. Section 3: Lake Major Dam
 a. Section 1: Lake Major Dam
 b. Section 2: Lake Major Dam
 c. Section 3: Lake Major Dam



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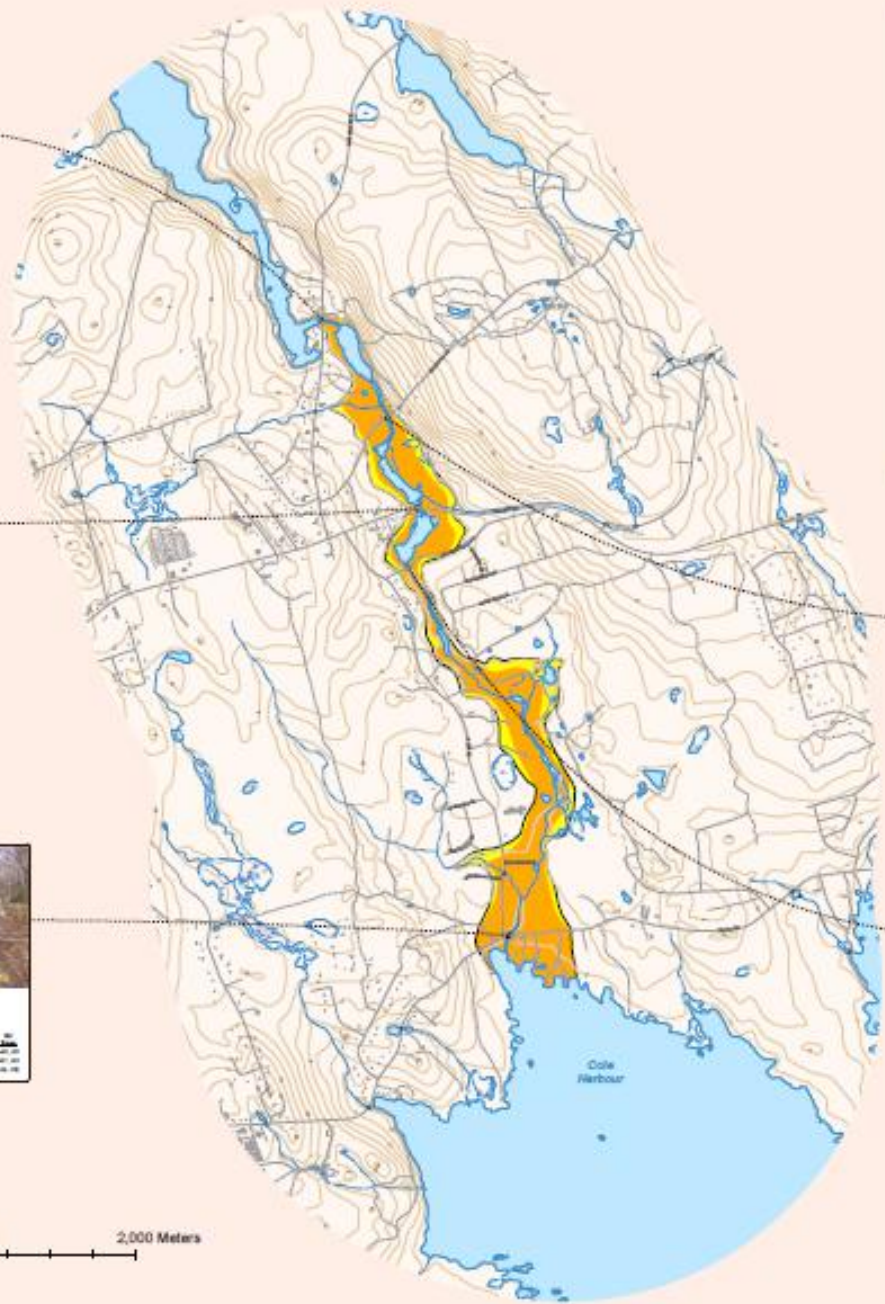


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Prepared by: Mitchell Engineering & Construction Ltd.
 Date: 10/10/05
 Project: 1000 Burrard Street



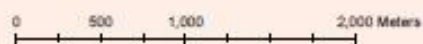
Evacuation Zones

The inundation limits due to dam failure during a flood and dam failure during non-flood are shown. Therefore, it is recommended to implement an evacuation plan of Lake Major for all residents.

- The following areas are to be immediately evacuated upon dam failure during the F10 flood:
- Area #10: 1000 Burrard Street
 - Area #20: 1000 Burrard Street
 - Area #30: 1000 Burrard Street
 - Area #40: 1000 Burrard Street
 - Area #50: 1000 Burrard Street
 - Area #60: 1000 Burrard Street
 - Area #70: 1000 Burrard Street
 - Area #80: 1000 Burrard Street
 - Area #90: 1000 Burrard Street
 - Area #100: 1000 Burrard Street

- The following areas are to be immediately evacuated upon dam failure during the F20 flood:
- Area #10: 1000 Burrard Street
 - Area #20: 1000 Burrard Street
 - Area #30: 1000 Burrard Street
 - Area #40: 1000 Burrard Street
 - Area #50: 1000 Burrard Street
 - Area #60: 1000 Burrard Street
 - Area #70: 1000 Burrard Street
 - Area #80: 1000 Burrard Street
 - Area #90: 1000 Burrard Street
 - Area #100: 1000 Burrard Street

- Because of the method, procedures and assumptions used in developing the flood areas, limits of flooding are approximate only and should be used only as a guide for establishing evacuation zones. For this reason, the following areas outside of the inundation area should be evacuated and ready to evacuate should conditions deteriorate:
- Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street
 - Residents of 1000 Burrard Street





Design of a New Dam

- **2012 DSR recommended replacing the dam as soon as possible**
 - Rotting timber
 - Leakage
 - Deteriorating fish ladder
- **Conceptual design started in August 2014**
- **Detailed design started in October 2016**
- **Anticipated construction of a new dam is the 2017 construction season**



Stabilizing the Existing Dam

- **Completed a Probable Failure Mode Analysis (PFMA) of the dam in August 2014**
- **PFMA report recommended to reinforce/rebuild the fish ladder**
 - Initial design work started in November 2014 began
 - Planned to meet with NSE and DFO

December 11, 2014

107 mm rain fell in a
48 hour period
(Halifax Intl Airport)



December 11, 2014



December 11, 2014



December 11, 2014



December 11, 2014



January 15, 2015



January 15, 2015



January 15, 2015





January 15, 2015

January 16, 2015



2015/01/16



Emergency Response Coordination – January 16

- **Halifax Water advises Halifax's Emergency Operations Centre (EOC) of the risks and consequences of the repair operation before noon**
- **Initial meeting at 1:00 PM to discuss the situation and the merits of an evacuation**
- **Second meeting at 4:00 PM to make a decision on evacuation**
- **A press conference was held at 5:30 PM so that we could make the supertime newscast**



Planned Emergency Measures

- 135 homes in and around the inundation zone to be evacuated
- Three bridges in the inundation zone would be closed
- Two bridges would remain open with police on stand-by
- Comfort centres established on both sides of the river
- Halifax Water staff were on standby to activate the Lake Lamont Emergency Supply and the bridge line to bring water from Halifax

January 17, 2015



2015/01/17

January 17, 2015



January 17, 2015



January 17, 2015





Ongoing Operation of Dam





Nova Scotia drought unusual, catches people unprepared

'People aren't as familiar with managing through drought situations'

By Rachel Ward, CBC News Posted: Sep 18, 2016 7:47 AM AT | Last Updated: Sep 18, 2016 7:47 AM AT



CANADA

September 16, 2016 3:29 pm

Updated: September 16, 2016 4:58 pm

Drought reaches 1,000 families in southwestern Nova Scotia



By Natasha Pace

Reporter Global News

News / Halifax

Halifax Water implements mandatory water restrictions over critically low levels

Windsor residents ordered to conserve water to avoid 'critical' shortage

Order affects thousands of people in Hants County as conditions 'worsen on a daily basis.'

By Paul Palmer, CBC News Posted: Sep 16, 2016 6:05 PM AT | Last Updated: Sep 16, 2016 6:05 PM AT



The water level at Mill Lake, which serves as Windsor's water supply, has dropped by more than 60 centimetres since the spring. (Paul Palmer/CBC)

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Drought Timeline

- **July 12 – 19.00 m**
 - Highest level of the summer
- **August 11 – 18.82 m**
 - Activated siphons
- **August 20 – 18.78 m**
 - Lake stops spilling
- **September 6 – 18.56 m**
 - Siphons stop working – Out of compliance
- **September 19 – 18.42 m**
 - Water restrictions enacted
- **October 9 – 18.28 m**
 - Historic low water level
- **October 10 – 18.29 m**
 - 90 mm of rain
- **October 21 – 18.58 m**
 - 68 mm of rain
- **October 24 – 18.89 m**
 - Water restrictions lifted
 - Dam is spilling
 - In compliance
- **October 28 – 19.05 m**
 - 37 mm of rain
- **November 8 – 19.16 m**

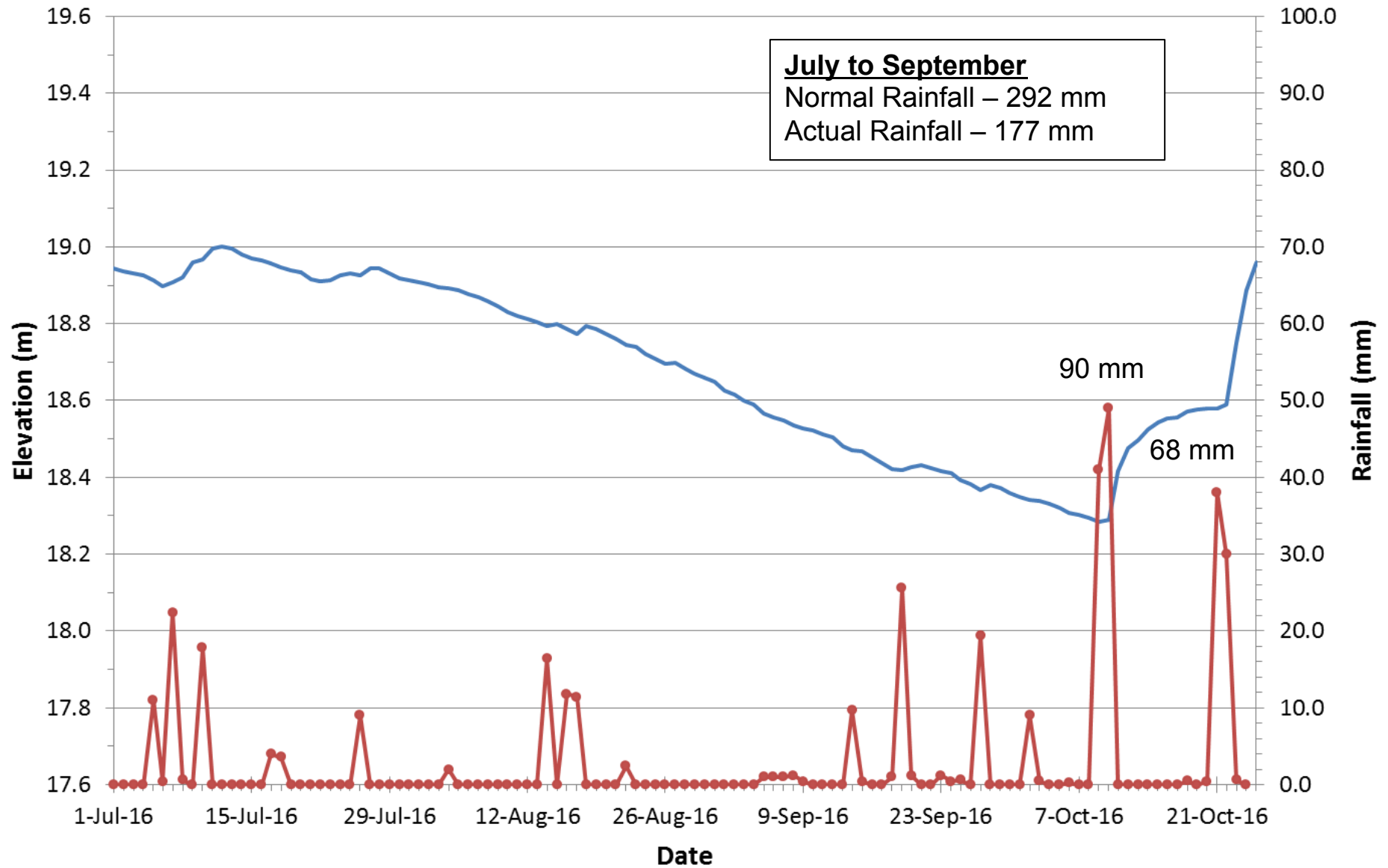
Lake Major Water Level

— Water Elevation —●— Rainfall

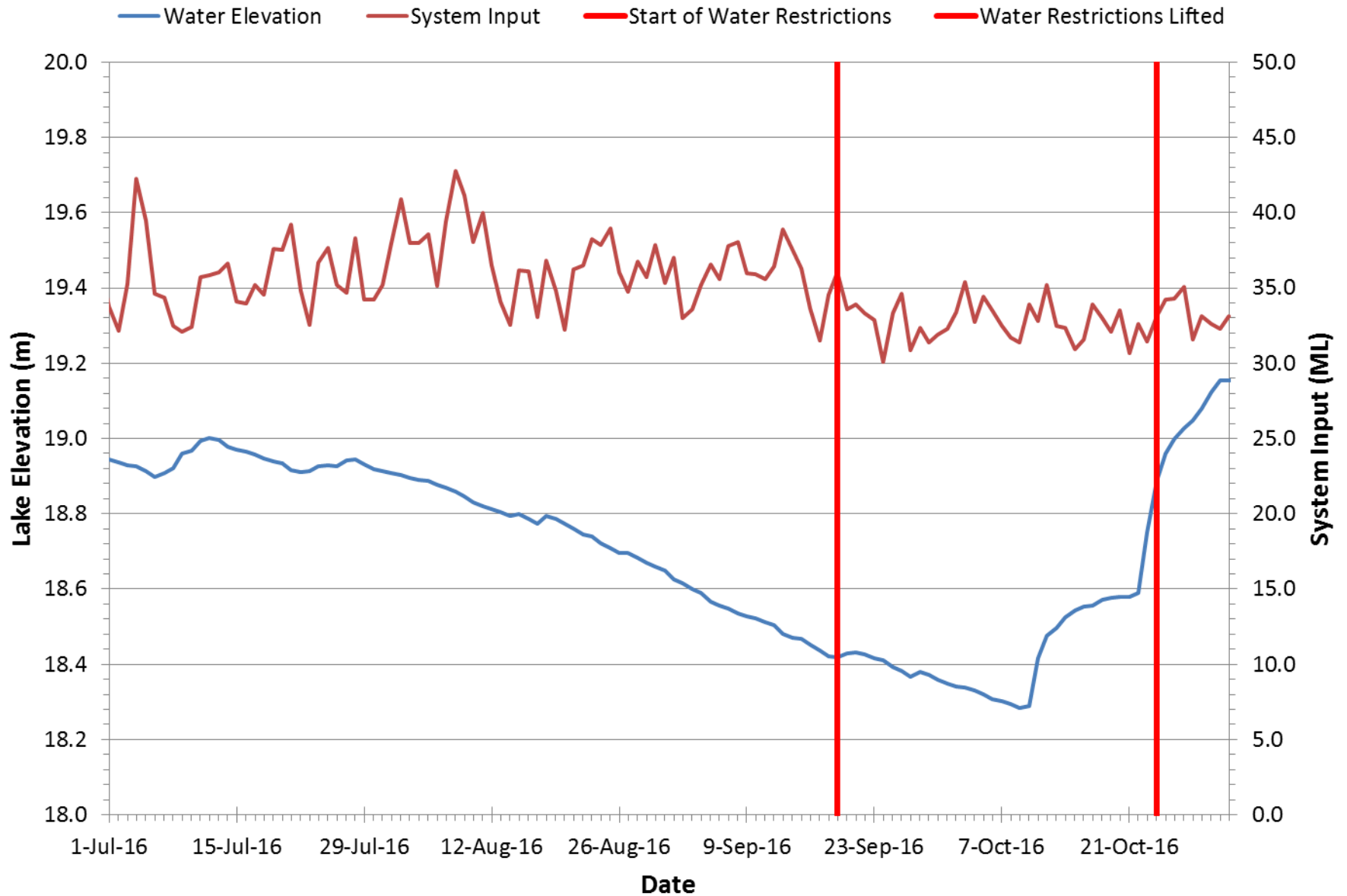
July to September

Normal Rainfall – 292 mm

Actual Rainfall – 177 mm



Lake Major Water Level & Dartmouth Water Consumption





**Questions or
Comments?**