



**Credit Valley
Conservation**
inspired by nature



halton hills
Small Town Living at Its Best

CVC Ice Jam Recap

PFFWC

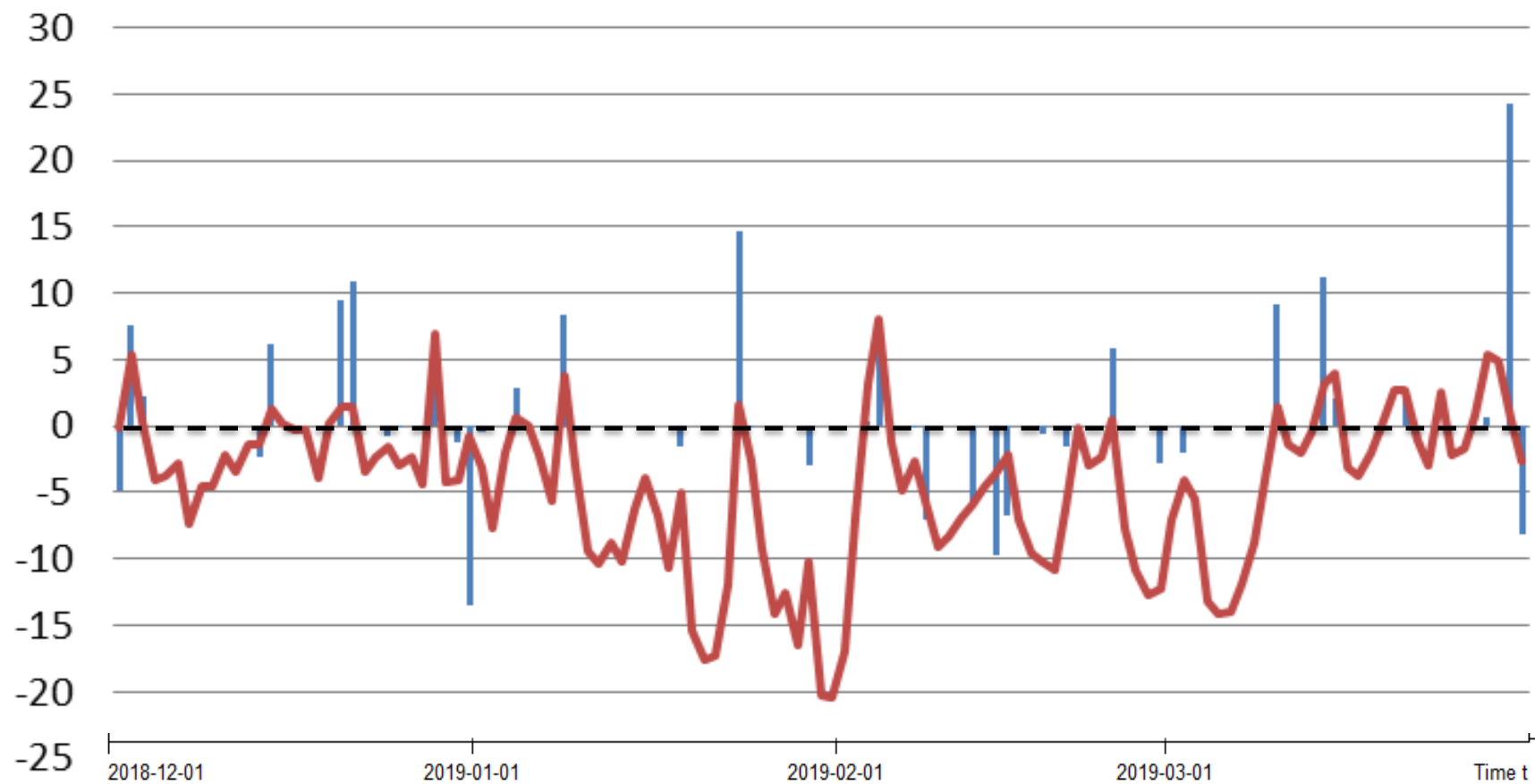
Sept 18, 2019

Jeff Wong jeff.wong@cvc.ca

Bryce Marshall brycem@haltonhills.ca



Dec 01 - Mar 31, Daily Mean Temps and Precip



Units: Temperatures in °C and Precipitation in mm

Ending	8-Jan	22-Jan	23-Jan	2-Feb	4-Feb	23-Feb	24-Feb	9-Mar	10-Mar	13-Mar	15-Mar	18-Mar
Deg Days	3.7	-136.9	1.6	-130.0	11.2	-104.8	0.6	-126.2	1.4	-4.1	7.1	-8.9
Precip	8.4	1.6	14.6	3.2	6.4	32.0	5.8	5.0	9.2	0.0	13.2	0.0

Ferndale in Caledon: Feb-05-2019



Brampton | Mississauga



Paper Mill Dam Feb-05-2019



Paper Mill Dam Feb-05-2019



Paper Mill Dam Feb-05-2019



Glen Williams: Mar-09-2019



Looks like the same water level as yesterday but perhaps more flowing today.

Halton Hills Ice Mitigation

Welcome

Bryce Marshall | Deputy Chief

Halton Hills Fire Department

brycem@haltonhills.ca



Ice Jam Glen Williams



Footage captured by BFES Drone Team

Barber Mill Dam

#9 & #11 Confederation Street

Ice approximately 3 feet thick

Debris (trees, etc.) frozen within ice jam

Weeks of monitoring water
flow & ice conditions.

Glen Williams Flooding



“Remove population from danger vs. danger from population.”

- Public Works staff prepared as best they could.
- Flooding worsened along Confederation Street.
- Heritage Homes threatened.
- Park flooded



Decision Made to Blast



Primary Concerns:

- Ferndale Ice Jam
- Anticipated change in weather (fast thaw)
- Effect of further flooding in Glen Williams
 - Streets
 - Homes
 - (Electrical/Power Concerns)
- Potential effect of blasting down river
- Concerns from council, residents, etc. to act
- OFMEM & PEOC notified

Blasting Process



Ice Augers procured and borrowed



Holes drilled to place charges

Blasting Process (cont'd)



- Pentex boosters
- Auger holes backfilled with snow/ice
- Placed strategically for best water flow
- South to North blast pattern
- Careful/safe detonations
- Staging areas established (TRT)



After the Blasting



Unobstructed route for
flow

Result

March 11th, 2019

Water flows unobstructed through river and east forest overflow



CEMC Collaborative Efforts

Monitored and Reported on the Ice Conditions



Organized CEMCs to ensure resources were not over extended



Fire Department provided Aerial Drone Footages and CEMCs Monitored Conditions



Police Drone Footages and CEMCs provided GIS Support

CVC Issued / Conducted

- 4 Watershed Outlook Statements
- 5 Flood Watches
- 3 Watershed Safety Statements
- 4+1 Snow, Ice and Break-Up Forecast
- 6 Rain and Snow Melt Runoff Estimates
- 49 Updates to CEMCs on water levels (real-time monitoring off line)
- 29 Flow estimates for the Ferndale Ice Jam
- 5 River Watch Exercises

Thermal and Mechanical Break Up

Ice Management Manual



Ministry of
Natural
Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

Number of Accumulated Degree-days of Melting

One 'degree-day of melting' occurs when the mean of the maximum and minimum air temperatures is +1C. In 1981, an accumulation within a four-day period of sixteen to twenty-three degree-days was enough to cause problems in most watersheds. In others, twenty-four to thirty-two degree-days

A simple empirical approach has been used whereby the breakup is expected to start when the water level rises above that of the preceding freeze-up by a "critical" amount, H_B . In turn, this rise depends on ice cover thickness, h_i , and strength (Beltaos, 1984; and Shulyakovskii, 1963) and is represented as:

$$H_B = c h_i$$
The logo for the New Brunswick River Ice Manual, featuring a stylized snowflake icon.

New Brunswick River Ice Manual

in which c = site-specific dimensionless coefficient. The coefficient c is dependent on several variables such as river bends and slope, flow shear stress, ice strength and thickness loss, and steepness of the river banks. Where the thermal effects (thickness/strength losses) on the ice cover are small, the value of c has a maximum of c_0 at a given site; where c_0 generally falls in the range of 2.2 - 3.5 (Beltaos, 1989). Where the thermal effect is significant, the difference, $c_0 h_i - H_B$, has been empirically related to a thermal index (of which the simplest version is the accumulated degree-days of thaw). Such relationships are site-specific (Beltaos, 1984; Tang and Davar, 1984; Burrell et al., 1986) and more field data are needed to enable generalization.

Snow, River Ice and Break-Up Forecast



Snow Survey Information February 14, 2019

This snow survey conducted on Thurs-Feb-14-2019 showed the following amounts at these locations. The lower watershed value may be misleading due to flooding in the survey area.

Watershed Location	Snow Pack Water Content, mm
Upper	40
Middle	23
Lower	36

These values will change over the forecast period with additional precipitation, melt, sublimation or evaporation.

7-DAY WEATHER FORECAST

	Sat Feb 16	Sun Feb 17	Mon Feb 18	Tue Feb 19	Wed Feb 20	Thurs Feb 21	Fri Feb 22
Daily Max Temp	-4	-6	-7	-6	-6	-2	-1
Daily Min Temp	-16	-14	-21	-14	-7	-9	-7
Mean	-10	-10	-14	-10	-6	-5	-4
Sum degree-days	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Precipitation					Snow		
Amount					5 cm		

ICE BREAK-UP AND FLOODING POTENTIAL

	Sat Feb 16	Sun Feb 17	Mon Feb 18	Tue Feb 19	Wed Feb 20	Thurs Feb 21	Fri Feb 22
Ice Break-Up	Low	Low	Low	Low	Low	Low	Low
Flooding	Low	Low	Low	Low	Low	Low	Low

Glen Williams (Main St), Town of Halton Hills
Site 501120008



Date: February 14, 2019
Upstream Ice Cover: 95%
Downstream Ice Cover: 100%
Notes:

Snow Melt and Rainfall, Runoff Estimates

Forecast	Date –Time of Data YYYYMMDD.HH	Forecast Period	Feb 23	Feb 24	Feb 25	Feb 26	Supplemented Data
NAM	20190223.07	3.5 days	0	11	0	0	Actual
HRDPS	20190223.01	2 days	0	14	0	0	Actual, NAM
RDPS	20190223.07	2 days	0	21	0	0	Actual, NAM
HRRR	20190223.15	18 hour	0	6	0	0	Actual, NAM
RAP	20190223.15	21 hour	No	Rain	Forecasted		Actual, NAM
MNRF TO	20190222.07	24 hours	No	Weekend	Forecast	Provided	
MNRF PIA	20190222.07	24 hours	No	Weekend	Forecast	Provided	
Actual	20190223.16						

Using Snow Melt Models from CH and NVCA for Mechanical Break Up
 Forecast provided to Emergency Managers prior to melt and rainfall events
 Data from Spotwx.com: Feel free to donate and keep website going

Estimating Mobilization of Grounded Ice



Grounded Ice Jam
in Ferndale



Neutral Buoyancy of Porous Ice

At Neutral Buoyancy, the relative height-of-the-water *to the* height-of-an-ice-column *is equal to* the value for the specific-gravity-of-ice [similar to an iceberg]

$$\frac{(\textit{Height of Water})}{(\textit{Height of Ice Column})} = \textit{Specific Gravity of Ice}$$

Specific Gravity of Ice being 0.92 and Jam Height is 2.4m

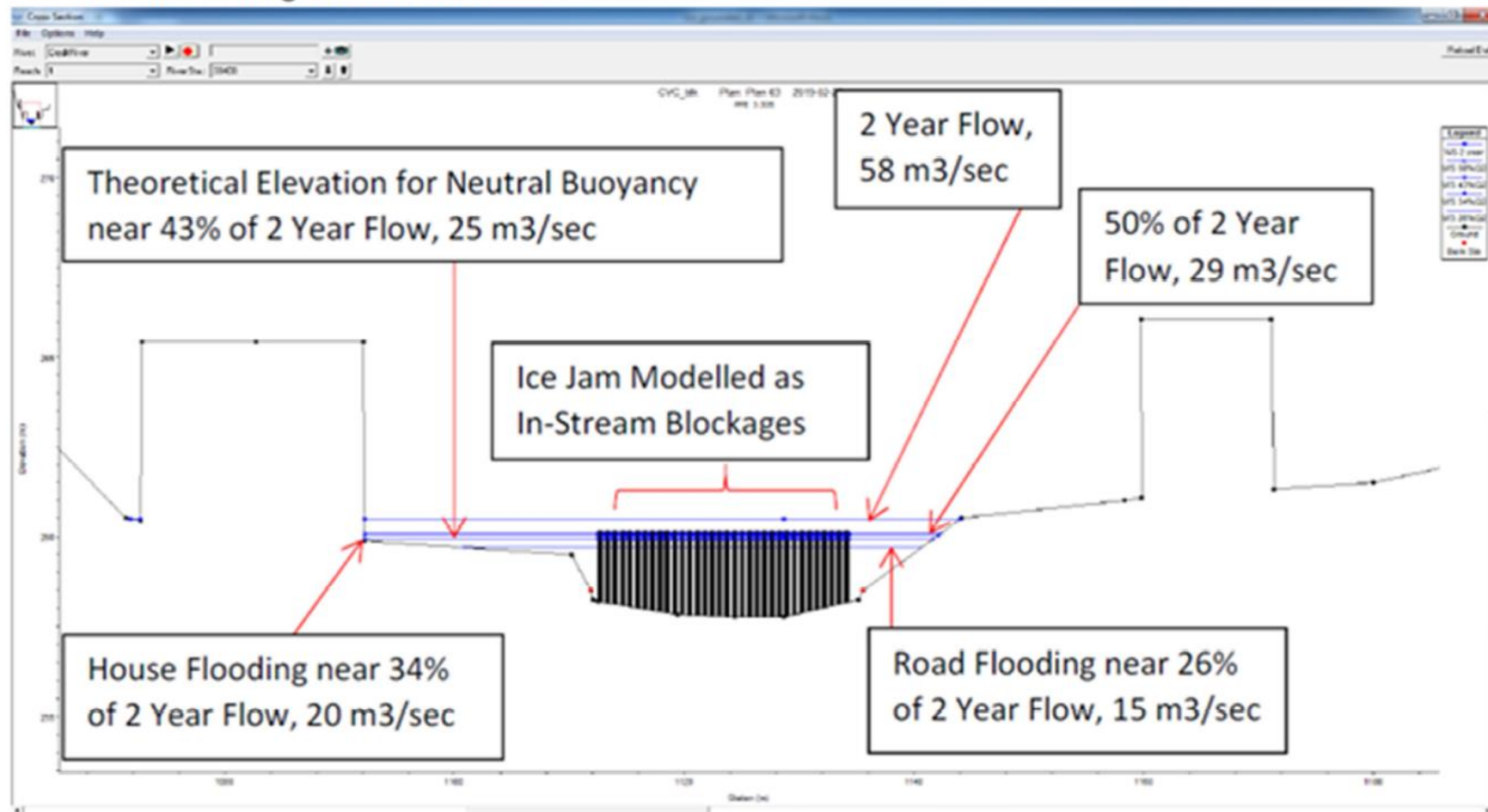
Various flows (by trial and error) were used in a HEC-RAS model to match the height of water at neutral buoyancy

So, the “right now” answer was ...

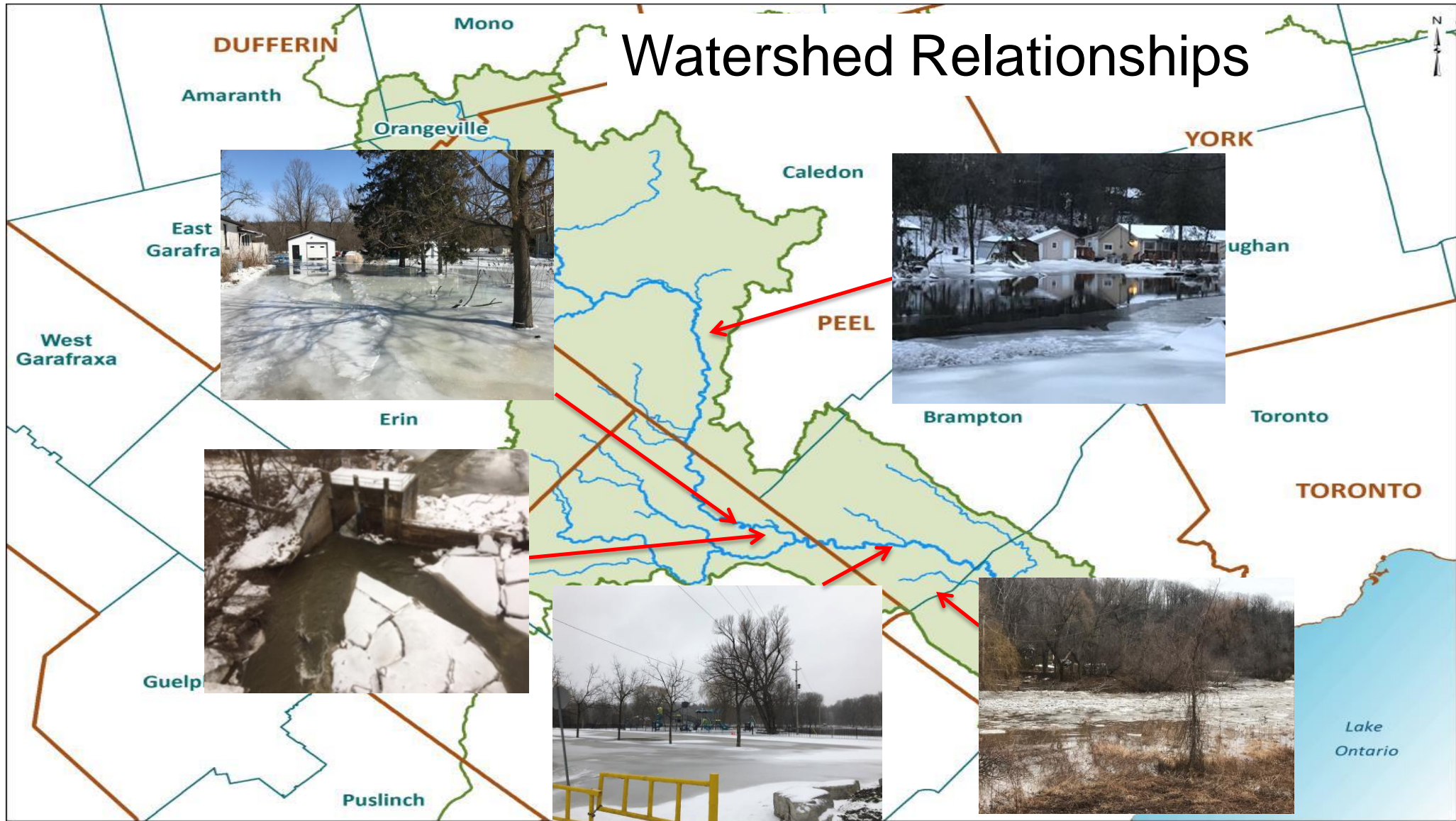
HEC-RAS Section thru Ferndale

DRAFT FOR EMERGENCY MANAGEMENT USE ONLY

Sections are looking downstream



Watershed Relationships

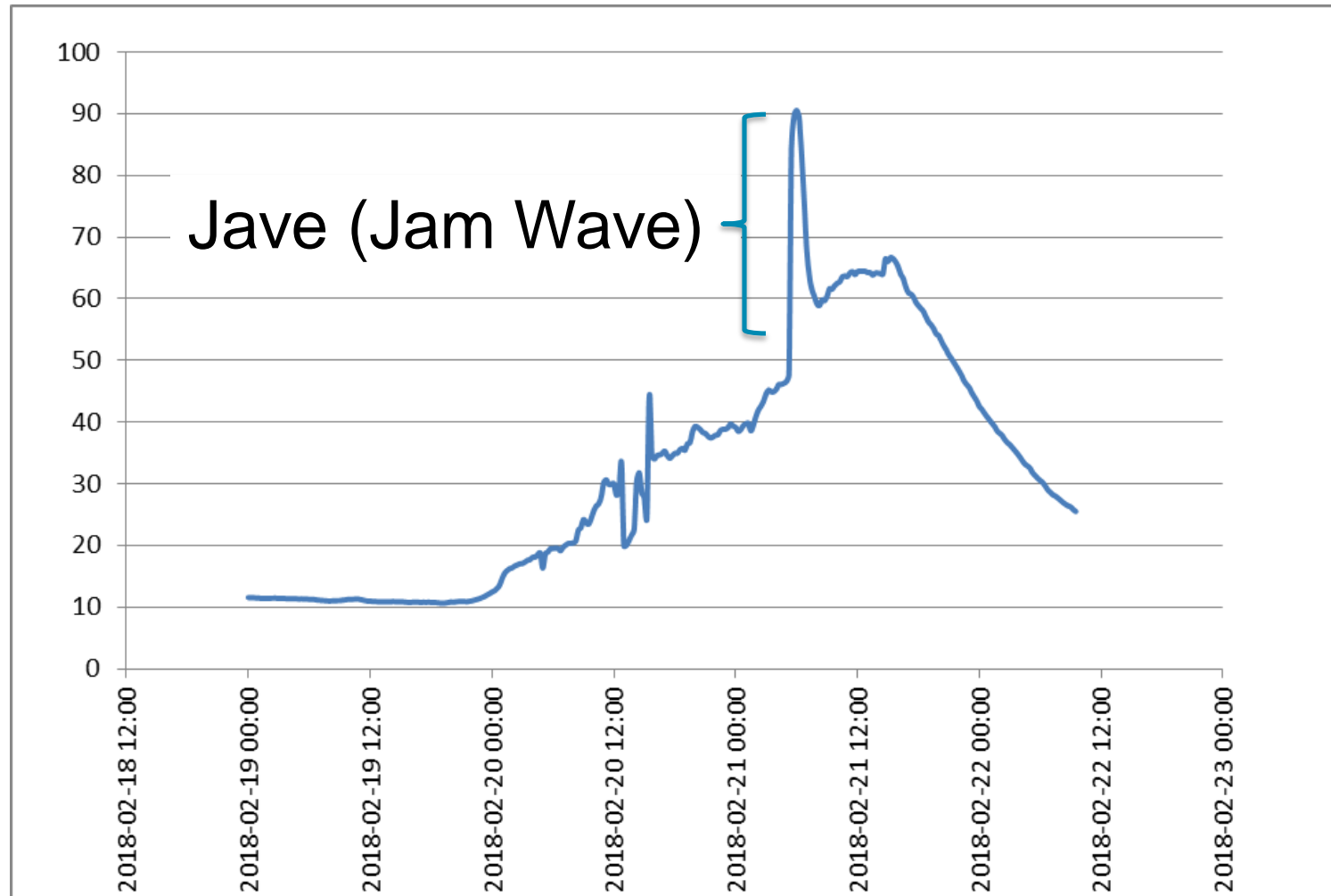


The Credit River Watershed

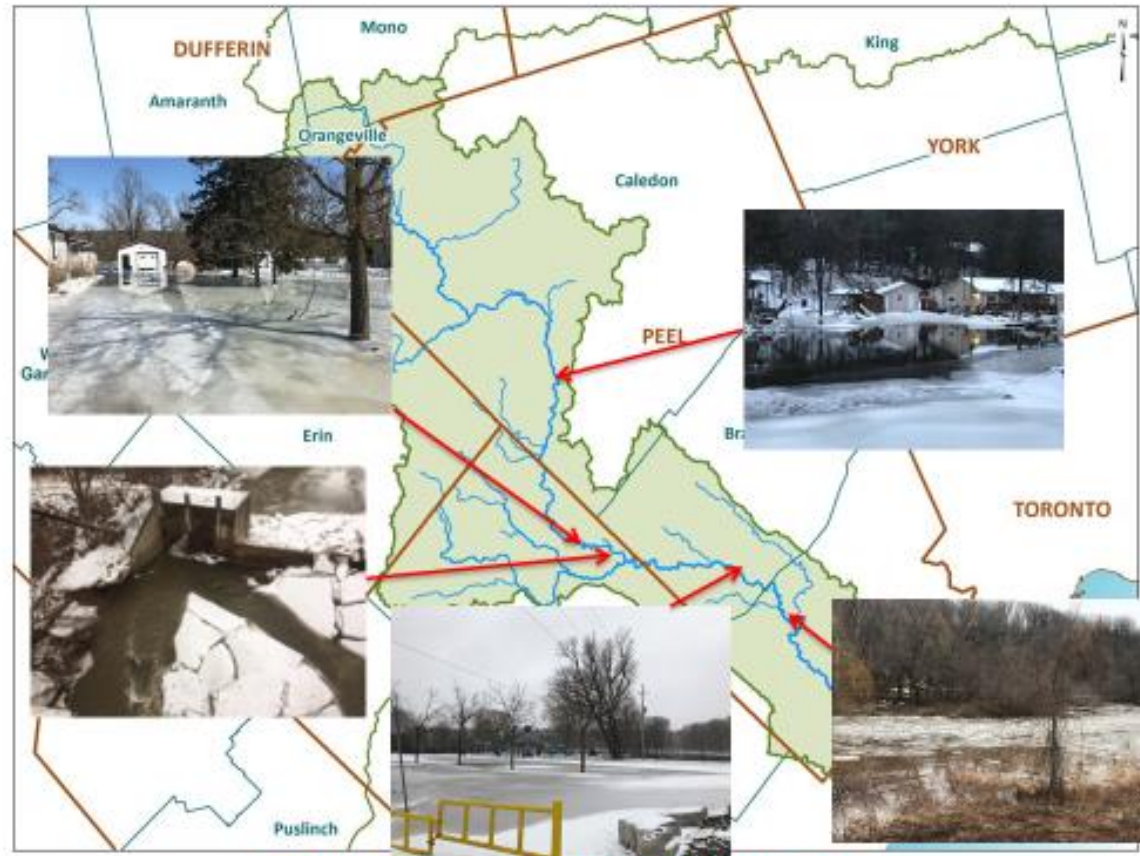
Paper (Barber) Mill Dam Overtops at 58 cms



Recap: Feb-21/22-2018 GW Flows



Recap and Poetry (RAP)



The Credit River Watershed

Recap and Poetry (RAP)

The Town of Halton Hills is our friend, they own the Paper Mill Dam



Recap and Poetry (RAP)

For the Communities downstream: it is kind of nice, the dam
hold back the ice



Looking Downstream

Looking Upstream of Dam



Recap and Poetry (RAP)

Upstream: many emergencies they endure, safety of their residents the Town ensured



THEIFP.CA

**Town blasts Credit River ice to mitigate flooding in
Glen Williams**

Recap and Poetry (RAP)

When the flows are really high, the ice would just go by ...



Recap and Poetry (RAP)

Which is kind of sad, then it becomes all around BAD!



inspired by nature

THANK YOU

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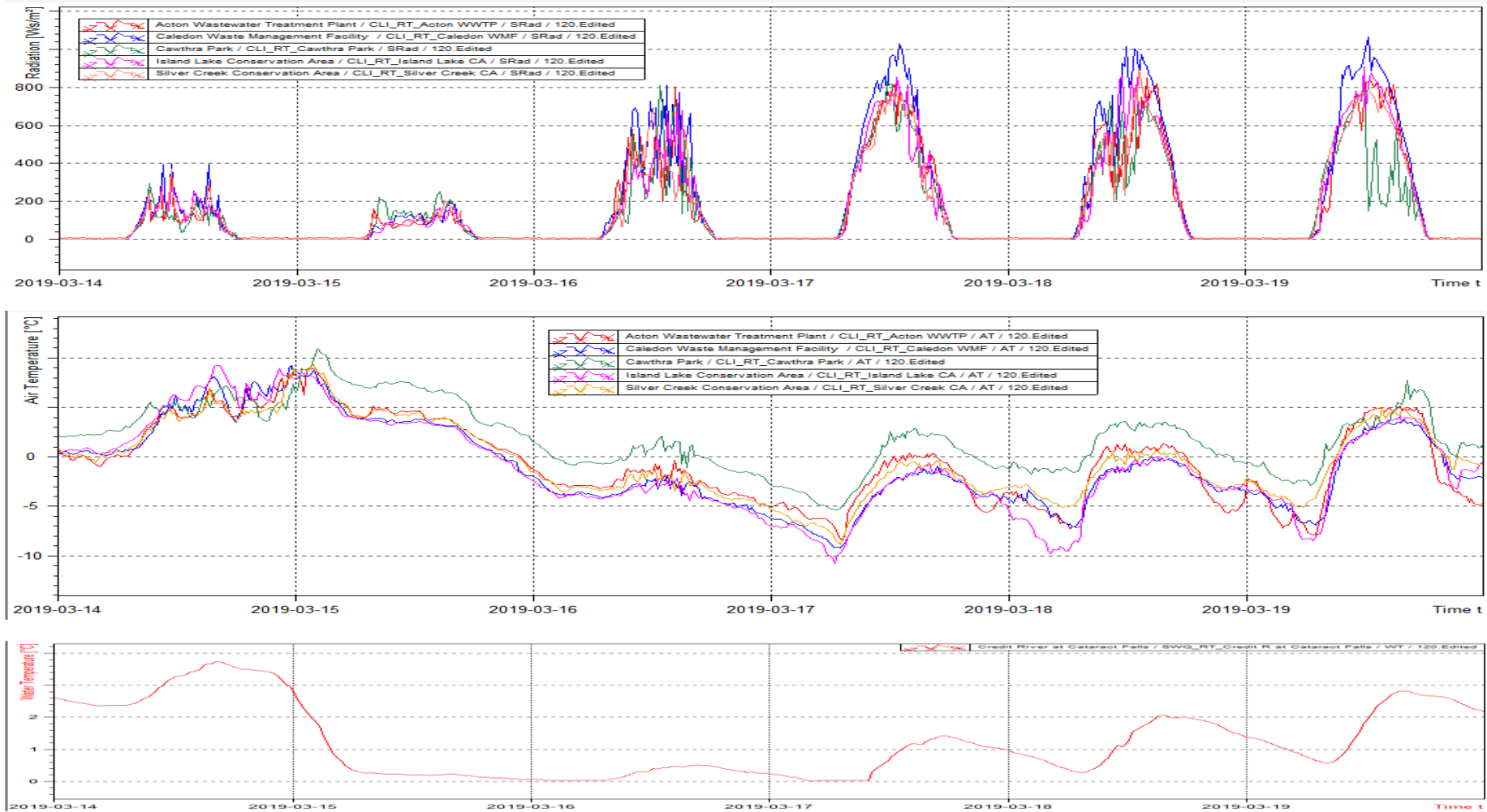
brycem@haltonhills.ca

questions?

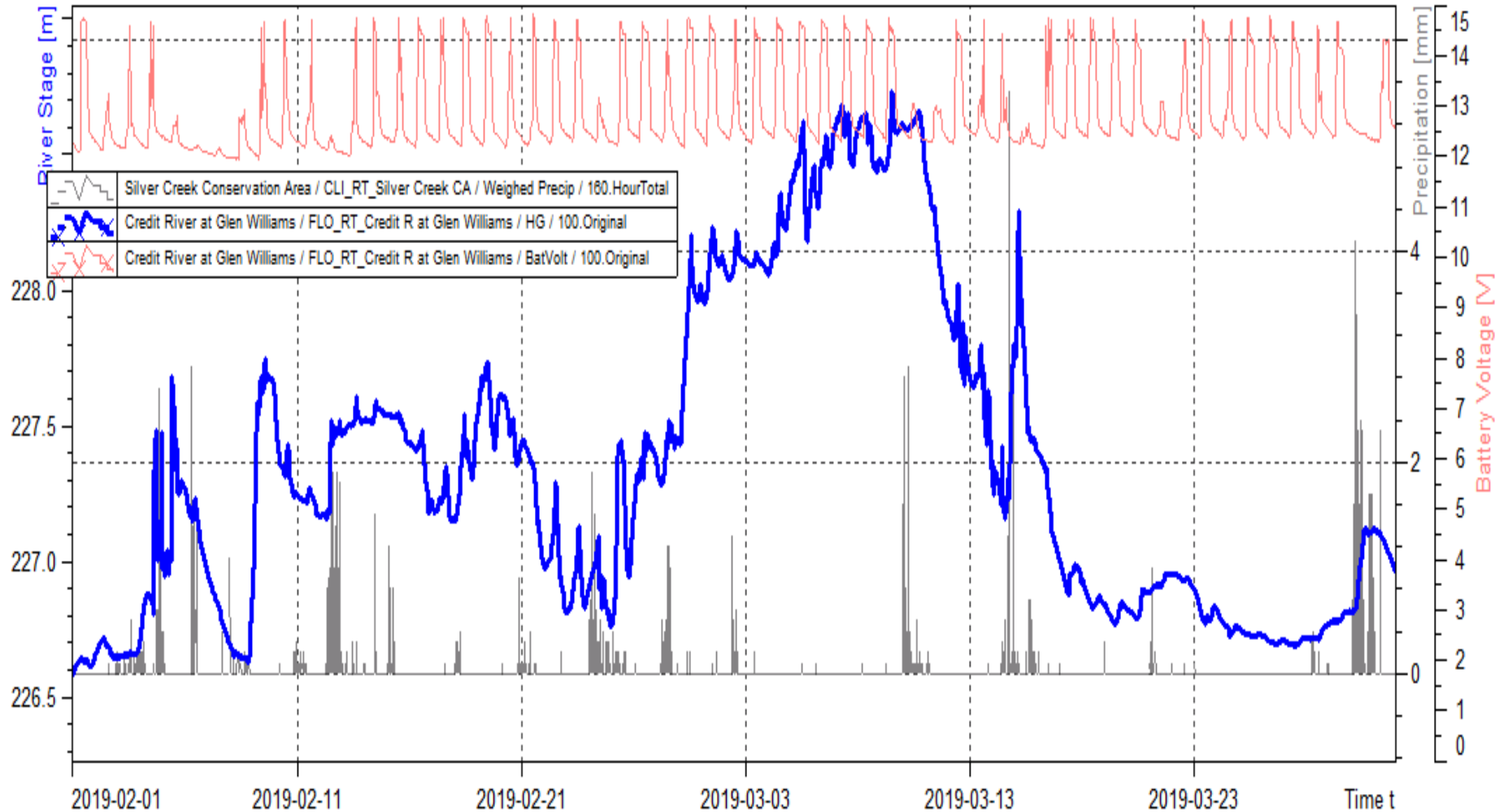
OUT TAKES

- Presentation Ends Here
- DRAFT / Un-used Slides below

Ice Gone at PMD: Mar-19-2019



Glen Williams Water Levels



Watershed Relationship

From Upstream - Ferndale

To Downstream – Brampton and Mississauga



Outline

- Conditions
- Upstream and Downstream Relationships
- Messaging and Forecasting



CONDITIONS

Weather / Climate

Water Levels

Ice

Monitoring - River Watch



Messaging and Forecasting

Provincial-GTA Standard Flood Messages

Snow Surveys, River Ice and Break Up Forecast

Tailored to the Situation

- Water Level Updates
- Snow Melt and Rain Runoff
- Calculated Flows for Ferndale



20/20 and Retro-Respect



Blunders

Mis-Steps

Mis-Calculations

Errors

Omissions

Admissions

Lessons Learned

Next Time ...

Watershed Relationship

Upstream of Paper Mill Dam

Halton Hills (Glen Williams, Terra Cotta)

Caledon (Cheltenham, Ferndale, Boston Mills ...)

Downstream of Paper Mill dam

Halton Hills (Norval)

Brampton (Huttonville, Churchville)

Mississauga (Meadowvale, Streetsville)



Recap and Poetry (RAP)

- The Town of Halton Hills is our friend, they own the Paper Mill Dam
- For the Communities downstream: it is kind of nice, it holds back all the ice
- Upstream: many emergencies they endure, safety of their residents the town ensured
- When the floes get really high, the ice would just goes bye
- Which is kind of sad, then it becomes all around bad

Paper Mill Dam: Feb-05-2019

2003



2019



2009



Halton Hills Ice Mitigation



Directed Operations, provided Logistics, Co-ordination Efforts ...



Provided Areal Drone Video of Exercise. Used infrared to estimate ice thickness.



www.QMenv.com Devised and executed mitigation plan along with Explosive Experts from Belville



Observers and Ensured Environmental Compliance

Monitoring – River Watch

CVC River Watch Staff Monitored Watershed Conditions on

2019-02-05

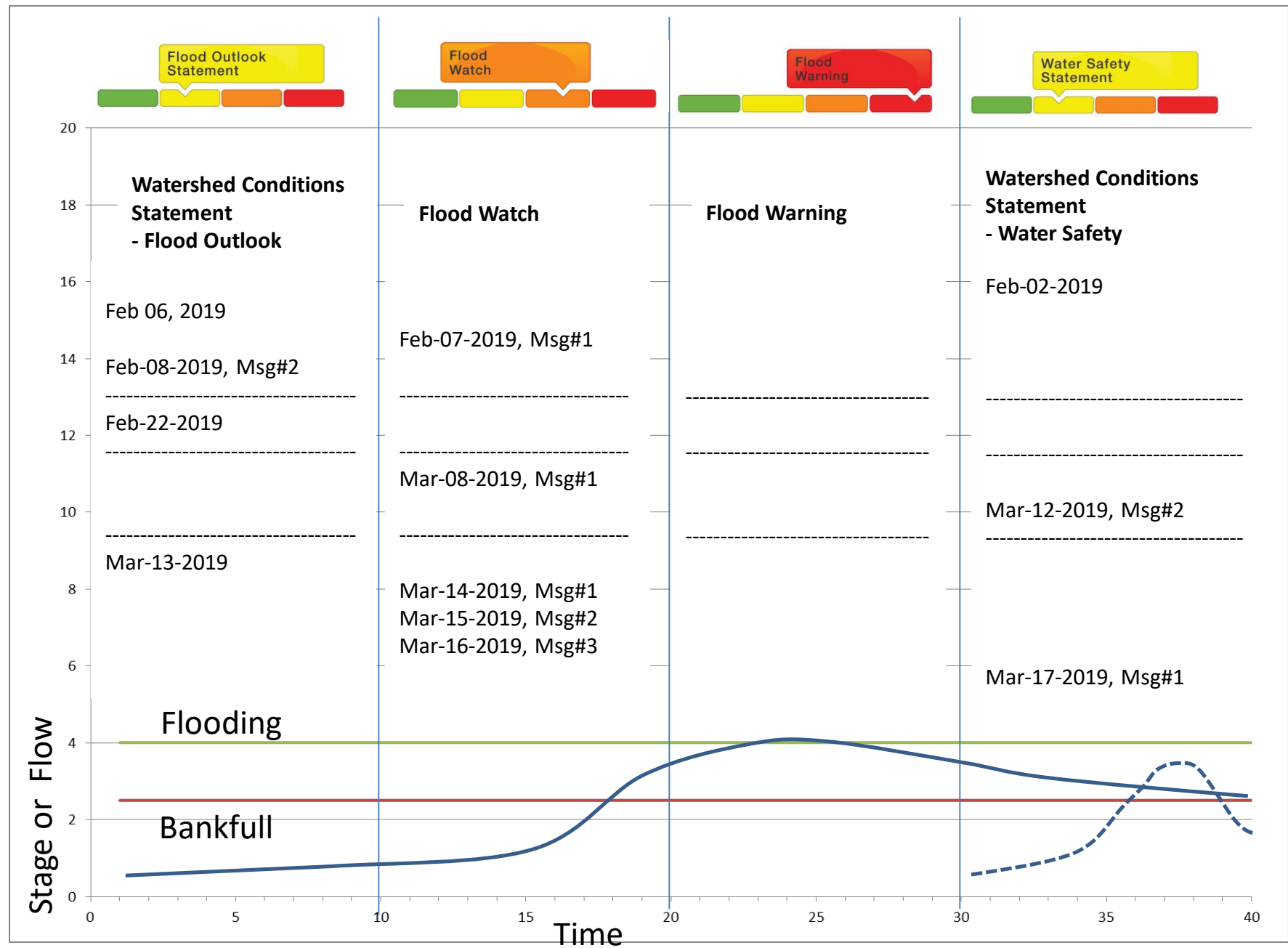
2019-03-11

2019-03-14 (GW & Ferndale)

2019-03-15

2019-03-16 (Scaled Down / Limited)

To assess and confirm conditions, photo-documentation



Monitoring network down, 49 manual updates to CEMCs

	20190209.2300	20190214.2330	20190220.1030	20190224.2300
20190205.0930	20190210.0900	20190215.0930	20190220.2030	20190225.0630
20190205.2246	20190210.1630	20190215.2030	20190221.0900	20190226.0930
20190206.1337	20190210.2200	20190216.0830	20190221.2300	20190227.1330
20190207.1616	20190211.0730	20190216.1900	20190222.0800	20190228.1530
20190207.2300	20190211.1930	20190217.0800	20190222.1900	20190301.0900
20190208.0330	20190212.0800	20190217.1930	20190223.0730	20190304.1100
20190209.1200	20190212.2230	20190218.0930	20190223.1830	20190305.1000
20190209.1800	20190213.0800	20190218.2200	20190224.0900	20190306.0900
20190209.2030	20190213.2000	20190219.2030	20190224.1630	20190307.1100

Snow, Ice and Break-Up Forecasts

As part of the MNRF SWMC Snow Surveys Program, CVC conducts two (2) snow surveys a month at 3 locations

Usually around the middle and start/end of month

We also monitor/photograph the ice while we are out and about

Forecasts are provided shortly after or as necessary

20190201

20190215

20190304

20190308 (Ice Forecast Only)

20190321 (Notice for End of Forecast, Ice Melted)

Rain and Snow Melt Runoff Estimates Updates

Long range forecasts are less reliable

Runoff estimates are only done a day or hours in advance

20190223.1600
20190309.1400
20190310.0900
20190311.0900
20190313.1000
20190314.0900

Monitoring Flows to Ferndale

Date.Time	Grange SR	East Credit River	+/- Boston Mills
20190314.1100	2.788	1.111	3.9
20190311.0600	4.646	1.364	6
20190310.2100	6.202	1.102	7.3
20190310.1630	4.161	0.898	5.1
20190310.1330	4.562	0.767	5.3
20190310.0830	3.947	0.635	4.6
20190310.0400	3.947	0.584	4.5
20190307.1130	2.431	0.542	3
20190306.1715	3.122	0.601	3.7
20190306.0815	2.743	0.542	3.3
20190305.2100	2.788	0.618	3.4
20190305.1000	2.219	0.485	2.7
20190304.1445	2.868	0.635	3.5
20190304.1030	2.766	0.437	3.2
20190302.1145	2.973	0.601	3.6

Date.Time	Grange SR	East Credit River	+/- Boston Mills
20190301.0900	4.546	0.609	5.2
20190228.1930	3.476	0.718	4.2
20190228.1500	3.918	0.657	4.6
20190227.1300	3.814	0.696	4.5
20190226.1515	3.756	0.852	4.6
20190226.1145	3.422	0.807	4.2
20190226.1030	4.334	0.816	5.2
20190225.1415	3.11	1.058	4.2
20190225.0630	3.614	1.194	4.8
20190224.2300	3.8	1.001	4.8
20190224.1945	3.435	0.926	4.4
20190224.1700	3.173	0.843	4
20190224.1430	2.985	0.722	3.7
20190224.1145	2.788	0.631	3.4

Right Answer: Mar-14-2019, due to Thermal Effects

Example Project Partners

