

Section III – Items for the Information of the Board

TO: Chair and Members of the Board of Directors
Meeting #3/19, Friday, March 29, 2019

FROM: Sameer Dhalla, Interim Director, Development and Engineering Services

RE: **2019 BOLTON ICE JAM FLOODING**
Overview of March 15-16 ice jam flooding of Bolton Core

KEY ISSUE

On March 15-16, 2019, an ice jam and subsequent flooding occurred on the Humber River between Humber Lea Road and King Street in Bolton. Over 80 homes were evacuated and approximately 30 homes were negatively impacted by the flooding. This report summarizes TRCA's forecasting, warning, and response activities in relation to the event and highlights lessons learned.

RECOMMENDATION

IT IS RECOMMENDED THAT this staff report regarding the 2019 Bolton Ice Jam Flooding be received.

BACKGROUND

In order to provide support to our municipal partners during flood events, Toronto and Region Conservation Authority (TRCA) operates a Flood Forecasting and Warning Program that operates 24 hours a day, 7 days a week. The information TRCA provides plays a critical role in assisting our municipal partners in preventative decision making and maintenance works and in directing emergency response actions. Primary communication to both our partners and the public occurs through our Flood Messages, which outline the potential for flooding based on weather conditions. Detailed direct communications with municipal staff can also include site-specific information such as real-time water levels, structures and roads at risk, and expected conditions within the watershed. During the winter months, TRCA also undertakes monitoring of historical ice jam locations, and provides River Ice Outlook forecasts to our municipal partners.

Ice Jams and TRCA Monitoring

Ice jam flooding occurs when there is an accumulation of ice sheets or slabs that impede the flow in a watercourse. Ice jams can occur when ice cover first starts to form on a river. More commonly, they can occur during mid-winter thaws and spring rainfall events. At these times, snowmelt and rainfall raises the water level in a stream, putting pressure on the ice cover and causing it to break up. Ice pieces carried downstream with the flow can become caught at channel constrictions or bends and accumulate rapidly. Because ice jamming is a dynamic process, it is extremely difficult to predict. While warming weather patterns can point to higher likelihood of ice break-up, and while there are some areas of historical jam occurrence, the exact location of a future jam is highly unpredictable. Some locations may not experience any ice jamming at all, and other locations may experience multiple ice jams forming and then releasing over the course of a season. The sudden release of an ice jam can also result in downstream flooding as the impounded water is let loose. It is also possible for a released ice jam to re-accumulate in a different location further downstream. For these reasons, as well as due to safety concerns, ice-blasting is rarely an effective tool for managing ice jams.

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There are over 3,500 km of watercourse within our jurisdiction, and while an ice jam could theoretically form anywhere if the circumstances allow, there are 34 locations which have a history of ice jamming. TRCA's seasonal River Ice Monitoring program focuses on 12 high priority sites from among these. Two high priority ice monitoring locations exist upstream and downstream of the Bolton Core area where flooding occurred – specifically at Hickman Street and Glasgow Road, and further downstream between Sneath Road and Albion Vaughan Road.

Throughout the season, Flood Risk Management staff issue River Ice Outlook statements to municipal partners based on field observations by Hydrometrics and River Watch staff, specifically outlining the potential for ice jams at high priority locations.

In addition to River Ice Outlooks sent to municipal partners, TRCA issues an annual Spring Safety message to partners and the general public, reminding citizens of the hazards near rivers, including ice, as the weather warms. Furthermore, when winter temperatures allude to the potential for ice jams, TRCA includes specific areas of concern in flood messaging.

Bolton Core Flooding

The historic village of Bolton, in the Town of Caledon, is located within the valley corridor and floodplain of the Humber River. This area has a long history of flooding with 233 structures susceptible to flooding during a Regional Storm event. TRCA has a real-time stream gauge in the vicinity, at Bolton McFall Dam. There is also a Water Survey of Canada gauge located farther upstream at Palgrave.

Due to the flood vulnerability of the Bolton Core community, that was largely constructed before protective policies were in place, the area was designated as a Special Policy Area (SPA). Flood protection measures were constructed in the 1980's to provide flood protection up to and including the 500-year flood, as per the applicable special policies. As outlined in report Item 8.2 of this agenda, TRCA had already undertaken a remediation study of this infrastructure, which identified that the berm requires some capital improvements to meet its intended level of flood protection. As noted in Item 8.2, TRCA had already begun a process towards undertaking the recommended improvements to the local flood infrastructure.

As of February 5th, 2019, TRCA became aware of a different ice jam location, directly upstream of King Street East and Old King Road. This location was included in all further ice monitoring visits, including aerial surveillance using drones on February 7. Photographs from the various monitoring visits illustrate that the initial jam reported on February 5 directly upstream of King Road had already begun to clear by February 21, and the field visit to the location on the morning of March 15 revealed openly flowing water directly upstream of King Street East and Old King Road. While a retrospective engineering study is necessary to confirm the exact cause of the ice jam on March 15, it appears to have been a different, subsequent jam to the one originally noted on February 5.

Table 1 summarizes the various field assessments and communications to municipal partners and the public throughout the winter. Among the various communications are three flood messages that refer specifically to the initial jam at King Street at Old King Road in Bolton.

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Table 1: Summary of Monitoring and Communications up to March 15

Communication Type	Date(s) issued	Audience and purpose
River Ice field assessments	January 15, 23, 31; February 5, 7, 8, 15, 21, 24; March 7, 13	Sent to internal staff for use in daily assessments and disseminating to municipal staff as required
Spring Safety Message	March 7	Sent to public to remind of hazards near rivers during warmer weather
River Ice Outlook Messages	February 1 March 8	Sent to municipal contacts to advise of river ice conditions and potential for ice breakup
Riverine Flood Messages mentioning Ice Jam (Feb 7, 22, and 23 specifically mention King Street and Old King in Bolton)	Watershed Conditions Statement – Water Safety: Jan. 23, 24; Feb.4, 7, 22 ; Mar.15 Watershed Conditions Statement – Flood Outlook: Feb.5, 23 ; Mar.9,13 Flood Watch: Jan.23; Feb.4; Mar.14 Flood Warning: Feb.5	Sent to public and municipal contacts – primary tool for communicating flood threats. Most of the flood messages indicate potential for localized ice jamming that could create hazardous conditions close to any river, stream or other water bodies, etc.
Media Interviews	March 11-March 15	Delivered to public via multiple media channels (CP24, CBC, CTV, etc.). Key messages include warming weather and higher flows creating potential for ice jams.

The winter of 2019 included the accumulation of a large snowpack as well as multiple freeze-thaw cycles. Between Wednesday March 13, 2019 and Friday March 15, 2019, our jurisdiction had received approximately 20mm rain and warming temperatures reaching up to 10 degrees. These factors and the corresponding higher flows would have resulted in a higher potential for ice jams. A Flood Watch was issued on March 14, followed by a Watershed Conditions Statement – Water Safety on March 15 which remained in effect citing the potential for ice jam related flooding.

As part of the ongoing ice monitoring effort, King Street East at Old King Road was visited on Friday March 15 at approximately 10 AM by River Watch staff. Photographs and field observations were provided, indicating open water conditions at the site of the previous jam.

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Communications as well as data logs from the upstream gauges at McFall Dam and Palgrave appear to indicate that the flooding in the Bolton Core on March 15 resulted from an ice jam situation that formed and rapidly escalated as higher flows moved through the river over the course of the afternoon and into the evening.

TRCA Response Actions

Where prevention is not possible, a co-ordinated mitigation effort is necessary to help safeguard lives and protect property to the extent possible. TRCA's primary capacity in a flood response situation is as a technical advisor to our partners undertaking emergency services. At approximately 7:00 PM on Friday March 15, upon receiving reports of flooding in the vicinity of King Street East at Humber Lea Road, TRCA mobilized to assist the Town of Caledon in its emergency response which it had initialized earlier that afternoon. Staff was dispatched to the site and a technical advisory was provided to the local Community Emergency Management Coordinator (CEMC); in this case the Town of Caledon Fire Chief.

TRCA staff remained on site from 9:40 PM Friday March 15 through to 7:00 PM Saturday March 16, while multiple members of the Flood Forecasting and Warning program activated a remote Incident Management System structure to provide supporting analysis. At one point over 80 homes were evacuated, and many roads were flooded in knee-deep water. Key information provided by TRCA that facilitated the Town of Caledon's response included:

- Maps of the 500-year inundation zone, impacted structures, and a list of affected addresses to aid with prioritizing evacuations. The expertise of Flood Duty Officers in correlating the reports from the scene to a scenario with similar impact area was very useful. These maps were utilized by first responders from OPP and Caledon Fire and Emergency Services, and were identified as a very valuable tool. This information was provided by leveraging the data and process developed for the Flood Risk Assessment and Ranking process.
- On-site technical advice and expertise to the Town of Caledon emergency contractor and Caledon Fire and Emergency Services on approaches to address the ice jam and flooding, taking into account dynamic conditions and the presence of the berm. TRCA Flood Infrastructure staff played a key role in ensuring an effective ice removal strategy.
- Situation reports shared with the Community Emergency Management Coordinator, and the TRCA Senior Leadership Team, about the work being done at the site and remotely, as well as updates on upstream watershed conditions.
- Key messages regarding the dynamic and unpredictable nature of ice-jam flooding utilized in communications with the media and public.

After some attempts to undertake mechanical removal of the ice jam, drone footage taken on the morning of March 16 helped identify the critical pinch point in the jam as being directly behind 181 King Street. With the technical guidance provided by TRCA Flood Infrastructure staff, the Town of Caledon utilized excavators to manually remove the ice from within the channel. As water had been flowing over the top of the Bolton berm, concerns were raised regarding potential erosion of flood infrastructure. TRCA Geotechnical staff visited the site on March 16 to assess the status of the berm. While there was some indication of mild settlement, the berm was deemed stable thanks to the fact that the ground was still frozen at the time of the flood. Further monitoring for changes was recommended, as well as suggestions for erosion protection, which would be taken into account as part of the comprehensive restoration of the berm.

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Lessons Learned and Next Steps

TRCA staff convened on March 18 to initiate the post-event analysis and continue the collection of high water marks. TRCA has also initiated the process to engage a consultant to conduct a retrospective engineering study of the jam causes. Pertinent information from this study will be taken into account for the detailed design of the preferred berm remediation option. A notable lesson learned this season was in the use of drones in surveying ice conditions both pro-actively (in February), and during the Bolton Jam event itself. Planned improvements to the River Ice Monitoring program include the use of various aerial surveillance methods, including drone, helicopter, and potentially satellite imagery in order to increase monitoring coverage area. As per the advice of geotechnical staff, the berm should continue to be monitored for any evidence of settling, and any repairs required will be completed as part of the planned rehabilitation of the berm. Together with the Town of Caledon, workflows developed during this emergency can be codified for future incident response plans.

Relationship to Building the Living City, the TRCA 2013-2022 Strategic Plan

This report supports the following strategy set forth in the TRCA 2013-2022 Strategic Plan:
Strategy 2 – Manage our regional water resources for current and future generations

FINANCIAL DETAILS

Flood Forecasting and Warning efforts fall within TRCA's operating budget under account 115-60, and improvements to Flood Risk Management programs are considered within account 115-62. Please refer to item 8.2 for financial details regarding the berm restoration.

DETAILS OF WORK TO BE DONE

Please refer to item 8.2 for details of work to be undertaken as part of the berm restoration.

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