

Section III – Items for the Information of the Board

TO: Chair and Members of the Authority
Meeting #4/18, Friday, June 08, 2018

FROM: Nick Saccone, Senior Director, Restoration and Infrastructure

RE: **FLOOD FORECASTING AND WARNING PROGRAM OVERVIEW**
Summary of Toronto and Region Conservation Authority's Flood Forecasting and Warning Program

KEY ISSUE

Summary of the Flood Forecasting and Warning Program which provides early detection of potential floods and assists municipal partners in emergency response.

RECOMMENDATION

IT IS RECOMMENDED THAT the Flood Forecasting and Warning Program Overview report and website demonstration be received.

BACKGROUND

Toronto and Region Conservation Authority (TRCA) plays a critical role in mitigating and reducing risks from flooding. Advanced warning of potential flooding allows municipal and regional partner agencies to prepare a response to reduce risks to the public and damage to property. The original concept of flood forecasting and warning at TRCA was introduced under the "Plan for Flood Control and Water Conservation" (Metropolitan Toronto and Region Conservation Authority, 1959) where it was proposed to have a network of stream gauges and dedicated staff to monitor watersheds for potential flooding. This system would increase lead time and allow municipalities to evacuate areas at risk of flooding more quickly.

Since 1959, flood forecasting and warning has evolved continuously due to improvements in technology and greater understanding of risk management. The provincial government recognized the importance of early detection of floods and has formally assigned the mandate for flood forecasting and warning to conservation authorities. The standards that govern this mandate are stipulated in the "Provincial Flood Forecasting and Warning Implementation Guidelines" (Ministry of Natural Resources, 2008). The current flood forecasting and warning program at TRCA encompasses the latest advancements in technical tools, hazard communication and flood risk management. The program is embedded within Engineering Services at TRCA under the Flood Risk Management section.

Flood forecasting and warning is a core responsibility of TRCA and is reflected in TRCA's Strategic Plan under Leadership Strategy #2; Objective 4 which states TRCA will oversee the "Reduction or elimination of flood risks within our jurisdiction". This report will provide an overview of the key components of TRCA's Flood Forecasting and Warning Program.

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Flood Forecasting and Warning Program Personnel

Municipalities are responsible for emergency response such as evacuation and road closures. Forecasting the timing and severity of flooding helps TRCA in developing specific messaging to external agencies so that emergency management resources are mobilized efficiently. This requires TRCA staff to be on-call 24/7. As well, TRCA maintains an Emergency Operations Centre (EOC) and uses the Incident Management System (IMS) to ensure inter-operability with other agencies in times of crisis. There are several key positions at TRCA that are involved in flood forecasting.

Flood Duty Officer (FDO)

The FDO position is on call 24/7 and is filled on a rotational basis by TRCA staff from Engineering Services. The FDO monitors weather forecasts and watershed information to identify conditions that could produce flood situations. They also monitor TRCA's Floodline phone number and email account where members of the public can provide or request information. The FDO populates the Daily Planning Cycle (DPC) that summarizes various weather prediction models for circulation to TRCA Flood Risk Management staff. There are numerous weather prediction tools available to the FDO including radar, satellite and advanced precipitation/storm models. The FDO is also in regular contact with Environment Canada's Ontario Storm Prediction Centre (OSPC) where FDO's can get the latest weather predictions from a professional meteorologist. Using this information, the FDO can determine if conditions require TRCA to issue a flood message. If warranted, the FDO may call municipal partners to advise of expected impacts and provide more detailed information on specific flood situations so that a targeted response can be implemented such as road closures. They also direct the operation of TRCA's dams. All staff designated as FDO's must participate in monthly training sessions and complete mandatory specialized courses in crisis communications and meteorology.

Chief Flood Duty Officer (CFDO)

The CFDO position is also a 24/7 responsibility and is filled on a rotational basis by senior engineers from Engineering Services. While the FDO is primarily responsible for the day to day monitoring of weather and watershed conditions, when potential flooding is identified, the CFDO is tasked with supporting the FDO during flood events. Specific tasks for CFDO's include responding to media requests, coordination of flood message releases, composition of situation reports for TRCA staff and authorizing dam gate operations. CFDOs also have to complete specialized monthly training.

Hydrometric Technologist

The Hydrometric Technologist is responsible for maintaining the real-time stream and rain gauge network. During floods they may be required to service equipment to ensure gauges are functioning correctly. They also conduct site visits to investigate and document flooding to assist the CFDO/FDO in preparing reports for internal staff and external agencies.

Dam Operator

TRCA currently has dam operators at Claireville Dam and G. Ross Lord Dam. Dam operators are available 24/7 to operate dam gates if requested by the FDO/CFDO. During potential flood situations, dam operators remain onsite at the dams to carry out operations, monitor dam safety, report reservoir levels and to activate emergency back-up systems if required.

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Incident Management System Positions

Incident Management System (IMS) is an organizational tool for coordinating a response for emergencies. Based on international practice, the Ministry of Community Safety and Correctional Services developed the IMS program to assist agencies involved in emergency management to develop standardized organizational structures, functions, processes and terminology for responding to emergencies. The IMS structure consists of five main components for delegating responsibilities. They include Operations, Planning, Finance, Logistics and Command. TRCA staff with expertise and responsibilities in the above components have been identified and trained to fill the required IMS roles when activated.

Flood Warning Messages

Flood warning messages are sent to municipalities, school boards, local police, emergency services, media and other external agencies via email and SMS (short message service). The public can also view flood messages on the corporate website (trca.ca) and via Twitter. Starting in 2018, the public can also now self-subscribe to receive TRCA flood messages by email. If flooding is predicted, TRCA will issue a flood message that best describes the level of potential flood hazard. As new information becomes available during a flood, messages can be upgraded or downgraded. The following message types are issued by TRCA depending on the forecasted flood risk:

Normal Condition

A normal condition is defined as a general notice that no flooding conditions exist.

Watershed Conditions Statement – Water Safety Statement

This is issued when high flows, unsafe river banks, melting ice or other factors could be dangerous for recreational users such as anglers, canoeists, hikers, children and pets. Flooding is not expected.

Watershed Conditions Statement – Flood Outlook

This message provides early notice of the potential for flooding based on weather forecasts calling for heavy rain, snow melt, high winds or other conditions that could lead to high runoff, ice jams, lakeshore flooding or erosion.

Flood Watch

A Flood Watch is defined as a notice that flooding is possible in specific watercourses or municipalities. Municipal divisions, emergency services and individual land owners in flood prone areas should prepare.

Flood Warning

A Flood Warning is defined as a notice that flooding is imminent or already occurring in specific watercourses or municipalities. Municipalities and individuals should prepare to take action to respond including road closures and evacuations.

Lake Ontario Shoreline Hazard Warning

This message is issued when there is potential for high water levels and waves along the Lake Ontario shoreline (within TRCA's jurisdiction) that could lead to flooding and erosion. This type of message was in place during the period of high water levels in Lake Ontario in 2017.

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River Ice Forecasts (not a Flood Message Type)

As part of the Flood Forecasting and Warning Program TRCA's hydrometric technologists monitor ice conditions in various watercourses that historically have experienced ice jams. If conditions in ice cover and flows exist that could lead to potential ice jams, in combination with forecasted weather, the Flood Risk Management group will send a message to municipalities describing the risk.

A total of 35 messages were issued in 2017.

Real-Time Stream and Rain Gauge Network

TRCA has constructed an extensive network of real-time stream and rain gauges to provide the most up to date and accurate data to the Flood Forecasting and Warning Program. It is critical that FDO's have current water level and precipitation amounts when determining the potential or extent of flooding so that flood warning messages can be issued in a timely manner. These gauges have been strategically placed throughout TRCA's jurisdiction in locations with known flood risk. Stream gauges measure water level every 15 minutes and transmit the data back to TRCA. If predetermined water level thresholds are exceeded, Flood Risk Management staff receives an alarm through email and text. Alarm thresholds are set below flood stage to provide early warning that flooding is possible. To provide even greater lead time for potential flood events, TRCA has installed multiple real-time rain gauges. Precipitation amounts are measured every five minutes and if a threshold is exceeded, alarms are sent to Flood Risk Management staff.

TRCA owns and operates four large dams for flood control. Reservoir gauges have been installed because real-time monitoring of the reservoir levels is critical for dam operations and dam safety.

Attachment 1 maps the location of real-time stream and reservoir gauges. Attachment 2 maps the location of real-time rain gauges.

Number of Real-Time Stream Gauges and Rain Gauges by Region

Location	York Region	Peel Region	City of Toronto	Durham Region	Total
Stream Gauges	0	5	8	1	14
Rain Gauges	9	6	5	1	21
Reservoir Gauges	2	1	1	0	4

To further assist FDO's in flood prediction, TRCA has installed real-time cameras at two locations so flood conditions can easily be determined. TRCA will be installing four more cameras in 2018/2019.

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TRCA's Flood Forecasting and Warning Website

On August 19, 2005 extensive flooding occurred throughout TRCA's jurisdiction. During the post-event analysis it was determined that the FDO would have benefitted from a central website where all water level information could be displayed. The system at the time required the FDO to manually dial up each stream gauge to get water level data. This was time consuming and unreliable. In response, in 2006, TRCA developed the Flood Forecasting and Warning website (trcagauging.ca) where real-time data collected from stream, rain and reservoir gauges could be displayed automatically. Maps, graphs and tables were incorporated so that short and long-term trends could be easily interpreted. The site was also made available to the public.

In 2017, TRCA initiated a redevelopment of the website to meet current standards for security and accessibility as well as integrating a modern web design platform. The website redevelopment project was approved as Resolution #A36/17 at Authority Meeting #2/17, held on March 27, 2017. At time of approval, the Executive Committee directed staff to provide a demonstration of the website once completed.

The new website incorporates a number of features to enhance the FDO's ability to monitor the potential and extent of flooding. Some new features include:

- New user interface with interactive gauge station map with overlay toggle and "click for information" capability.
- Enhanced mobile device technology.
- Gauge icons depict trends and status through symbols and colours.
- User customizable dashboard displays.
- Clear alarm thresholds displays.
- Incorporation of dam safety codes depicting condition of dams.
- Consistent TRCA branding that matches TRCA's current corporate website.
- Custom reporting charts.
- Data Explorer tool to allow user to search for other available data sets.
- At a glance station cards for quick assessment of conditions.
- Watershed data summary in tabular views.
- Document Library for important reference materials and manuals such as Emergency Preparedness Plans.

DETAILS OF WORK TO BE DONE

TRCA will continue to develop the Flood Forecasting and Warning Program to increase flood prediction accuracy and public safety. Future projects include:

- TRCA has secured National Disaster Mitigation Program funding to add four new gauges to the real-time network.
- TRCA will be adding four new cameras to the Flood Forecasting and Warning website.
- A flood risk assessment project is underway for 46 flood vulnerable areas in the TRCA jurisdiction. This project looks to characterize the flood hazard for the two-year through 100-year and Regional storms at each flood vulnerable area and then determining the damages at each structure for each return-period storm. This study will also calculate the average annual damages that would be caused by riverine flooding at each flood vulnerable area. A GIS tool will be created to visualize the extent of flooding and a database for each effected structure at each storm event.
- Another flood risk assessment will be undertaken to evaluate flood risks on the Toronto Island to inform decisions for mitigation measures.

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- Currently underway is the project to create a new Decision Support System (DSS). The DSS will be a next-generation flood forecasting and warning platform that will allow for more informed decision-making for flood messaging, dam operations and advice to municipalities before, during and after major flood-related emergencies. It will provide flow forecasts for those rivers that have high flood risk within TRCA's jurisdiction by leveraging TRCA's hydrologic models and real-time gauging network, and incorporating new sources of meteorological forecast data.

FINANCIAL DETAILS

Funding for the Flood Forecasting and Warning Program is provided through operating accounts 115-60 and 115-62 for CFDO/FDO staffing, support staff and program maintenance. Stream gauges, rain gauges, website, data management and field support is funded through capital account 107-01. All accounts are funded by Peel Region, City of Toronto, York Region and Durham Region. The Ministry of Natural Resources and Forestry provides additional funding for 115-60.

Account	2018 Funding Totals
115-60	\$350,000
115-62	\$315,000
107-01	\$240,000
Total	\$905,000

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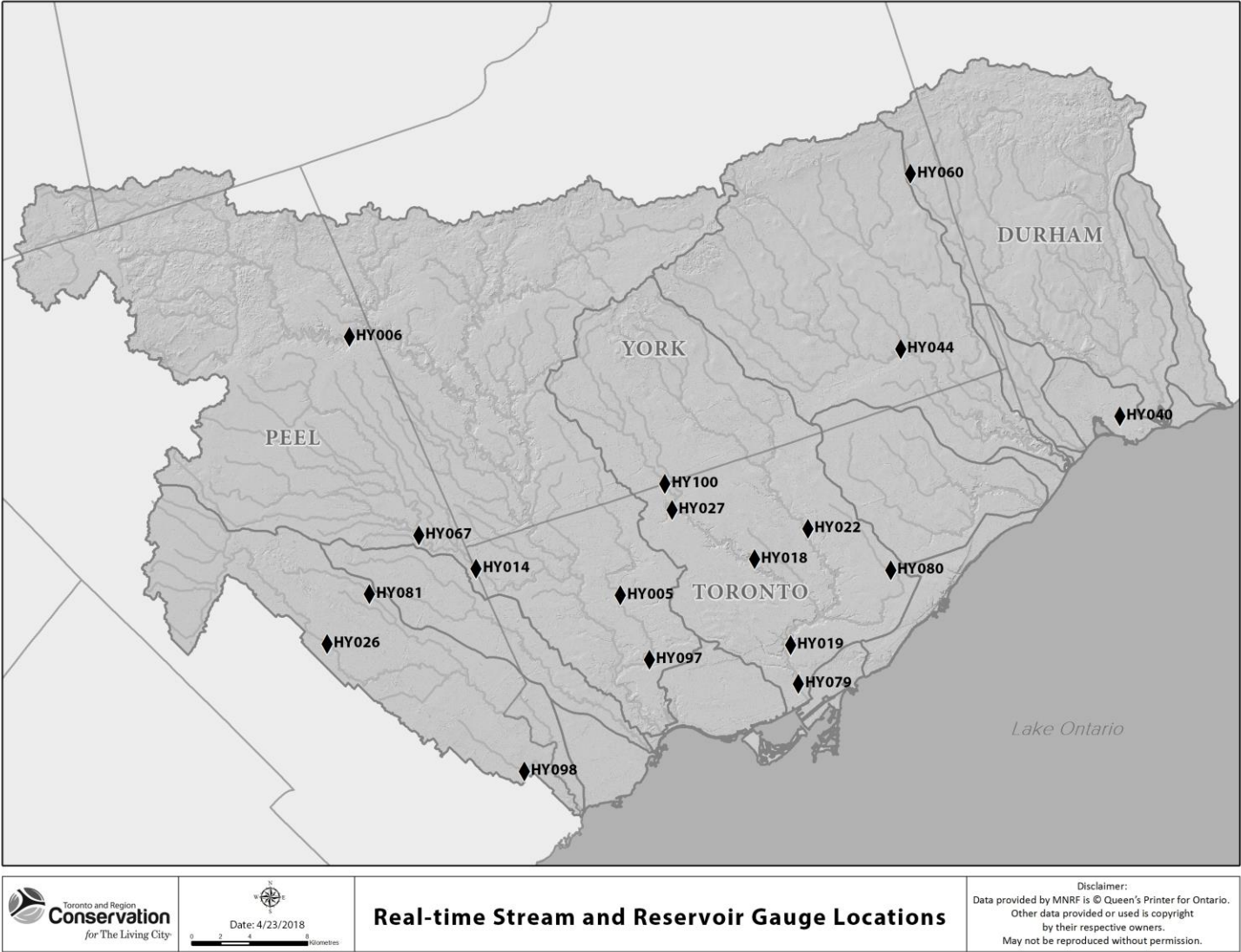
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Attachments: 2

Attachment 1



Attachment 2

