Floodplain Mapping for Lynde Creek Public Open House

CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

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Central Lake Ontario Conservation Authority

Funding Partners

Canada

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CLOCA retained AECOM to update the floodplain mapping for Lynde Creek: Why is floodplain mapping important?

- Floodplain mapping shows the extent of potential flooding across an area for significant storm events, such as the 100-year event (the 100 year storm event has an Annual Exceedance Probability of 1% i.e. a 1% chance of happening every year) or the Regional event (worst storm ever recorded - Hurricane Hazel)
- Once the extent of flooding is known, steps can be taken to
  - limit future development to ensure nothing is built within the floodplain
  - mitigate impacts where property is within the floodplain, and
  - re-examine development guidelines within the area

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Why was an update to floodplain mapping necessary?

- Previous floodplain mapping was completed in 2008
- A new hydraulic model was needed to determine accurate water levels along the creek
- Several changes within the watershed have been constructed since 2008, such as:
  - The addition of 17 new road crossings, including Highway 407 & Highway 412
  - Several changes to the Highway 401 profile and interchange configurations
  - Widening of Victoria St. and improvements to bridges and road embankments near the outlet into Lynde Marsh
  - Urban development has increased the impervious area within the watershed
- Future impacts due to climate change needed to be included

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The Study Area of Lynde Creek watershed

- Total drainage area of 130 km^2
- Located in the Town of Whitby, and extends into adjacent municipalities; Township of Scugog, Township of Uxbridge, City of Pickering, and the Town of Ajax
- Divided into five subwatersheds; Lynde Main, Heber Down, Kinsale, Ashburn, and Myrtle Station
- Within the watershed there are 79 culvert crossings and 36 bridge crossings
- Lynde Creek outlets into Lake Ontario

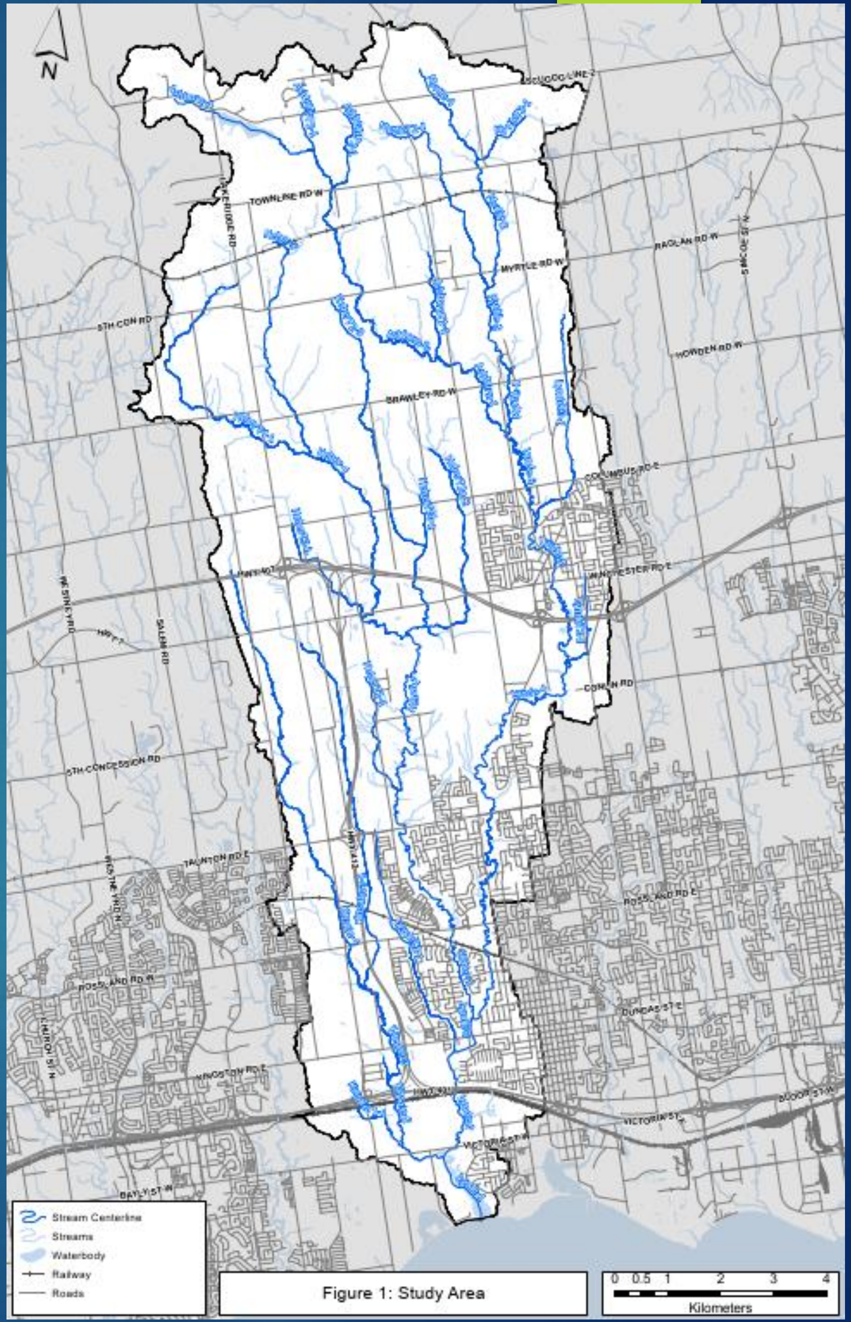

Figure 1: Study Area

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Hydrology Model: how does it work?

- A hydrology modelling software called Visual OTTHYMO (VO) uses rainfall data and catchment characteristics (such as area, % impervious and slope) to determine **peak flows** that would results from different storm events
- Lynde Creek is divided up into many catchment areas, and characteristics are summarized for each area and input into the model
- The runoff flows determined for each catchment are added together, routed along a watercourse or through ponds, as stormwater flows downstream
- For the 2-year to 100-year storms, flows are determined accounting for flow reduction from storage ponds within the watershed and assume normal soil moisture conditions
- For the Regional event, a worst-case analysis is run assuming that all of the storage ponds are full/not considered, and all the ground soils are saturated and not able to infiltrate any runoff, giving the highest possible runoff flows

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Hydraulic Model: how does it work?

- The hydraulic modelling software called HEC-RAS takes all the flows from the Hydrology model and runs them through watercourse cross-sections and structures (bridges/culverts) to determine what the highest **water levels** would be for each storm event
- Cross-sections are cut in regular intervals along each tributary of the watercourse. They contain the low point where the main channel flows, the banks sloping up and any adjacent area that may convey flow.
- Bridges and culverts, which convey flow beneath roads, highways and railways, are included in the model
- Based on the amount of flow, the cross-sectional area, as well as other parameters, the model determines the high-water levels, and other details like velocity, for every cross-section
- The extent of the high-water levels are connected from one cross-section to the next, based on topography, to create floodlines

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Hydrology Model Updates

- The hydrology model was updated to have a Regional flow that ran the Hurricane Hazel rainfall through the model without considering storage from ponds and assuming soils were saturated (worst-case scenario)
- Storm intensities for the 2-year to 100-year storms as well as Hurricane Hazel were increased to account for future impacts from climate change, based on recommendations from Environmental and Climate Change Canada (ECCC)
  - Recent precipitation trends indicate that rainstorms are getting worse, resulting in higher rainfall volumes, higher intensities and more runoff
  - A 100-year storm represents a storm event that has an Annual Exceedance Probability of 1% i.e. a 1% chance of happening every year
  - As stormwater engineers design bridges, culverts, overland flow routes and sewers to convey specific design flows based in these statistics, rainfall data must now be increased to account for future climate change impacts

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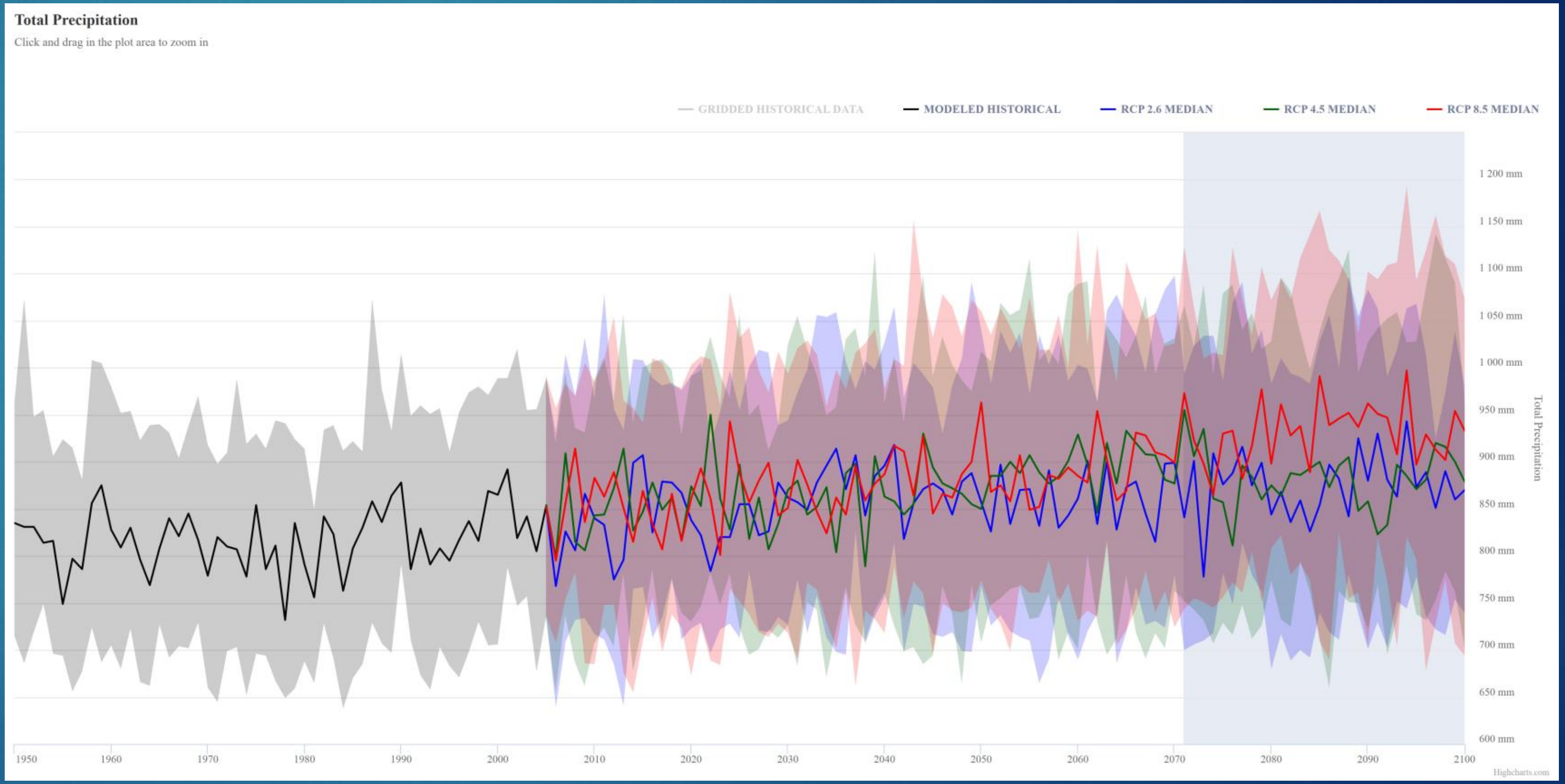
How are climate change impacts to precipitation determined?

- Future precipitation is estimated based on a variety of models referencing historical data, recent trends and future estimations. More information can be found at climate.ca
- Future rainfall estimates for Whitby, Ontario



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Hydrology Model Results

- The model results in increased flows are compared to the 2008 model used in the floodplain mapping as a result of:
  - removal of storage elements (i.e. stormwater ponds)
  - an increase in land cover coefficients.
  - A revised climate change storm event

- Regional results show a 3 – 15% increase in flows as compared to the 2008 floodplain mapping
- Climate change results show a 3 – 13% increase in flows as compared to the 2008 floodplain mapping

- Climate change results show a 20 – 25% increase in Regional flows

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Hydraulic Modelling Updates

- A new HEC-RAS model was set up referencing many data sources from CLOCA, different government databases, drawings, surveys and site observations
- Flows were added based on the latest hydrology model output from the 2022 Master Drainage Plan Update
- 1,847 Cross-sections were cut along 45 reaches, based on 2018 LiDAR data (topographic mapping representing the ground surface)
- Downstream cross-sections were updated with a low flow channel based on field observations, which would not be captured by LiDAR
- A total of 104 structures were added based on LiDAR data, drawings and site observations
- Additional details such as roughness values, boundary conditions and ineffective flow areas were included in the model

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Hydraulic Model Inputs

LiDAR mapping showing topographic elevations in a colour gradient

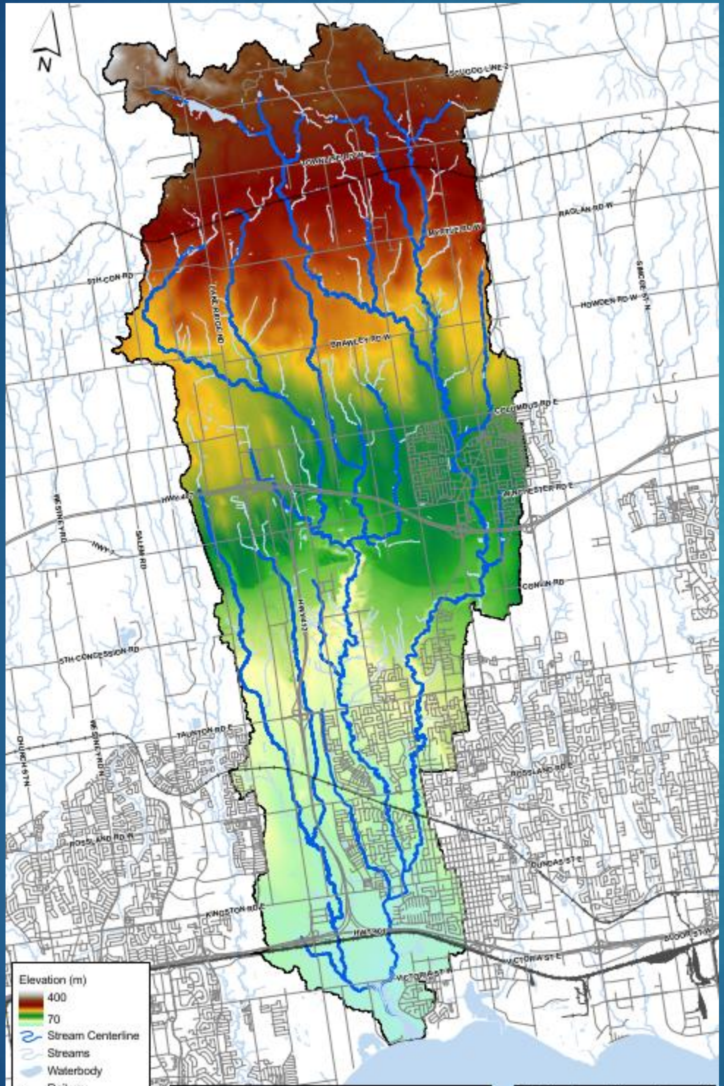

Figure 5: Topography of Lynde Creek

Locations of hydraulic structures included in the model; bridges and culverts

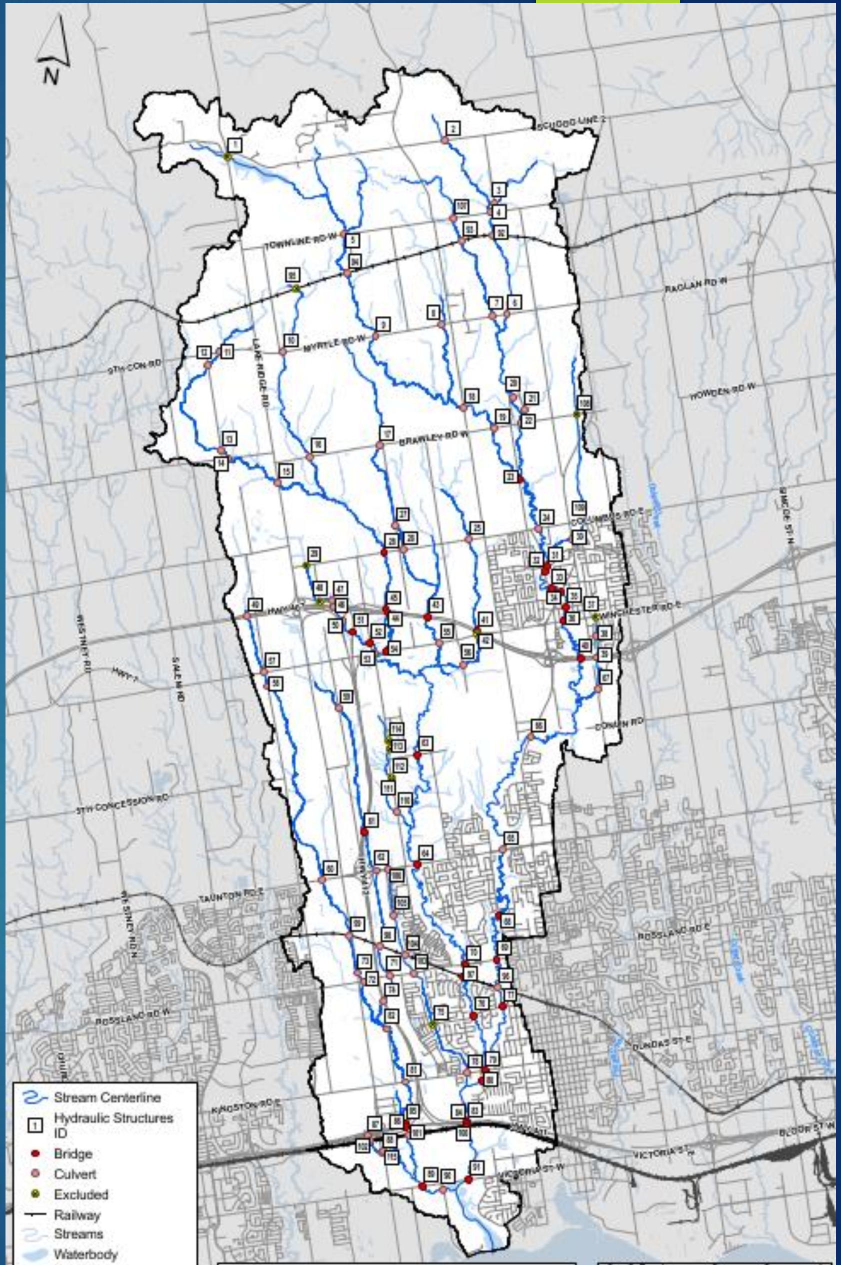

Figure 6: Location of Hydraulic Structures

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Hydraulic Model Inputs

- Flow change locations are shown, referencing output from the updated hydrology modelling
- Flows input at a certain cross-section location are applied to all cross-sections downstream until the next flow change location

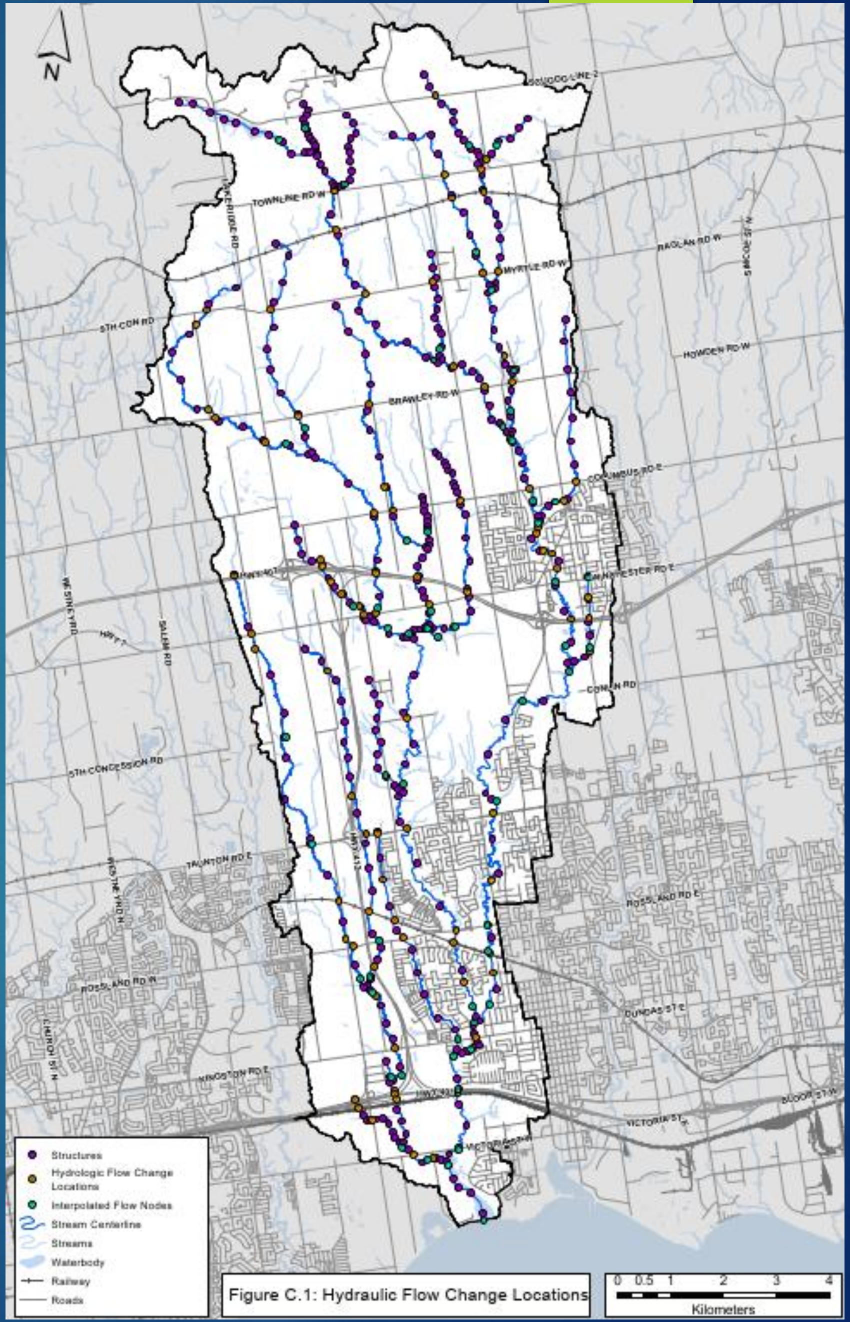

Figure C.1: Hydraulic Flow Change Locations

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Hydraulic Model Results

- The stream discharge at the reaches of Lynde Creek increased for the Regional Event by approximately 35 cms to 90 cms due to increased flows from the hydrologic model
- There are several hydraulic control points that are governed by hydraulic structures throughout the system. These control points are particularly important near major highways.
  - Overtopping occurred at 28 structures during a 25-year storm
  - 39 more overtopped during a 100-year and/or Regional storm
- Relevant hydraulic structures that were overtopped by the Regional flood event are located at:
  - Three locations each at Townline Road West, Myrtle Road West, Brawley Road West, Columbus Road West, Winchester Road West (Highway 7), Rossland Road West, Dundas Street West, Highway 401 and Railway Line south of Townline Road.
  - Two locations each at Baldwin Street North, Way Street, Coronation Road, Cochrane Street, Halls Road North, Victoria Street West and Railway Line south of Highway 401.
  - One location each at Scugog Line 2, Bryant Side Road, 8th Concession Road, 9th Concession Road, Ashburn Road, Calistoga Drive, Cedarbrook Trail, Country Lane, Carnwith Drive West, Cassels Road East, Winchester Road East, Audley Road, Taunton Road East, Taunton Road West, Lyndebrook Road, Baldwin Street South, St. Thomas Street, Lake Ridge Road North, Bonacord Avenue, Jeffery Street, Eastbourne Beach Road, Columbus Road East and CPKC Railway Line south of Rossland Road West.

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Floodplain Mapping

- In 11 locations, water levels get so high during large storms that they spill beyond the model cross-section, as they are not able to be contained by the creek
- Spill locations include: west of Winchester Road West and Country Lane intersection, west of Lake Ridge Road, east of Highway 412 and Highway 401 interchange, at the intersection of Dundas Street West and Halls Road North, between Dundas Street West and McQuay Boulevard, north of Dundas Street West adjacent to Halls Road North, at the intersection of CPKC and Des Newman Boulevard, north of Myrtle Road West, east of Ashburn Road and Railway Line intersection, north of Highway 401 and west of Halls Road North.
- Because of the increase in discharge, floodplain boundaries around Michael Boulevard are larger than previous hydraulic models for the Regional Event. For other flood events, the floodplain boundaries remain similar to previous results at other locations of Lynde Creek and tributaries.

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Floodline Comparison

- The updated floodplain maps are similar to the previous maps in some locations, and quite different in others. The reasons for the discrepancies are:
  - LiDAR data used for the new hydraulic model cross-sections provides a much more accurate ground surface than what was available in 2008
  - New structures were added to the model to represent new bridges and crossings, and existing roads and structures were updated
  - Higher flows due to climate change
  - Lake Ontario was set at a constant elevation of 74.31 m, which in combination with flows control the lower floodplain boundaries of Lynde Creek.
- Floodlines along the entire Lynde Creek can be seen on the Upper, Middle and Lower Floodline Figures.

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