

International Symposium on Flood Defence (ISFD4) May 7,2008

Storm of August 19, 2005, a Catalyst for Change from Reactive to Adaptive Urban Flood Management in Toronto, Ontario, Canada

Presented by: Donald Haley

Authors: Laurian Farrell, Donald Haley, Toronto Conservation Michael D'Andrea, Bill Snodgrass, City of Toronto











The Storm of August 19, 2005



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Radar Image from King City Station - 1 Hour Corrected Total Depths (mm)



The afternoon storm cell passed through jurisdiction over a 4 hour period between 2:00 PM and 6:00 PM

• The most intense rainfall generally occurred in the afternoon between 3:00 PM and 5:00 PM

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Storm Event Information

Recorded Daily Rainfall Depths at Available Gauges for August 19th





Storm Event Information

Maximum Hourly Rainfall Intensity Recorded Available Gauges on August 19th



• Minimum measured hourly intensity approximately 6 mm/hr at Goodwood Pumping Station

•Maximum measured hourly rainfall intensity approximately 99 mm/hr at TRCA -York Green Roof

Rain Gauge IDF and Total Depths Analyzed

Historic Rain Gauge IDF and Depth Statistics



Storm Event Information

Rainfall IDF Curves - Comparison at Several Rain Gauges

Rainfall Depths - Comparison at Several Rain Gauge Locations for August 19th Storm



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Storm Event Information

- Rainfalls along the storm path exceeded the 2-100-year return period intensities at the historic City of Toronto rain gauge. (IDF used for infrastructure design)
- In addition, the storm event exceeded the 24 hour 100-year return period depth at City of Toronto rain gauge.

Flood Control Infrastructure

 Existing flood protection infrastructure functioned well, but was taxed to its design limits in some instances



Highland Creek Flood Channel (at design capacity-100 year)

Impacts from the storm on Existing Flood Infrastructure



West Don River at G. Ross Lord Dam and Reservoir – Looking East at Outlet Structure and Reservoir Flood Depths increased by over 7 m (highest operational levels recorded)



Impacts from the storm on Existing Flood Infrastructure



Black Creek flood channel (at 90 % design Capacity)

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George Kourouni

Impacts from River Flooding Steeles Avenue at West Don River





DVP Flooding **Don River**

Highland Creek

Highland Creek overtopping of Bellamy Road

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Finch Avenue



Res Charles

Stream Erosion

 80 sites identified within the City of Toronto, 40 of which were considered as major, impacting public infrastructure or private residences. To date close to 10 million dollars have been spent.

 Impacts ranged from minor fence damage to complete reaches of stream bank collapse, affecting flood protection works, parks facilities and municipal infrastructure.



Erosion Impacts from the storm





Highland Creek at Ellesmere and Birkdale Road –Note Extensive Bank Erosion (+/- 7m of back yard lost)

> East Don River at York Mills and Don Mills – Note Damage to Concrete Channel Lining



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Erosion Impacts from the storm Highland Creek Trunk Sanitary Sewer Collapse

 A large section of sanitary trunk sewer was exposed and a section collapsed as the Creek flooded and changed course.

• The collapse of the trunk sewer was recognized when debris began showing up in the treatment plant.

 some flooding also occurred in the plant.





Highland Creek Pre-Flood





Post Flood







Surface Flooding

Rainfall intensities exceeded the design capacity of minor drainage systems, resulting in surcharging.

Most interchanges along path of storm experienced flooding.





Surface Flooding Impacts





Basement Flooding

Basement flooding was concentrated within developed areas which pre-dated a major – minor drainage design standard. A number of factors contributed;

- Sanitary Sewer and storm Sewer backup(Flooded streets)
 Blocked sewer drains and local drainage problems
- Surface flooding (both overland and street)
 Poor lot grading, Window wells, reverse slope driveways and clogged drain pipes

Basement Flooding Locations





Basement Flooding





- 4,200 complaints received by Toronto Water
- Majority of complaints from North York area where storm was concentrated

Flooding Summary

 Flooded interchanges and underpasses across the north end of the City;

•Flash floods along small urban creeks, rivers and ravines;

•Watercourse erosion;

•Damage to public and private infrastructure and property; and,

 4,200 basements flooded due to sanitary sewer surcharging and overland flow.

- The impacts of the August 19,2005 storm served to identify the deficiencies of previous urban flood management approaches and,
- •The recognition that with Climate Change these types of storms are and will continue to increase in frequency has led to a need to modify how we deal with managing urban flooding impacts within the TRCA and the City of Toronto.



Key amongst being able to adapt will be to understand the risk that urban flooding creates for critical infrastructure.

e.g.: critical urban infrastructure within roadways and in river valleys.





Defining an approach to design projects which can allow for an adaptive design to deal with both the impacts from this event and also for future flooding.

e.g.: River reach based designs, new science/approaches and monitoring of projects to determine how and what works





Review design standards and planning standards related to drainage design and begin to adopt new design standards To minimize future flood risk. Such as;

- enhanced source controls for urban runoff,
- installation of back flow preventers in older subdivisions
 creation of overflow diversion routes in older subdivisions
- isolate sanitary sewers from surcharged roadways
- eliminate any continued development with reverse grade driveways



Undertake all of the above and other activities in a watershed or sub-watershed / sewershed context to allow for the understanding of changes on a system basis.

Adaptive design to account for Climate Change



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Questions?







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About Conservation Authorities:

- •1946 by an Act of the Provincial Legislature
- Conservation
- restoration
- management



Objectives of Conservation Authorities

>ensure that Ontario's rivers, lakes and streams are properly safeguarded, managed and restored;

Protect, manage and restore Ontario's woodlands, wetlands and natural habitat;

develop and maintain programs that will protect life and property from natural hazards such as flooding and erosion;

Provide opportunities for the public to enjoy, learn from and respect Ontario's natural environment.



Under the objective to develop and maintain programs that protect life and property from natural hazards such as flooding and erosion;

Conservation Authorities work in partnership with municipalities to protect life and property through the development of programs that minimize or prevent the impact of disasters such as flooding and erosion..



 On Friday afternoon, August 19, 2005, one of the most severe rain storms on record occurred over the northern portions of the City of Toronto.



 The intensity and amounts of rainfall resulted in some of the most significant flooding and erosion experienced in twenty years including the worst urban flooding ever experienced in Toronto.

•The resultant flooding impacts of this storm also identified a need for the City and TRCA to review their current management process's and begin to creat a new adaptive approach's to flood management for urban infrastructure.