



AHEAD OF THE STORM: Extreme Weather Resilience in the City of Toronto

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Environmental Applied
Science and Management
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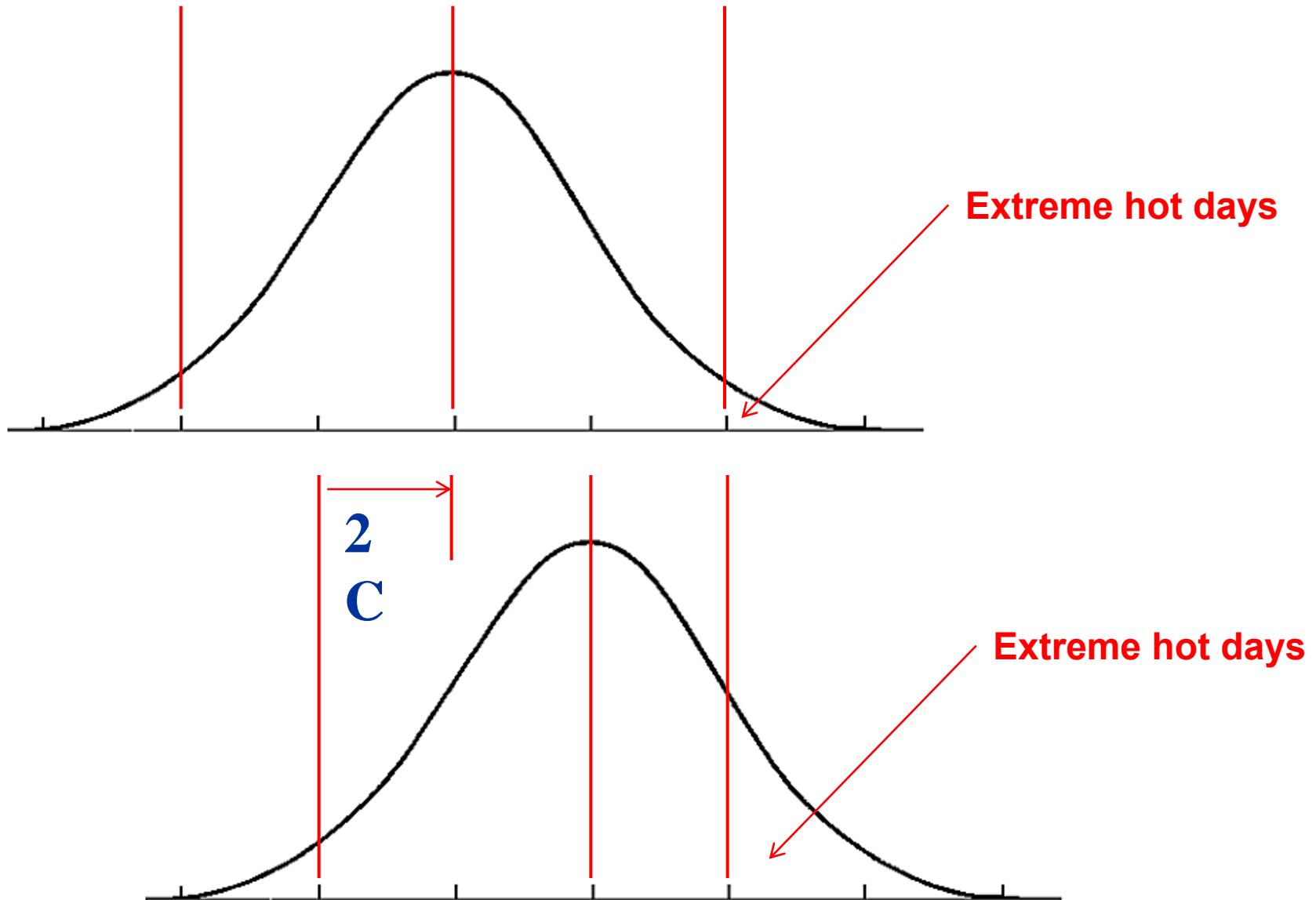




A photograph of a steep, dark, eroded bank, likely composed of volcanic ash or sand. The bank shows signs of erosion with vertical rills and a rough, textured surface. At the top of the bank is a dense forest of tall, thin evergreen trees. The foreground is a flat, sandy area with sparse, low-lying vegetation and some fallen branches. A red arrow with a black outline points from the top right towards the eroded bank. Inside the arrow, the text "Life on the edge!" is written in white, bold, sans-serif font.

Life on the edge!

Climate shift

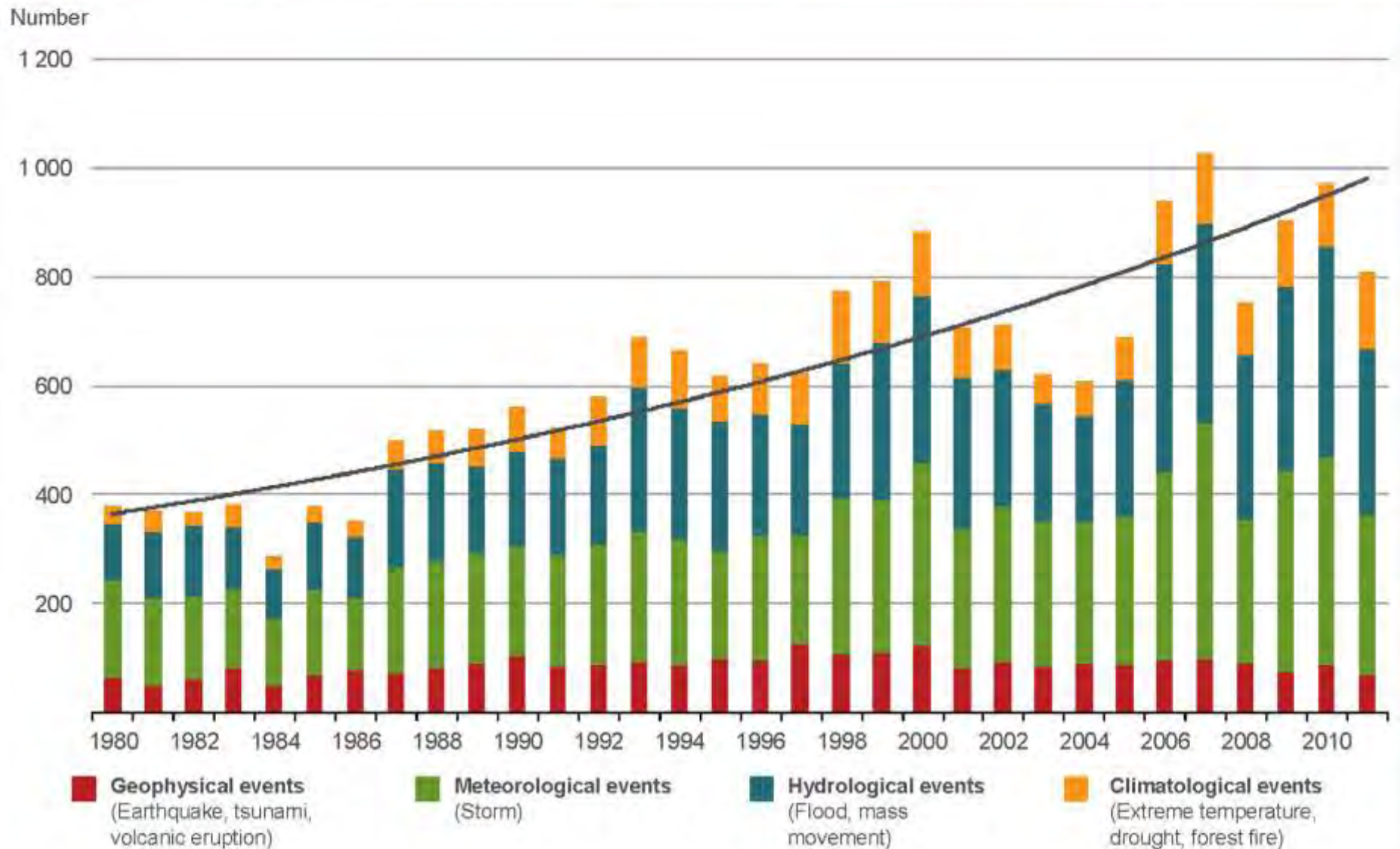


Canadian catastrophes



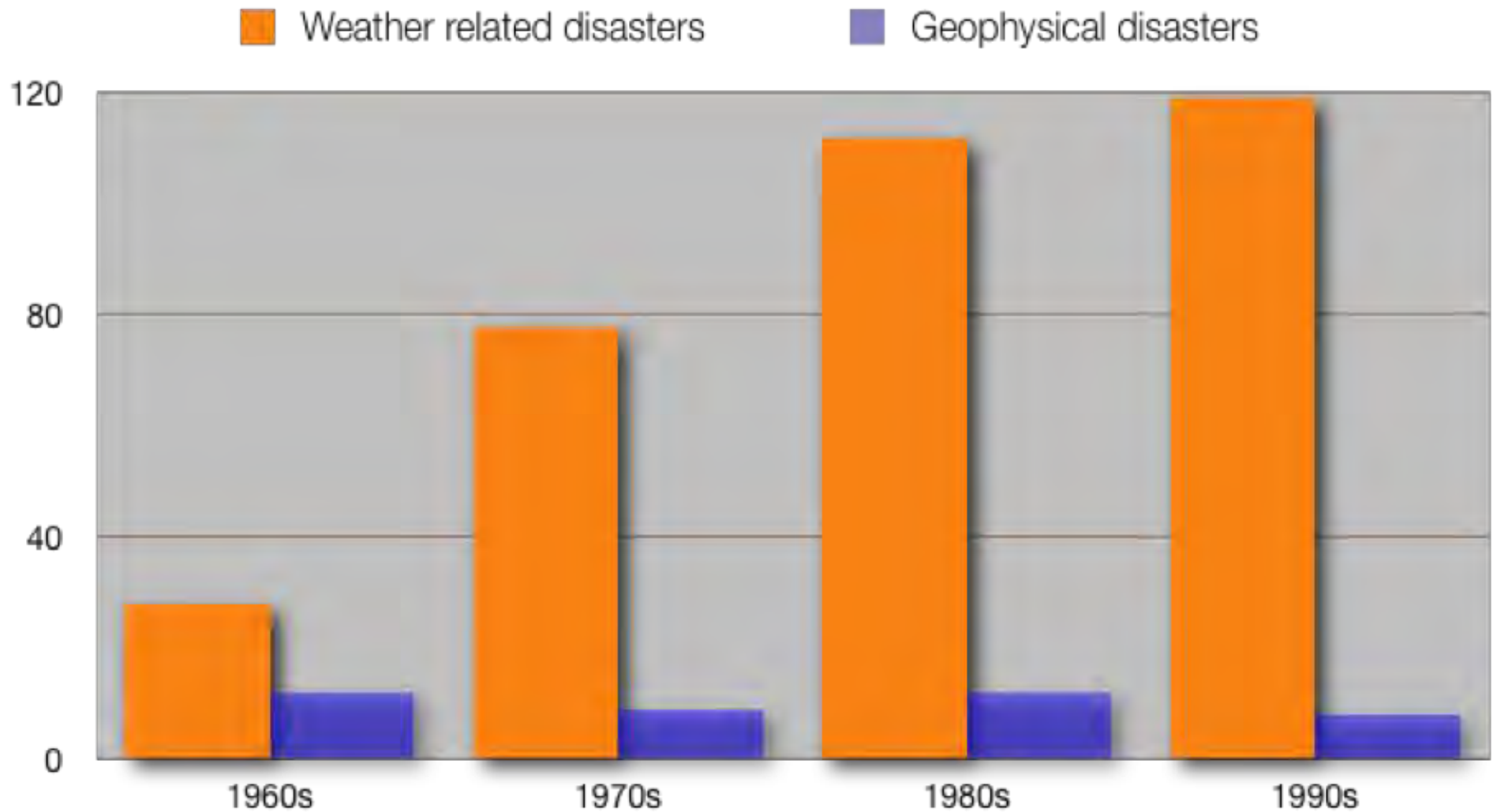
Natural catastrophes worldwide 1980 – 2011

Number of events with trend



Canadian disaster damage

Number of events



Recent Canadian cats

- Ice Storm (January 1998)
- **\$2 billion (2005 dollars)**
- Slave Lake wildfire
- **\$700 million**
- “Freaky Friday” GTA rainstorm (August 19, 2005)
- **\$590 million**
- Calgary area windstorm (July 2009)
- **\$500 million**
- Calgary hailstorm (July 2010)
- **>\$400 million**
- B.C. wildfires (Summer 2003)
- **\$200 million**
- Edmonton floods (July 2004)
- **\$170 million**
- Hurricane Juan (September 2003)
- **\$115 million**

Model: 2040 in GTA » Changes in Precip.

Snowfall & Rainfall

- Less Snow & More Rain -- in Winter
- More Rain in July (80%) & August (50%)

Extreme Daily Rainfall > 25 mm

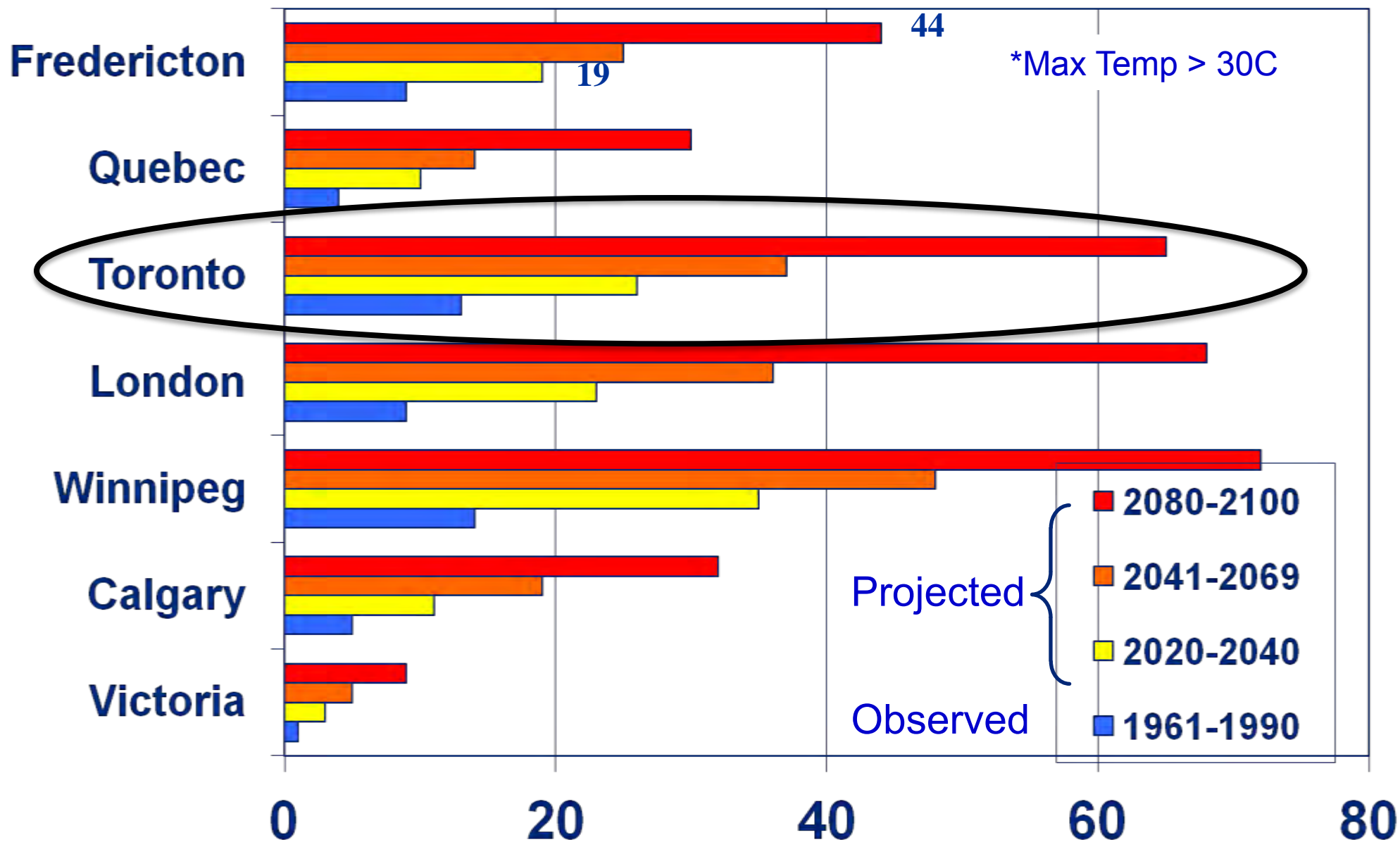
- Same Number of Storms in Summer
BUT - Much More Intense Storms !!

Model: 2040

Warmer Temps

- *Average annual temp increase by 4.4°C*
- **Average winter temp. increases by 5.7°C**
- **Average summer temp. increases by 3.8°C**
- **Extreme daily min. temp becomes less cold by 13°C**
- **Extreme daily max. temp becomes warmer by 7.6°C**

Number of hot days* rising





TORONTO DAILY STAR
Toronto Area

FEAR 30 DIE 300 MISSING

CITY BANS ALL TRAFFIC FROM WEST

See Dead in
Yard, That Is in
Flood, Has Frozen Lost
Place Damage in Millions

Lake That Was
Holland

BANS
See Dead in
Hudson Toll is to be
\$100,000 Firemen Lost
Place Damage in Millions

TRAFFIC FROM WEST
Like That Was Holland March



RELIEF FUND NEAR \$1,000,000
MARSH MAY GIVE UP 25 BODIES

TORONTO DAILY STAR

METRO EDITION

HEARTS ARE TOUCHED AND OFFERS FROM WHOLE NATION

ALL HEARTS ARE TOUCHED
CASH GOODS AND OFFERS
COME FROM WHOLE NATION

2. JOURNAL
DE
LA
SOCIÉTÉ
DE
MÉTÉOROLOGIE



AT ONTARIO HURRICANE RELIEF FUND
TORONTO DAILY STAR

KNOWN DEAD:

78

**ATTINSON FUND GIFT
FOR FLOOD IS \$250,000**

DISASTER AID POURS IN

DISAS
1000 Van Ness
Apt. 2000
San Francisco, CA 94109



The Globe and Sun

High Europe Union
To Cut Born Arms

800-Man Army Operation
To Seek 16 Humber Bodies

Franklin, MA



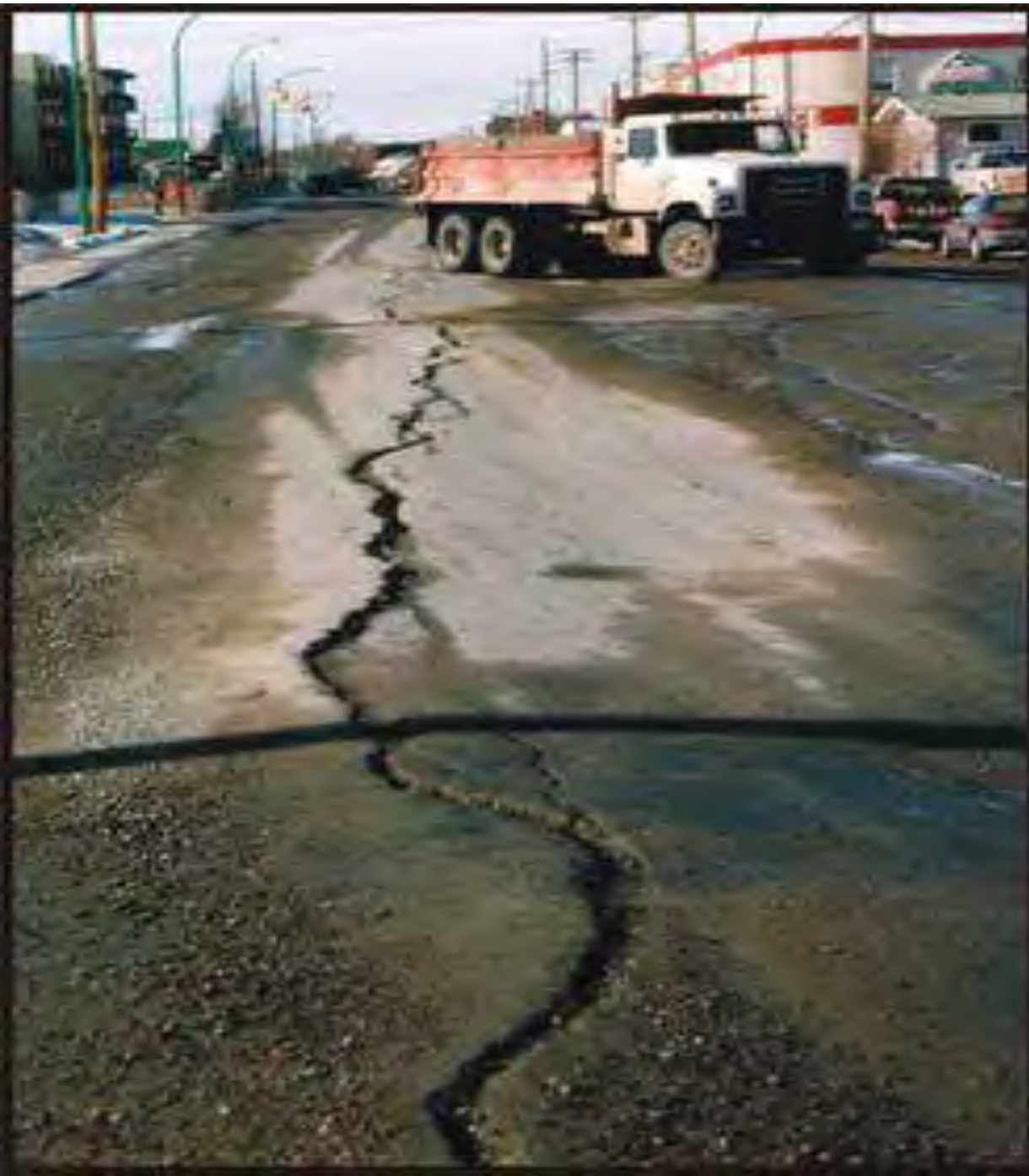
Vaughan, Ont. tornadoes

August 20, 2009

Two F-2s



Damage to infrastructure



Health risks



Vulnerable populations



Impacts on natural systems

















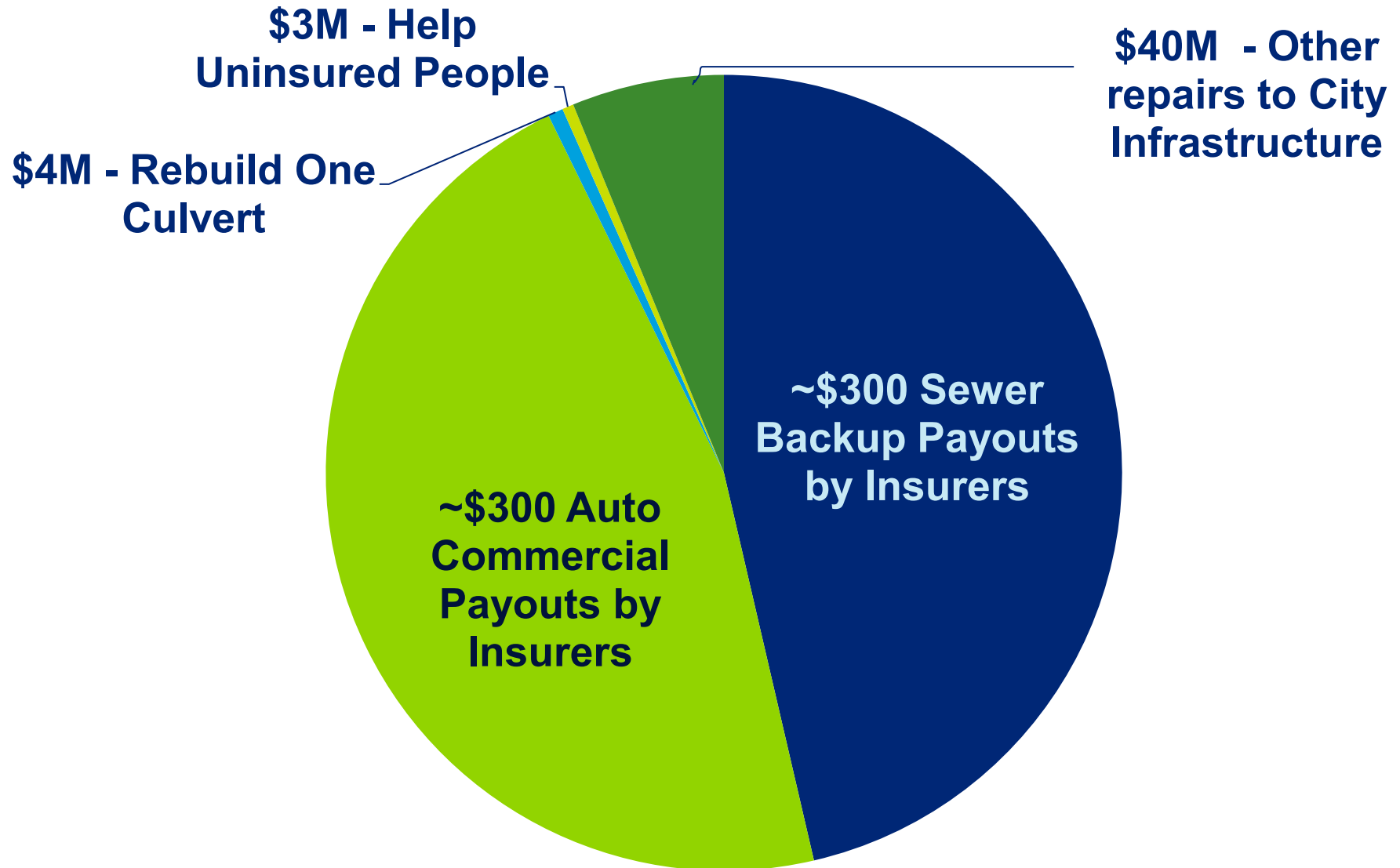
Photos courtesy
Jane-Finch.com





2006 7 27

Toronto: August 2005 Storm



TOTAL
\$647 Million



We are not alone



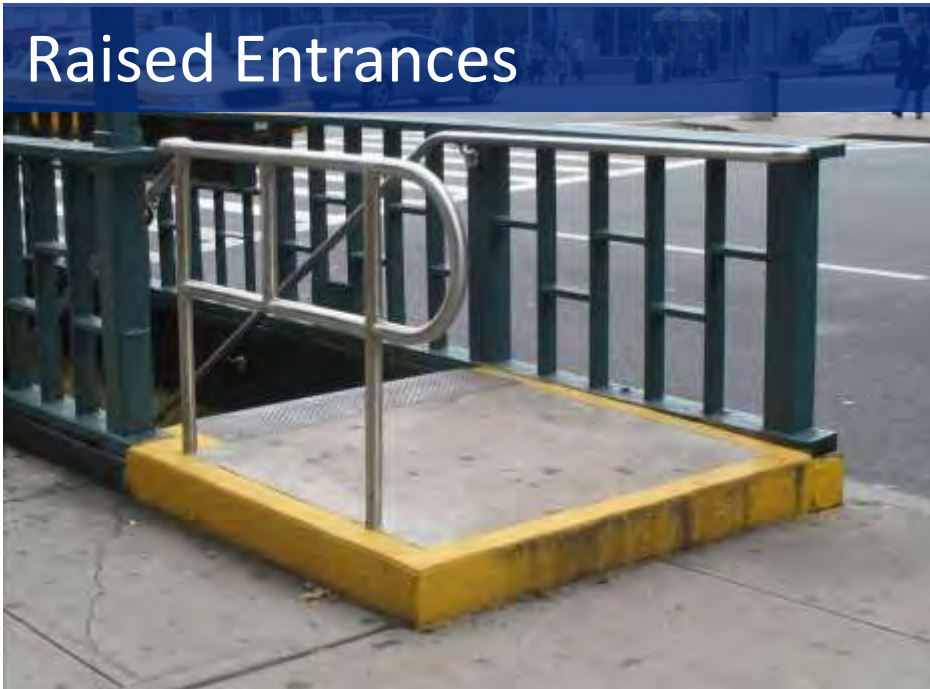
Toronto, 2005 - \$647 Million
Calgary, 2005 - \$300 Million
Edmonton, 2004 - \$166 Million
Peterborough, 2004 - \$87.3 Million

New York City

Raised Ventilation Grates



Raised Entrances



Toronto is Taking Action on Adaptation



Climate Change Risk Assessment

Process & Tool developed (Deloitte)

2 Pilots completed:

Roads dept. & Shelter / Support

Roads dept.  **\$12.1 B** replacement value

- 2** time periods: now & 2040
- 7** extreme weather types
- 90** critical asset & service classes
- 15** workshops
- 1700** risk scenarios





PART NO. 100-00000
Control Cabinet
PEEK
SERIAL NO. 100-00000
100-00000-000
100-00000-000
100-00000-000
100-00000-000

CAUTION
DANGEROUS VOLTAGE
OR ADJUSTMENTS
FOR PROPER AND
MAINTENANCE IS
NECESSARY FOR
PROCEEDURES
THIS EQUIPMENT
IS NOT TO BE
TAMPERED WITH
OR REPAIRED
WITHOUT THE
ASSISTANCE OF
A QUALIFIED
TECHNICIAN

NOTE
THIS CABINET IS
NOT A STAND-
ALONE UNIT
AND MUST BE
INSTALLED
IN ACCORDANCE
WITH THE
INSTALLATION
MANUAL
WARNING
VOLATILE
SUBSTANCES
WILL NOT
TRANSFER
THEREFORE
SHOULD BE
TO AVOID
BURNING

PEEK
A Buss Company

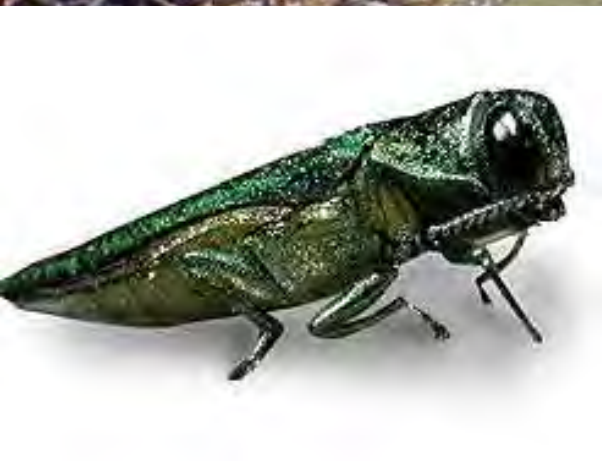
60 Hz REF

CABINET
POWER

24 VDC

POWER

QUELLEY











1889



Increasing the tree canopy

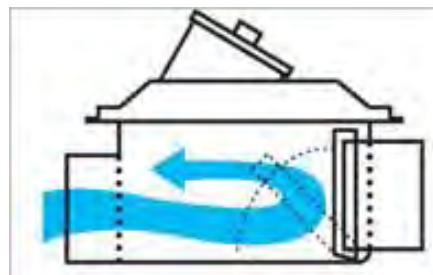
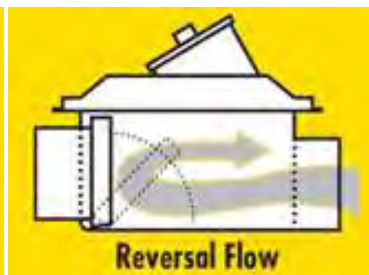
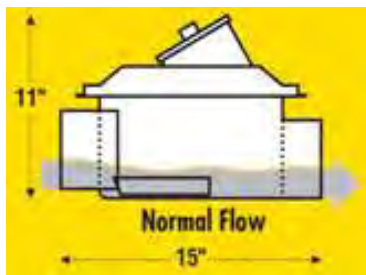


Residential flood protection



Lot grading

Sewer backflow valve



Green roofs



New collaboration: WeatherWise Partnership



WeatherWise Partnership

60 Membership Organizations

- Insurance, Banking, Telecom, Transportation, Electrical, Real estate, Water, 3 levels of gov't

Purpose

- ID & manage risks due to extreme weather in Toronto region

Focus for 2012

- Regional electrical power system risk assessment

City's Adaptation Responsibilities

- Air Conditioning Peaks & Blackouts **Toronto Hydro**
- Storms & Urban Flooding **Toronto Water**
- Culverts & City Roads **Toronto Transportation**
- Gardens & Trees **Toronto Parks & Recreation**
- Storms **Toronto Region Conservation Authority**
- People in Need **Shelter, Support & Housing**
- Street Ventilation (re Smog etc) **City Planning**

Adaptation Opportunities

- Weather insurance products
- Investment risk analysis
- Infrastructure design
- Construction and rehab
- Water quality & quantity
- Risk management
- Climate Information

**Insurance
Banking**

Engineers

Construction

Water Tech Companies

Legal & Consulting firms

Scientists

Conclusions

- Our **Future Weather Will Be Different** with an increase in extreme weather events
- Greenhouse gas reduction actions are essential
- We Must **Continue to Adapt** to the Changes
- There are local & international opportunities for those with solutions

Thank you

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www.toronto.ca/teo/adaptation

