CLIMATE CHANGE

IMPACTS ON INFRASTRUCTURE & WATER MANAGEMENT

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Presentation Overview

• Climate Change Effects
• Impacts From Recent Extreme Events
• Adaptive Management:
  – Sewer Design
  – Water Quality Improvement Project Designs
  – Drinking Water Quality
  – Water Supply Issues
• Conclusions
Climate Change Effects

• Confidence in ability to forecast global warming trends/projections on air temperature.

• Less certain about effects on precipitation.

• Increased open water evaporation expected as a result of warmer water temperatures: likely to affect future lake levels.

Climate Change Effects (cont’d)

• Evidence suggests that intensity of rainfall events may increase, as a result of increases in “precipitable water” content of the atmosphere:
  - increased flooding risks
  - increased stream erosion

• Evidence leading to suggest substantial changes in seasonal distribution of flows and extremes:
  - high and low flow conditions
  - greater winter runoff
  - reduced summer flows
Our we seeing effects of Climate Change?

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- 7 extreme events over 20 year period
- storm return frequencies > 25 years
- severe flooding: surface and basement
- works designed and implemented for a given storm condition - insufficient for larger/subsequent event
- public confidence?

Impacts of August 19, 2005 Storm

- 2-3 hour storm
- exceeded 1 in 100 year storm in north part of the City
  - Highway 401 to Steeles Avenue corridor
- City of Toronto rain gauge station recorded 153 millimetres
Rain Gauge Data
(August 19, 2005)

Rainfall Comparison

Design May-00 Aug-05

Rainfall (max 3 hr mm)
Damage Summary

- Flash floods of creeks, rivers and ravines
- Overflowed stream banks
- Watercourse bank erosion
- Damage to public and private infrastructure and property
- Sewer Backups

Flooding Damage
Flooding Damage

Flooding Damage

Flooding Damage
Basement Flooding

- Over 2,000 complaints & climbing
- Over 3,000 complaints in May 2000

Basement Flooding Locations
(August 2005)
• Damage ranges from fence damage to stream bank collapse

Stream Erosion

• Over 140 sites (Toronto Water, Parks & TRCA) being investigated to prioritize repairs
Exposed Trunk Sanitary Sewer

Road Infrastructure Damage
“Adaptive Management”
Design Standards?

- Municipal Operations: service delivery focus
- Adapt:
  - change design thresholds?
  - change/alter service delivery expectations?
  - reduce M to sanitary sewer systems to the degree practical
  - joint responsibility (e.g. homeowner - lot grading)
- Considerations in implementing changes:
  - increase sizing of storm sewers for minor system design?
  - what about areas without a major system design?
- Rebuild systems & if so, when & how?

Reality Check: Budget Forecast

![Budget Forecast Chart]

- Underground Infrastructure
- Water Efficiency Program
- Water Meter Program
- Wet Weather Flow Management
- Environmental Protection
- Basements Flooding Relief
- Plants & Facilities
- Water Loss Reduction Strategy
- York Region Cost Sharing
- Biosolids Management

$ Millions

- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
Water Quality Impacts

Comined Sewer System
Wet Weather Flow Management Facilities

WESTERN BEACHES STORAGE TUNNEL

- 4 km, 3 metre diameter tunnel - 50 metres deep
- 7 shafts intercept flow from existing system
- 3 - 30 metre diameter storage/interception shafts
- 85,000 cubic metres of total storage
- $52 million

Design Standards?

- MOE - Procedure F-5-5: “typical year” based analysis
- 1-2 combined sewer overflows permitted if impacting beach areas
- Questions:
  - does “typical year” need to be reviewed and adjusted over time?
  - is current sizing appropriate - given expected drier summers with “extreme” storms?
  - “reality check” & reduce expectations?
Water Treatment Plants
(Taste & Odour Issues)

Compounding problems:
- warmer lake temperatures
- increased water clarity along Great Lakes nearshore
- nutrient enrichment

Design Considerations:
- deeper intakes
- improve treatment processes
- O&M considerations

Daily Water Consumption

[Graph showing daily water consumption and monthly averages]
**Water Supply Considerations**

**Warmer & Drier Summer Impacts on Supply:**

- Groundwater serviced systems may be impacted: move towards servicing by lake based systems

- Increased demand for outdoor water use eg. lawn watering & irrigation:
  - build larger infrastructure?
  - reduce demand: public education, promote xeriscaping, seasonal pricing strategies?

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**Conclusions**

- Climatological changes are observed

- Municipal infrastructure and corresponding service delivery is being impacted by more frequent extreme events

- Public/political expectations are high

- More collaboration required among affected agencies
Conclusions (cont’d)

- Joint responsibility: public also assuming some responsibility and affecting change
- Adaptive management strategy advocated
- Standard design practices based on historical climate records - need to review based on projected new “norms”

Conclusions (cont’d)

- Need to establish service delivery targets & corresponding design standards
- Modify existing infrastructure - rather than build new
- Social/economic standpoint:
  *assess the cost of adapting versus the losses that can be expected if we don’t!*
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Basement Flooding Locations

[Map of Toronto showing basement flooding locations]
Basement Flooding Sources

- Sanitary Sewer
  - Sewer backup
  - Blocked sewer drains
  - Local drainage problems resulting in high flows in foundation drains
- Surface flooding
  - Poor lot grading
  - Window wells
  - Reverse slope driveways
  - Clogged drain pipes