Sewers that Don’t Stand the Test of Time: a Canadian Problem
ICLR Friday Forum, October 9, 2020

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Norton’s Experience

- 30 years in Engineering, specifically dealing with clean water in sewers.
- Hands on experience in the field.
- Chair of new CSA Guideline on Basement Flood Protection and Risk Reduction.
- Contributor to most Basement Flood Reduction documents in Canada
- CBC Radio 1 Infrastructure columnist across Ontario.
Overview: Leaking Sewers

- Introduction
- Costs & risks
- What exactly is the problem
- What solutions/best practices have been proposed
- Uptake & next steps

Lots and lots of extra water in sewers. Seems legit.
Leaking Sewers are Pretty Simple

“Inflow” and “Infiltration” (I/I)

(The only difference is how we find and fix them)
New Sewers are Not Being Delivered to Municipalities in a Leak-Acceptable Condition

- Data collected since 2005 shows that new sewers show excessive leakage at inception, often more than the long-term allowable amount
- The engineering, building and development industries were unaware of this
- Leaking occurs in both public and private side sewers
- We know sewers are leaking through visual evidence, wastewater or pumping station data, in-sewer flow monitoring, or flooding
Direct, Measurable COSTS of New Sewers Badly Leaking

<table>
<thead>
<tr>
<th>Typical Growing GTA Municipality Treatment Costs of Leaking New Sewers</th>
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<tbody>
<tr>
<td>Projected New Homes in Any GTA Municipality to 2041</td>
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<tr>
<td>Leakage as Measured in new subdivisions in Ontario</td>
</tr>
<tr>
<td>Total Cost of Base Leakage (just one Municipality!)</td>
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Chronology of this Body of Work

• The first new subdivision that was **leaking** was found in 2005

• When Norton was founded in 2015, detailed **research** into this phenomena was initiated

• The work was, and is, funded directly by municipalities who recognize the **value to them** in reducing I/I

• The Institute for Catastrophic Loss (ICLR) was a foundational sponsor (since 2016) and has supported ongoing research, pilot projects and standards development to **develop of better practices**
What does this Clean Water Cost?

The present value of a single 1 L/s of l/l, over a 40-year life is $1,000,000\(^1\)

\(^1\): (@ $1.50/m3 and 3%), for treatment costs alone
What does this Clean Water Cost?

This capacity could be used to:
- Reduce routine backups & flooding
- Reduce catastrophic flooding
- Allow more new development
- Delay the need to expand wastewater treatment plants
- Ensure sewers reach their design life (leaking sewers fail sooner)

But also:
- Reduce insurance claims
- Reduce non-insured costs to homeowners
- Reduce staff costs associated with flooding events ($$$)

“The real savings for a municipality lies in the ability to defer infrastructure upgrade costs (sewers and treatment plants). While flooding costs grab public attention and can influence voting outcomes, it is the everyday costs that utilities silently struggle against and transfer quietly to rate payers.”

David Kellershorn, P.Eng., Manager, Stormwater, City of Toronto, October 2020
I/I in all Existing Sewer Systems: A Tale of Two Cities

- City “A” treats 5,730,000 m³ of clean water a year ($15.8 million)
- City “B” treats 5,590,000 m³ of clean water a year. ($15.4 million)
The Societal Costs of Excess Inflow and Infiltration (I/I) are Very High, and Climbing

Excessive I/I has numerous negative consequences, including:

- Impacts on the environment, public health and safety
- Acute and ongoing financial impacts for municipalities, insurers, taxpayers and homeowners
- Not included are the risks to homeowners of denial of insurance, increased premiums, and capping of payouts

These negative impacts of I/I are expected to intensify in many regions under projected changes.
And, it Begins
There is a Connection Between Leaking Sewers and Flooding

- New subdivisions are experiencing basement backup and flooding

- Recently in Ontario:
  - Ottawa area (3)
  - Small town east of Toronto
  - Town north of GTA
  - Several in SW Ontario
  - Thunder Bay area
Municipalities are Starting to be held Liable

Amherstburg sued for 2011 flood; $9M lawsuit claims town negligent

The Town of Amherstburg is facing a $9 million lawsuit filed on behalf of 129 residents whose basements and crawlspaces flooded in August 2011.

SARAH SACHELI, WINDSOR STAR    Updated: November 20, 2013
What is the Problem?
Brand New Sewers Leaking

Large GTA Municipality
Sewers

Flow, L/s

Rainfall, mm/hr
Large GTA Municipality
New Sewers are Overwhelmed When it Rains

What is the Problem?
Data Categorized as Excessive by Others
What is the Problem?
Extra Water Reduces the Useful Life of a Sewer

Stage 1: Initial defect, but sewer remains held in position by the surrounding soil.
Stage 2: Development of zones of loose ground or voids caused by the loss of ground into the sewer.

Source: WEF/ASCE Existing Sewer Evaluation & Rehabilitation, Manual of Practice 6
“A cracked fitting which failed from the weight of the fill placed over it and inadequate support...this basement flooded in an extreme weather event”
What is the Problem?
(We CCTV Inspect Sewers)

Look for wows, dips, rock indentations, flow path and joints
We can see sewers leaking when we CCTV them: most public side sewers are CCTV inspected.
What are the Underlying Causes of Unacceptable I/I in New Subdivisions

- Lack of understanding of guidelines & standards
- Jurisdiction
- Conflict of interest
- Silos
- Political pressure*
- Code focus
- Materials used
- Code Interpretation

*Political pressure or perceived political pressure is reported widely
What are the Causes and Conditions Different Jurisdictions
What are the Causes and Conditions

Public Side Air & Water Testing

MUNICIPALITIES PERFORMING AIR & WATER TESTS IN NEW SUBDIVISIONS

Survey Size: 50

- **NO** 69%
- **YES** 28%
- Other 3%
- If suggested by CCTV

*Remember that we test to ensure pipes are watertight and don’t allow clean water to enter sewers*
What are the Causes and Conditions
Private Side Air & Water Testing

Building Departments Performing
3m Water Column or Air Test
of Private Laterals

Survey Size: 60

NO 90%

YES 5%

Test function not understood

Other 5%
### What are the Causes and Conditions

#### Other Required Tests

<table>
<thead>
<tr>
<th>Required Test per OPS or MOECC</th>
<th>Percentage of Municipalities Reporting Requiring the Test</th>
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</thead>
<tbody>
<tr>
<td>Feeler Gauge Test of Each Gasket</td>
<td>0%</td>
</tr>
<tr>
<td>Mandrel (out of round) Test on Sewers</td>
<td>29%</td>
</tr>
<tr>
<td>Air or Water Tests on Sewers</td>
<td>28%</td>
</tr>
<tr>
<td>MH Infiltration/Exfiltration Tests</td>
<td>20%</td>
</tr>
<tr>
<td>CCTVing of Laterals to P/L</td>
<td>12%</td>
</tr>
</tbody>
</table>

We have a problem.
PVC Pipes are FLEXIBLE
This isn’t going to last.
Failing a Mandrel (Roundness) Test
What are the Causes and Conditions

Issues on the Public Side (governed by Provincial Guidelines & Specifications; ultimately owned by the municipality):

- Required tests not being performed
- Best available technologies not being applied or not available
- Inspection by the developer’s engineering consultant
- Insufficient municipal staff to oversee work
- Perceived or actual political pressure
- Folks who work with I/I disappear after public side complete.
- Municipalities do not check flows in new construction.
What are the Causes and Conditions

Issues on the **Private Side** (governed by the Building Code; ultimately owned by the homeowner):

- Building Code was not developed with sewers in mind
- Building staff are not trained in sewer systems
- Installation methodology for PVC pipe & PVC pipe type
- Building Code interpretation
- Most work takes place without third party oversight.
- Inspection of the connection at property line not explicitly called for
Direct Quotes on “Political Pressure”

“We see political pressure from Council not to enforce our standards”
~Large Canadian Municipality, SCC Committee 2019

“We have developer consultant who wants us to accept 160 l/c/d for sewer flow design because new sewers don’t leak.”
~Single tier Municipality, north of GTA 2018

“Developers have a lot of power and are steamrolling the municipality”
~Heard on MECP New Sewer Design Committee, 2019

“Political influence is preventing good practice.”
~Large GTA Municipality, SCC Committee 2019

“Many municipal employees reported feeling pressure from the developer, with the perception that developers will approach senior management and politicians if they are not satisfied. Whether this occurs or not, the perception is sufficient to discourage municipal employees from being too stringent with testing and acceptance.”

“It was a pleasure to meet you, someone who understands the frustrations I go through dealing with I & I issues within new subdivisions. I loved your presentation yesterday.”
~Operations guy, Local Municipality in Large GTA Region, 2019

Former Toronto city councilor Maria Augimeri, said developers constantly pressure the TRCA to quickly issue permits for construction that could impact wetlands, ravines and other sensitive green space.
~Toronto Star
CSA Standard for Pipe is the same on the Public and Private Sides

Ontario standards/codes refer to the same CSA Standard for materials for laterals on public and private sides

We need better practices!
Sanitary public and private side lateral sewers should be SDR28, 100 mm in diameter and green in colour.

Pipe layers working in the field have no idea of the importance of correct connections.

Storm public and private side lateral sewers should be SDR28, 125 mm in diameter and white in colour.
Design of Sewers and Maintenance Holes in High Groundwater Conditions

“Where the invert of the sewer and MHs are below seasonally high groundwater elevation, they should be designed to be watertight (e.g. to drinking water standards).”

Source: R. Kowal & L. Pike, Trenchless Technology, April 2013

We specify leak testing technique in OPSS based on GWT elevation; why not design??
National Standards
Provincial Standards

Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval

Ministry of Environment, Conservation and Parks

DRAFT
November 2019

Ontario
Municipal Standards

4. SANITARY CONNECTION PIPE TO BE ANY COLOUR EXCEPT WHITE.
5. STORM CONNECTION TO BE ON THE LEFT WHEN FACING THE HOUSE.
6. SANITARY CONNECTION MUST INCLUDE A TEST FITTING AT PROPERTY LINE.
7. SINGLE SANITARY SERVICE CONNECTIONS SHALL BE 125mm.
8. MAIN STOP MUST BE PLACED AT PROPERTY LINE FOR WATER SERVICE.
9. SANITARY SEWER AND WATER CONNECTIONS TO BE Laid TO THE STREET LINE AS PER THE ABOVE STANDARD.
10. NO OBJECTION TO THE EXTENSION OF THE SANITARY SEWER OR WATER CONNECTIONS BEYOND THE STREET LINE INTO THE PRIVATE SIDE. PRIVATE SIDE CONSTRUCTION IS UNDER LOCAL MUNICIPALITY JURISDICTION.
11. LOCAL MUNICIPALITY IS RESPONSIBLE FOR STORM SEWER CONNECTIONS ON LOCAL ROADS.

PUBLIC WORKS
STANDARD DRAWING

NEW DEVELOPMENT CONSTRUCTIONS
EXTENDING SERVICES BEYOND PROPERTY LINE

DESIGN AND CONSTRUCTION
SPECIFICATIONS
(WATER, WASTEWATER & STORMWATER SYSTEMS)
2016 Edition

Halifax Water
Halifax Regional Water Commission
Publications
Work with Media for Public Education in Sewers

This is why you should keep your basement toilet seat closed: sewer expert

By Robert Williams Record Reporter
Fri., June 26, 2020 | 2 min. read

Article was updated Jun. 26, 2020
Great News: This Work does not Require Climate Change Predictions

- Every drop of clean water that enters a sewer on either side of the property line puts individual homes at higher risk of flooding.

- Exacerbated by increased flows due to climate change.

- “Engineering” solutions do not require accurate models, predictions, etc.:
  - We can improve our practises around inspection, testing, approvals.
  - Codes can be updated to reflect latest findings about leaking sewers.
  - Education across Silos is essential.
It's a great day to build better sewers, better.