ONTARIO CENTRE FOR MUNICIPAL BEST PRACTICES

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BEST PRACTICE SUMMARY REPORT

February, 2008

Water and Wastewater

INFLOW AND INFILTRATION – DOWNSPOUT DISCONNECTION

Abstract:
The City of Thunder Bay's Downspout Disconnection Program has been successful with reducing inflow and infiltration and alleviating basement flooding. This report describes how the program was implemented by identifying areas in the system with excessive inflow and infiltration and executing a customer outreach program for downspout disconnection.

Additional information regarding inflow and infiltration management and the OMBI Water and Wastewater Expert Panel 2007 Business question for which this report has been written can be found in the Project Approach and General Inflow and Infiltration Management Practices documents.

Practice Identification: Water and Wastewater

Case Study Municipality:

- City of Thunder Bay

Municipal Profile:

Municipality	**City of Thunder Bay**[1]
Population	102,500
Water Distribution	726 km of watermains with 36,942 service connections, and 7 pump stations
Wastewater Collection	500 km of sanitary sewers, with a total of 34,215 sewer service connections, and 3 pump stations

[1] Municipal Profile is based on 2006 Data

Water Treatment Plants	Population Served	Average Day Demand (ADD)
Bare Point	75,200	39.56 ML/day from Lake Superior
Loch Lomond	27,300	14.35 ML/day from Loch Lomond
Wastewater Treatment Plant	**Population Served**	**Annual Average Flow (AAF)**
Thunder Bay WWTP	100,000	62.94 ML/day

Key Words:

- Inflow and Infiltration, Basement Flooding, Surcharging, Capacity, Downspout Disconnection

Related National Benchmarking Goal(s):

- Operate a Reliable and Sustainable Sewerage and Drainage Infrastructure
- Sufficient Sewerage & Drainage Infrastructure
- Environmental Protection
- Customer Satisfaction

Related Performance Measures:

- Operating Cost ($000's) / Megalitre Treated
- Megalitres of Wastewater Treated per 100,000 population
- Percentage of Wastewater Estimated to have Bypassed Treatment.
- Operating Cost of Collection per KM of Pipe
- Annual Number of Wastewater Main Backups per 100 KM of Wastewater main
- Average Day Utilization of Individual Wastewater Treatment Plants
- Peak Utilization Rate of Individual Wastewater Treatment Plants
- # of Reported Overflows due to Capacity / 100 km length
- # of Connections with Sanitary Flooding / 1,000 Service Connections

Related InfraGuide Best Practices:

- Infiltration / Inflow Control / Reduction for Wastewater Collection Systems

Description of Case Study

Inflow and infiltration reduction has been a long standing initiative undertaken by the City of Thunder Bay. The Environment Division of the City of Thunder Bay has jurisdiction over both sanitary and storm water systems which, with areas of combined systems, has allowed greater control and understanding of how stormwater and sanitary systems are interrelated. Both of these systems are looked after by the same people in the Division.

In Thunder Bay, inflow and infiltration has been an issue that has caused occurrences of basement flooding, sewer surcharges and, to a lesser degree concerns relating to the unnecessary flow received at the wastewater treatment plant. Historically, the City had experienced 70-100 basements floods during extreme precipitation events.

Since 1986 the City has been proactively implementing practices and programs to reduce inflow and infiltration including the following:

- Installation of V-notch restrictors on catch basins (beginning in 1986)
- Installation/separation of storm sewers(beginning in 1986)
- Implementation of the Pollution Prevention Control Program (1996)
- Downspout Disconnection Program (1999)

In 1996, the City of Thunder Bay initiated its Pollution Prevention Control Plan (PPCP) and identified a number of programs to reduce inflow and infiltration of rainwater into the sanitary sewer system. While catch basin separation from the sanitary sewer system and installation of separate storm sewers had already begun, many years prior in 1986, it was evident that some of the basement flooding was due to downspouts connected directly to the sanitary sewer system. Downspout connections were also deemed be a significant contributor to the surcharging of the sanitary sewer system.

The City of Thunder Bay also looked at identifying properties with weeping tile draining to the sanitary sewer system. After some consideration, it was decided that the impact of weeping tile drainage on sanitary sewer surcharges in Thunder Bay was minimal due to ground and vegetation absorption, as well as the time delay in reaching the sanitary system. The costs associated with redirecting the weeping tile water made it cost prohibitive.

In 1999, a Downspout Disconnection Program (DDP) was initiated as part of the Wastewater Collection System Management portion of the PPCP. The City had issues with basement flooding in older neighbourhoods, both residential and commercial, where downspout connections to the sanitary sewer were most prevalent. This brought attention to Thunder Bay's Municipal Code #846.15 and the Sewer Use by-law which both prohibit the connection of downspouts to the sanitary sewer system but had not been strictly enforced up to that point.

The goals of the Downspout Disconnection Program were to accomplish the following:

1. Further reduce sanitary sewer surcharging and basement flooding.
2. Reduce loading at the City's Water Pollution Control Plant during rainstorm events.
3. Encourage and promote water conservation by utilizing the City's Rain Barrel program. This gave property owners an incentive to use their downspout water to conserve household water usage, while helping to alleviate surcharging of the sanitary sewer, basement flooding and overloading at the Water Pollution Control Plant.

Before executing the program, target areas were first identified. Although it was known that downspout connections were prevalent in older areas of the city, jar ladders installed in manholes were used to identify and confirm surcharging in these areas. The Downspout Disconnection Program (DDP) was prioritized based on greatest need where historical records showed basement flooding had occurred. Closed circuit television (CCTV) inspection of sewermains and manhole inspections confirmed pipe integrity not

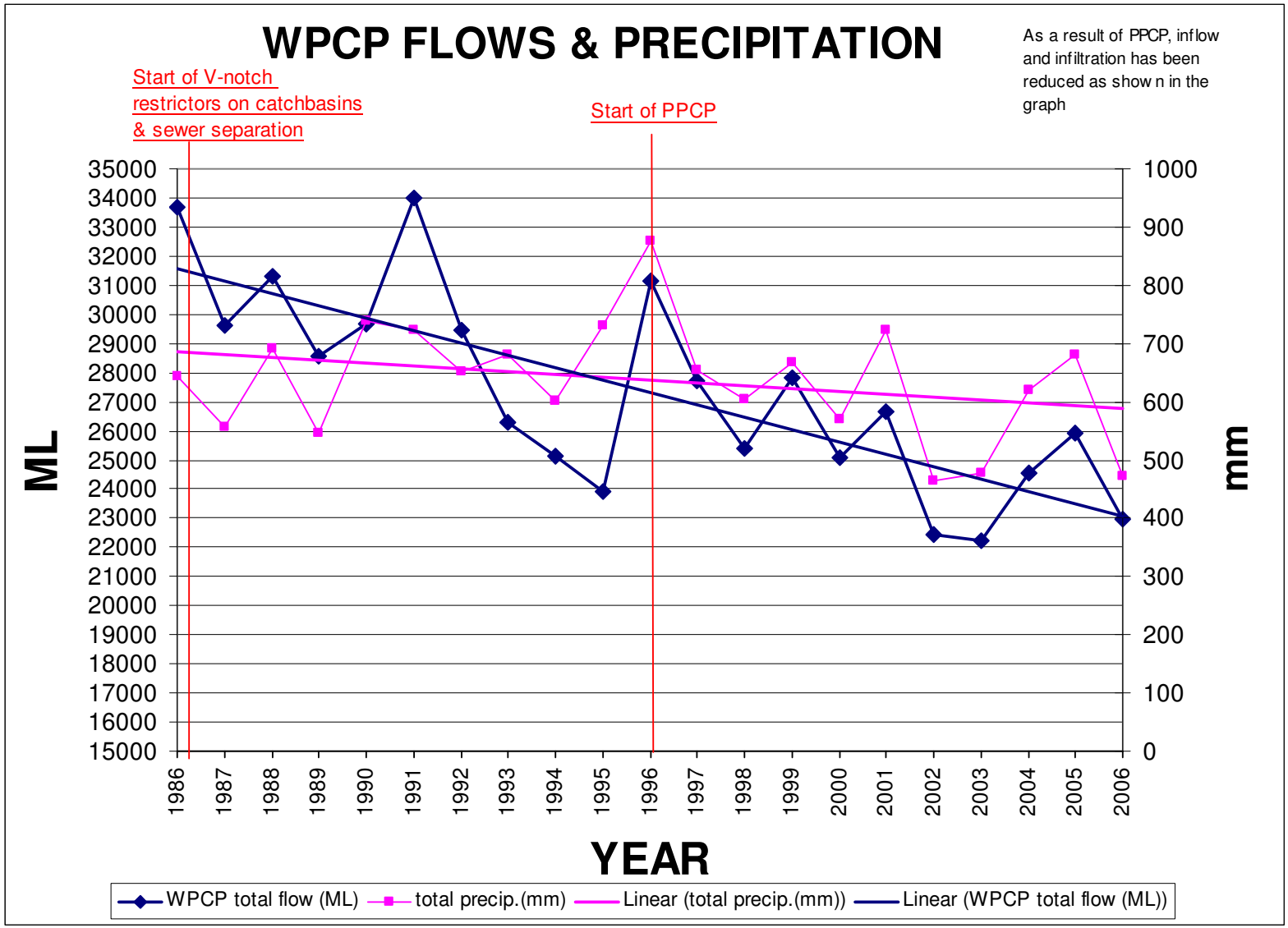
to be a concern. The Downspout Disconnection Program (DDP) was executed through customer outreach. The City enlisted the help of a private not for profit organization, EcoSuperior Environmental Programs, to aid property owners in disconnecting their downspouts. EcoSuperior, who had previously worked on a number of other similar types of projects for the City, delivered information to property owners identifying the need to remove their downspout connections from the sanitary sewer, as well as suggested methods of removal. (The Homeowner's Guide to Thunder Bay's Downspout Disconnection Program has been attached at the end of this document for reference.)

EcoSuperior first surveyed the entire city and identified properties requiring downspout disconnection. The property owners were then notified of their duty to disconnect and were supplied with the necessary information on how to properly disconnect downspouts. At the same time, customer awareness of the Rain Barrel Program was raised, which entailed the selling of rain barrels to city water account holders at a discounted rate. Rain barrels were one of the possible options provided to customers when disconnecting downspouts.

In total, 786 properties were identified by staff at EcoSuperior. Of those properties, 64% complied and disconnected their downspouts from the sanitary sewer. There are still properties which require attention, because they are not able to disconnect due to site constraints, or require the assistance of the City's Engineering Division on how to disconnect. These properties are being dealt with as road/infrastructure upgrades occur.

Benefits

Since the initiation of the storm sewer separation and the Pollution Prevention Control Program, inflow and infiltration have clearly been reduced as shown in the graph below.


WPCP FLOWS & PRECIPITATION
As a result of PPCP, inflow and infiltration has been reduced as show n in the graph
Start of V-notch restrictors on catchbasins & sewer separation
Start of PPCP
ML
mm
YEAR
35000
34000
33000
32000
31000
30000
29000
28000
27000
26000
25000
24000
23000
22000
21000
20000
19000
18000
17000
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700
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200
100
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
WPCP total flow (ML)
total precip.(mm)
Linear (total precip.(mm))
Linear (WPCP total flow (ML))

The largest benefit from the disconnection program is the alleviation of basement flooding due to the reduced surcharging on the sanitary sewer system. Not only does this decrease the loading on the sanitary sewer system, it also eliminates the requirement and expense of unnecessarily treating storm water at the City's wastewater treatment facility.

From a water conservation standpoint, the disconnection program gives property owners the opportunity to take advantage of the subsidized Rain Barrel Purchase Program to reduce their own treated water consumption, which in turn reduces municipal water and wastewater system operational costs. Along with the economic benefit, utilizing rain water helps conserve our natural resources as less fresh water requires treatment keeping water conservation issues and source protection at the forefront.

The City estimates that there have been no basement flooding events due to sewer surcharging since 2000 which has also translated into the following benefits:

- Estimated savings of $17,000/ year which would have historically been paid out in overtime to deal with rainstorm events (based on 2 events per year).
- Estimated cost savings from reduced insurance claims is approximately $60,000/yr
- Estimated savings of $980,000 from reduction of inflow and infiltration from 2000 to 2006, considering the variable operation and maintenance cost of $113.72 per ML treated (costs dependant on flow such as energy costs and, chemical costs)

Efficiency

Prior to the program, 70-100 basements would flood during a large rain event. By 2000, 98-99% of catch basins had been directed to storm sewers. There was a 64% success rate of downspout disconnection of those identified as requiring disconnection. Since 2000, there have been no reports of basement flooding due to sewer surcharging, even with similar intense precipitation events in the past 6 years that would be comparable to the events prior to year 2000.

Also, the City of Thunder Bay has found efficiencies within their system by having both sanitary sewers and storm sewers being looked after by the same personnel in the Environment Division.

Effectiveness

Of the 786 properties identified by staff at EcoSuperior requiring downspout disconnection, 64% successfully removed their connections. The remaining connections were not disconnected either because they were not able to disconnect due to site constraints or required the assistance of the City's Engineering Division on how to disconnect. These properties are being dealt with as road/infrastructure upgrades occur.
The Environment Division's structure of having both sanitary and storm water systems overseen by the same people increases the effectiveness of operations and maintenance related activities, along with project planning and customer satisfaction.

Community or Environmental Outcomes
Through facilitating the implementation of the Downspout Disconnection Program, EcoSuperior was able to raise customer awareness relating to inflow and infiltration and the impact it has on the sanitary sewer system and basement flooding. The rain barrel program which was offered as one alternative to redirect downspouts also contributes to the conservation of natural resources since fresh water does not have to be treated for uses such as grass/garden watering. The use of rain barrels plays an important role in keeping conservation issues and source water protection in the forefront.

Statutory Requirements
None

Replication of the Case Study
Municipalities experiencing basement flooding may consider implementing the downspout disconnection program if downspout connections are prevalent among residential and commercial properties. Properties need to simply be surveyed for downspouts directly connected to the sanitary sewer system. Areas prevalent with downspout connections can be identified and focused on for initiating the program. Using comprehensible literature to communicate the need to disconnect downspouts and the methods to disconnect downspouts, property owners can take part in the initiative.

Other OMBI Members that have implemented this practice:
There are several other municipalities investigating and implementing the downspout disconnection and the reduction it has on inflow and infiltration. Specifically, the City of Toronto has a downspout disconnection program where customers are encouraged to disconnect.

The City of Toronto's voluntary program ended November 20, 2008. Approximately 60,000 properties registered for the voluntary program in 2007 and due to the volume, these properties will be addressed over the next few years. In previous years, approximately 5000 to 10,000 properties annually, expressed interest in the voluntary program with approximately 2,000 annually actually agreeing to be disconnected. Participants of the voluntary Downspout Disconnection Program are eligible for one free rainbarrel, if it is feasible for installation. Additional rain barrels can be purchased for $60.00.

A mandatory program is being implemented in the core area of the City served by combined sewers. This is a priority area where reducing stormwater from the system would significantly reduce the risk of basement flooding. In this area, it will be the residents' responsibility to pay for the disconnection work. The City is hoping to achieve approximately 80% disconnection through the mandatory program.

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The Homeowner's Guide to Thunder Bay's Downspout Disconnection Program

EcoSuperior

Thunder Bay Downspout Disconnection Program

Presently there are households and businesses that have their downspouts connected to the city's sanitary sewage system. This causes problems for both the residents and the city. Fortunately, there are several simple ways to redirect rainwater with many benefits for your yard and garden.

Why do DOWNSPOUTS need to be disconnected from the Thunder Bay Sewage System?

- During rain storms the sewage system may back up which in turn floods basements.
- Overloading of the sewage treatment plant causes excess wear and tear, adding unnecessary cost to the city and to you the customer.
- During heavy rainstorms, untreated sewage may overflow into rivers and streams.
- If your downspout is connected, the sewage plant is treating clean water that does not require treatment.

Why is Rainwater Beneficial?

- It is FREE!
- It is easily collected and stored.
- It is naturally soft and contains no chlorine.
- It is warm in temperature which is good for plants.
- It can be used to water flower and vegetable gardens, and even the grass.

CAUTION

Be careful when you are redirecting rainwater:

- Direct water away from the house foundation.
- Do not direct rainwater in such a way that it might cause erosion.
- Do not direct water onto another persons property.
- Do not direct water in such a way that it might cause icing on sidewalks or driveways

Where Can I Get The Necessary Materials For Disconnecting My Downspout?

- Local Hardware Stores
- Yard and Patio Stores
- Roofing and Siding Companies
- Local Contractor

List of possible materials needed for disconnecting and redirecting downspouts:

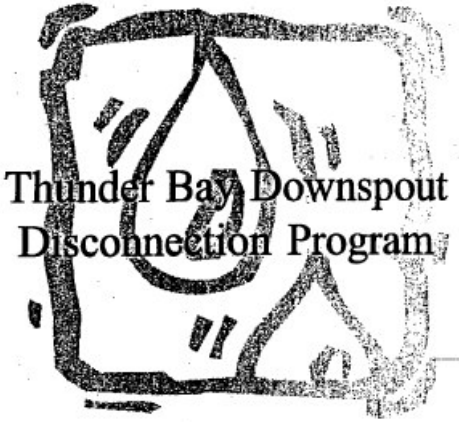
- Downspout extension
- Splash pad
- Roll-out style downspout extension
- Pop-up drainage emitter
- Rain barrel
- Downspout angle joints
- Pipe straps
- Plastic or concrete plug (to plug sewer connection)
- Rain valve
- Screws for plastic or metal downspouts

PLEASE NOTE

If you are not able to perform the downspout disconnection yourself, please contact a contractor for help.

Homeowner's Guide

Thunder Bay Downspout Disconnection Program



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Superior by Nature

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- The following diagrams describe possible options when disconnecting your downspout. Choose the one that suits your property and budget.