

Consolidated Clause in Works Committee Report 2, which was considered by City Council on April 25, 26 and 27, 2006.

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### **Work Plan for the Engineering Review Addressing Basement Flooding (City-wide)**

*City Council on April 25, 26 and 27, 2006, amended this Clause by adding the following:*

*“That the General Manager, Toronto Water, be requested to report to the Works Committee on:*

- (1) the basement flooding protection program, the number of applications made and the number fully completed; and*
- (2) the number and cost to construct storage facilities to provide sufficient protection in areas that have experienced chronic flood occurrences.”*

*This Clause, as amended, was adopted by City Council.*

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**The Works Committee recommends that City Council adopt the staff recommendations in the Recommendations Section of the report (February 23, 2006) from the General Manager, Toronto Water.**

Purpose:

To report on the progress to date on measures taken to address basement flooding City-wide, a work plan to undertake the necessary engineering investigation to develop remedial options, and allocation of funds needed for infrastructure renewal to address basement flooding that occurred as a result of the August 19, 2005, storm.

Financial Implications and Impact Statement:

Multi-year funding in the amount of \$15.817 million to undertake basement flooding relief works is available in the approved 2006-2010 Toronto Water Capital Budget under WBS Element No. CWW421 – Basement Flooding Relief. A cashflow of \$6.399 million, \$5.306 million and \$4.112 million has been approved in 2006, 2007 and 2008, respectively, which accommodates the estimated \$4.0 million necessary to undertake the necessary engineering assessments over this three-year period. The funding necessary for the construction of works identified in these assessments will be programmed into future Toronto Water Capital Budgets. Accordingly, the adequacy of the approved cashflow in 2007 and 2008 will be

reviewed in the preparation of Toronto Water's 2007-2011 Capital Budget and adjusted, as necessary, based on the results of the engineering assessments initiated in 2006.

The Deputy City Manager and Chief Financial Officer has reviewed this report and concurs with the financial impact statement.

Recommendations:

It is recommended that:

- (1) the work plan, focusing on chronic basement flooding areas, consisting of:
  - (a) sewer inspection to identify problems in the sanitary sewer system (such as blockages) and sources of extraneous stormwater (such as deteriorated pipes and maintenance holes; and illicit catchbasin connections or roof leader connections) for corrective action;
  - (b) targeted implementation of the City's Downspout Disconnection Program;
  - (c) engineering assessments of stormwater overland flow routing and evaluation of options to reduce or eliminate the severe ponding on streets during extreme storm conditions; and
  - (d) engineering assessments of the storm sewer and sanitary sewer systems to reduce stormwater inputs and identify and evaluate options to reduce or eliminate hydraulic bottlenecks to alleviate basement flooding during extreme storm conditions,be approved;
- (2) the Work Plan Schedule in Appendix 3 be approved;
- (3) the works identified in Recommendations (1)(a), (1)(c) and (1)(d) be programmed into the forthcoming Toronto Water 2007-2011 Capital Budget, subject to satisfying the requirements of the Municipal Class Environmental Assessment process, including public consultation;
- (4) a storm event equivalent to the May 12, 2000, storm be adopted as the enhanced level of protection against basement flooding from sanitary sewer backup, in areas of the City experiencing chronic basement flooding; and
- (5) the 100-year storm be adopted for the City of Toronto as the level of protection, where feasible, against surface flooding from ponding on the street, in areas of the City experiencing chronic basement flooding, where a proper major (overland flow) stormwater drainage system does not exist.

### Background:

On August 19, 2005, Toronto experienced a severe storm event that resulted in the flooding of many residents homes, erosion in ravines and watercourses and damage to City infrastructure such as roads, bridges and culverts. Toronto Water, as of February 13, 2006, received over 3,600 reports of basement flooding. The majority of the basement flooding occurred north of Highway 401, where the storm exceeded a 100-year event with over 150 mm of rainfall in a three-hour period. In the area of the City south of Highway 401, where the storm was much less intense, 580 of the 3,600 reports of basement flooding were for isolated incidences spread across the City.

City Council, at its meeting of September 28, 29 and 30, 2005, in considering Clause 38 of Report 8 of the Policy and Finance Committee, titled "Status of Rain Damage Resulting from the August 19, 2005, Storm", approved the recommendation from the Works Committee that the appropriate staff be directed to undertake an engineering review of the affected flood damaged areas, that the review include proposals to speed up the Wet Weather Flow Master Plan, specifically dealing with, but not limited to, the Downspout Disconnection Program, and that the appropriate staff report thereon to the Works Committee.

City Council, at its meeting of December 8, 9 and 12, 2005, amended Clause 1 of Report 12 of the Policy and Finance Committee, titled "2006 Capital and Operating Budgets for Toronto Water", to request Toronto Water to report to the Works Committee on the allocation of funds to deal with infrastructure repairs needed to address basement flooding as a result of the August 2005 storm and to request additional funds to deal with the necessary sewer improvements.

### Comments:

Historically, a typical residential house in areas of the City serviced with separate storm and sanitary sewers has two sewer laterals as shown in Figure 1 (attached). One lateral is connected to the storm sewer and the second lateral is connected to the sanitary sewer. Generally, the house downspouts and foundation drains are connected to the storm sewer lateral, whereas internal plumbing for wastewater and floor drains are connected to the sanitary sewer lateral. However, in some areas of the City, foundation drains are also connected to the sanitary sewer lateral.

Basement flooding can result from the following factors:

- excessive infiltration/inflow of stormwater into the sanitary sewer (referred to as I/I) causing the sanitary sewer to surcharge and backup into basements. Excessive I/I into the sanitary sewer can occur through:
  - maintenance hole (MH) covers and cracked MH walls;
  - sewer connections, pipe joints and cracked or broken pipes; and
  - surcharged storm sewers;
- obstructions in the main sewer line; and

- problems on private property including:
  - water entering the basements through windows, doors, cracked walls, etc. due to surface flooding or poor lot grading;
  - foundation drains connected to the sanitary sewer, which is particularly problematic during extreme storm conditions – and exacerbated where the lots are poorly graded;
  - illegally connected downspouts to sanitary sewers;
  - illegally connected catchbasins, draining private property, to sanitary sewers; and
  - a blockage in the house service connection.

The assessment of over 3,000 registered basement flooding complaints as the result of major storm events of May 12-13 and July 17, 2000, revealed that 30 to 40 percent of the basement flooding cases were caused by situations that existed solely on private property.

It should be noted that, under normal conditions, where the rainfall event characteristics fall within the design parameters of the local sewer systems (where the storm sewers are typically designed to a one in two to a one in five-year return frequency), basement flooding complaints are rare occurrences, across the City. However, the incidence of basement flooding complaints is usually commensurate with the severity of the rainfall event, when the sewer systems are overloaded and there is significant ponding of stormwater on public and private property. Unfortunately, it is acknowledged, that in areas of the City (particularly to the north), there have been many extreme storms, particularly in the last 20 years, which have far exceeded municipal storm drainage and sewer design standards.

#### Past Practices to Alleviate Basement Flooding:

Historically, there are several instances where wide spread basement flooding has occurred as a result of extreme storm events. Over the past 30 years the City has undertaken numerous remedial measures to upgrade the sewer system to provided basement flooding protection from sewer backup. For the most part, basement flooding resulting from sewer backup has been eliminated, except for extreme storm events.

In the 1970/80s the former municipalities of Toronto, East York and Scarborough constructed separate storm sewers to collect road drainage in the combined sewer areas to reduce flow to the combined sewers and eliminate surcharging. The former City of York, to eliminate surcharging of their combined sewers, constructed several underground storage facilities.

In the former City of North York, where the sanitary and storm sewers are completely separated, improvement measures in the separate sanitary sewer system were implemented in response to the large number of reported basement flooding caused by an extreme storm in August 1986. The improvement works consisted largely of eliminating hydraulic bottlenecks with oversized pipes and constructing in-system storage facilities to provide sufficient protection against a storm equivalent to the 1986 storm.

Following the extreme storm event of May 12, 2000, where over 3,000 basement flooding complaints were received across the City, three engineering consulting firms were commissioned to investigate the causes of basement flooding and recommend remedial measures. Recommended improvement measures to provide sufficient protection against a storm equivalent to the May 12, 2000, storm were adopted by City Council in November 2001. This typically consisted of:

- voluntary downspout disconnection and/or “home isolation” through the installation of backwater valves to isolate homes from the sewer system and protect against flooding when the system surcharges during high flow conditions; and
- improving sewer system capacity by removing hydraulic bottlenecks and upgrading system capacity through:
  - sewer separation in combined sewer service areas; and
  - providing in-system storage facilities and/or upsizing pipe sections within the sanitary sewer system.

These remedial works are only part of the solution to basement flooding caused by severe storm events as they do not address the need to reduce the impact of surcharging storm sewers or reducing the impact of surface flooding. A more comprehensive approach is required consisting of the measures noted above; eliminating the sources of I/I into the sanitary sewers (e.g., stormwater entering through: MH covers, cracked or broken MH and pipes, and open pipe joints and connections); implementing inlet controls on roadside catchbasins to prevent the storm sewers from surcharging; and relieving constraints in the stormwater overland flow system to eliminate severe ponding and surface flooding on streets.

#### Measures Undertaken to Date to Address Basement Flooding from the August 2005 Storm:

Toronto Water is continuing to work on preventative measures and improvements to help alleviate basement flooding. The City owns and operates over 1,290 km of combined sewers, 4,440 km of sanitary sewers and 5,200 km of storm sewers. Conducting camera inspections and sewer cleaning as well as the assessment of the hydraulic capacity of a sewer system of such a length is a significant task. Given the severity and degree of flooding complaints across the City, there is an urgency in addressing the problems as expeditiously as possible. Accordingly, sewer inspection, cleaning and capacity analyses to determine the necessary improvements has been focused on chronic basement flooding areas.

In the short term, until a detailed hydraulic analysis of the storm and sanitary sewer systems is completed and remedial works are implemented, the City has undertaken several measures City-wide to address basement flooding.

- (1) Site visits by Toronto Water staff have been undertaken in the chronic basement flooding areas to identify the source of basement flooding, depth of water in basement, evidence of sewer discharge/sewer blockage, flooding history, lot grading, downspout discharge locations, reverse slope driveway, etc. Initial investigations indicate that major sources of basement flooding as well as I/I into sanitary sewers resulting in back-up into basements are surcharged storm sewers, poor overland drainage systems and poor lot grading. Further detailed analysis of the sewer systems and area drainage characteristics is

required to completely assess the extent of the problem and determine appropriate solutions and their cost implications.

- (2) In cases where a blockage in the main sewer was suspected, the sewer was promptly inspected and applicable corrective action taken (typically through sewer cleaning and flushing).
- (3) The City has concentrated its closed circuit television (CCTV) camera inspection of the sewer system and sewer cleaning program in the areas hardest hit with basement flooding to ensure the sewers are clean of debris, fat and grease accumulation.
- (4) To help protect residents, who have experienced basement flooding, from future flooding, the City also provides the following programs:
  - (a) Downspout Disconnection Program - where downspouts are disconnected at no cost to the homeowner. Homeowners who experienced basement flooding have been given priority in the program.
  - (b) Blocked Drain Program - where the City will inspect house laterals at no cost to the resident and repair the lateral if damage is caused by roots from a City owned tree.
  - (c) Basement Flooding Protection Subsidy Program - City Council, at its meeting of September 28, 29 and 30, 2005, expanded the Basement Flooding Protection Subsidy Program eligibility to include homeowners who experienced basement flooding as a result of the August 2005 storm where total subsidies available to a homeowner can be up to \$3,200.00 if they install a backflow valve, a sump pump, disconnect and cap their foundation drain and disconnect their downspouts. To be eligible for any of the subsidies the property's downspouts must be disconnected from the sewer system, where feasible. The deadline for submitting an application for this program was February 1, 2006.

Information packages have been mailed to each of the approximate 3,600 residents who registered a basement flooding complaint with the City informing them of the above programs. The availability of these programs has been advertised in seven community papers and eleven multi-cultural papers. Program information has also been posted on the Toronto Water web site, provided to Access Toronto and published in the winter 2006 edition of WaterWatch. Through these communications, Toronto Water has encouraged residents who have not reported flooding to call the City, as knowledge of these locations will assist in the hydraulic assessment of existing sewer systems. To date, 1,963 Basement Flooding Subsidy pre-approval applications have been received by the City and 206 property owners have submitted invoices for work completed.

The affected homeowners have also been informed of the following measures that should be implemented on their properties to help prevent future flooding:

- fix leaks in walls, floors, windows, doors and foundations;
- install a backflow valve;
- have a licensed plumber/drain company inspect existing flood-proofing devices, such as backflow valves, sump pumps, floor drains or caps, to ensure they are working properly;
- ensure lot grading around the home is sloped away from all exterior walls;
- repair/replace damaged weeping tile systems;
- ensure that disconnected downspouts are draining properly, ideally 1.8 meters (six feet) from your the basement walls – with the water flow directed away from the house;
- clear plugged eavestroughs and downspouts of leaves and other debris to ensure proper drainage;
- where possible, safely rake leaves away from sewer catchbasins;
- consider soft-surface landscaping that allows stormwater to soak into the ground rather than runoff directly into the sewer system (i.e., increased sodded areas or porous pavement);
- be sure property flood insurance is up-to-date; and
- do not block the sewer connection by pouring grease down the drain or flushing objects down the toilet.

#### Storm Drainage Problems Contributing to Basement Flooding:

In the past, to eliminate basement flooding, assessment and remedial work focused on the sanitary and combined sewer systems. Accordingly, the storm drainage system, both minor (sewers) and major (overland flow) were rarely assessed. However, based on recent investigations and analysis undertaken by Toronto Water, experiences of other municipalities and a review of the relevant literature, the storm drainage system can also be a major source of stormwater flows into the sanitary sewer system contributing to basement flooding. Surcharging of the storm sewers causes house laterals and foundations drains to backup which can result in water leaking out of the storm lateral and into the sanitary lateral. Also, surcharging of the foundation drains can cause structural damage to basement floors and walls allowing water to leak into the basement and enter floor drains which discharge directly to the sanitary sewer. Further, roof downspouts connected to the storm sewers can be a major cause of storm sewers surcharging.

In addition, the lack of a proper major (overland flow) drainage system can cause significant surface flooding, particularly during extreme storm conditions such as the August 19, 2005, storm. As noted previously, current design standards for storm drainage, include a design for the storm sewer system to intercept and convey the stormwater runoff (largely road drainage) from a two to five-year return storm event. For larger storms, stormwater that can't be intercepted by the storm sewer (piped) system remains on the road surface and flows along the streets, typically to a low point where it outlets via an overland flow route to the nearest watercourse.

However, in many areas of the City the streets do not provide a continuous flow route, are very flat or have low points with no place for the water to outlet and therefore significant ponding can occur on the street, particularly during heavy rain conditions that exceed the sewer design capacity. During extreme storm conditions, significant ponding of water can occur on the streets, overtopping the curb and flowing onto private property. Further, investigations conducted by Toronto Water staff have shown that, in many of these areas, the lots are poorly graded (in many cases toward the house) and, in some cases, homes have reverse sloped driveways in which stormwater is conveyed directly to the house – particularly problematic during extreme storm conditions. This results in water ponding around the basement walls where it can enter through windows, doors, cracked walls, etc. Once the water is in the basement, it enters the floor drain and overloads the sanitary system. Water can also flow down the exterior of the basement wall into the foundation drains. Where the foundation drains are connected to the sanitary sewer this water enters the sanitary sewer causing it to surcharge and back-up into basements.

Therefore, in keeping with the goal of the City's Wet Weather Flow Master Plan, of reducing, and ultimately eliminating the impacts of stormwater runoff, Toronto Water is proposing an integrated approach to address basement flooding across the City. Instead of concentrating on providing capacity in the sanitary and combined sewers to accommodate the wet weather flows, the new approach will focus on preventing, to the degree possible, surface flooding and reducing the amount of stormwater entering the City's sewer systems, namely:

- storm sewers;
- sanitary sewers; and
- combined sewers.

This integrated approach requires the following analyses to determine the necessary remedial works:

- (1) sewer system inspection to identify problems in the sanitary sewer system (such as blockages) and sources of extraneous stormwater (such as deteriorated pipes, illicit catchbasin connections or roof leader connections) for corrective action;
- (2) an assessment of the stormwater overland flow routing and evaluation of options to reduce or eliminate the severe ponding on streets during extreme storm conditions;
- (3) completion and evaluation of two "source control" pilot projects, initiated in 2006, which include: (a) a focused downspout disconnection program and catchbasin inlet control program in a residential area serviced by separate storm and sanitary sewers; and (b) a comprehensive inspection of the sanitary sewer system to identify and eliminate all

sources of excessive I/I such as leaky MHs, sewer connections at MHs, cracked or broken pipes, open pipe joints and deteriorated house laterals, if discovered; and

- (4) a comprehensive sewer system analysis to determine hydraulic bottlenecks and sewer system improvements to accommodate the wet weather flows that cannot be removed from the sanitary and combined sewers during extreme storm conditions.

#### Level of Basement Flooding Protection – Establishing a City Standard:

Based on computer simulation modeling undertaken by Toronto Water, a storm event equivalent to the May 12, 2000, storm would result in the maximum I/I to the sanitary sewer system due to flooded streets and surcharged storm sewers. Therefore, it is recommended that the City standard for basement flooding protection, in areas of the City experiencing chronic basement flooding, from sanitary sewer backup be a storm event of a magnitude equivalent to the May 12, 2000, storm. As noted earlier, basement flooding as a result of storms larger than the May 12, 2000, storm, is exacerbated by major surface flooding on private property, such as occurred from the August 19, 2005, storm. To further protect homes from basement flooding during more extreme storm events will require extensive control of surface flooding.

The level of protection against surface flooding, in areas of the City experiencing chronic basement flooding, where a proper major drainage system does not exist is recommended to, where feasible, be the 100-year storm, consistent with current design standards for new developments. However, in many older areas of the City, a major (overland flow) system design does not exist and it may not always be possible to provide protection to the 100-year storm due to site constraints, local grading and topography, and infrastructure constraints.

#### Proposed Work Plan:

The proposed work plan to alleviate basement flooding across the City is composed of three main components:

- (a) Isolated Incidences of Basement Flooding - an isolated incidence of basement flooding is an indication that the sewer did not surcharge and typical causes of basement flooding are problems on private property such as blocked sewer laterals or poor lot grading.
- (b) Chronic Basement Flooding Areas - areas where basement flooding has occurred repeatedly during extreme storm conditions.
- (c) Pilot Projects – completing two pilot projects currently underway to determine the benefits of source control remedial measures in alleviating basement flooding, which have not been previously assessed.

- (a) Isolated Incidences of Basement Flooding:

Approximately 580 isolated incidences of basement flooding were reported across the City in the area south of Highway 401. An isolated incident of basement flooding (one or two houses on a street) is an indication the problem is not with the main sewer, otherwise, more houses would be affected. Based on past experience, it is surmised that the most probable cause of basement flooding in these cases would be a problem on private property such as a restriction in the house lateral or water leaking into the basements through windows, doors, cracked walls and floors, etc. Some water can also enter the basement when there is very little clearance between the

basement floor elevation and the sanitary sewer and only minor surcharging of the sewer. Therefore, an assessment of the sewer systems in these areas is not recommended at this time. Priority for sewer system analysis should be given to chronic basement flooding areas where there is evidence of sewer surcharging. In the long term the entire sewer system across the City will be assessed for capacity and I/I problems.

For each isolated incidence of basement flooding, the individual home owners have been contacted and provided with information on the Basement Flooding Protection Subsidy Program and the Blocked Drain Program as well as information on measures the homeowner can implement to help prevent flooding described previously. Where a backup through the floor drain occurred, the house lateral and the local sewer in the immediate area are to be inspected and the appropriate corrective action taken if any debris or obstructions are found.

(b) Chronic Basement Flooding Areas:

Basement flooding in the chronic areas needs to be addressed through several measures including scheduled sewer inspection, implementation of source controls to identify and eliminate I/I into the sanitary sewer system, and structural improvements and upgrades to the sanitary and storm sewer systems and the overland drainage system, if sufficient I/I reduction cannot be achieved.

Given the degree of chronic basement flooding areas across the City and complexity of the problem, there is a need to prioritize these activities on an area specific basis. Accordingly, it is proposed that the engineering assessments be undertaken in chronic basement flooding areas with priority given to the areas hardest hit by the August 2005 storm event. It is also recommended that ongoing engineering assessments and/or improvements works that have been initiated in other areas affected by the May 2000 storm should proceed.

The following describes the components of the work plan proposed for the chronic basement flooding areas identified in Figure 2 (attached) and schedule shown in Appendix 3.

Sewer Inspection:

In the short term, visual inspection and smoke testing of the sanitary and storm sewer systems are being undertaken, to identify system cross-connections and illicit stormwater flow connections to the sanitary sewer system, with priority given to the areas hardest hit by the August 2005 storm event. Targeted CCTV inspections are being undertaken where potential problems are observed and appropriate corrective action is taken as required. In the long term, all sewers in the chronic basement flooding areas are to be CCTV inspected on a seven-year cycle through the City's Sewer Infrastructure Renewal Program.

Source Controls:

The City's Downspout Disconnection Program for 2006 will be used to target the basement flooding cluster areas.

The implementation of other source control measures such as catchbasin inlet restrictors and a comprehensive infiltration/inflow inspection and sewer rehabilitation program, will depend on the results of the pilot projects described below.

#### Infrastructure Improvements:

Structural improvements and upgrades to the sanitary sewer system and storm drainage system will be required to alleviate basement flooding in the chronic basement flooding areas if sufficient I/I reduction cannot be achieved. The current level of I/I in sanitary sewers during extreme storm conditions cannot be predicted. It varies from one location to another due to varying soil types, topography, age and type of infrastructure, site conditions on private property, etc. Therefore, monitored flow data is necessary to determine the site specific amount of I/I that is entering the sewer system and is also required in the setup of the computer simulation models used to develop, help site and assess remedial options.

Obtaining a sufficient amount of accurate flow data is time consuming as the level of I/I from several storms of various magnitudes must be assessed. To be able to assess the performance of the sewers and evaluate alternative remedial works for the chronic basement flooding areas, flow monitoring at approximately 60 locations is required. Sewer flow monitoring will be required at each location for several months to obtain sufficient data under varied wet weather conditions.

The assessment of the performance of the sanitary and storm sewer systems for each of the chronic basement flooding areas is estimated to take 18 months allowing for flow monitoring, computer model set up and calibration, and assessment of remedial works options. The assessment of remedial options and selection of a preferred solution must be undertaken in accordance with the requirements of the Municipal Class Environmental Assessment process, which will include public consultation with the affected communities. The total cost to complete this analysis for all chronic basement flooding areas hardest hit by the August 2005 storm event is estimated to be \$1,750,000.00.

The earlier engineering studies addressing basement flooding resulting from the May 12, 2000, storm recommended immediate improvement works and identified areas where more detailed assessment of the sewer hydraulics should be undertaken through computer modeling. The recommended immediate remedial works have been implemented except for two projects where, after further review, it was determined that additional analysis was required. Most of the assessments of those areas requiring additional detailed sewer system analysis have been completed or are nearing completion in conjunction with the design and construction of remedial works in these cases. Funding for these remedial works is included in Toronto Water's Approved 2006-2010 Capital Budget.

It is estimated to take three to four years to complete the sewer system assessment for all of the chronic basement flooding areas across the City, that have been identified to date. Implementation of recommended sewer remedial works will commence as soon as the engineering assessment study is completed for a given chronic basement flooding study area.

As noted previously, one of the sources of basement flooding during extreme storms is surface flooding. The assessment of the storm sewer and overland flow system is required for all chronic basement flooding areas as previous work has only addressed remedial works required for the

sanitary sewers system. The overland flow assessment for each of the chronic basement flooding areas is estimated to take 12 months to complete. It is recommended that priority for this assessment be given to the areas hardest hit by the August 2005 storm event, while the ongoing sanitary sewer improvement projects to address basement flooding resulting from the May 12, 2000, storm proceed as currently scheduled. The total cost to complete the storm sewer and overland flow system analysis is estimated to be \$2,250,000.00.

It is estimated to take four years to complete the overland flow assessment for all of the chronic basement flooding areas across the City, that have been identified to date. Implementation of recommended sewer remedial works will commence as soon as the engineering assessment study is completed for a given chronic basement flooding cluster study area.

(c) Pilot Projects:

It is recognized that a major source of stormwater inflow to the sanitary sewer is from house laterals and/or foundation drains and surcharged storm sewers. To prevent storm sewers from surcharging two remedial measures have been identified, (a) downspouts must be disconnected from the sewer; and (b) inlet controls are required in the catchbasins, to restrict the flow into the storm sewer to the design capacity of the sewer. Implementing catch basin inlet controls alone is not sufficient as the flow contributed from roof downspouts will also cause the storm sewer to surcharge. Based on computer simulation models it has been estimated that to prevent the storm sewer from surcharging at least 50 to 60 percent of the downspouts in a typical residential area must be disconnected - not just the downspouts on properties that experienced basement flooding. However, experience with the City's existing Downspout Disconnection Program has shown that it is extremely difficult to attain a 50 to 60 percent uptake rate with a voluntary program.

To assess the effectiveness of catchbasin inlet controls and downspout disconnection in eliminating surcharging of the storm sewers, a pilot project is underway in a basement flooding cluster area, identified during the May 2000 storm, consisting of approximately 550 single family residential homes with separate storm and sanitary sewers. The foundation drains and the majority of downspouts are connected to the storm sewers in this area. Along with catchbasin inlet controls, a concerted effort is being made to disconnect all downspouts in the drainage area to assess, not only the impact on the storm and sanitary sewers, but also to determine the maximum uptake rate possible for downspout disconnection through a focused voluntary program. The findings of this pilot will be used to assess whether a mandatory downspout disconnection program is required to obtain the higher uptake rates required to prevent basement flooding. This pilot project is scheduled to be completed by the end of 2006.

Other sources of excessive I/I can be stormwater leaking into sanitary sewers through MH covers, MH chimneys, sewer connection to MH, pipe joints and crack or broken pipes. To assess the effectiveness of remedial measures to eliminate the I/I from these sources a second pilot project, in the same area, is underway where a comprehensive inspection of the sanitary sewer system is being undertaken to identify and eliminate all sources of I/I. This pilot project is estimated to take 18 months to complete.

If the remedial measures evaluated in the above two pilot projects are determined to be cost effective in reducing basement flooding then they will be incorporated in the development of remedial options, where appropriate, throughout the remaining chronic basement flooding areas. A further report will be submitted on the effectiveness of the pilot projects and associated costs to implement these measures across all other chronic basement flooding.

The effort in reducing the infiltration/inflow into sanitary sewers would not only prevent future basement flooding but also reduce flows to the City's sewage treatment plants and reduce plant bypasses

### Conclusions:

On August 19, 2005, Toronto experienced a severe storm event that resulted in over 3,600 basement flooding complaints, the majority of which occurred north of Highway 401. In the area of the City south of Highway 401, 580 isolated incidences of basement flooding were reported.

In the short term, until a detailed hydraulic analysis of the storm and sanitary systems is completed, the City has concentrated its sewer inspection and cleaning program in the areas hardest hit with basement flooding to ensure the sewers are clean of debris, fat and grease accumulation. In addition, information packages have been mailed to each resident who has registered a basement flooding complaint with the City informing them of the Basement Flooding Protection Subsidy Program, Downspout Disconnection Program and the Blocked Drain Program provided by the City to help protect their home from future basement flooding.

A work plan has been developed to address basement flooding across the City. The work plan incorporates a new integrated approach to alleviate basement flooding. In the past, the general approach used to address basement flooding, the sewer assessment and remedial work concentrated on providing capacity in the sanitary and combined sewers to accommodate the higher wet weather flows. The new approach will focus on preventing, to the degree possible, surface flooding and reducing the amount of stormwater entering all sewer systems: storm, sanitary and combined.

The work plan, which focuses on chronic basement flooding areas, includes extensive smoke tests and CCTV inspection of sanitary sewer systems to identify defects (such as blockages) and sources of extraneous stormwater (such as deteriorated pipes and maintenance holes; and illicit catchbasin connections or roof leader connections) for corrective action; targeting the City's Downspout Disconnection Program in these areas; engineering assessments of overland flow routing and evaluation of options to reduce or eliminate the severe ponding on streets during extreme storm conditions; and engineering assessments of the storm sewer and sanitary sewer systems to reduce stormwater inputs and identify and evaluate options to reduce or eliminate hydraulic bottlenecks to alleviate basement flooding during extreme storm conditions. The engineering assessments of the overland flow systems and of the storm and sanitary sewers across all chronic basement flooding areas is expected to take four years to complete at an estimated cost of \$4,000,000.00.

The work plan also includes the completion and evaluation of results from two “source control” pilot projects directed at assessing the effectiveness of using catchbasin inlet controls and an aggressive downspout disconnection initiative (which strives for 100 percent participation) in reducing stormwater infiltration/inflows (I/I) to the sanitary sewer system; coupled with a comprehensive inspection of the sanitary sewer system (including house laterals) to identify and eliminate I/I (i.e., stormwater entering from maintenance holes, cracks or joint separations in the main sewer line and/or sewer laterals). The degree to which these measures are implemented in chronic basement flooding cluster areas, will depend on the results of this pilot study.

In areas of the City experiencing chronic basement flooding, a level of protection against basement flooding from sanitary sewer backup for a storm event equivalent to the May 12, 2000 storm (equivalent to a one in 25 to a one in 50-year storm), and a level of protection against surface flooding for the one in 100-year storm event, where feasible, in areas where a proper major (overland flow) drainage system does not exist, is proposed.

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List of Attachments:

Appendix 1: Figure 1 – Typical Sewer Connections and Sources of Basement Flooding  
Appendix 2: Figure 2 – Chronic Basement Flooding Areas  
Appendix 3: – Basement Flooding Relief Work Program Schedule

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Appendix 1

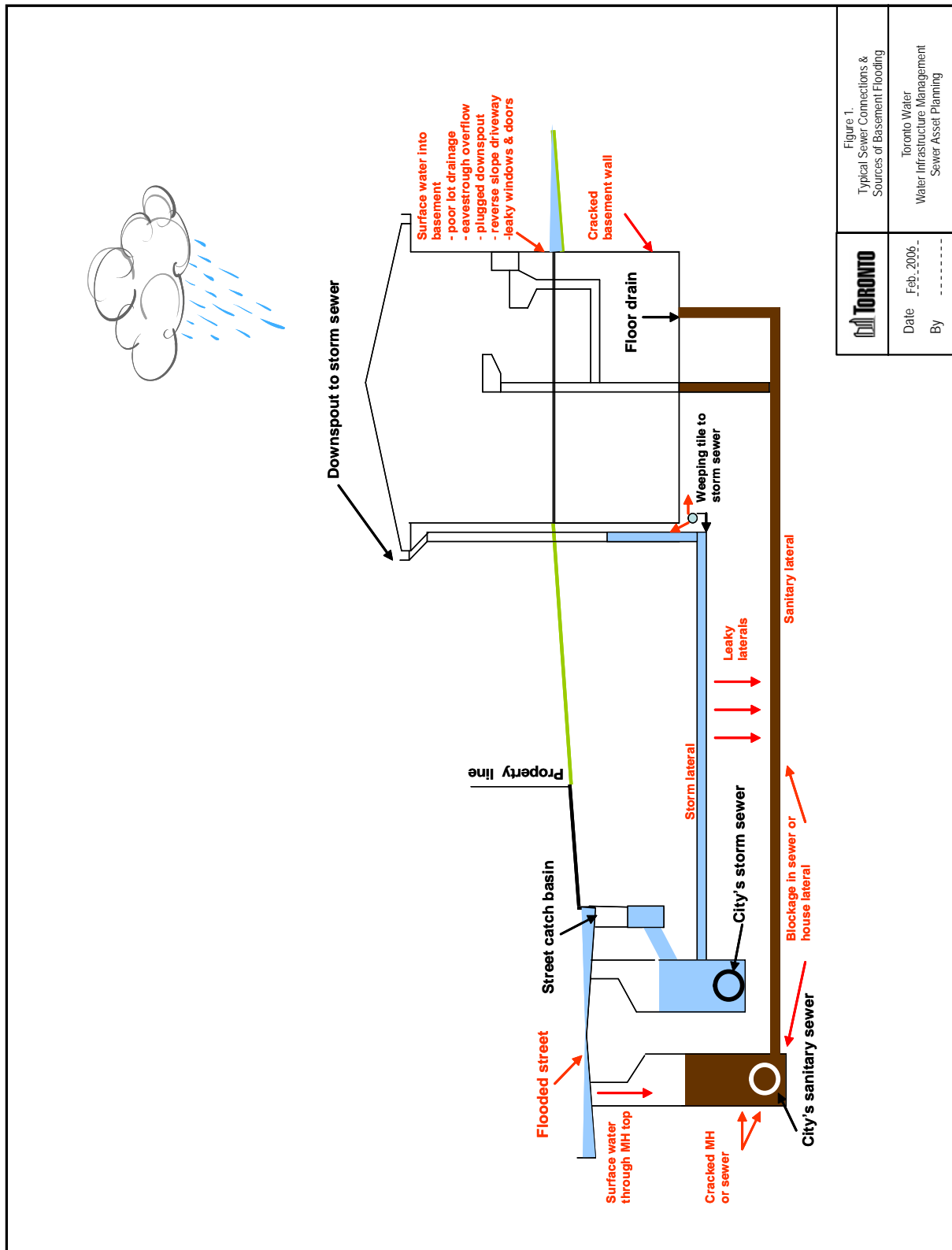
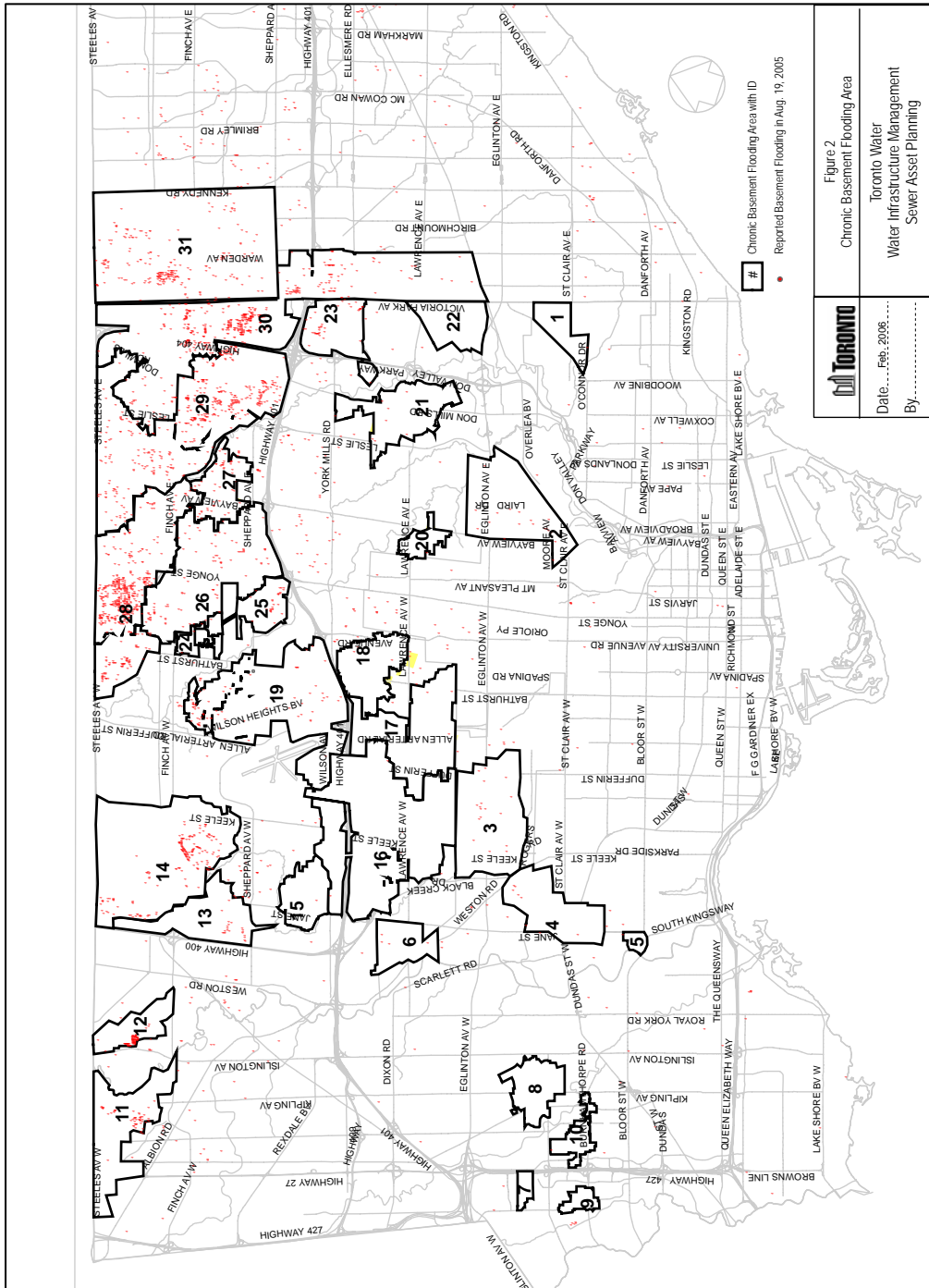


	Figure 1. Typical Sewer Connections & Sources of Basement Flooding
	Toronto Water Water Infrastructure Management Sewer Asset Planning
Date Feb. 2006	By -----

Appendix 2



Appendix 3 - Basement Flooding Relief Program Schedule

Engineering Assessment for Basement Flooding Task				2006	2007	2008	2009	2010	2011
Study Area	Area	Ward	Drainage System						
1	EY	3	Combined Sewer Storm Sewer & Overland Flow						
2	EY	26	Combined Sewer Storm Sewer & Overland Flow						
3	YK	12,15,17	Combined Sewer Storm Sewer & Overland Flow						
4	YK	11,13	Combined Sewer Storm Sewer & Overland Flow						
5	YK	13	Combined Sewer Storm Sewer & Overland Flow						
6	YK	11	Combined Sewer Storm Sewer & Overland Flow						
7	ET	3	Sanitary Sewer Storm Sewer & Overland Flow						
8	ET	3,4	Sanitary Sewer Storm Sewer & Overland Flow						
9	ET	3	Sanitary Sewer Storm Sewer & Overland Flow						
10	ET	3	Sanitary Sewer Storm Sewer & Overland Flow						
11	ET	1	Sanitary Sewer Storm Sewer & Overland Flow						
12	ET	7	Sanitary Sewer Storm Sewer & Overland Flow						
13	NY	7,8,9	Sanitary Sewer Storm Sewer & Overland Flow						
14	NY	8,9	Sanitary Sewer Storm Sewer & Overland Flow						
15	NY	7,9	Sanitary Sewer Storm Sewer & Overland Flow						
16	NY	9, 12,15	Sanitary Sewer Storm Sewer & Overland Flow						
17	NY	15,16	Sanitary Sewer Storm Sewer & Overland Flow						
18	NY	15,16	Sanitary Sewer Storm Sewer & Overland Flow						
19	NY	9,10	Sanitary Sewer Storm Sewer & Overland Flow						
20	NY	25	Sanitary Sewer Storm Sewer & Overland Flow						
21	NY	25,34	Sanitary Sewer Storm Sewer & Overland Flow						
22	NY	34	Sanitary Sewer Storm Sewer & Overland Flow						
23	NY	34	Sanitary Sewer Storm Sewer & Overland Flow						
24	NY	23	Sanitary Sewer Storm Sewer & Overland Flow	(study completed, no improvement required for Sanitary Sewer sewers)					
25	NY	23	Sanitary Sewer Storm Sewer & Overland Flow						
26	NY	23	Sanitary Sewer Storm Sewer & Overland Flow						
27	NY	23,24	Sanitary Sewer Storm Sewer & Overland Flow						
28	NY	10,23,24	Sanitary Sewer Storm Sewer & Overland Flow						
29	NY	24,33	Sanitary Sewer Storm Sewer & Overland Flow						
30	NY, Scarb	24,33,37,40	Sanitary Sewer Storm Sewer & Overland Flow						
31	Scarb	39,40	Sanitary Sewer Storm Sewer & Overland Flow						
Pilot study area - Roywood									

█ Sewer Assessment      █ Overland Flow Assessment  
▬▬▬ Work under implementation       Anticipated Implementation of Works

The Works Committee also considered a communication (March 4, 2006) from Karen Buck and Karey Shinn, Community Co-Chairs, Ashbridges Bay Sewage Treatment Plant Neighbourhood Liaison Committee.