TORONTO

STAFF REPORT
ACTION REQUIRED

Expansion of the Basement Flooding Protection Program's Priority Study Areas

Date:	October 30, 2013
To:	Budget Committee
From:	General Manager, Toronto Water
Wards:	All Wards
Reference Number:	P:\2013\Cluster B\TW\bc13021

SUMMARY

The purpose of this report is to advise City Council on the expansion of the Basement Flooding Protection Program city wide, to include new study areas, including the budget impacts and the prioritization methodology for new study areas. New study areas are recommended for initiation in 2014 and 2015, and for completion in 2016 and 2017.

On the afternoon and evening of July 8, 2013, severe thunderstorms and heavy rains flooded many parts of the City, causing damage to public and private property and infrastructure, stranding thousands of commuters, and leaving tens of thousands of residents and businesses without electricity. More than 4,700 basement flooding complaints were received during and immediately following the storm. Many of the impacted properties were located outside of the existing Basement Flooding Protection Program's 34 priority study areas resulting in the need to reconsider how basement flooding risks are assessed and addressed city wide.

RECOMMENDATIONS

The General Manager, Toronto Water, recommends that:

1. City Council request the General Manager, Toronto Water, to prioritize future Basement Flooding Protection Program studies based on the density of reported basement flooding complaints per sanitary sewer subsewershed for major storm events since 2000. The density of reported basement flooding complaints will be calculated on the basis of the number of complaints of basement flooding received by the City divided by the land area serviced by the sanitary sewer subsewershed.

2. City Council request the General Manager, Toronto Water, to initiate and expedite the completion of new Environmental Assessment studies for Area 35 (Silver Creek subsewershed), Area 36 (Chapman subsewershed), Area 37 (Hillary subsewershed), Area 38 (Etobicoke Creek subsewershed), Area 39 (Berry Creek subsewershed), Area 40 (Forman-Yonge subsewershed), and Area 41 (North Mimico Creek subsewershed).

3. City Council request the General Manager, Toronto Water, to report back on the schedule of future Basement Flooding Protection Program study areas (for Study Area 42 and beyond), across the remainder of the city, as part of Toronto Water's 2015 Budget Submission.

Financial Impact

The Recommended 10-Year Capital Budget and Plan for Toronto Water includes a total of $962 million in funding (including funds carried forward from 2013 into 2014) for the construction of Basement Flooding Protection Program (BFPP) over ten years. This reflects an overall increase of $47 million in 10-year funding as compared to the 2013 – 2022 approved Basement Flooding program.

Expanding the BFPP across the entire City will require the undertaking of Environmental Assessment (EA) studies to examine capacity of sewer and storm drainage systems and, therefore, an increase to the 10-Year Capital Budget and Plan. The Capital Plan impact for undertaking the studies on a city-wide basis is estimated to be $4 million per year, beginning in 2015, and continuing for an estimated 12-15 years using existing staff resources to project manage the consulting assignments.

Accelerating the expanded BFPP, so that it is completed sooner, will require additional annual increases to Toronto Water's Capital and Operating Budgets to hire more engineering consultants and staff within Toronto Water to manage the projects.

The estimated cost to construct projects identified by the EA studies in an expanded city-wide BFPP (includes construction projects not presently within the existing 34 priority study areas) will require additional capital funding beyond the 10-Year Capital Plan. The capital cost implications are not known at this time, but can be estimated to be well over $1 billion.

The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information

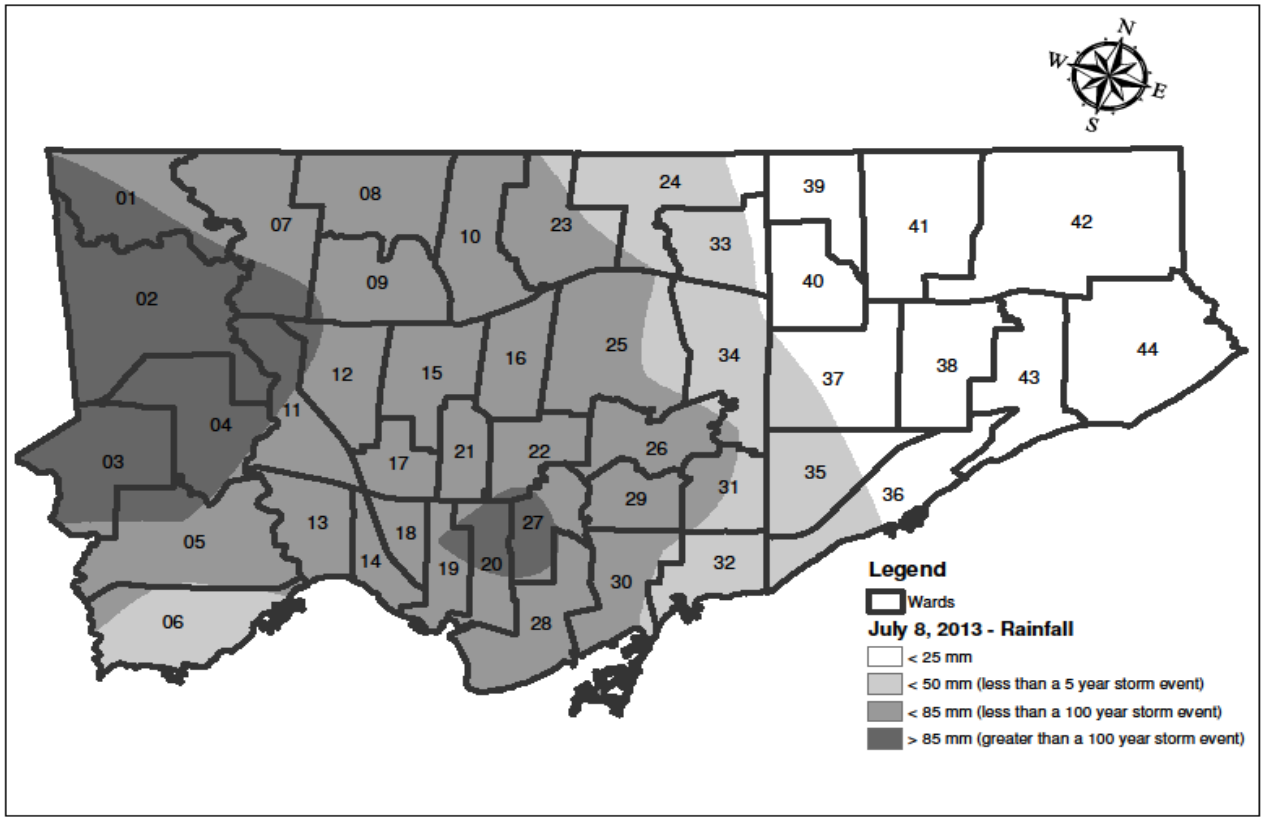
DECISION HISTORY

City Council, at its meeting on October 8-11, 2013, requested the General Manager, Toronto Water, to report back during the 2014 budget process on the capital and operating budget impacts of expanding the Basement Flooding Protection Program on a city-wide basis beyond the existing 34 priority study areas, including methodologies for setting priorities and resource implications, so that the program continues to address urban flooding risks in a fair, well-organized, and efficient manner. The Council decision can be viewed at:
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PW25.7

ISSUE BACKGROUND

On the afternoon of July 8, 2013, and extending into the night, thunderstorms and heavy rain showers blanketed the City of Toronto. Within a few short hours, almost 140 mm of rain had fallen in the west part of the city. In several wards, the storm intensity exceeded that of a 100 year return period storm event. Figure 1 shows that rainfall intensity varied across the city and demonstrates how the western portion of the city received the highest amounts of rainfall.

Figure 1: July 8, 2013 Storm Event - Distribution of Rainfall Density



The very high rate of rainfall resulted in the flooding of rivers, creeks, ravines, and low lying areas. Arterial roads and underpasses were flooded, public transit services were disrupted including the GO Train line in the Don Valley, stranding 1,400 passengers for more than seven hours. While various watercourses experienced substantial bank erosion, damage to Toronto Water's infrastructure was minor.

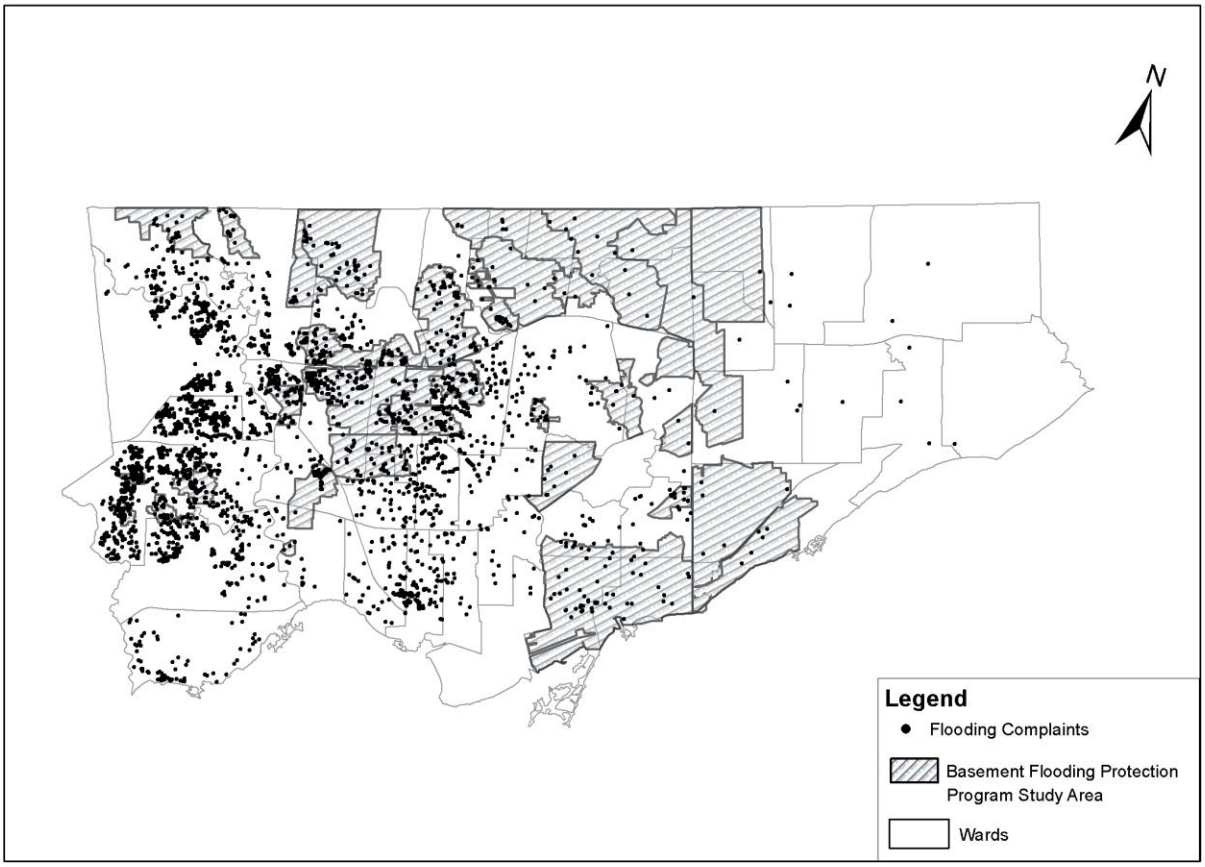
By August 8, 2013, Toronto Water had received more than 4,700 calls reporting flooded basements during the July 8, 2013 storm. This volume of reported flooding exceeded those received during the August 19, 2005, storm event when over 4,200 basement flooding were reported to the City. The locations where the calls originated for the July 8, 2013, storm event are shown in Table 1.

Table 1. Basement Flooding Calls (as of August 8), resulting from the July 8, 2013 Storm

District	No. of Basement Flooding Calls
North (North York)	991
East (Scarborough)	56
South (Toronto and East York)	607
West (Etobicoke and York)	3,105
Total	4,759

Almost two-thirds of basement flooding complaints were received from the west part of the city, and the majority of complaints occurred outside of the BFPP existing 34 priority study areas. Figure 2 illustrates how the density of flooding complaints varied across the city.

Figure 2: July 8, 2013 Storm Event - Reported Floodings



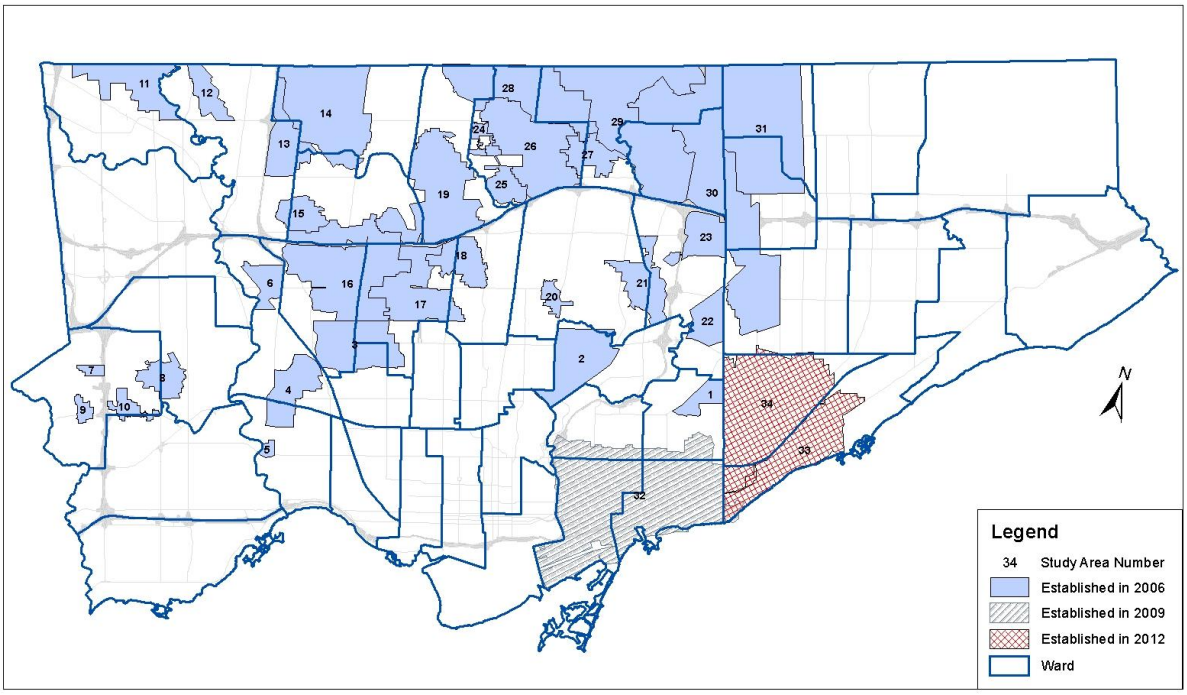
COMMENTS

The Basement Flooding Protection Program – Environmental Assessment Studies
When the Basement Flooding Protection Program was originally introduced, the City identified 31 priority study areas based on the number of properties that had experienced frequent basement flooding as of 2006. Subsequently, based on storm events prior to 2013, the program has grown to include 34 priority study areas as shown in Figure 3.

For each of the Basement Flooding Priority Study Areas, Toronto Water undertakes a Class Environmental Assessment (Class EA) study, as per the requirements of the *Ontario Environmental Assessment Act.* The Basement Flooding Class EA studies involve an investigation into the causes of flooding within the study area, including a complete and thorough capacity assessment of the existing sanitary sewer, storm sewer, and overland flow route systems in order to identify properties at risk of flooding during a theoretical 100 year storm event. Based on information from the technical assessment, options to reduce the risk of future flooding are evaluated, and solutions, such as infrastructure improvements, are recommended to achieve a desired level of basement flooding protection.

Of the 34 study areas, as of September 2013, fifteen Class EA studies had been completed. The first 33 of the BFFP EA studies are to be completed by the end of 2014, and the remaining Study Area 34 is planned for completion by the end of 2015.

Figure 3: Basement Flooding Study Areas



Identifying and Prioritizing Future Basement Flooding Study Areas

The current 34 basement flooding study areas were identified and sized in response to individual extreme storm events (e.g. storm of May 12, 2000, August 19, 2005, and July 2012). This has resulted in a reactive approach to storms rather than a system wide understanding of flood prone areas. As we have seen, basement flooding is likely to occur wherever extreme rainfall occurs. The frequency and density of flooding has much more to do with the difference between the capacity of the drainage systems and the intensity and duration of the rain event received than with the age or condition of the existing systems.

While there are no broad areas of the City that are more at risk than others, in most neighbourhoods there are locations where sewers become overwhelmed first during intense "beyond design" storms. In order to move away from a "storm chasing" approach, the program is being expanded beyond the current 34 priority study areas to develop a comprehensive understanding of the City's risks to future storm events.

Given that the entire City needs to be studied, it is not possible or practical to assess the entire remaining areas of the City at one time. Therefore a consistent and logical methodology is required to ensure that the parts of the City at most risk are addressed first and to ensure that the prioritization process is fair and transparent. The City's database of reported basement flooding is a good indicator of understanding which parts of the City are at greater future risk. To better highlight the "at risk and chronic flooding locations", Toronto Water is now using reported flooding data from a larger set of storm events and from more rain gauges.

A consistent approach is also required for the setting of Study Area boundaries. In the past, study boundary limits have been based on the limits of the sanitary sewer drainage areas, known as sewersheds or subsewersheds. This approach will continue to be followed in the setting of new study area boundaries.

A sanitary subsewershed is defined as the entire drainage area contributing to a sanitary sub-trunk sewer at the point where it discharges into a trunk sewer. A sanitary sub-trunk sewer is a sewer that discharges directly to one of the City's sanitary or combined trunk sewers. As these drainage areas will remain constant, the calculation of reported basement flooding densities should also remain constant. Figure 4 provides an illustration of the sanitary subsewershed boundaries for the City of Toronto.

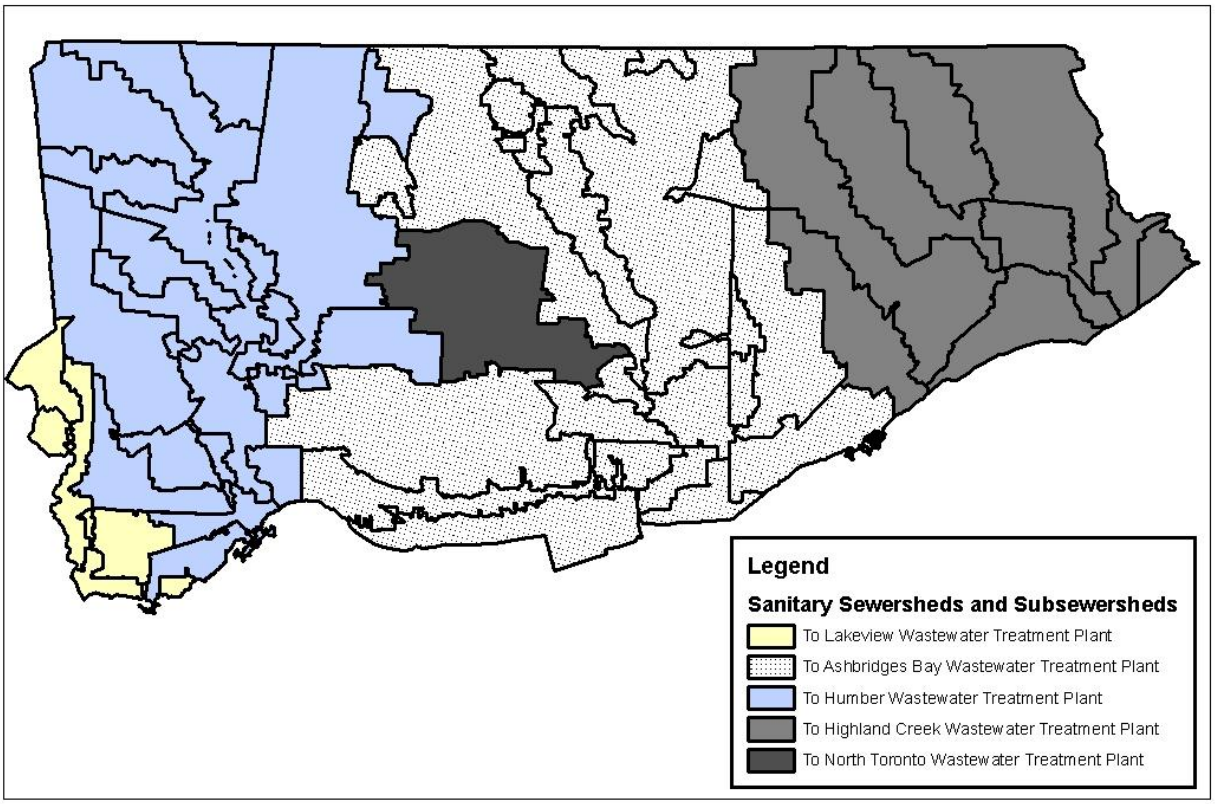


Figure 4: Sanitary Sewershed and Subsewershed Boundaries

Combining the history of reported basement flooding and the size of subsewersheds, a density of reported basement flooding per subsewershed can be calculated. This value can be used to determine the prioritization of future Basement Flooding Program Environmental Assessment Studies. Subsewersheds with a higher density of reported basement flooding are areas at greater risk and will be studied first.

By considering a larger set of storm events the prioritization approach will be able to:

- emphasize areas suffering from repeated flooding events;
- focus on areas with lower levels of existing service (as these areas will suffer from flooding during both extreme and medium to large sized storm events); and
- fairly identify and reduce flooding risks across the city (the inclusion of more storm events will allow the biases of single storm events to be de-emphasized).

For consistency, reported basement flooding results from all storm events greater than the 1 in 25 year return period design storm have been used to determine the density of flooding complaints and select the next areas to be studied. Starting with the May 12, 2000 storm, the storm events that have been found to meet this criterion over at least some parts of the City are as follows:

- May 12, 2000
- August 19, 2005
- July 18, 2007
- July 8, 2008
- July 15, 2012
- July 31, 2012
- August 10, 2012
- May 28, 2013
- June 28, 2013
- July 8, 2013

The proposed methodology will also allow previously set priorities to be maintained. The proposed prioritization approach will not change the order of completion, or the rate of delivery of the Class EA studies for the existing 34 priority study areas. Given the lead time required to set up and initiate new study areas, EA studies that are scheduled to begin within the next 2 years should be allowed to continue, even if new storm events occur that may significantly alter the density of flooding complaints or study priorities. EA studies that are planned to start greater than 2 years into the future can be reprioritized should new large rain storms (greater than a 1 in 25 return period design storm) occur.

What are the next Priority Study Areas?

The next priority study areas are situated largely in the west district of the City and their selection has been heavily influenced by the flooding events of July 8, 2013. The boundaries of the new study areas, as previously mentioned, will be the same as the existing sanitary subsewershed boundaries and they are as shown in Figure 5.

More specifically, the next Priority Study Areas are listed as follows:

1. Silver Creek Subsewershed (Humber Sanitary Trunk Sewer System) – "Study Area 35"
2. Chapman Subsewershed (Humber Sanitary Trunk Sewer System) – "Study Area 36"
3. Hillary Subsewershed (Humber Sanitary Trunk Sewer System) – "Study Area 37"
4. Etobicoke Creek Subsewershed (Etobicoke Creek Sanitary Trunk Sewer System) – "Study Area 38"
5. Berry Creek Subsewershed (Humber Sanitary Trunk Sewer System) – "Study Area 39"
6. Forman-Yonge Subsewershed (Don Sanitary Trunk Sewer System) – "Study Area 40"
7. North Mimico Creek Subsewershed (Humber Sanitary Trunk Sewer System) – "Study Area 41"

These study areas, based on a geographical area of approximately 7,000 hectares, represent a level of effort of approximately 2 years, based on existing resource availability.

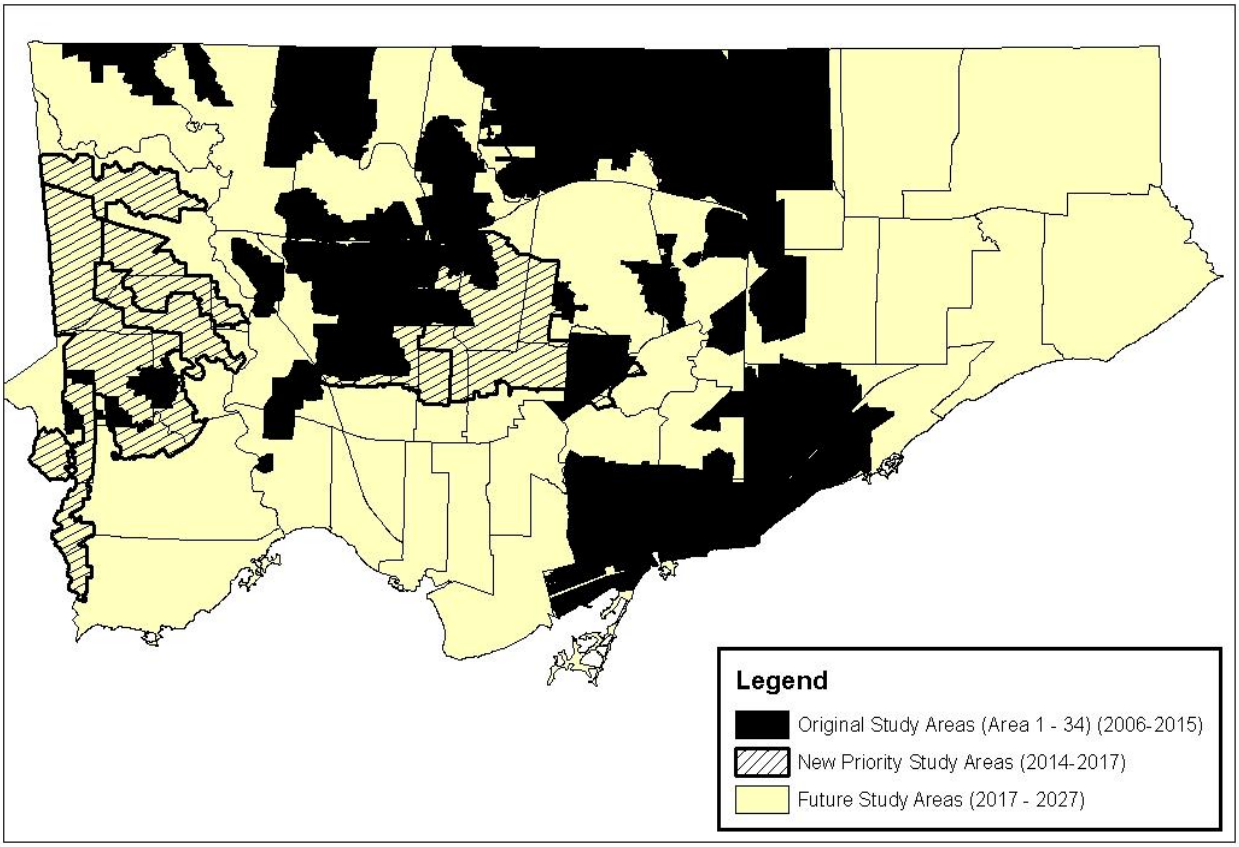


Figure 5 – New Basement Flooding Protection Program Study Areas

The start dates for the new study area basement flooding protection investigation studies will be staggered to suit both internal resource availability and consulting industry capacity with the goal of initiating the first studies in the fall of 2014. As well, subject to more detailed analysis, the study area boundaries may be refined and the studies may be bundled or subdivided and delivered through separate consulting contracts as required.

Basement Flooding Investigation studies for future study areas beyond those areas listed above will likely begin in late 2016. The sewershed boundaries of these new future study areas aren't yet defined, but they will be presented to council as part of the 2015 Budget process.

How fast can studies be completed?
Since the initiation of Toronto Water's BFPP, efficiency improvements have resulted in a marked reduction in the time required to complete Basement Flooding Protection Environmental Assessment studies. Class EA studies, in most cases, are now completed within 2 years, from the time that a consulting team has been retained. There is a continuous push to accelerate the process further and complete studies in a shorter timeframe.

A number of factors impact the time it takes to complete a Basement Flooding Class Environmental Assessment study. These factors include:

- Municipal Class EA process as per the requirements of the *Environmental Assessment Act*
- Technical Engineering analysis
- Consultation
- Resources available

Municipal Class Environmental Assessment Process - The City of Toronto undertakes Basement Flooding studies following the Municipal Class Environmental Assessment process, as per the requirements of the *Ontario Environmental Assessment Act.*

The Municipal Class Environmental Assessment process is a planning and design process that ensures that potential effects of a project are identified, managed and discussed with the public prior to implementation. The Class EA process is a proponent driven process that includes five phases:

- **Phase 1** Defining the problem or opportunity;
- **Phase 2** Identifying and evaluating alternative solutions to address the problem and establishing the preferred solution;
- **Phase 3** Examining alternative design concepts for the preferred solution and establishing a preferred design concept;
- **Phase 4** Preparing an Environmental Study Report which summarizes the rationale, planning, design and consultation process for the Project; and
- **Phase 5** Implementation of the Project.

The number of phases to be completed in the Class EA process depends on the complexity and magnitude of potential environmental impacts of the project. Most basement flooding studies to date have been required to complete Phases 1 and 2 of the Class EA process. Stakeholder consultation is an important component of the Class EA process, and there are requirements for mandatory notification and consultation with the public, agencies, and other stakeholders at key phases of the process.

Technical Engineering Analysis - The majority of time spent undertaking a study is consumed through the engineering analyses of the existing sewer systems and the development of solution to increase the capacities of the existing drainage systems. For example:

- A computer simulation model of the existing sewer and overland drainage system often needs to be built from scratch. As our library of existing sewer systems lacks all of the

information needed for these complex models, considerable time can be required to survey the existing field conditions.

- The computer model needs to be calibrated against field observations to ensure its validity. This is accomplished by comparing simulation results against flow monitoring data. As the length of the record of flow monitoring increases so does the accuracy of the model validation stage. Meaningful data is created during larger rain storms. At times, the monitoring stage needs to wait for enough rain storms to take place.

- The development of recommended solutions is a collaborative process requiring the input from multiple engineers and the evaluation of alternatives. Rushing through this process can result in less effective or more expensive solutions being pursued.

In short, the time to complete these steps cannot be significantly shortened without impacting the reliability of the analysis or the quality of the solutions being recommended.

Consultation - Consultation with the public, regulatory agencies, interested parties and First Nations is a critical component of the basement flooding investigation studies. Typically, Toronto Water conducts two Public Information Centres (PIC) during the course a basement flooding study to present and receive input on: (1) problem/opportunity and options under consideration (PIC #1); and (2) recommended solutions (PIC #2), respectively. Additional public meetings are held for more complex projects and to address issues that arise during the study process, in addition to other mechanisms for input.

While consultation activities can add time to the completion of the Basement Flooding Class EA studies, based on experience, early, consistent and meaningful consultation with the public, regulatory agencies and interested parties is imperative to the successful completion of the studies. Consultation leads to better decision-making and resolves issues, to help ensure that recommended infrastructure improvements are supported by the community. Consultation also builds trust and provides a mechanism to raise awareness and provide educational materials to residents about basement flooding protection measures.

Available Resources - The speed at which studies can be completed is influenced heavily by the resources available to complete a study, and by the size and complexity of the area being examined. Staff are capable of completing BFPP studies at an average rate of approximately 3,000 hectares per year (i.e. every two years about 6,000 hectares of the city can be studied). While some studies can be completed quicker and some will take more time, this average rate of study is sustainable. With current studies being largely completed by the end of 2014, we will be able to start new studies in late 2014 and early 2015. The newly proposed Priority Study Areas presented in this report reflect approximately two years worth of effort for the existing staffing resources, resulting in new study completion times of 2016 and 2017.

As the studies for the original 31 (now 34) study areas were intended to be completed by the end of 2014, it was planned that TW engineering staff would become available to support the planned increase in the design and construction phase of the Capital Program. With the expansion of the study areas across the City, these staff will not be available to assist with capital

programming and, therefore, additional staff may be required in future to maintain the proposed pace of the construction program. Although design and construction is largely handled by engineering consultants and staff from the Engineering & Construction Services Division, Toronto Water staff are required to review and approve scope changes and design alterations that inevitably occur while translating conceptual designs to detailed designs and in the capital coordination process. The need for additional staff resources will be assessed during 2014 and brought forward to the 2015 budget process if required.

Next Steps

The next step is to initiate new studies, as described in this report, and to move the works recommended by the studies into preliminary design in accordance with the council approved project prioritization criteria. With many new EA studies being completed by the end of 2014, a reassessment of the Capital Program will be undertaken to ensure that it is sufficiently funded to allow ongoing reasonable project delivery. This reassessment will be reported on through Toronto Water's Capital Budget during the 2015 budget process.

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