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Involving Homeowners in Urban Flood Risk Reduction

A Case Study of the Sherwood Forest Neighbourhood, London, Ontario

By Dan Sandink

May 2011

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ICLR's mission is to reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters. ICLR is achieving its mission through the development and implementation of its programs *Open for business,* to increase the disaster resilience of small businesses, *Designed for safer living*, which increases the disaster resilience of homes, and *RSVP cities*, to increase the disaster resilience of communities.

Table of contents

Table of contents (continued)

List of tables

List of tables (continued)

List of figures

Executive summary

Urban flooding is a considerable and growing problem for residents, municipalities and insurers across Canada. Homeowners and residents who can take action to reduce their risk of experiencing damages and can limit their homes' impact on sewer and stormwater management infrastructure have important roles in urban flood mitigation. Many municipalities in Canada have developed comprehensive programs designed to increase homeowner involvement in urban flood reduction including education campaigns, and subsidy and grant programs. Municipalities have also applied by-laws and policies to require basement flood mitigation measures in homes and insurers are beginning to incentivize risk reducing plumbing measures for home insurance policy holders. Despite the important role of homeowners in urban flood mitigation, there has been very little research investigating public perceptions of urban flood risk. This study compliments earlier ICLR studies to help fill this research gap.

This study investigated basement flood perceptions and mitigative behaviours of residents in the Sherwood Forest neighbourhood of London, Ontario. Though the Sherwood Forest area is relatively new and serviced by a separated sewer system, considerable sewer backup flood risk exits largely due to foundation drain connections to the sanitary sewer system. On May 28, 2009, a rainfall event consisting of 83 mm of precipitation over a five hour period flooded dozens of homes in the neighbourhood. This study investigated several aspects of homeowner knowledge and behaviour related to urban flood reduction and revealed many opportunities for both the City of London and insurers to increase homeowner knowledge and home-level action for urban flood reduction.

Similar to previous urban flooding surveys, respondents in this study had limited awareness of sewer backup insurance coverage. Almost half of the respondents could not indicate if they had sewer backup insurance coverage. One third of respondents also did not know whether or not their home had a backwater valve. Inability to indicate the existence of backwater valves has implications for insurers, specifically reliability of sewer backup questionnaire responses for new business. The City of London had taken various measures to inform residents in the Sherwood Forest area of flood risk and city programs for flood risk reduction, including information mailings, surveys, brochures and public meetings. However, many respondents reported that they had not read or received any City of London information on flooding and many respondents had not heard of the City's basement flood reduction subsidy program. Further, a considerable proportion of respondents who experienced sewer backup flooding and the majority of respondents who experienced clean water flooding did not report their flood experiences to the City.

Several respondents experienced flooding from sump pumps and open-ended responses indicated that residents were concerned about flood risks associated with sump pumps. If there is the perception that sump systems lead to flooding, the City may experience difficulty in encouraging the use of sump systems as a means of flood reduction. Also, several respondents were concerned about how increasing development near the Sherwood Forest area had affected flood risk. However, the sewer systems of new development in the area are unrelated to those serving the Sherwood Forest area and increased development would not have exacerbated flood risk. Uptake of mitigative adjustments was relatively low, and very few respondents reported having installed sump pump systems or backwater valves on their own. Further, a considerable proportion of respondents reported having experienced infiltration flooding; a type of flooding that is largely not addressed in current City of London education materials.

There are opportunities for the City of London to partner with the insurance industry to address several of the abovementioned issues, specifically addressing resident uncertainty about sewer backup insurance coverage and in identifying which residents have experienced sewer backup in the past. Government sponsored inspections may also help address homeowner uncertainty about flood reduction measures in their home. To increase lot-level flood reduction, the City may choose to implement stronger means of incorporating mitigation measures into homes, including by-laws or policies requiring backwater valves in all new homes. Requiring mitigation in all new homes could also help address uncertainties created by climate change.

Results from this study indicated that residents, by far, preferred information from the City rather than from their insurer or insurance broker. However, as insurance brokers and insurers often serve as first point of contact for homeowners who experience a basement flood event, insurers and brokers may serve as an essential conduit for City information. Though public meetings are an important part of effective public education and engagement, respondents preferred other means of information distribution, including handbooks and brochures mailed to homes and websites. A large proportion of respondents reported that they would like to receive information from City websites; however, only a small number of respondents had reported accessing the City's existing website. More aggressive information distribution methods may be required to increase resident up-take of city information. While only a small proportion of residents reported having read City information about basement flooding, almost two thirds indicated that they would like to receive more information about basement flood reduction from the City. An incremental approach to information distribution that takes advantage of strategic moments, including times when a flood event has made local news or when residents are purchasing new homes, may help increase uptake of City flood reduction education programs.

1. Introduction

Urban flooding presents a severe and continuing problem for homeowners, municipalities and insurers in Canada. Several recent events have exemplified the financial and social impact of severe urban flooding events, including the August 19, 2005 event in Southern Ontario, which resulted in over $500 million in insured damages and caused significant damage to infrastructure throughout the Greater Toronto Area, from Hamilton to Durham Region (IBC, 2007). Residents in the City of Hamilton have endured numerous basement flood events over the past five years, from July 26, 2005 and the August 19, 2005 storm to as recently as Autumn, 2010 (City of Hamilton, 2010a; City of Hamilton, 2006a; Stockton, 2010). Other recent severe events include flooding in Southern Alberta in 2005, resulting in $300 million in insured damages, and the 2004 flood event in Peterborough, Ontario, resulting in over $87 million in insured damages. The 2004 event in Peterborough also resulted in provincial disaster relief payments of $25 million, almost $6 million of which was paid to residents (IBC, 2008; Sandink, 2006, 2007).

Aside from damage to infrastructure and the impact to the homes of their citizens, municipalities have also faced litigation associated with basement flooding, including the municipalities of Thunder Bay, Port Alberni, St. John's and Kenora (Campbell *et al*., 2007). In early 2010, the City of Stratford settled a class-action lawsuit related to a flood event in July, 2002. Under the settlement, $7.7 million was to be paid to approximately 800 homeowners in the City (City of Stratford, 2010).

Flooded homeowners may experience significant hardship as a result of basement flooding events. While sewer backup coverage is available for most homeowners in Canada, claiming insurance for damages may result in increased premiums or reduced payout limits for future claims. Insurers may also require specific damage reducing measures for homeowners to continue their coverage levels and premiums or to retain sewer backup coverage. In some cases, multiple claims for sewer backup damage can result in cancellation of sewer backup coverage for homeowners. Homeowners may also experience uninsurable damages caused by infiltration or overland flooding. While provincial disaster relief may fill this gap after wide-spread flood events, homeowners are often responsible for these damages on their own (Sandink *et al*., 2010). Aside from financial hardship, flood events may result in health and safety concerns and stress associated with the recurrence of flooding (Arthur *et al*., 2009), mould issues (Sandink, 2006) as well as the loss of valued personal items and reduced enjoyment of one's home.

Along with infrastructure and planning approaches, actions at the homeowner or private property level can play a significant role in the reduction of urban flood risk (Miguez *et al*., 2009; Turley, 2002). Private homeowners can adopt measures to reduce the risk of flood waters entering their home and can take actions to reduce the amount of water their home contributes to municipal sewer systems, thus reducing the risk of flooding for buildings serviced by the same system. Many Canadian municipalities have adopted programs to encourage the implementation of flood mitigation adjustments by private homeowners, including education programs, by-laws and policies and financial incentive programs to offset the cost of altering home plumbing and drainage characteristics.

This study investigates the basement flood perceptions and mitigative behaviours of residents in the Sherwood Forest neighbourhood of London, Ontario. On May 28, 2009, a rainfall event consisting of 83 mm of precipitation over a five hour period flooded dozens of homes in the Sherwood Forest neighbourhood of Northwest London (City of London, 2009a; Van Brenk, 2009). This storm was estimated as being a 1 in 100 to 1 in 150 year event. Forty-seven complaints of basement flooding were made to the City as a result of the event, and the City of London subsequently hired a consulting firm to model the area, held a public meeting and targeted the area for basement flood education and subsidy programs. Engineering work is ongoing in the area, and the City has identified the Sherwood Forest neighbourhood as potentially vulnerable to future flooding events.

This paper is organized into four different sections. The first section provides a brief review of major findings in the hazards perception literature, followed by a description of lot-level mitigation adjustments for urban flooding. Provided in the first section is also a summary of measures employed by several Canadian municipal governments to educate and encourage the adoption of lot-level urban flood mitigation adjustments. Section 2 describes the methods applied in this study, including a description of the case study (the Sherwood Forest neighbourhood of London, Ontario). Results and discussion are then provided in Section 3. Section 4 summarizes the findings of the study, discusses the implications of the results and provides recommendations based on the findings.

1.1. Hazard perceptions and individual risk mitigation behaviour

Though there is a long tradition of studying the perceptions of natural hazards, including flooding from natural water bodies, research on urban flood risk perceptions is extremely limited (Terpstra *et al*., 2006). This is especially true in Canada. To date, few known studies have investigated public perceptions of urban flood hazards, including sewer backup (Sandink, 2006; 2007). However, many of the characteristics of urban flooding are similar to previously studied hazards, including riverine and coastal flooding, due to their relatively infrequent occurrence and the fact that they are often triggered by extreme natural events (heavy rainfall or snowmelt). Thus, many of the findings from previous hazard studies may apply to residential perceptions and behaviours associated to urban flooding.

There is considerable evidence that hazard vulnerable residents have a low level of awareness of their risk. For example, nearly three quarters of respondents from a North Carolina community rated their flood risk as low despite their occupancy in an officially defined 1 in 100 year flood risk zone (Horney *et al*., 2010), and Siegrist and Gutscher (2006) found that residents occupying identified flood risk areas were no more likely to adopt adjustments than residents in low risk areas. Yoshida and Deyle (2005) also found that adoption of adjustment by small business owners in Duvall County, Florida was not affected by their occupancy of an identified 1 in 100 year flood zone. Further, in Glen Williams, Ontario, Kreutzwiser *et al*. (1994) found that 72% of residents who occupied the officially defined floodplain perceived no risk of future flooding. Similar results were identified in a survey of London, Ontario residents by Shrubsole *et al*. (1997), who investigated actual and perceived impacts of floodplain zoning on homes located in the

regulatory flood zone in the Coves area of London (Shrubsole *et al*., 1995). The survey results revealed that 25 of 37 respondents believed that there was no future risk of flooding, despite their occupancy of the regulatory flood zone. Further, it has been argued that individuals may occupy hazard vulnerable lands for aesthetic or quality of life reasons, and that these factors may overshadow risk of occupying desirable areas. For example, Terpstra *et al*. (2006) revealed that, in a study of Netherlands residents, respondents felt that the benefit of their location in flood vulnerable areas far outweighed flood risk.

Kunreuther (2006) argued that a reason for low levels of preparedness for disaster events and subsequent damages are a result of the "decision processes of individuals with respect to low-probability high-consequence events" (pg. 209) such as category 4 hurricanes. Due to their low probability, individuals tend to denigrate or deny disaster risk, and adopt the perception that disasters "'... will not happen to [them]'" (Kunreuther, 2006: 209). Further, given the low probability of extreme events, individuals may not consider investment in damage reducing adjustments as worthwhile (Kunreuther, 2006). As a result, it is often only after a disaster experience that they will adopt risk reducing measures. Indeed, many authors have identified a link between recent experience with hazards and both awareness of hazards and the adoption of mitigative adjustments (Browne & Hoyte, 2004; Coulibaly, 2008; Grothmann & Reusswig, 2006; Nguyen *et al*., 2006; Siegrist & Gutscher, 2006). Further, lack of historical experience with disaster events may reduce the adoption of mitigation adjustments by both the public and governments (Burn, 1999). This finding is reflected in the study by Zaleskiewicz *et al*. (2002), where flood experience increased the purchase of flood insurance. Local flood events and historical flood damages were also found to increase purchase of optional flood insurance in the U.S. (Brown & Hoyte, 2000). It has also been argued that policy makers should learn to take advantage of the "window of opportunity" that is often present shortly after a major disaster, when both public officials and residents are most receptive to investing in disaster reducing measures (Henstra & McBean, 2004; Sandink, 2009a; Solecki & Michaels, 1994).

While it is generally argued that hazard experience is a necessary condition for risk reducing behaviour, experience with multiple storms over a short time period may result in decreased risk perception (Horney *et al*., 2010). This phenomenon may be a result of the perception that extreme events occur over a regular pattern (e.g., that a 1 in 100 year flood will occur once every 100 years) and has been referred to as the "gambler's fallacy" (Arvai *et al*., 2006; Burton *et al*., 1993; Slovic *et al*., 1979; Slovic *et al*., 1974). Further, "false experiences" with relatively weak storms may lead individuals to misinterpret future risk (Horney *et al*., 2006). Conversely, experience with an unusually severe event may result in overestimation of future risk by vulnerable individuals (Arlikatti *et al*., 2006; Horney *et al*., 2010). There is some evidence to suggest that individuals in urban areas may be more fearful of urban flooding rather than flooding from natural water bodies. In a study of Netherlands residents, Terpstra *et al*. (2006) found that residents were more worried about water nuisance, defined as "abnormal amounts of water in the streets or on the land due to heavy rainfall, maximum a few decimetres" (pg. 432),

than they were of flooding from natural water bodies, as respondents felt that there was a higher probability of water nuisance while respondents felt that a flood was highly unlikely.

It has been argued that there is a strong reliance of individuals on structural flood control measures to reduce flood risk (Laska, 1986; McPherson & Saarinen, 1977; Yoshida & Deyle, 2005). Reliance on governments for risk reduction may reduce protective behaviour by residents, as they feel that structures reduce disaster risk to a point where further lot-level mitigation is not necessary (Burby, 2006). However, in an investigation of perceptions of urban flash flood risk in Carbondale Illinois, Coulibaly (2008) revealed that respondents who had experienced urban flood damages still perceived a level of flood risk despite the fact that stormwater management infrastructure in their area had been upgraded to a point as to essentially eliminate risk. Further, dependency on structures to reduce risk may depend on past experiences with structural failure (Yoshida & Deyle, 2005).

Though it has been found that individuals place the majority of responsibility on governments for both flood damages and flood mitigation (Burby, 2006; Sandink, 2007), this finding is not universal. For example, it has been shown that in a hurricane prone region of the U.S., homebuyers were willing to pay more for homes that had mitigation features (Simmons & Kruse, 2002). Arthur *et al*. (2009) found that survey respondents in Edinburgh, Scotland also accepted a level of responsibility for both sewer related flood damages and mitigation. While 64% of respondents in Edinburgh identified insufficient sewer system capacity, and 61% identified poor maintenance of sewer systems as the most important failure mechanisms for municipal sewer systems, 69% of respondents in their study reported that "pipework blocking due to household and business activities" was the most important failure mechanism. Further, 59% of respondents in the Arthur *et al*. (2009) study were willing to pay more for sewer system services if the increased cost resulted in improvements to the system, suggesting an understanding of the role of homeowners in maintenance of the system and in urban flood risk reduction.

Various methods have been employed to increase awareness and risk reducing behaviour by hazard prone individuals. As described below, several Canadian municipal governments have employed incentive and education programs to increase awareness of urban flood risk and to encourage risk reducing behaviour. Mass media is a common method of distributing hazards information, though this method has met with varying levels of success (Mileti *et al*., 1992). The development and dissemination of riverine floodplain maps has been widely applied as a method to increase hazard awareness (Montz, 1982; Sandink *et al*., 2010; Shrubsole *et al*., 2003; Yoshida & Deyle, 2005), and have been found to be successful means of increasing awareness in some cases (Siegrist & Gutsher, 2006). Some studies have found that communication with family members, friends and co-workers may have a positive impact on disaster awareness, including the likelihood that individuals will evacuate an area at immediate risk of experiencing a disaster (Drabek & Boggs, 1968; Horney, *et al*., 2006).

Adoption of risk mitigating measures is low amongst private residents. Several studies, for example, have found that fewer than 15% of individuals exposed to earthquake risk choose to adopt mitigation measures (Kunreuther *et al*., 1978; Palm *et al*., 1990). Similar results have been found for those exposed to flood risk (Laska, 1986; 1991). Kunreuther (2006) identified several explanations for limited adoption of risk reducing adjustments by private residents. Residents may underestimate or ignore probabilities of hazards, and thus are unable to accurately assess the benefits and costs of implementing risk reducing adjustments. Further, residents may choose not to seek out information on the probabilities of disaster events or may choose to anchor or focus their perceptions on the lowest probability of events if they do seek probability information (Kunreuther, 2006). Short time-horizons may also be a barrier to the adoption of risk reducing adjustments. When considering adopting risk reducing adjustments, homeowners may only consider benefits over a few years after adoption (Kunreuther, 2006). Further, residents are more likely to take into consideration the up-front costs of mitigation measures, rather than considering the long-term benefits these measures may provide (Kunreuther, 2006). Indeed, difficulty in considering long-term consequences of current actions is a well documented failing of human decision making (Kunreuther, 2006), and short-sighted policy decisions by governments has also been an identified culprit in the occurrence of disasters (Burby, 2006).

Interdependencies between neighbours' actions may also serve as a barrier or driver for mitigative action—if many homeowners in a neighbourhood implement a specific action, the probability of an individual adopting the action may increase. Conversely, homeowners may not want to be the "first person on the block" to adopt mitigative actions, especially if they change the appearance of the home or property as changes in appearance may reduce property values (Kunreuther, 2006). Family budgets, especially for low-income homeowners, serve as a further barrier to mitigative action (Kunreuther, 2006).

Kunreuther (2006) argues that the expectation of government financial assistance after a disaster event serves as an additional barrier to mitigation, as an expectation of financial assistance for damages may preclude physical adjustments for damage reduction. Though adoption of insurance for flooding where available or for sewer backup in Canada may be considered as a risk reducing adjustment, as it limits financial loss to the insurance purchaser, expectation of insurance coverage may also reduce the probability that an individual will adopt mitigative adjustments. This phenomenon, where "…obtaining of insurance tends to alter an individual's incentives to prevent loss or to take specific [loss reducing] actions…" (Parsons, 2003: 451) is referred to as moral hazard (Jongejan & Barrieu, 2008; Lamond & Proverbs, 2008; McLeman & Smit, 2006). It has been argued that moral hazard created by the subsidized provision of flood insurance under the U.S. National Flood Insurance Program has led to intense development of hurricane prone areas in the U.S. (Cutter & Emrich, 2006) and has contributed to substantial damages caused by U.S. hurricane events (Kousky, 2010).

1.2. Residential/homeowner urban flood mitigation

During urban flood events, which often result from extreme rainfall or extreme snowmelt, homeowners have typically experienced impacts from one or more of three types of flooding: Overland flooding, infiltration flooding and/or sewer backup. There are a number of adjustments that can be adopted at the private-property (or lot) level and that can assist in mitigating the risk of one or more of these types of flooding. These adjustments can largely be categorized as "behavioural" and "structural." Adjustments that relate to actions of homeowners in attaining knowledge, informing others of their risk, maintenance of home or lot features or changing the way they use their home or plumbing are considered behavioural. Adjustments that result in changes to the nature of a property, lot or home are considered structural. These adjustments are described below. For more information on homeowner level adjustments for urban flood risk reduction, see Sandink (2009b).

1.2.1. Behavioural measures

Several behavioural measures may be adopted to directly or indirectly reduce the risk of flooding for homeowners and neighbourhoods. Homeowners may choose to seek out and read information about basement flood reduction, which may be available through their municipality or other sources. Ideally, homeowners would seek information from their own municipality, as municipal-specific information will be more reflective of local sewer system and plumbing characteristics. It is also important that residents inform their municipality of flooding they have experienced in the past. This information may be used by a municipality to identify areas of concern and may assist in the prioritization of infrastructure projects or other measures that alleviate urban flood risk (City of Hamilton, 2006). A further important behavioural measure is becoming informed of one's own home plumbing by hiring a licensed professional to conduct a plumbing investigation. Proper plumbing investigations can ensure that property owners install the proper measures to reduce flood risk. The importance of plumbing investigations is reflected by their incorporation into several municipalities' homeowner sewer backup subsidy programs, including the City of Ottawa, the City of St. Catharines, Halton Region and the City of Welland, where subsidy programs include site investigations by municipal representatives (City of Ottawa, 2010a; City of Ottawa, 2006; City of St. Catharines, 2010; City of Welland, 2009; Halton Region, 2010). Other programs require third party inspections by licensed professionals before subsidy funds are disbursed (City of Toronto, 2010).

Only insurance coverage for sewer backup damage is widely available for Canadian homeowners (Sandink *et al*., 2010). However, previous research has revealed a considerable lack of awareness of insurance coverage related to flooding. A 2004 ICLR survey revealed that close to 70% of Canadian homeowners believed that overland flooding is covered under typical homeowners' insurance policies (ICLR, 2004 cited in Sandink *et al*., 2010). A 2007 survey of homeowners in Toronto and Edmonton revealed that close to a third of respondents who had experienced sewer backup at some time in the past did not know whether or not their insurance covered sewer backup (Sandink, 2007). Thus, talking to one's broker or insurance provider or carefully reviewing one's policy is an important behavioural risk mitigating measure.

Fats, oils and grease (FOGs) can accumulate in both home sanitary sewer laterals and municipal sanitary or combined sewer systems, resulting in reduced capacity to convey heavy flows of water and leading to blockages in the system, which may directly cause sewer backup. Thus, avoiding pouring FOGs down household drains can reduce sewer backup risk for both homeowners and the community. Further, the blockage of storm sewer grates by leaves, snow and ice or other debris may result in increased surface flows during a heavy rainfall event (UMA, 2005). Thus, either clearing out or reporting blocked sewer grates can reduce overland flows during extreme rain events. Reducing water use during heavy rainfall events, including delaying running of dishwashers, washing machines and using showers and bathrooms helps reduce stress on municipal systems. Further, if a backwater valve has been installed, residents should refrain from the use of any household plumbing during extreme rainfall events, as the valve may be closed and water will not be able to exit the home through the sanitary lateral. The maintenance of eavestroughs and downspouts may also reduce flood risk. Eavestroughs and downspouts plugged with leaves or debris may result in water pouring over the side of the eavestrough and landing directly next to the home and foundation wall. This water may enter window wells and windows and cause basement flooding. Further, water pouring over the side of eavestroughs may increase the amount of water that enters the homes foundation drains, which may increase the amount of water that enters the municipal sewer system. Homeowners may also choose to change the way they use their basements, including choosing not to store or locate valuable or expensive items in basements.

1.2.2. Structural measures

Structural measures include those that result in the alteration of plumbing or other components of the home and property. Like behavioural measures, structural measures may directly or indirectly reduce flood risk.

Identifying and sealing cracks in basement floors and foundation walls can serve to reduce the risk of infiltration flooding, and the identification and sealing of cracks in basement walls or other unsealed openings around utilities (wires, pipes) in the foundation above ground level may reduce the risk of water entering the basement from overland flooding. Window well covers may also help prevent overland flow water from entering basements through basement window wells and windows. Extending eavestroughs away from the side of the foundation wall helps keep eavestrough drainage away from the soil directly adjacent to foundation walls, thus reducing the amount of water that enters foundation drains. Lot grading should accommodate water flows from the property during rainfall and snowmelt events. Appropriate lot grading may not have be been incorporated into older developments, or homeowners may have changed the nature of lot grading resulting in grading that does not direct water away from the home or directs water toward the home. Homeowners should ensure lot grading redirects flows away from the home as much as possible.

Backwater valves and sewage ejector systems serve to reduce the risk of sewer backup at the homeowner level. Backwater valves are placed in either the main sanitary sewer connection (mainline valves) or in branch connections throughout the home (inline valves). When the municipal sanitary sewer surcharges, backwater valves prevent flows from entering the home. The installation of sewage ejector systems includes increasing the height of the main sewer connection where it enters the home above the potential flood level in the municipal sewer. Basement plumbing drains are then directed to a sump where they are pumped up into the lateral by the sewage ejector (Tinley Park, n.d.).

Cracks and loose joints in older sewer lateral or sanitary sewer connections may serve as a source of infiltration and excess water in municipal sanitary sewer systems. Further, blockages on private property, including those caused by tree roots or a build up of FOGs, can cause isolated sewer backup events. Thus, laterals should be inspected and repaired if necessary. As an example of a municipal program designed to address sewer laterals, the City of Surrey, British Columbia requires replacement of sewer laterals for redeveloped land or major upgrades to homes if camera inspections reveal that the lateral is in poor condition. The city may also require replacement of the lateral if it is over 30 years old without camera inspections (City of Surrey, 2008).

Foundation drains consist of perforated pipes that surround the outside of the foundation footing and serve to drain excess groundwater away from foundation walls. When connected to a home's sanitary sewer lateral, foundation drainage can contribute significant amounts of water to the municipal sewer system and result in or exacerbate the risk of sewer backup. Subject to lot conditions and local drainage infrastructure, foundation drains can be routed into a sump pit and pumped out of the home onto the surface of the lot. Municipalities may also allow connection of foundation drains into municipal storm or "third pipe" systems via storm-sewer laterals. Downspout connections into sanitary sewers may also contribute substantial quantities of water into municipal sanitary sewer systems and exacerbate sewer backup risk. Given appropriate lot characteristics, downspouts can be disconnected from sanitary or combined sewer systems and made to drain over the surface of the lot.

Foundation drain and downspout disconnection do not directly reduce a home's risk of basement flooding. However, if numerous homeowners serviced by a particular sewershed remove these extraneous sources of inflow from the sanitary or combined sewers, sewer backup risk can be reduced for neighbourhoods generally. Further, disconnection of foundation drainage and downspouts from sanitary laterals is crucial for proper backwater valve installation. "Self flooding" may result from the connection of downspouts and foundation drains to laterals upstream of backwater valves, as water will not be able to get in or out of the home when a backwater valve closes. Thus, when the backwater valve closes, foundation drainage and downspout water may be forced up through floor drains or other bathroom drains and result in basement flooding.

1.2.3. Categorization of adjustments

Aside from behavioural and structural, lot-level adjustments can be categorized based on the type of flood they will mitigate and how they reduce risk (either for the homeowner directly or for the community or neighbourhood). Available adjustments are displayed in Table 1. It is important to consider that some lot-level mitigation measures, specifically downspout disconnection and foundation drain disconnection, do not directly reduce flood risk for the home that employs them. However, as described above, if several homeowners employ these measures, risk can be reduced for all homeowners serviced by the same sewer.

Table 1: Lot level adjustments for urban flood risk reduction

Adjustment	Type of flooding addressed			Who does it help?		Classification	
	Overland	Infiltration	Sewer Backup	Homeowner	Neighbourhood	Structural	Behavioural
Seek out or read information on flood reduction	■	■	■	■	■		■
Inform municipal government about flood experiences	■	■	■	■	■		■
Plumbing investigation	■	■	■	■	■		■
Review insurance coverage			■	■			■
Avoid pouring FOGs down drains			■	■	■		■
Keep storm sewer grates clear	■			■	■		■
Reduce water use during heavy rainfall events			■	■	■		■
Maintain eavestroughs and downspouts		■	■	■	■		■
Change use of basement	■	■	■	■			■
Seal cracks in foundation walls, basement floors		■		■		■	
Identify/Seal overland flood entry points	■			■		■	
Extension of downspouts/splash pads		■	■	■	■	■	
Lot grading/backfilling/swales		■	■	■	■	■	
Backwater valve(s)			■	■		■	
Sewage Ejector System			■	■		■	
Maintenance, repair of sewer laterals			■	■	■	■	
Window wells/well covers	■			■		■	
Downspout disconnection from municipal sanitary/combined sewer			■		■	■	
Weeping tile disconnection and sump installation			■		■	■	

Source: City of London, 2010; Sandink, 2009b

1.3. Education and incentive programs and requirements for basement flood reduction measures

Reflecting the role of private property owners in urban flood reduction, many Canadian municipalities have employed programs to increase public awareness of urban flood risk and encourage the adoption of mitigation measures. There may be several components to these programs, including educational programs, by-laws and financial incentive programs.

Education programs that rely on mass media, printed materials, information mailings and public meetings are often employed in cities that have been affected by wide-spread basement flooding events. Municipal government materials are often focussed on sewer backup issues, rather than infiltration and overland flood risk reduction, though some municipalities (e.g., Richmond, B.C. and Calgary, Alberta) discuss measures to reduce the risk of severe overland flooding (e.g., riverine, coastal flooding) (City of Calgary, 2010; City of Richmond, 2010). Public meetings are a common method of basement flood communication and are often held by municipal governments and consulting firms involved in infrastructure work (Sandink, 2007). For example, The City of Edmonton, Alberta conducted public meetings focussed on backwater valves and sump pumps, which drew attendance from hundreds of residents (Sandink, 2007). Cities across Canada have developed basement flooding websites and public education materials, which focus on several aspects of urban flooding. For example, the cities of Vancouver, Calgary, Edmonton, Regina, Saskatoon, Winnipeg, Toronto, Ottawa, Montréal, Moncton and St. John have developed websites and public information materials for basement flooding and flood reduction (City of Calgary, 2010; City of Edmonton, 2011; City of Moncton, n.d.; City of Montréal, n.d.; City of Vancouver, 2009; City of Regina, 2010; City of Saskatoon, 2011; City of Saint John, 2010; City of Toronto, n.d.; City of Winnipeg, 2011a). Some cities, including Calgary, Regina and Edmonton, have developed comprehensive flood guides. The Canadian Mortgage and Housing Corporation has also developed and posted general basement flood reduction information on their website (CMHC, 2010).

The City of London has applied numerous measures to increase flood awareness, including social media (e.g., Twitter and Facebook), basement flooding websites, newspaper ads, public meetings, brochures and other printed materials, as well as public service announcements that run on a local television station. As explained below, the City of London has also employed mass information mailings for affected neighbourhoods. The City of London also undertakes surveys in neighbourhoods that are targeted for infrastructure upgrades, and has employed a financial incentive program (see Section 2).

Many Canadian municipalities have developed and implemented financial incentive (grant or loan) programs to subsidize the adoption of flood reducing measures for homeowners. Municipalities that have or once had such programs include Toronto; Brantford; Edmonton; London; Ottawa; The Region of Halton; St. Catharines; Welland; Niagara Falls; Hamilton; Saskatoon; Vaughan; Durham Region; The Region

of Peel/Mississauga; Sudbury; Winnipeg, and; Peterborough. These programs are generally aimed at reducing the risk of sewer backup caused by surcharging of municipal sewer systems rather than damages caused by overland or infiltration flooding. Maximum subsidies or loans provided through the programs are generally in the range of $3,000, which may provide funding for downspout disconnection, foundation drain disconnection and the installation of a sump pump system, and the installation of a backwater valve. However, subsidy levels vary from program to program. Several provide a portion of the cost of installing sewer backup reducing measures to a specific maximum (e.g., the City of Toronto may provide 80% of the cost of installing a backwater valve to a maximum of $1,250 and Halton Region may provide 50% to a maximum of $675 for the installation of a backwater valve), while some programs provide the full cost to a certain maximum (for example, the City of Niagara Falls may provide 100% of the cost of the installation of a backwater valve to a maximum of $500). Of note are the varying levels of assistance provided for the installation of backwater valves, which range from $1,250 in Toronto and $1,200 in Edmonton, to $675 in Halton and Peel/Mississauga and $500 in Niagara Falls. For a summary of several of these programs, see Appendix A. The City of London's grant program is summarized in Section 2.1.1.

Homeowners are often required to sign a release form along with their application to subsidy programs, releasing municipalities from liability from failed plumbing measures and indicating that provision of subsidies are not admissions of guilt by municipalities. Maintenance of backwater valves has been identified as a concern by some municipal professionals. Backwater valves must be maintained to ensure that blockages do not affect the operation of the valve during a sewer backup, and should be monitored to ensure that they are in general good condition. Reflecting these maintenance issues, the City of Brantford's *Basement Flooding Grant Programme Application Form, Agreement, and Release* states that "in the event of the sale or lease of the property, the applicant will inform the purchaser or lessee of the existence of the completed work installed and the applicable maintenance requirements" (City of Brantford, n.d.).

Some municipalities have adopted by-laws or policies that include requirements for backwater valves in all new homes. The adoption of by-laws or policies for the requirement of backwater valves may relate to both implementation and interpretation of the relevant section of the relevant provincial building or plumbing codes. Ontario Building Code Section 7.4.6.4(3) states that "where a *building drain* or a *branch* may be subject to *backflow*, a *backwater valve* shall be installed on every fixture drain connected to them when the fixture is located below the level of the adjoining street." A key factor in implementation of this section of the building code is the interpretation of whether or not a lateral "may" be subject to backflow. Municipalities may consider only new development in areas that have had historical sewer backup problems as those that "may" be subject to backflow. However, other municipalities may consider any home serviced by the municipal sewer system as potentially vulnerable to sewer backup.

In an August, 2008 staff report, City of Toronto staff recommended wider adoption of backwater valves in homes through the requirement of their installation when a plumbing permit is requested from the City for work on sewer drains. The staff report recommended that:

> The whole City be declared at risk of basement flooding in the event of unusually severe or extreme precipitation, and the Chief Building Official, in collaboration with the General Manager, Toronto Water, the Chief Planner, the Executive Director of Municipal Licensing & Standards, and the City Solicitor, in accordance with the Ontario Building Code, require any applicant of a Plumbing Permit related to the sewer drain where there is a below grade living area anywhere in the City of Toronto to install a backwater valve on their sanitary sewer lateral (City of Toronto, 2008: 5).

Toronto City Council adopted the recommendation in September, 2008. Several other municipalities throughout Canada have required backwater valves in new homes, sometimes for several decades. For example, the City of Edmonton has had this requirement since 1989 and the City of Winnipeg since 1979 (City of Edmonton, 2008; City of Winnipeg, 2011b). The City of Ottawa has also recently taken steps toward requiring backwater valves on sanitary sewer connections in all new homes (City of Ottawa, 2010b).

Neepawa, Manitoba's by-law number 3059 requires that "all new plumbing fixtures below ground level shall be protected by a backwater valve" and that the "owner shall maintain the backwater valve to ensure that it is in good mechanical condition." Similar wording requiring backwater valves is also used in Portage La Prairie, Manitoba's by-law number 6748. The City of Welland, Municipal Standards, 9.6 requires that "… all new houses (single detached, semi-detached and townhouses) to be fitted with a normally open backwater valve, in accordance with the Ontario Building Code 7.4.6.4, located in the building drain inside the house." Some municipalities may only require backwater valve installation when there is living area below street level on a home, or if the municipality feels that the home or development may be subject to sewer backflow at sometime in the future. For example, the City of Kenora's by-law number 168-2004 states that "every building drain branch serving fixtures below street level that may be subject to backflow…shall have installed a backwater valve or other approved device to prevent [backflow]" and by-law number 949-07 of Red Lake, Ontario states that "where a building drain or a branch may be subject to backflow, a backwater valve shall be installed on every fixture drain connected to them when the fixture is located below the level of the adjoining street." However, By-law number 005 of Quispamsis, New Brunswick states that "backwater valves are to be installed on building drains, inside foundation walls on all new building construction regardless of foundation elevation with roadway… ."

Some municipalities integrate maintenance requirements into by-laws for backwater valves. For example, by-laws in Welland and Kenora, Ontario and Neepawa, Manitoba require that if a backwater valve is installed in a home that it be maintained by the occupant or owner of the home. Similarly, Pointe Claire, Quebec's by-law number 2495C states that "… any connection to public sanitary, storm or combined sewer shall be equipped with a backwater valve…" and that "any backwater valve shall be maintained in good working condition by the owner."

As described in this section, Canadian municipalities have employed numerous methods to increase public awareness of basement flooding issues, ranging from mass media campaigns to the requirement of basement flood reducing measures "in new development. Incentive programs are also a relatively common method of encouraging flood reducing behaviour, but not all municipalities affected by flooding use incentive programs and incentive programs vary widely between municipalities.

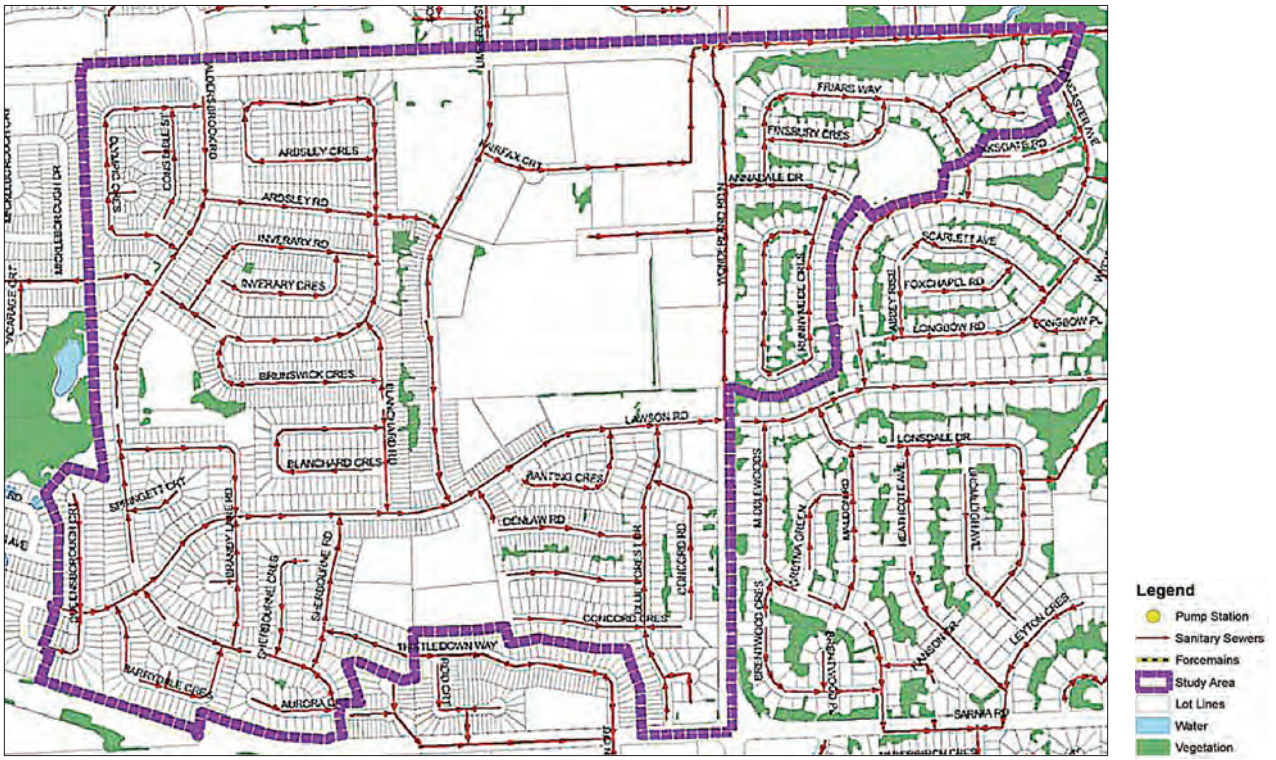
2. Methods

This section describes the case study investigated in this report (the Sherwood Forest neighbourhood), including a historical flooding event in the area. The questionnaire administration technique is also described, following a brief summary of questionnaires received and analysis methods employed in the report.

2.1. Case study

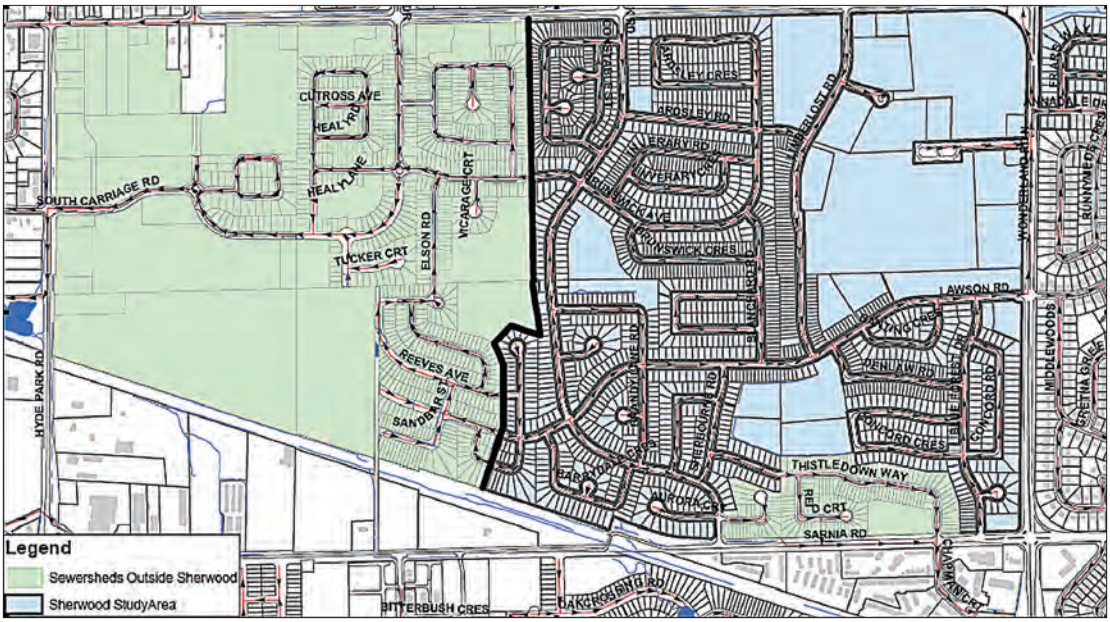
The Sherwood Forest neighbourhood of London, Ontario is located in the northwest portion of the City. The study area consisted of 2,065 single detached, semi detached and apartment units (including both rental and condominium apartments) (Figure 1). The study area is defined by a sanitary sewershed that services only that neighbourhood. The sewershed services an area bounded by Gainsborough Rd. to the north, Wonderland Rd. to the east and Sarnia Rd. to the south. The western boundary of the study area included homes west of Aldersbrook Rd., Queensborough Crt., and Olympic Cres. (Figure 2). The area is serviced by a separated sewer system.

Figure 1: Study area



Adapted from AECOM, 2009

Figure 2: Sherwood Forest area sewershed

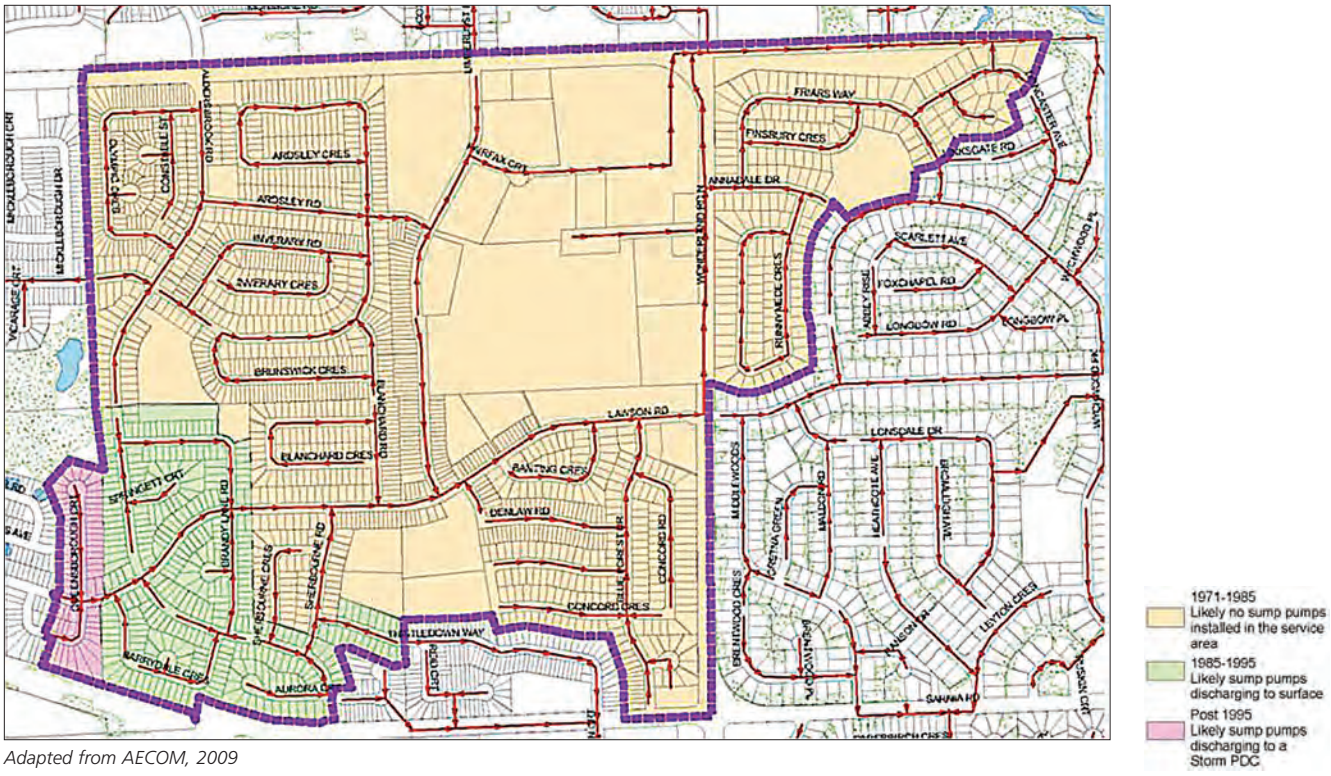


The Sherwood Forest neighbourhood experienced a severe rainfall event on May 28, 2009 that resulted in 47 basement flood complaints made to the City (City of London, 2009a). Eighty-three millimeters of rain was recorded over a five-hour period at the City of London Aquatic Centre, located west of Wonderland Rd., between Gainsborough Rd. and Sarnia Rd., translating to a 1 in 100 to 1 in 150 year rainfall event for the area (City of London, 2009a). City records indicated that 78 mm of the rainfall occurred during a three hour period between 9:30 am and 12:30 pm (Personal Communication, K. Chambers, Wastewater and Drainage Engineering, City of London, Jan. 27, 2011). Note that London received an average of 82.9 mm of precipitation in the month of May between 1971 and 2000 (Environment Canada, 2010), however this event resulted in 83 mm in just a five hour period. While the event was rare, when extended over the life of a home or the life of a mortgage a 1 in 100 year event becomes much more probable. For example, the U.S. Federal Emergency Management Agency (FEMA) estimated that a 1 in 100 year flood event has a 26% chance of occurring over the life of a 30 year mortgage (FEMA, n.d.).

The Sherwood Forest neighbourhood has gone through several phases of development, starting in the 1970s (Figure 3). The vast majority of the neighbourhood was developed by 1985, while a section in the southwest portion of the area was developed between 1985 and 1995 and the far west portion of the neighbourhood was developed after 1995. The dates of development are relevant for responses relating to sump pumps, sump pump discharge practices and downspout connections. Before 1985, new homes in the City of London were not required to have sump pumps, and foundation drains were generally made to drain into sanitary sewer connections. Thus, homes built before 1985 would likely not have sump pumps unless they were installed by homeowners. Between 1985 and 1995, new homes in London were required to have sump pumps. During this

period, sump pumps would largely have been designed to drain over the surface of lots, rather than into the municipal storm or sanitary sewer. After 1995, all new homes in London were required to have both a storm private drain connection (PDC) and a sump pump, which was required to drain into the storm PDC. Further, as it was common practice by the 1970s to drain eavestrough downspouts over lot surfaces, it is likely that the majority of residents do not have downspouts that connect into the municipal sewer system.

Figure 3: Development history of Sherwood Forest



Adapted from AECOM, 2009

On July 6th, 2009, the City of London, through the Wastewater and Drainage Engineering Division, distributed information packages to residents in the Sherwood Forest neighbourhood, which included a letter of explanation, basement flood communication materials, a pamphlet on basement flood issues in the City of London and a one-page questionnaire for residents to be mailed back to the City (see Appendix B) (City of London, 2009a). City staff reported that the City received 350 responses from this initial survey, generating a response rate of approximately 17%. The basement flooding pamphlet mailed with the questionnaire contained information on specific homeowner responsibilities for drainage and flood reduction, the importance of lot-level flood mitigation actions, who to contact for flood reduction work, notification of the City's basement flooding subsidy program, causes of flooding and information on home plumbing and drainage (including schematics) among other topics (see Appendix C for the brochure).

A subsequent mailing on November 26th, 2009 notified and invited Sherwood Forest residents to a public meeting about basement flooding, held on Dec. 9th, 2009. The public meeting was not associated with an environmental assessment process, and included a presentation on basement flooding issues. Included in the presentation was information on the causes of basement flooding, areas in the City of London that have experienced basement flooding issues, methods the City was applying to address infrastructure, information on the May 28th, 2009 flood event in Sherwood Forest, the role of private-side (lot-level) and city infrastructure measures for flood reduction, how residents can reduce basement flooding risk, information on the City of London's basement flooding grant program and additional sources of information residents could access on basement flood reduction. Approximately 100 residents attended the meeting, representing 73 properties in the Sherwood Forest neighbourhood. Further, in 2010 the City of London was engaging residents in the Blanchard Cres. area of Sherwood Forest in a downspout extension pilot, and information on the pilot program was mailed to these residents as well.

2.1.1. Basement flooding grant program

The City of London currently operates a basement flood reduction grant program, entitled the *Sump Pump, Sewage Ejector, and Storm Private Drain Connection Grant Program* (City of London, 2010). The program is available to homeowners, condominium corporations and non-profit housing co-operatives that have experienced flooding caused by surcharging of sanitary or storm sewers, or are likely to experience this type of flooding in the future (City of London, 2010). Further eligibility criteria for homeowners include the existence of weeping tiles that are directly connected to the sanitary or storm sewer system, and flooding, erosion or icing issues which are a problem on the property. Further, all proper permits and inspections must be secured by the contractor conducting the work (City of London, 2010).

Detached, semi-detached and duplex dwellings are eligible to receive assistance for disconnection of weeping tiles, installation of sump pumps, construction of a storm private drain connection, installation of a full-port, mainline backwater valve and/or installation of a sewage ejector system in lieu of a backwater valve. Funding levels differ depending on the characteristics of the home and are provided in Table 2.

Table 2: Basement flood grant program funding for ground-related homes

75% to a maximum of $1,875 for out-of-pocket expenses to disconnect the weeping tiles when they are connected to the main drain inside of the basement
75% to a maximum of $2,650 for out-of-pocket expenses to disconnect weeping tiles when they are connected to the main drain outside the basement
75% to a maximum of $575 for out-of-pocket expenses when a full port type backwater valve is installed in a residential home that already has an approved sump pump
75% to a maximum of $1,525 for out-of-pocket expenses for installation of a sewage ejector and holding tank to dispose of sewage from basement plumbing fixtures in lieu of a full port type backwater valve installed with the sump pump.
75% to a maximum of $3,775 for out-of-pocket expenses for the construction of a storm private drain connection within the City road allowance or with a city easement where the owner extends the storm PDC onto the property and connects it to a catch basin, pumped footing tile water, or both

Source: City of London, 2010; 2009b

Condominium corporations and non-profit housing co-operatives may be eligible for 75% to a maximum of $2,000 for out-of-pocket expenses for an engineering report and costs associated with sump, sewage ejector and/or private drain connections and 75% of expenses up to $900 per condominium unit for out-of-pocket expenses for lot grading, sump systems and backflow prevention systems (City of London, 2010). Also included on the grant program website is a list of 16 contractors who have attended an information session hosted by the City of London and are aware of the program and its purposes.

From 1994 to 2010, 48 homes in the Sherwood Forest area have received assistance from the City's grant program for the installation of sump pumps, sewage ejectors, storm private drain connections (PDCs) and backwater valves. Of the 48 grant recipients, 41 received assistance for the installation of sump pumps, three received assistance for sewage ejectors and 11 received assistance for the installation of a storm PDC. One homeowner received assistance for both a sump pump and sewage ejector and six homeowners received assistance for both a sump pump and storm PDC installation. Though records of which homeowners received assistance for backwater valves were not recorded by the City, all recipients of grants in 2009/2010 (a total of seven homeowners in the area) would have received assistance for the installation of a backwater valve (Personal Communication, K. Chambers, Wastewater and Drainage Engineering, City of London, July 15, 2010). Very few London residents received assistance for sewage ejectors, as backwater valves are the preferred means of reducing sewer backup risk. The City only provides assistance for sewage ejectors in extenuating circumstances, such as when a homeowner has experienced repeated backwater valve failures (Personal Communication, K. Chambers, Wastewater and Drainage Engineering, City of London, Jan. 26, 2011).

Of note was the historic progression of the City's grant program. Originally designed to provide a 100% subsidy for flood reduction measures, City staff found that contractors were taking advantage of the program through canvassing homeowners in areas not designated to receive funding. City staff also indicated that in some instances the subsidy was being applied to install improper measures or install measures where they were not necessary. This situation created undue strain on the subsidy program, and subsequently the grant portion was reduced to 50% of the cost of installation of flood related measures. The 50% subsidy, however, was not widely adopted by residents and in August, 2009, the subsidy was increased to 75% of the out-of-pocked expenses for installing risk reducing measures. The City of Hamilton has also reported cases where contractors were aggressively recruiting homeowners to participate in their subsidy program without city encouragement or authorization. Similar to the experience in London, some homeowners in Hamilton were convinced by contractors to install measures in their home that were subsidized through the grant program that may not have reflected the needs of particular homes. Further, it was reported that contractors were canvassing neighbourhoods and misrepresenting themselves as City employees to encourage homeowners to sign up for the grant program, likely to create business for themselves (City of Hamilton Media Release, 2010).

2.2. Questionnaire administration

A self-administered survey method was applied, based on a modified Dillman *et al*. (2009) Tailored Design Method. Survey delivery was completed June through September, 2010 by two research assistants. Both research assistants were students at the University of Western Ontario, specializing in engineering and sociology. The research assistants were provided resources on basement flood reduction and instructed on interview conduct and communication methods with potential respondents. To help increase interview responses and to provide homeowners an opportunity to speak directly with the research assistants about the content and purpose of the survey, research assistants delivered surveys on evenings and weekends. The questionnaires were administered through four phases. Phase one included a notification letter sent approximately one week before survey delivery began, phase two included an initial survey drop, where surveys were hand delivered to residences, phase three included a second drop of surveys to residents who did not respond and phase four included a reminder postcard, mailed to the entire survey population.

The first phase of survey administration included the mailing of an initial contact letter to homeowners in the Sherwood Forest neighbourhood (including those who owned but did not occupy homes in the neighbourhood). The initial contact letter, mailed to each potential respondent in early June, 2010, provided a general explanation of the problem of basement flooding in Canada and identified the study sponsors (the Institute for Catastrophic Loss Reduction and the City of London). The letter specifically requested responses from all recipients, even if they had never experienced basement flooding, and notified that letter recipients would be hand-delivered a basement flood survey sometime throughout the summer (see Appendix D).

Several homes in the study area were not owner-occupied. As the address list obtained from the City only included addresses of homeowners, several of the letters went to homeowners outside of the Sherwood Forest area, and in some cases, outside of the City of London. Thus, the notification letter requested that land-owners either send the letter to tenants occupying homes in Sherwood Forest or let tenants know about the study. Also included in the letter was contact information for both ICLR and City of London Staff and a guarantee that information about their specific home would not be published or publicly released.

The second phase of survey administration included hand-delivering of survey packages to the study population from early June to mid- to late-July. Included in the survey packages were: A cover letter; a seven-paged, double-sided questionnaire, and; a post-stamped reply envelope. The cover letter and questionnaire are available in Appendix E. Similar to the initial contact letter, the cover letter in the survey package explained the purpose and goals of the survey study, included contacts for both ICLR and City of London representatives and requested responses from residents even if they had never experienced basement flooding. The questionnaire was comprised of close and open-ended questions, and explored the following topics:

- Basement flood experiences;
- The characteristics of respondents' most recent flood events;

- Whether or not respondents had reported their flood to the municipal government or made an insurance claim;
- Perceptions of the likelihood of future flood events;
- Insurance coverage for sewer backup and knowledge of insurance coverage;
- Interactions with municipal urban flood education and mitigation subsidy programs;
- Desire for information on basement flood reduction, and;
- Mitigation options adopted (including backwater valves, foundation drain disconnection and sumps, sewage ejectors and downspout connections).

Photos and descriptions of backwater valves, sump pumps, sewage ejectors and downspouts were included in the survey to help educate respondents and to assist in their responses to the survey questions (see Appendix E). Also, respondents were provided an opportunity to provide general comments on flood issues in London through an open-ended response section. To ensure repeat surveys were not delivered to respondents, surveys were marked with a serial number to allow tracing of surveys back to specific properties.

The third phase of survey delivery included a survey re-drop, where a second survey package was delivered to those who had not responded to the first survey drop. The re-drop process began in late July, after research assistants had completed the first drop to all residences. Similar to the initial survey drop, residents were given the opportunity to fill out the questionnaire at the door, or were left with the survey package and asked to return the completed questionnaire by mail. Included in the re-drop survey package was a cover letter, a postage-paid reply envelope and a questionnaire identical to the one included in the first drop. The re-drop cover letter is available in Appendix F. The cover letter notified the recipient that the package provided an additional copy of the initial questionnaire, and further guaranteed confidentiality for survey responses.

The final phase of administration included the mailing of a reminder/thank you postcard. The postcard informed recipients that one or two questionnaire packages had been dropped at their residence sometime during the summer, and served as both a thank you letter for those who had responded and a final reminder/appeal for a response for those who had not yet responded. The reminder/thank you post card is available in Appendix G.

2.3. Responses and analysis

A total of 674 responses were received, providing a response rate of 32.6%. Four hundred sixty-four (69%) respondents replied to the survey by mail, while 210 (31%) respondents filled out the survey with the research assistant at the door of their home (Table 3). The vast majority of respondents owned their home (Table 4). Data was entered into an excel spread sheet as questionnaires were returned. Data was then organized and transferred into SPSS data files for analysis. In the analyses of statistical correlations, results in the 95% confidence level (p=0.05) or higher were considered statistically significant.

Table 3: Response method

	n	%
Mail	464	69%
Interview	210	31%
Total	674	100%

Table 4: Respondent home tenure

Do you own your home?	n	%
Yes	590	88%
No	81	12%
No response	3	<1%
Total	674	100%

3. Results and discussion

The following sections provide the results and analyses of survey data and discussion of findings. The results are largely organized in this section as they appeared in the questionnaire delivered to residents (Appendix E).

3.1. Flood history

Two-hundred and nine respondents (31%) reported having experienced basement flooding at some time in the past. Four-hundred and three reported never having experienced a flood, while 52 (8%) indicated that they did not know whether or not their basement flooded in the past (Table 5). Several respondents who did not know whether or not they had flooded wrote comments on the survey indicating that they did not know if their home flooded before they purchased it.

Respondents were not asked directly whether they had experienced sewer backup, overland or infiltration flooding; rather, respondents were asked first to report whether or not they had experienced any type of flooding, and whether their most recent flood event consisted of clean or sewage water. Respondents were then asked to indicate the source of the flooding (i.e., how the water entered their basement). Respondents had the option of indicating that flood waters entered their homes through the following: Floor drain; Other basement drains (e.g., toilet, sink); Sump pump; Sewer clean out; Cracks in basement floors or walls; The base of the basement wall; Basement window or door, and; Other. Respondents could also select a "don't know" option.

Of the 209 respondents that reported having been flooded in the past, 44 reported having experienced sewage flooding, 120 reported having experienced clean water flooding and eight reported having experienced both sewage and clean water flooding during their most recent flood event. Thirty-seven did not indicate whether they experienced sewage or clean water flooding (Table 6).

Respondents were asked to report the month and year of their most recent flood event. One-hundred and seventy-seven respondents with flood histories provided a clear response to this question (see Appendix H). The highest frequency of flooding for respondents occurred in 2008, 2009 or 2010 (Table 7), May, 2009 (37 of 209 flooded respondents, or 18%) and June, 2010 (16 of 209 flooded respondents, or 8%). A high frequency of flooding for respondents in May, 2009 was expected, as a heavy rainfall event in May, 2009 resulted in 47 complaints of basement flooding made to the City from residents in the Sherwood Forest neighbourhood. When categorized by month, the data revealed that most recent flood events reported by respondents occurred in April through June (Figure 4).

Table 5: Flood History

Has your basement ever flooded?	n	%[1]
Yes	209	31%
No	403	60%
Don't know	52	8%
No response	10	1%
Total	674	100%

Table 6: Flooding type and total number flooded

Flooding Type	n	%[1]
Sewage only	44	21%
Clean water only	120	57%
Sewage and clean water	8	4%
Did not indicate flooding type	37	18%
Total	209	100%

[1] Percentage based on total number of those flooded

Table 7: Number of reported most recent flood events by year

Month	n	%
1990	1	0.5%
1992	2	1.0%
1997	3	1.5%
1998	3	1.5%
1999	1	0.5%
2000	7	3.0%
2001	1	0.5%
2002	1	0.5%
2003	2	1.0%
2005	2	1.0%
2006	8	4.0%
2007	8	4.0%
2008	27	13.0%
2009	65	31.0%
2010	46	22.0%
No response	32	15.0%
Total	209	100%

Figure 4: Number of reported most recent flood events by month

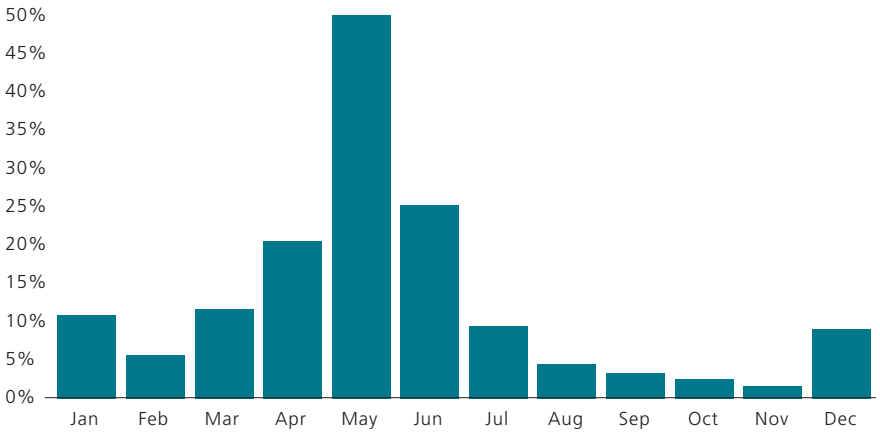


Table 8 displays the reported sources of clean water flooding. The majority of those who experienced clean water flooding (a total of 128) indicated that the water came from cracks in basement walls or floors (32%), suggesting that they experienced infiltration flooding. Further, 22% of those who experienced clean water flooding reported that water entered their home through the base of the basement wall. Amalgamated responses indicated that 44% of those who experienced clean water flooding cited infiltration flooding as the source.[1] These findings suggest that infiltration flooding is a major source of clean water flooding in the study area. The next most common source of clean water flooding was the basement window or door, with 20% of clean water flooding respondents reporting this type of flooding. Thus, though frequent, overland flooding may not be as common as infiltration flooding.

A portion of clean water flooding respondents reported that flooding entered their home through their basement floor drain (19%). Further, 17% of clean water flood respondents reported that flooding entered their basement through their sump pump. There are several explanations for clean water flooding through floor drains and sumps, including improper installation and maintenance of flood reduction measures. In some cases, sewage backup could have been heavily diluted with groundwater from foundation drainage or stormwater and thus may have appeared to be clean when backing up through floor drains.

The vast majority of those who experienced sewage flooding reported that this flooding entered the home through the basement floor drain (81%). This reflects the nature of sewer backup flooding, which is likely to enter the home through the lowest elevation drain in the home. Following the floor drain, other basement drains (e.g., bathroom drains) were cited as frequent sources of sewage flooding. It is important to note that backwater valves are effective means of reducing the probability of sewer backup flooding through basement floor drains and other

Table 8: Sources of clean water flooding

Source of flooding	n	%[1]
Floor drain	24	19%
Other basement drains	3	2%
Sump pump	22	17%
Sewer clean out	1	1%
Cracks in basement floors or walls	41	32%
The base of the basement wall	28	22%
Basement window or door	26	20%
Don't know	11	9%
Other	18	14%

[1] Percentage based on a total of 128 reported clean water flood events

Table 9: Sources of sewage flooding

Source of Flooding	n	%[1]
Floor drain	42	81%
Other basement drains	7	13%
Sump pump	4	8%
Sewer clean out	3	6%
Cracks in basement floors or walls	4	8%
The base of the basement wall	5	10%
Basement window or door	1	2%
Don't know	2	4%
Other	2	4%

[1] Percentage based on a total of 52 reported sewage flood events

[1] Infiltration flooding included flooding that entered the home through the base of the basement wall or cracks in basement walls and floors.

basement drains. The sewer clean out is also a common source of sewer backup flooding, and is reflected in results from the survey (Table 9). Interestingly, several respondents reported uncommon sources of sewage flooding, including the sump pump (8%), cracks in basement walls and floors (8%) and the base of the basement wall (10%).

As discussed above, the source of much of the clean water flooding reported by respondents was infiltration flooding. Further supporting this finding, the majority (24%) of respondents who did not indicate they type of flooding they experienced reported that flood waters entered their homes through cracks in basement walls and floors, and 16% reported that flood waters entered their home through the base of the basement wall (Table 10). However, a considerable portion (21%) of these respondents reported that overland flooding entered their home through basement windows and doors (Table 10)

Table 10: Respondents who did not indicate clean or sewage flooding

Source of Flooding	n	%[1]
Floor drain	7	18%
Other basement drains	0	0%
Sump pump	2	5%
Sewer clean out	1	3%
Cracks in basement floors or walls	9	24%
The base of the basement wall	6	16%
Basement window or door	8	21%
Don't know	4	11%
Other	4	11%

[1] Based on 37 respondents who did not indicate whether they experienced clean water or sewage flooding

3.2. Reporting flooding to city and claiming insurance

As discussed above, it is important that those who experience urban flooding report events to the municipal government, as this information can help municipalities identify risk areas and assist in reducing flood risk for homeowners. Despite the importance of reporting flood events to municipal governments, it has been found that many homeowners do not report these events (City of Hamilton, 2006; Sandink, 2007). Survey results indicate that a considerable portion of Sherwood Forest neighbourhood residents have not reported flood events to the City of London. Fifty-six percent of the 52 respondents who reported sewage flooding indicated that they reported their flooding to the City of London. Only 13% of respondents who reported clean water flooding reported their flooding to the City (Tables 11 and 12).

Table 11: Sewage flooding: Respondents who reported flooding to the city

Reported flooding to the City	n	%[1]
Yes	29	56%
No	22	42%
No response	1	2%
Total	52	100%

[1] Based on 44 respondents who reported sewage flooding and eight respondents who reported both sewage and clean water flooding

Table 12: Clean water flooding: Respondents who reported flooding to the city

Reported flooding to the City	n	%[1]
Yes	16	13%
No	111	87%
No response	1	1%
Total	128	100%

[1] Based on 120 respondents who reported clean water flooding and eight respondents who reported both sewage and clean water flooding

Claiming insurance has been one of the most common means of reducing the impacts of sewer backup damages. For example, in a 2005 survey of residents who experienced sewer backup during a severe flood event in Peterborough in 2004, 93% of respondents reported claiming insurance for their sewer backup damages (Sandink, 2006). Reliance on or expectation of insurance coverage after a hazard event may be so strong as to result in a "moral hazard," where insurance coverage

precludes further action to reduce risk at the individual level (see Section 1.1.). However, survey results in this study indicated that only a portion (52%) of respondents who experienced sewage flooding claimed insurance for their most recent event (Table 13). A much smaller proportion (20%) of those who experienced clean water flooding claimed insurance, likely reflecting the fact that their damages would not be covered under conventional home policies (Table 14) (see Section 1.2.).

Table 13: Sewage flooding: Respondents who made an insurance claim

Claimed insurance for flood	n	%[1]
Yes	27	52%
No	23	44%
No response	2	4%
Total	52	100%

[1] Based on 44 respondents who reported sewage flooding and eight respondents who reported both sewage and clean water flooding

Table 14: Clean water flooding: Respondents who made an insurance claim

Claimed insurance for flood	n	%[1]
Yes	26	20%
No	102	80%
No response	0	0%
Total	128	100%

[1] Based on 120 respondents who reported clean water flooding and eight respondents who reported both sewage and clean water flooding

3.3. Insurance Coverage

As discussed earlier, homeowners can purchase coverage for sewer backup damage under home insurance policies, generally as an additional endorsement. Previous research has indicated that homeowners possess considerable uncertainty about home insurance coverage for flooding and sewer backup (ICLR, 2004; Sandink, 2007; Sandink *et al*., 2010). A 2007 study of homeowners in Toronto and Edmonton revealed that 33% of respondents from Edmonton and 38% of respondents from Toronto who had experienced sewer backup in the past did not know whether or not they had insurance coverage for sewer backup (Sandink, 2007). These results are reflected in the current study. Of the total of 674 respondents in this study, 45% could not report whether or not they had sewer backup coverage (Table 15).

Table 15: Insurance coverage: Total sample

Do you have insurance coverage for sewer backup?	n	%[1]
Yes	289	43%
No	75	11%
Don't know	301	45%
No response	9	1%
Total	674	100%

When results were separated into type of flooding experienced by respondents, results still revealed considerable uncertainty about sewer backup coverage. Of the 52 respondents who reported sewage flooding, 23% could not identify whether or not they had insurance coverage for sewer backup (Table 16). Further, 45% of respondents who reported clean water flooding could not identify whether or not they had coverage for sewer backup (Table 17).

Table 16: Insurance coverage: Respondents who reported sewage flooding

Do you have insurance coverage for sewer backup?	n	%[1]
Yes	27	52%
No	13	25%
Don't know	12	23%
No response	0	0%
Total	52	100%

[1] Based on 44 respondents who reported sewage flooding and eight respondents who reported both sewage and clean water flooding

Table 17: Insurance Coverage: Respondents who reported clean water flooding

Do you have insurance coverage for sewer backup?	n	%[1]
Yes	59	46%
No	11	9%
Don't know	57	45%
No response	1	<1%
Total	128	100%

[1] Based on 120 respondents who reported clean water flooding and eight respondents who reported both sewage and clean water flooding

Of the 75 respondents who indicated they did not have insurance coverage for sewer backup, 31 (41%) indicated that they chose not to buy it. Twenty-five percent of these respondents indicated that they did not know this type of coverage was available, while 13 (17%) respondents indicated that their sewer backup coverage was cancelled (Table 18).

A total of 13 respondents who had experienced sewage flooding indicated that they did not have insurance coverage for sewer backup. The majority of these respondents (54%) indicated that they did not have sewer backup coverage because it was cancelled (Table 19).

Table 18: Reasons for not having insurance coverage for sewer backup

Why don't you have insurance coverage for sewer backup?	n	%[1]
Didn't know it was available	19	25%
It was cancelled	13	17%
Chose not to buy it	31	41%
Other	7	9%
No response	5	7%
Total	75	100%

Table 19: Reasons for not having insurance coverage for sewer backup: Respondents who reported sewage flooding

Why don't you have insurance coverage for sewer backup?	n	%[1]
Didn't know it was available	2	15%
It was cancelled	7	54%
Chose not to buy it	3	23%
Other	1	8%
No response	0	0%
Total	13	100%

3.4. Perceptions of future flood probability

Respondents were asked to rate their perceived likelihood of experiencing basement flooding within the next 10 years and during the next major rainstorm or snowmelt event. Though the mean ($\bar{x}$) reported likelihood of experiencing flooding during the next 10 years was higher for those who experienced sewage flooding ($\bar{x} = 4.10$) than those who experienced clean water flooding ($\bar{x} = 3.75$), an independent samples t-test revealed no significant difference (p=0.726) between the likelihood of experiencing flooding in the next 10 years for these two groups. Further, though the mean likelihood of experiencing flooding during the next major rainfall/snowmelt event for those who experienced sewage flooding ($\bar{x} = 3.52$) was higher than those who experienced clean water flooding ($\bar{x} = 3.33$), the independent samples t-test revealed no significant difference between these two groups' perception of risk (p=0.546). Thus, results for both likelihood scenarios were categorized by flood experience generally (i.e., those with flood experience include both respondents who experienced clean water flooding and sewage flooding).

Results revealed that there was a lower perception of future risk by those who had not experienced basement flooding than those who had (Tables 20 through 23). Statistical tests revealed a statistically significant difference between those who experienced flooding and those who had not for both likelihood scenarios (Figures 5 and 6). It has been revealed that perception of future likelihood of hazards is influenced by historical experience with hazards (see Section 1.1.), and the findings of this research reflect these previous findings.

Table 20: Likelihood that basement will flood in next 10 years: Respondents with no flood history

Range of response	Ranked likelihood	n	%	Combined %
Extremely unlikely	1	181	39%	
	2	99	21%	77%
	3	79	17%	
	4	52	11%	
	5	12	3%	18%
Extremely likely	6	17	4%	
No response		25	5%	5%
Total		465	100%	100%

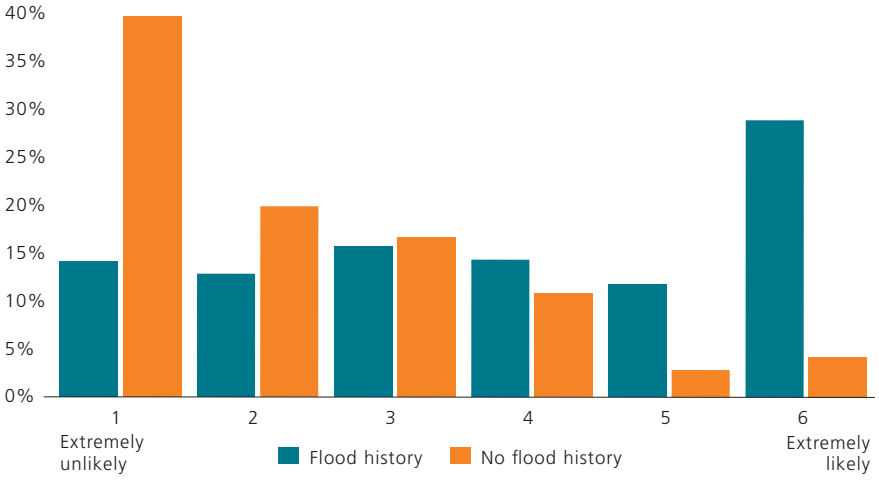
$\bar{x}$ =2.13

Table 21: Likelihood that basement will flood in next 10 Years: Respondents with a history of flooding

Range of response	Ranked likelihood	n	%	Combined %
Extremely unlikely	1	29	14%	
	2	28	13%	44%
	3	34	16%	
	4	29	14%	
	5	26	12%	55%
Extremely likely	6	59	28%	
No response		4	2%	2%
Total		209	100%	100%

$\bar{x}$ =3.76

Figure 5: Likelihood that basement will flood in next 10 Years vs. flood history



t-test, p=0.000

Table 22: Likelihood that basement will flood during next major rainstorm or snowmelt event: Respondents who did not report flooding

Range of response	Ranked likelihood	n	%	Combined %
Extremely unlikely	1	246	53%	
	2	108	23%	87%
	3	49	11%	
	4	21	5%	
	5	12	3%	<10%
Extremely likely	6	10	2%	
No response		19	4%	4%
Total		465	100%	100%

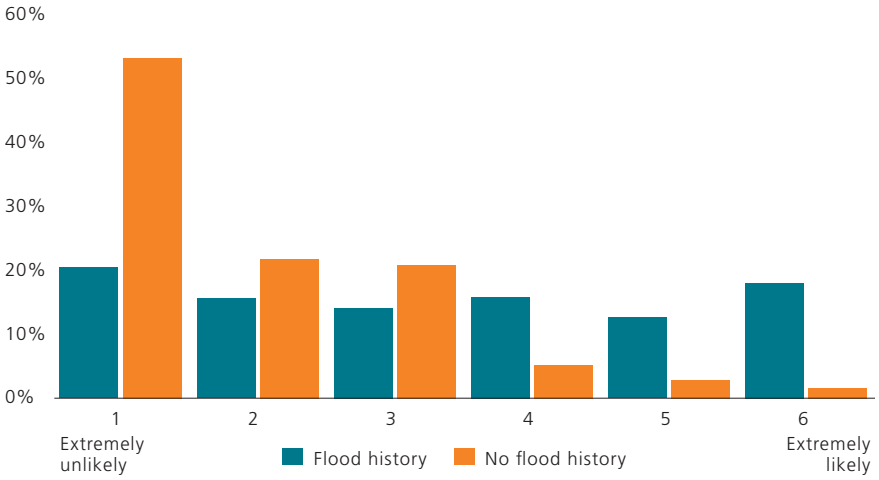
$\bar{x}$ =1.75

Table 23: Likelihood that basement will flood during next major rainstorm or snowmelt event: Respondents who reported flooding

Range of response	Ranked likelihood	n	%	Combined %
Extremely unlikely	1	43	21%	
	2	34	16%	51%
	3	29	14%	
	4	34	16%	
	5	27	13%	47%
Extremely likely	6	38	18%	
No response		4	2%	2%
Total		209	100%	100%

$\bar{x}$ =3.33

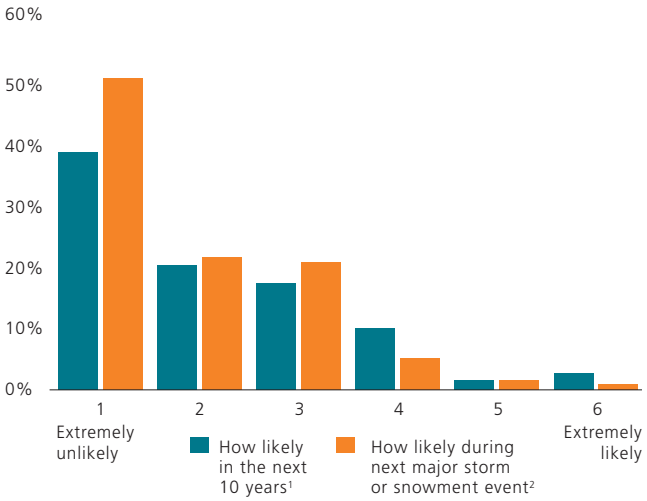
Figure 6: Likelihood that basement will flood during next major rain or snowmelt event vs. flood history



t-test, p=0.000

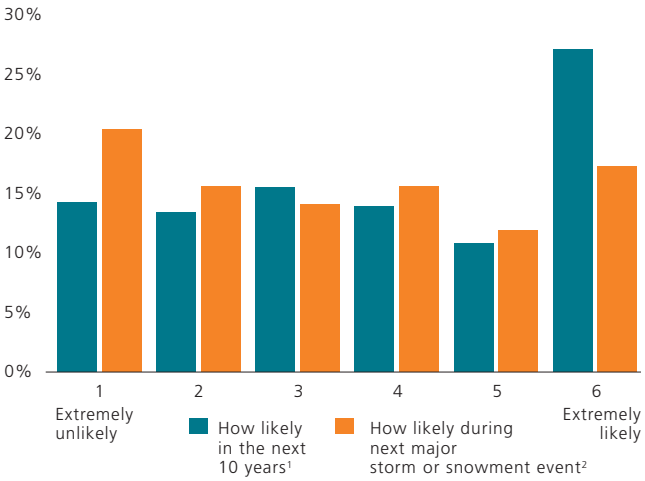
An interesting finding was the difference in perceptions of a flood event in the next 10 years and a flood event during the next major rain or snowmelt event for both those who experienced flooding and those who did not experience flooding. In both respondent groups, there was the perception that it was more likely that respondents would experience flooding in the next 10 years rather than during the next major rainfall or snowmelt event (Figures 7 and 8). The difference was found to be statistically significant using Pearson's correlation test. These findings suggest that not all respondents associate basement flooding with extreme natural events.

Figure 7: Likelihood of flooding in next 10 Years[1] vs. likelihood of flooding during next major rain/snowmelt event[2]: Respondents with no flood history



Pearson correlation: p=0.000
[1] n=440
[2] n=446

Figure 8: Likelihood of flooding in next 10 years[1] vs. likelihood of flooding during next major rain/snowmelt event[2]: Respondents with flood history



Pearson correlation: p=0.000
[1], [2]n=205

3.5. Knowledge and information sources

Respondents were asked several questions related to their current knowledge of basement flood reduction options and sources of information for basement flood education. First, respondents were asked whether or not they knew how to reduce basement flood risk. Fifty-eight percent of those who had a history of flooding indicated that they knew how to reduce basement flood risk and 47% of respondents with no flood history reported that they knew how to reduce flood risk. The difference in responses for these two groups was found to be statistically significant using the Chi-Square (χ^2) statistical test (Table 24).

Table 24: Knowledge of risk reduction measures

	Flood history		No flood history		
Question	**n**	**%[1]**	**n**	**%[2]**	**Significant difference[3]**
Do you know how to reduce your chances of having basement flooding?	121	58	219	47	Yes (p=0.009)[3]

[1] n=209
[2] n=465
[3] χ^2

Previous research has revealed that knowledge and perceptions of hazards can be affected by length of residence in a hazard prone area (Kreutzwiser *et al*., 1994; Schiff, 1977). That is, the longer one has occupied a specific neighbourhood or community, the more aware they may be of local hazards. To test this hypothesis, the number of years respondents had occupied their current home was tested against whether or not they knew what to do to reduce basement flooding risk. A total of 648 respondents indicated on the questionnaire both how many years they had lived in their residence and whether or not they knew what to do to reduce basement flooding risk. The results of the test are presented in Table 25. The hypothesis was proven to be correct, as there was a statistically significant difference between the number of years lived in the residence of respondents and whether or not they knew what to do to reduce the risk of basement flooding. The average number of years the respondents lived in their current home and who indicated they knew what to do to reduce risk was 13.2, while the average number of years of residence for those who did not know what to do was 9.9 (Table 25).

Table 25: Years lived in residence vs. know what to do to reduce basement flood risk

Know how to reduce risk?	Mean years lived in residence	n
Yes	13.2	333
No	9.9	315

2-Tailed Independent Samples t-test: p=0.000

Forty-two respondents who had historical flooding reported having read, received or downloaded information from the City of London and 29% of respondents who did not report flooding read, received or downloaded City of London information (Table 26). The relatively low frequency of having read City of London basement flooding information is interesting, as an informational brochure was mailed along with a one page questionnaire to all homes in the Sherwood Forest neighbourhood in the summer of 2009 (see Section 2.1.).

A relatively low proportion of respondents reported having accessed the City of London's basement flooding webpage, with 18% of those with a history of flooding and 5% of those with no history of flooding having reported this action (Table 26). A combined total of 54 respondents reported having attended a City of London public meeting (8% of the total sample of 674 respondents). When broken down in terms of flood history, 15% of respondents with a history of flooding and 5% of respondents with no flood history reported having attended a City of London public meeting. Very few respondents read information produced by organizations other than the City of London. Considering the low responses for visiting the City of London's basement flooding webpage, a relatively high number of respondents reported having known about the City's basement flood grant program, as 39% of those with a history of flooding and 22% of those with no flood history reported having known about the program (Table 26).

Table 26: Interactions and knowledge of city programs

	Flood history		No flood history		Significant
Question	n	%[1]	n	%[2]	difference[3]
Have read, received, downloaded City of London information?	87	42	137	29	Yes (p=0.002)[3]
Visited City of London basement flooding webpage?	38	18	25	5	Yes (p=0.000)[3]
Attended City public meeting?	31	15	23	5	Yes (p=0.000)[3]
Read other organizations' material?	7	3	5	1	Yes (p=0.000)[3]
Heard of City grant program?	82	39	102	22	Yes (p=0.000)[3]

[1] n=209
[2] n=465
[3] χ^2

A relatively high proportion of respondents were interested in receiving more information on basement flood reduction. Sixty-seven percent of respondents with a history of flooding indicated that they would be interested in receiving more information and 56% of respondents with no flood history indicated an interest in receiving more information (Table 27). From the total sample of 674, 401 (60%) indicated that they would like more information about basement flooding. The majority of these respondents indicated that they would prefer information only from the City of London (Table 28). No respondents preferred information only from their insurer or insurance broker, while 123 respondents indicated that they would like information from both their insurer or insurance broker and the City of London (Table 28).

Table 27: Interest in receiving more Information about basement flooding

	Flood history		No flood history		
Question	**n**	**%[1]**	**n**	**%[2]**	**Significant difference[3]**
Interested in receiving more information about basement flood reduction?	141	67	260	56	Yes (p=0.004)[3]

[1] n=209
[2] n=465
[3] χ^2

A further break-down of information preference results indicates that "handbooks that tell one everything about basement flooding" and "pamphlets and brochures mailed to my home" by the City were the most popular measures (Figure 9 and Table 29). Websites were also a popular measure, with 45% of respondents indicating that they would like to receive information about basement flooding through City websites. This is an interesting if somewhat contradictory finding, as very few respondents have reported accessing the City's existing website on basement flooding. Public meetings, newspaper ads and TV ads were among the least popular measures, especially if only provided through insurers (Figure 9 and Table 29).

Table 28: Preferred information sources

Information source	**n**	**%[1]**
City of London	276	69%
Insurer or insurance broker	0	0%
Both insurer and City	123	31%
No response	2	<1%
Total	401	100%

[1] n=401

Figure 9: Preferred information dissemination method

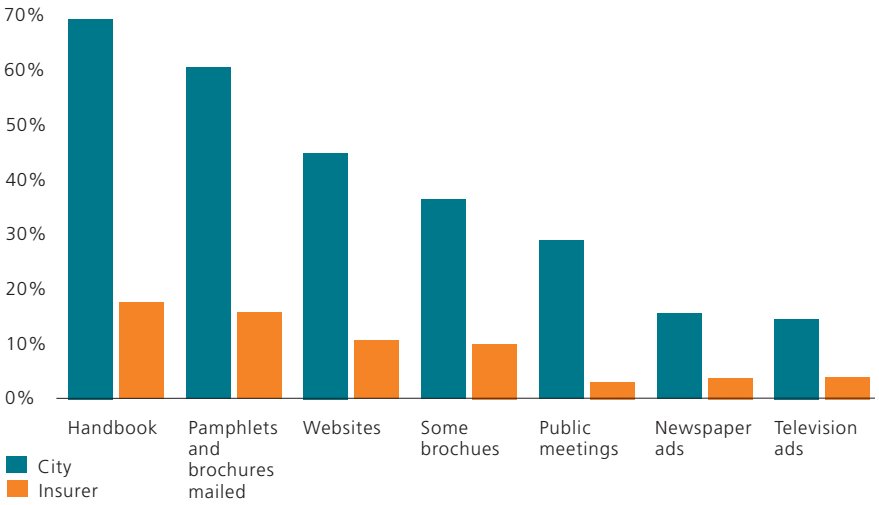


Table 29: Preferred information sources

Information provider	Information medium	n	%1
City of London	Pamphlets and brochures mailed to home	244	61%
	Some brochures that tell me a few different things about basement flooding	148	37%
	One handbook that tells me everything about basement flooding	275	69%
	Websites	182	45%
	Newspaper advertisements	63	16%
	TV commercials	59	15%
	Public information meetings and open houses	79	20%
Insurance company or broker	Pamphlets and brochures mailed to home	66	16%
	Some brochures that tell me a few things about basement flooding	41	10%
	One handbook that tells me everything about basement flooding	74	18%
	Websites	46	11%
	Newspaper advertisements	15	4%
	TV commercials	16	4%
	Public information meetings and open houses	11	3%
Other		15	4%

[1] n=401

3.6. Structural mitigation measures

Structural mitigation measures that reduce the risk of sewer backup were the focus of this study. To simplify the survey and increase response rates, respondents were asked only about backwater valves, sump pump systems, sewage ejectors and downspout connections. Respondents were also asked whether they were responsible for installation of backwater valves, sump pumps and sewage ejectors or if these features were already in the home when they moved in. Further, respondents were asked to indicate if they installed the measures themselves, if they hired a licensed plumber or contractor for installation, or if they hired someone but did not know their qualifications. Considering the potential complexity of home plumbing systems and the requirement for permits for proper installation, professional installation by a licensed plumber or contractor is ideal. Indeed, in many cases, municipal subsidy programs require professional installation of mitigation measures before funds are disbursed, and professional installation is required by many insurers to retain coverage, increase caps and/or reduce premiums after a sewer backup event.

A total of 223 respondents (35%) reported having a backwater valve, sump pump system or sewage ejector system in their home. The vast majority (594 or 88%) of respondents indicated that their downspouts were not connected into the municipal sewer system. The high frequency of this adjustment reflects the relative newness of the developments in the neighbourhood, as the homes were built after it was common practice to drain downspouts over the surface of lots rather than into the municipal sewer system. Twenty-six respondents reported that their downspouts were connected into the municipal sewer system.

3.6.1. Backwater valves

Eighty-six (13%) respondents reported having a backwater valve in their home. Thirty-three (16%) of the 209 respondents who reported flooding in the past reported the adoption of backwater valves. A considerable proportion of respondents (32%) could not indicate whether or not they had a backwater valve despite photographs and explanations of backwater valves in the questionnaire (see Appendix E), suggesting a considerable amount of public uncertainty about this adjustment. However, given the current perception literature, this uncertainty is not completely unexpected and, in fact, mirrors uncertainty about sewer backup insurance (see Table 30).

Table 30: Total responses: Backwater valve

Have backwater valve?	n	%
Yes	86	13%
No	365	54%
Don't know	214	32%
No response	9	1%
Total	674	100%

When responses were categorized into flood history, the data revealed that 33% of respondents who have never experienced basement flooding could not indicate whether or not they had a backwater valve, while only 8% of respondents who have experienced sewer backup in the past could not indicate if they had a backwater valve. This finding reflects previous research that associates hazard experience with hazard knowledge.

Knowledge of having a backwater valve in the home was tested against the number of years respondents occupied their current homes. In this case, the number of years respondents occupied their current homes was not statistically correlated to knowledge of whether or not backwater valves were in respondents' homes (Table 31), suggesting that residents who have occupied their home for a greater period of time were no more aware of this adjustments than new residents.

Table 31: Years lived in residence vs. knowledge of whether or not a home had a backwater valve

Know if a backwater valve is in the home	Mean years lived in residence	n
Yes[1]	11.9	442
No[2]	11.1	210

[1] Includes respondents who responded "yes" or "no" to: Does your home have a backwater valve?

[2] Includes respondent who responded "don't know" to: Does your home have a backwater valve?

2-Tailed Independent Samples t-test: p=0.288

The majority of respondents (66%) who reported the existence of a backwater valve in their home indicated that it was already installed when they moved in, while only 23% of those with a backwater valve indicated that they were responsible for its installation (Table 32). If this finding is extended to the entire sample, only 3% of respondents (n=674) chose to install a backwater valve themselves. However, 75% of those who were responsible for the installation of their backwater valve hired a professional plumber for installation, which is a positive finding (Table 33).

Table 32: Responsibility for backwater valve installation

	n	%
I was responsible	20	23%
It was already installed when I moved in	57	66%
No response	9	10%
Total	86	100%

Table 33: Who installed backwater valve?

	n	%
Installed myself	3	15%
Hired plumber	15	75%
Hired contractor	1	5%
Hired someone but didn't know their qualifications	1	5%
Total	20	100%

The greatest proportion of those who had a backwater valve in their home consisted of those who experienced sewage flooding in the past (37%). Twelve percent of those who experienced clean water flooding had a backwater valve in their home, while 11% of those who did not experience flooding had a backwater valve in their home (Table 34).

Table 34: Backwater valve in home by type of flood and flood history

Type of flooding	n	%	
Sewage	19	37%	(out of 52 respondents)
Clean water	15	12%	(out of 128 respondents)
Did not indicate type of flooding	3	8%	(out of 37 respondents)
No flooding	53	11%	(out of 465 respondents)

Statistical tests revealed that, while having a backwater valve in one's home was not correlated with uncategorized flood history (Table 35), there was a statistically significant correlation between sewage flooding experience and having a backwater valve (Table 36).

Table 35: Flood history vs. have backwater valve

	Have backwater valve	
Flooded	**Yes**	**No**
Yes	33	110
No	53	255

χ^2 , p=0.090 (not statistically significant)

Table 36: Type of flooding vs. have backwater valve[1]

	Have backwater valve	
Clean or sewage flooding	**Yes**	**No**
Clean	11	62
Sewage	15	21

χ^2 , p=0.003

[1] Includes only respondents who clearly identified that they had either sewage flooding or clean water flooding and whether or not they had a backwater valve

3.6.2. Sump pumps

Thirty-six percent of respondents reported having a sump pump in their home and 67% reported that there was no sump pump in their home (Table 37). A small proportion of respondents (5%) could not identify whether or not a sump pump was in their home. The number of respondents who could not identify whether or not a pump was in their home was considerably lower than the counterpart group for backwater valves, likely because sump pumps are highly visible in basement floors. As displayed in Figure 3, sump pumps were incorporated into new homes after 1985. Of the 174 respondents who reported that they had a sump pump in their basements, approximately 110 were from the area of Sherwood Forest that was built after 1985.

Table 37: Total responses: Sump pump

Have a sump pump?	n	%
Yes	174	26%
No	454	67%
Don't know	35	5%
No response	11	2%
Total	674	100%

Respondents were asked to identify where their sump pump drained. In Sherwood Forest, the majority of homes do not have storm PDCs. Thus, in the majority of cases, if a sump is installed in the home the discharge should be drained over the surface of the lot. However, as discussed in Section 2, homes built after 1995 were required to drain sump pumps into a storm PDC. A total of 10 respondents occupied the area of Sherwood Forest that was developed after 1995, and two of these respondents reported that their sump pump drained onto the surface of their lot. Further, homes that have received assistance through the City's basement

flood grant program may have sump pumps that drain into storm PDCs. However, only three respondents who reported that they had a sump pump connected into the municipal sewer system also reported that they had received assistance through the City's grant program.

The majority (59%) of respondents who had a sump in their home indicated that the pump discharge drained over the surface to their lot outside of their home (Table 38). Thirteen percent (n=23) of those who had a sump indicated that it drained into their sewer connection. Considering only three respondents who's sump pumps drained into their sewer connection have received assistance through the City's basement flooding grant program, and considering only eight residents who responded from the area built after 1995 likely have sumps that drain into storm PDCs, it is possible that many of these 23 homeowners' sumps do not drain into the storm sewer. Five respondents who had sumps (3%) reported that their sumps drained into their laundry tub or other internal plumbing. Draining into internal plumbing and laundry tubs essentially negates the purpose of having a sump pump system for foundation drainage, as water that drains into laundry tubs or other internal plumbing will continue to enter the municipal sanitary sewer system.

Respondents who had sump pumps in their homes were asked if the sump system was installed in their home when they moved in or if they were responsible for the installation of the sump. The vast majority of those who had sumps (85%) reported that the sump was already installed when they moved into their homes. Only 18 (10%) respondents reported that they were responsible for sump installations (Table 39).

The 18 respondents who were responsible for the installation of their sumps were asked to indicate who installed their sump system. Most of these respondents (61%) reported having hired a professional plumber to install the sump (Table 40).

Table 38: Where does your sump pump drain?

	n	%
Surface of ground outside home	103	59%
Into sewer connection	23	13%
Into laundry tub or other plumbing	5	3%
Don't know	31	18%
Other	6	3%
No Response	6	3%
Total	174	100%

Table 39: Responsibility for sump pump installation

Who was responsible?	n	%
I was responsible	18	10%
Already installed when I moved in	148	85%
No response	8	5%
Total	174	100%

Table 40: Who installed sump pump?

Who installed pump?	n	%
Installed myself	4	22%
Hired plumber	11	61%
Hired contractor	2	11%
Hired someone but didn't know their qualifications	1	6%
Total	18	100%

There existed a statistically significant relationship between having been flooded in the past and having a sump in the home (Table 41). This relationship likely results from the fact that several homeowners experienced flooding from their sump pump. However, there was no relationship between type of flooding respondents experienced (clean or sewage flooding) and having a sump in their home (Table 42).

Table 41: Flood history vs. have sump

	Have sump	
Flooded	**Yes**	**No**
Yes	73	125
No	85	291

χ^2 , p=0.000

Table 42: Type of flooding vs. have sump

	Have sump	
Flooded	**Yes**	**No**
Clean water	48	73
Sewage flooding	16	24

χ^2 , p=0.557 (not statistically significant)

3.6.3. Sewage ejectors

Very few respondents (1%) reported having a sewage ejector system in their home (Table 43). This is not surprising, as the City only subsidizes the installation of sewage ejectors where backwater valves are not viewed as appropriate. Indeed, from 1994 to 2010, only three homes in the Sherwood Forest neighbourhood received financial assistance from the City to install a sewage ejector system in place of a backwater valve (see Section 2.1.1.).

Of the 10 respondents who reported having a sewage ejector system, only two reported that they were responsible for its installation. Seven reported that the system was already in the home when they moved in (Table 44).

Table 43: Total responses: Sewage ejector

Have sewage ejector system?	**n**	**%**
Yes	10	1%
No	519	77%
Don't know	132	20%
No response	13	2%
Total	674	100%

Table 44: Responsibility for sewage ejector installation

	n	**%**
I was responsible	2	20%
It was already installed when I moved in	7	70%
No response	1	10%
Total	10	100%

Of the two respondents who reported that they were responsible for installing their sewage ejector system, one reported having hired a professional plumber and one reported having hired a professional contractor to install the system. Only three respondents who had a sewage ejector system reported having experienced basement flooding in the past. Of those three respondents, two reported sewage flooding and one reported both overland and sewage flooding. All three respondents experienced flooding in 2009 and 2010.

3.6.4. Downspout connections

The vast majority of respondents (88%) reported that their downspouts were not connected into the municipal sewer system (Table 45). As discussed above, this finding reflects the relative newness of developments in the Sherwood Forest neighbourhood. Some respondents reported that, though their downspouts entered the ground, they were not connected into the municipal sewer system and were routed toward other parts of their properties. As downspouts in the area were not connected to the municipal sewer system as a matter of development design, it was expected that downspout connection would not have been correlated to flood history or flood type. Indeed, there was no statistical relationship found between flood history and type of flooding experienced and having one's downspouts connected to the municipal sewer system (Tables 46 and 47).

Table 45: Total responses: Downspout connection

Is your downspout connected into the municipal sewer system?	n	%
Yes	26	4%
No	594	88%
Don't know	47	7%
No response	7	1%
Total	674	100%

Table 46: Flood history vs. downspout connections

	Downspout connected to municipal system?	
Flooded?	**Yes**	**No**
Yes	7	182
No	16	365

χ^2 , p=0.487 (not statistically significant)

Table 47: Type of flooding vs. downspout connections

	Downspout connected to municipal system?	
Flooded?	**Yes**	**No**
Clean water	3	114
Sewage flooding	2	37

χ^2 , p=0.599 (not statistically significant)

3.7. Correlations: Responsible for adjustments vs. flood history and flood type

Of the 223 respondents who reported having a backwater valve, sump or sewage ejector in their homes, 32 reported that they were responsible for having installed any one of these items at their particular home. It was expected that being responsible for installation of various flood reduction measures would have a strong correlation with flood history and flood type. Indeed, a strong statistical correlation was found between flood history and being responsible for the installation of flood reduction measures (Table 48) and type of flooding experienced and being responsible for the installation of flood reducing measures (Table 49).

Those who experienced sewage flooding were far more likely to take action by being responsible for flood reduction measure installation than those who experienced clean water flooding (Table 49). It has been found through previous surveys that residents have a stronger negative reaction to sewage flooding than to clean water flooding (UMA, 2005). It has also been argued that sewer backup is viewed as a technological hazard rather than a natural hazard, and overland and infiltration flooding tend to be perceived as natural hazards (Baum *et al*., 1983; Sandink, 2006). Thus, those who experience sewer backup may be more willing to employ technological measures to reduce their risk than those who experience clean water flooding. Further, natural hazards may be perceived as "uncontrollable" forces of nature (Baum *et al*., 1983; Mileti, 1999; Wong & Zhou, 2001) and result in a lower willingness of individuals to take action for the reduction of risk. Thus, the finding that a higher proportion of respondents who experienced sewage flooding were responsible for the adoption of adjustments has some precedent in the literature.

Table 48: Flood History vs. responsible for backwater valve, sump or sewage ejector installation

	Responsible for mitigation	
Flooded?	**Yes**	**No**
Yes	26	56
No	4	107

χ^2 , p=0.000

Table 49: Type of flooding vs. responsible for backwater valve, sump or sewage ejector installation

	Responsible for mitigation	
Type of flooding	**Yes**	**No**
Clean	9	44
Sewage	12	7

χ^2 , p=0.000

Statistically significant relationships were found both between perceptions of likelihood of experiencing flooding in the next 10 years and during the next major rainfall event and having adopted various flood adjustments on one's own (Tables 50 and 51). This finding is not surprising, as perceptions of risk of experiencing future events have been associated with the adoption of adjustments in other studies (Penning-Roswell, 1976; Preston *et al*., 1983; Sandink, 2007).

Table 50: Responsible for adjustment[1] vs. how likely in next 10 years?

Responsible for adjustment?	How likely in next 10 years $\bar{x}$	n
Yes	3.55	29
No	2.63	175

Independent samples t-test, p=0.007

[1] Respondent was responsible for installation of a backwater valve, sump pump or sewage ejector system

Table 51: Responsible for adjustment[1] vs. how likely during next major event?

Responsible for adjustment?	How likely during next major event? $\bar{x}$	n
Yes	2.29	32
No	2.20	179

Independent samples t-test, p=0.014

[1] Respondent was responsible for installation of a backwater valve, sump pump or sewage ejector system

3.8. Applications for the subsidy program

Respondents who were responsible for the installation of a backwater valve, sump pump or sewage ejector were asked to indicate whether or not they applied for the City of London's Basement Flooding Grant Program and whether or not they received funding through the program. Overall, 14 (2%) of the total of 674 respondents reported having applied for the grant program in the past. Six respondents with a history of flooding reported having applied for the program, all of whom had experienced flooding from sewage in the past (Table 52). Most of the respondents who reported having made an application program reported receiving financial assistance (Table 53).

Table 52: Respondents who applied for grant program

	n	%	
Total Sample	14	2%	(out of 674 respondents)
Respondents with flood history	6	3%	(out of 209 respondents)
Sewage flood respondents	6	12%	(out of 52 respondents)

Table 53: Respondents who received assistance from the grant program

	n	%	
Total sample	12	86%	(out of 14 respondents, carried from previous table)
Sewage flood respondents	4	67%	(out of 6 respondents, carried from previous table)

3.9. Open ended responses

At the end of the questionnaire, respondents were invited to provide comments on anything related to basement flooding in the City of London. A total of 108 open-ended responses were received and are provided in Appendix I. A short summary of key findings from the open-ended responses is provided here.

A review of the open-ended responses revealed several main themes, including:

- Comments and concerns surrounding insurance coverage;
- Comments on the role and responsibility of the City of London in basement flooding, including comments on the capacity and design of sewer infrastructure, perceived poor planning decisions made by the City and requests for compensation from the City;
- The perceived role of increased development in and around the Sherwood Forest neighbourhood as a factor in increased flood risk, and;
- Comments on the perceived attitude of the City toward residents in the occurrence of basement flooding.

Further, the open-ended question was used by many respondents as an opportunity to request specific information on their homes for basement flood reduction or on city programs. When specific information was requested, surveys were forwarded to the City of London for follow-up.

Several respondents used their open-ended response as an opportunity to make comments regarding insurance coverage, including concerns regarding increased premium prices for sewer backup coverage and dropped sewer backup coverage. For example, a respondent reported that their "sewer backup insurance coverage has been dropped" and another reported that their "insurance rates have gone up dramatically due to flooding." Despite these concerns, survey results indicated that most residents in the Sherwood Forest neighbourhood have not experienced sewer backup coverage cancellation, though no questions regarding changing nature of coverage (e.g., increased premiums, caps, etc.) were included in the survey. It is possible that a larger number of respondents experienced changes in the nature of their sewer backup coverage than cancellation of sewer backup coverage altogether.

Twenty-nine (27%) of the 108 open-ended responses included comments regarding the responsibility of the City of London for both flood risk and solving flood risk problems. These responses often included comments on the perceived inadequacy of sewer infrastructure. For example, one respondent commented that "the city should be taking care of infrastructure as top priority to prevent basement flooding," and another commented that "the problem is inadequate sewer/sanitary lines for the area…." Some respondents felt that flooding problems were a result of both inadequate sewer infrastructure and increased development in the area, exemplified by one respondent who reported that the "city needs to build a bigger sewer pipe; stop home construction until then" and another respondent requested that the City "stop allowing houses to be built unless [the City is] prepared to increase the size of the sewage system."

There were several comments about the perceived role of increased development in and around the Sherwood Forest area and increased flood risk. One respondent stated: "From 1985 to 1999, no floods… from 2000 to 2009, 9 floods – way more houses…". The following represent further respondent comments on the topic of perceived over-development:

- "The excess water in our backyards (Brandy Lane Crt) is a direct result of the completion of Aldersbrook Rd. (18 years ago)."
- "In 20 years we have never had a basement flooding issue. Has the developments to the west tied into the storm water system [caused] the recent neighbourhood problems?"
- "Happens two times and the City do nothing to solve the problems – there are now too many new houses linked to this system in my street."
- "When we purchased our home fifteen years ago the issue or concern of flooding did not come up. Now there has been considerable development in our area and we are noticing more problems with standing water, slow water drainage on our street and water in our basement."
- "We were OK until additional subdivisions were built all around us."

There were also comments about the perceived attitude of the City of London toward homeowners on the issue of basement flooding. For example, one respondent reported that "when [they] attended [a] meeting [they] felt that the City kept cutting people off when voicing their concerns. They only seemed to push back responsibility to the homeowner…" There were also some comments about the adequacy of the City's subsidy program, including one respondent who reported that they "used the City's Grant program, but it was difficult – took 2 tries to get the money. Hope that it won't be used against you. Too little, too late. The City should have acted years ago."

Of note was a respondent who reported that they had newly arrived in Canada, and did not have a complete understanding of home plumbing systems and home maintenance practices, as they were considerably different than in their original country. The respondent reported that "we need a program to introduce how everything in house works in this type of weather." Some respondents voiced concern that flood reduction measures installed in homes will decrease resale values. Concerns about sump pumps, including their capacity to handle heavy flows, the impact of power failure, and concerns that battery backup systems would not have the capacity to continue running during a heavy rainfall event were also reported by respondents.

4. Summary, implications and conclusions

This section provides a summary of the major findings of the study, followed by a discussion of implications of the findings. Recommendations are provided in tandem with the implications. Recommendations relate directly to the City of London, municipalities in general and to the insurance industry. A conclusion is then provided for this study, including recommendations for further study.

4.1. Summary of findings

1. Summary of questionnaire administration findings:
    a. The survey methods applied for this project yielded a response rate of 32.6%. This is considered to be good, as a similar survey using less intensive distribution methods mailed to each homeowner in the study area the previous summer yielded a response rate of 17%.
    b. Most respondents chose to fill out and mail back their survey rather than fill it out with the research assistant.

2. Summary of flood history findings:
    a. A total of 209 respondents reported that their basement had flooded at some time in the past. Fifty-two respondents could not indicate whether or not their basement had flooded in the past.
    b. A significant portion of flooded respondents reported flooding in May, 2009 and June 2010. The majority of flooding events were reported to have occurred in April, May and June.
    c. The majority of respondents who reported clean water flooding indicated that flooding entered their homes through cracks in basement walls and floors and through the base of basement walls, indicating that infiltration flooding caused the majority of clean water flood events for the study sample.
    d. Twenty-four percent of respondents who did not indicate whether they had clean or sewage flooding indicated that water entered their home through cracks in basement walls and floors.
    e. Twenty percent of clean water flooded respondents reported that flood waters entered the home through basement windows and doors, while 19% indicated that clean water entered the home through the floor drain and 17% indicated that water entered the home through the sump pump.
    f. Eighty-one percent of those who reported sewage flooding indicated that sewage entered their home through the floor drain. The next most common source (13%) was other basement drains. Five respondents reported that sewage water entered their home through the base of the basement wall.

3. Summary of findings, reporting flooding to City and claiming insurance:
    a. A significant proportion (42%) of respondents who reported sewage flooding indicated that they did not report their flood event to the City of London.
    b. The majority (87%) of respondents who reported clean water flooding did not report their flood event to the City.

c. Fifty-two percent of respondents who experienced sewage flooding claimed insurance for their flood event, and 20% of respondents who experienced clean water flooding claimed insurance for their most recent event.

4. Summary of findings, insurance coverage:

   a. Forty-three percent of respondents reported that they had insurance coverage for sewer backup, and 11% indicated that they did not have insurance coverage for sewer backup.

   b. The majority of respondents (45%) could not indicate whether or not they had insurance coverage for sewer backup.

   c. When responses were separated in terms of flood history, it was revealed that a greater proportion of respondents with a sewage flood history (77%) could indicate whether or not they had insurance, however, 23% of these respondents did not know whether or not they had insurance coverage for sewer backup.

   d. Forty-five percent of respondents who reported clean water flooding could not indicate whether or not they had insurance coverage for sewer backup.

   e. Most respondents (41%) who indicated that they did not have insurance coverage for sewer backup indicated that they chose not to buy sewer backup coverage.

   f. A total of 13 respondents indicated that their sewer backup coverage was cancelled.

   g. Seven (54%) of the 13 respondents who reported sewage flooding and reported that they did not have sewer backup insurance coverage reported that their sewer backup insurance coverage was cancelled.

5. Summary of results, perceptions of the likelihood of future flooding events:

   a. The majority of respondents who had no flood history (77%) felt that it was unlikely that they would experience flooding in the next 10 years. Further, 87% of these respondents felt that it was unlikely that they would experience flooding during the next major rainstorm or snowmelt event.

   b. Fifty-five percent of respondents who experienced flooding in the past indicated that it was likely that they would experience flooding again at some time over the next 10 years, and 28% of these respondents felt that it was "extremely likely" that they would experience flooding again in the next 10 years.

   c. Forty-seven percent of respondents who experienced flooding in the past reported that it was likely that they would experience flooding again during the next major rainstorm or snowmelt event, and 18% of these respondents felt it was "extremely likely" that they would experience flooding during the next major rainstorm or snowmelt event.

   d. Results indicated that, generally, respondents felt it was more likely that they would experience flooding over the next 10 years than during the next major rainstorm or snowmelt event.

6. Summary of results, knowledge and information sources:

   a. Fifty-eight percent of those with a history of flooding and 47% of those with no flood history reported that they knew how to reduce their chances of having basement flooding. The difference between these two groups was statistically significant.

   b. Results indicated that those who occupied their current homes for a longer period of time were more likely to know what to do to reduce the risk of basement flooding in their homes.

   c. Forty-two percent of respondents with a history of flooding and 29% of respondents with no flood history reported having read, received or downloaded City of London information on basement flooding.

   d. Eighteen percent of respondents with a history of flooding and 5% of respondents with no flood history reported having visited the City of London's basement flooding webpage.

   e. Fifteen percent of respondents with a history of flooding and 5% of respondents with no flood history reported having attended a City of London public meeting on basement flooding.

   f. Thirty-nine percent of respondents with a history of flooding and 22% of respondents with no flood history reported having heard about the City's basement flooding grant program.

   g. Sixty-seven percent of respondents with a history of flooding and 56% of respondents with no flood history were interested in receiving more information of basement flood reduction.

   h. Of the respondents who reported that they would like to receive more information about basement flooding, most indicated that they would like to receive this information from the City of London. No respondent indicated that they would like to receive information only from their insurance provider or insurance broker.

   i. Preferred methods for receiving information included a single handbook that describes everything about basement flood reduction, brochures and pamphlets mailed to the respondents' homes, and websites. Respondents preferred that this information be provided by the City.

7. Summary of results, structural mitigation measures:

   a. 35% of respondents reported having a backwater valve, sump pump and/or sewage ejector.

   b. Eighty-six respondents reported having a backwater valve in their home. Twenty (23%) of these respondents indicated that they were responsible for the installation of the backwater valve, and 66% of these respondents reported that the backwater valve was already in their home when they moved in.

   c. A considerable proportion of respondents (32%) could not indicate whether or not they had a backwater valve in their home.

d. A greater proportion of those who experienced sewage flooding had a backwater valve in their home compared to those who experienced clean water flooding.

e. One-hundred and seventy-four respondents reported that they had a sump pump in their home. Only 5% of respondents could not indicate whether or not there was a backwater valve in their home.

f. Most respondents who had a sump pump (59%) reported that the pump drained on the surface of the ground outside of their home. However, 13% of these respondents indicated that their sump pump drained into their sewer connection.

g. Only 10% of those who had a sump pump in their home were responsible for its installation.

h. Very few respondents reported having a sewage ejector in their home, and 20% of respondents could not indicate whether or not there was an ejector in their home. Only two respondents reported having been responsible for the installation of their sewage ejector system.

i. Most respondents who were responsible for the installation of a backwater valve, sump pump or sewage ejector reported having hired a professional plumber or contractor for installation.

j. Eighty-eight percent of respondents reported that none of their downspouts were connected into the City sewer system.

8. Summary, factors associated with adopting structural adjustments:

a. A total of 32 respondents reported that they were responsible for the installation of a backwater valve, sump pump and/or sewage ejector.

b. There was a strong correlation between flood history and being responsible for the installation of a structural measure.

c. Respondents who experienced sewage flooding were more likely to have been responsible for the installation of a structural measure than those with clean water flooding.

d. Perceiving a risk of flooding in the next 10 years was statistically correlated with being responsible for the installation of a structural measure, as was perceiving a risk of flooding during the next major rainstorm or snowmelt event.

9. Summary of results, applications for subsidy program:

a. Very few respondents (2%) reported having applied for the City's basement flood grant program. Six respondents with a history of flooding reported having applied for the program, all of whom experienced sewage flooding.

b. A total of 12 respondents reported having received financial assistance through the program, four of whom had experienced sewage flooding.

4.2. Implications and recommendations

Reflecting the findings of previous surveys (ICLR, 2004; Sandink, 2007), a considerable lack of awareness of insurance coverage for sewer backup was revealed in this study, as 45% of respondents did not know whether or not they had sewer backup insurance coverage. Also, 23% of respondents who experienced sewage flooding in the past could not indicate if they had sewer backup coverage. Further, only 31 respondents indicated that they chose not to buy insurance coverage for sewer backup, indicating that those who know about sewer backup coverage are likely to purchase it. Thus, there is an identified need for insurers and governments to increase awareness about sewer backup and insurance coverage. Though information on insurance coverage is often included as part of municipal education programs, municipalities should consider developing more targeted information on this topic, including, for example, a brochure that focuses exclusively on issues surrounding insurance coverage for basement flooding. The City of London may wish to partner with the insurance industry in the development of insurance education materials for basement flooding.

There existed a relatively high rate of "don't know" responses when asked if respondents had a backwater valve in their home (32% of respondents). This finding indicates that there is low awareness of current states of homes as they relate to basement flood risk. A lack of knowledge about the plumbing characteristics of the home also indicates the potential importance and benefits of municipal government sponsored inspections of homes, as applied in Halton Region and other municipalities (see Appendix A), which help homeowners identify the current state of their home and the appropriate measures for flood reduction. The City of London may wish to investigate incorporating municipally sponsored home inspections into their current grant program. Government sponsored inspections may also increase the confidence of homeowners and may help ensure they know what to ask for when seeking out plumbers and contractors for the installation of flood reduction measures. As discussed in Section 1.3., some municipalities have incorporated requirements that homeowners pass on information about basement flood reduction measures to whomever purchases or rents the home, including maintenance requirements for these measures. This requirement may also assist in increasing awareness of basement flood reduction measures.

There was a much greater lack of awareness of backwater valves than of sump pumps or sewage ejectors. The City, thus, may choose to make a concerted effort on increasing awareness about this particular flood adjustment. For example, a separate brochure or separate set of information materials on backwater valves could be developed and aggressively distributed in the Sherwood Forest area. The City may also choose to work with insurers or insurance brokers on the distribution of information on backwater valves.

Residents who occupied the neighbourhood for a greater period of time reported having more awareness of basement flood reduction measures than newer residents. This indicates a greater need to "reach out" to newer residents. The point of sale may serve as an opportune time to communicate information. Further, when purchasing a home, residents are likely to deal with insurance providers or insurance brokers, further identifying the insurance industry as a potential key player in the education of homeowners and residents about basement flooding. Though new residents indicated that they were less knowledgeable about basement flood reduction in general, knowing whether or not a backwater valve was in the home was not correlated to length of residence in the home. Thus, there is a need to communicate with all homeowners about backwater valves, regardless of the length of time they have lived in their home.

Twenty-two respondents reported that they experienced clean water flooding that entered their home through their sump pump, representing a considerable portion of those who experienced clean water flooding (17%). Previous research has argued that information passed through various conduits must remain consistent in order for it to be perceived as trustworthy (Nathe *et al*., 1999). Also, previous research has indicated that private residents may rely heavily on family and friends for information on basement flood reduction (Sandink, 2007). If a large proportion of individuals are flooded through their sump pump systems, and if this information is passed through neighbourhood social networks, individuals may develop a negative perception of sump pump systems and may be less likely to adopt this important flood reduction measure. Reflecting this concern, there were several comments in the open-ended response section expressing concern over the use of sump pumps. Thus, identifying and addressing sump pump related flooding may be considered as a priority for urban flood managers. For example, it may be in the City's interest to follow-up on homeowner complaints of sump pump failure and ensure that proper remedies are applied.

Despite the fact that all residences in the Sherwood Forest neighbourhood received a package including a brochure identifying City of London programs for flood reduction, only 42% of respondents with a history of flooding and 29% of no flood history reported that they had ever read any City of London information on basement flooding. Further, only 39% of respondents with a history of flooding and 22% of respondents with no flood history reported that they knew of the City's basement flooding grant program. Though previous research has revealed that residents have a low level of awareness of hazard issues, this finding is somewhat surprising considering brochures were mailed to each home the previous summer that contained information on City programs including the subsidy. The finding is even more surprising when considering that respondents identified the mailing of brochures and pamphlets to homes as one of the preferred means of receiving information on basement flooding. This findings indicates that a one-time mailing of information may not be, in and of itself, sufficient for the communication of flood reduction information.

Several respondents expressed concern that development in the area surrounding the Sherwood Forest neighbourhood may be increasing flood risk. Further, some respondents perceived a direct relationship between development and increased occurrence of flooding in the area. However, as displayed in Figure 2, Sherwood Forest is serviced by a specific sanitary sewer system, separate from the systems that serve developments around the area. Thus, increased development outside of the Sherwood Forest area would not impact sewer backup risk for Sherwood Forest residents. It may be beneficial to communicate this fact to residents in the Sherwood Forest neighbourhood.

The argument that homeowners are often unwilling to adopt risk reducing adjustments on their own (Kunreuther, 2006) was supported in this research, as the majority of those who had risk reducing plumbing features in their home were not responsible for their installation (i.e., only 32 respondents reported that they were responsible for the installation of a sump pump, backwater valve and/or sewage ejector). Further, though sewer backup is often viewed as a problem with older developments, Turley (2002) reported that in New Lennox, Illinois, there were cases where new development had higher rates of infiltration and inflow than older developments due to poor construction and inspection practices. Compared to many neighbourhoods in London, the developments in the Sherwood Forest area are relatively new, but many homes have still had problems with sewer backup. For these reasons, the City may consider implementing more coercive means for the installation of backwater valves, such as the requirement that valves be installed in all new homes or requirements for the installation of backwater valves when permits are requested for work related to sanitary sewer connections, as other Canadian cities have done (see Section 1.3.).

Changing development patterns throughout the City and climate change may serve to alter the nature of urban flood risk in the future. For example, Nirupama and Simonovic (2006) reported that increasing urbanization in the Upper Thames watershed has changed the nature of urban runoff in the City of London. In 1970, 400 mm of total precipitation resulted in 350 m^3/s of peak flow in the Thames River, as recorded by a Byron monitoring station. In 1997, a 200 mm precipitation event resulted in a flow of 800 m^3/s in the Thames River (Nirupama & Simonovic, 2006). Further, a 2007 study by Prodanovic and Simonovic revealed that climate change may result in increasing severity and intensity of short duration rainfall events in London, Ontario. As well, a report by Cheng (2007) suggested that seasonal rainfall totals during the warm months (April-November) could increase under certain climate change scenarios in several Southern Ontario cities, including London. The study indicated that the frequency of heavy rainfall events that include equal or at least 15 mm of precipitation in one day could increase anywhere from 8% to 40% in the 21st Century from average frequencies in the same basins between 1961 and 2002. The frequency of rainfall events that include at least 25 mm of precipitation in one day could increase by 10% to 50% (Cheng, 2007). These factors suggest that the nature of urban flooding events

could change in London in the future, perhaps in unpredictable ways. Practicing the precautionary principle and mandating wider implementation of basement flood reducing measures could serve as one way to address these uncertainties.

In the open-ended sections of the questionnaires, there was evidence that some homeowners felt that the City was placing responsibility for basement flooding on homeowners, and some respondents felt that placing responsibility on homeowners was a method adopted by the City to shift responsibility away from itself. It may be worthwhile to address this concern in public education efforts. For example, the City may wish to communicate to homeowners that, while they have a role in urban flood reduction, the City is also taking actions that will reduce risk. Hazard researchers have argued in the past that hazard managers should make use of as many information conduits as possible, and should make sure that information is consistent across these conduits to increase the effectiveness of public education programs (Nathe *et al*., 1999; Sandink, 2007). As discussed earlier, the City of London has applied numerous conduits for the transmission of basement flood information, including mailings of brochures and questionnaires, TV commercials and websites. However, the interaction of the study group with City basement flood materials remained relatively low, as only 42% of respondents with history of flooding and 29% of respondents with no flood history reported having ever read any City information. The City has not incorporated the insurance industry into their education campaign, and this presents a considerable opportunity to spread information on basement flood reduction. As described in this study, respondents would prefer information from the City rather than from insurers, however, insurers may serve as a conduit for City information.

Public participation in government planning exercises can assist governments in increasing public support for decision making and policy initiatives, and increase the ability of decision makers to identify potential conflicts in policy and decision making exercises (Healey, 1992; Innes & Booher, 1999). Burby adds that public participation can increase awareness of certain planning related issues and help to persuade relevant stakeholders of a need to address issues (Burby, 2003). Further, effective participation can increase the legitimacy of, and reduce cynicism about government initiatives (Forester, 2006). As reported by City staff, the public information session held in the Sherwood Forest area following the May, 2009 flooding event provided an opportunity for residents to "blow off steam" and address their concerns directly to City staff. Thus, there is no doubt that public engagement and public information meetings are an important part of the public education and engagement process. However, relatively few respondents (15% of flooded respondents and 5% of respondents with no flood history) reported having attended a City public meeting about basement flooding. Further, only 20% of respondents who were interested in receiving more information about basement flooding indicated that they would like this information to be provided through

municipal public meetings (12% of the total sample of 674). The lack of attendance of respondents and potential lack of interest in public meetings as an information distribution tool further supports the need to use multiple conduits to both disperse and receive information about basement flooding (Nathe *et al*., 1999; Sandink, 2007).

While only 33% of respondents reported reading City of London basement flood materials, 59% expressed interest in receiving more information from the City. As described in this paper, repeated appeals for homeowner response to the questionnaire significantly increased response rates when compared to the singular questionnaire mailing used by the City the previous summer. Further, an incremental approach to information dissemination can be an effective means of increasing hazard awareness. An incremental approach may include providing information of specific aspects of basement flooding over a period of time (for example, spacing out the mailing of brochures on sump pumps, backwater valves, lot grading, etc. over a period of time). Strategic moments, including when a flood event has made local new media, serve as effective times to send information on flood reduction to residents. As the majority of flood events reported in this survey occurred in the spring, and the spring is when most flooding events in Canada occur (Shrubsole *et al*., 2003), the City may choose the spring months as a further strategic information distribution moment.

Though 27% of the total sample of 674 (or 45% of the 401 respondents who indicated they would like to receive more information on basement flood reduction) indicated that they would like information provided to them by use of a City website, only 18% of respondents with a history of flooding and 5% of respondents with no flood history reported that they had ever visited the City's current webpage on basement flooding. This finding suggests that residents are unaware of the flooding webpage on the City of London website. The City may consider placing a link to the basement flooding section of their website in a more accessible area, including the home page. Though the flooding website was mentioned in the brochure mailed to residents in the Sherwood Forest neighbourhood (see Appendix C), it was mentioned in relatively small text near the bottom of the brochure, and directed residents to use the website's search function to access the flooding webpage.

A significant portion of respondents in this study experienced infiltration flooding. However, most municipal education programs are focussed only on flood reduction from surcharging of the City's sanitary sewer, causing sewer backup. Cities may choose to increase educational content relating to the reduction of infiltration flooding.

Sewer backup endorsement summaries have indicated that several Canadian insurers that write sewer backup risk in Ontario consider the existence of flood reducing plumbing measures when setting premiums, caps and/or deductibles for homeowner sewer backup coverage. When a homeowner makes a claim for sewer backup damage and the insurer subsequently requests the installation of sewer backup mitigating devices, the insurer may ask for evidence of installation, such as an invoice or receipt from a professional plumber. However, when writing new business, insurers may rely on homeowner responses to sewer backup questionnaires to indicate whether or not a potential insured has sewer backup mitigating devices. Arguably the most important mitigation device at the homeowner level is a properly installed backwater valve, in combination with foundation drains that are disconnected from the sanitary sewer. However, a considerable proportion of respondents in this study (32%) could not indicate whether or not they had a backwater valve in their home. If a large proportion of homeowners do not know if they have appropriate risk mitigating devices in their homes, it calls into question the legitimacy of homeowner responses to sewer backup questionnaires.

As discussed above, it is important that residents who experience basement flooding report flood events to their municipality. This information can be used to help the municipality identify areas at risk of flooding and the potential causes of flood events. However, 42% of respondents who experienced sewage flooding and 87% of respondents who experienced clean water flooding did not report their most recent events to the City of London. When recommending mitigation measures or when dealing with homeowner claims for basement flooding, insurers or insurance brokers should consider requesting that homeowners report their flood events to their municipality.

As discussed in Section 3.6.2, there is evidence to suggest that the some of the 23 respondents who reported that their sump pumps are draining into their sewer connection are actually draining their pumps into the sanitary sewer. Further, five respondents reported that their sump pumps were draining into their laundry tub or other internal plumbing. The City may wish to follow-up with these homeowners and identify their sump pump connections, and take action to correct them if they are indeed draining into the sanitary sewer.

4.3. Conclusion and further study

Urban flooding presents one of the more significant risks to Canadian urban municipalities, homeowners and insurers. Given the possible changes in the nature of extreme events caused by climate change (Kharin & Zwiers, 2000; Madsen & Figdor, 2007; Prodanovic & Simonovic, 2007), combined with increasing development and deteriorating infrastructure, urban flooding stands to continue or possibly increase as a threat to the well being of urban residents. While addressing infrastructure and planning issues serve as important means of reducing

urban flood risk, private residents also play a considerable role in urban flood risk reduction. Thus, understanding how residents perceive and react to urban flood risk is an important component of effective urban flood management.

Reflecting previous perception studies, there appears to be significant opportunity to increase awareness and mitigative behaviour of residents in the Sherwood Forest neighbourhood. Though the City of London has been relatively aggressive in the communication of flood risk information (including the use of multiple information conduits and mailing information to each home in the area), actual use of City information was surprisingly low. Further, the prevalence of infiltration flooding in the study sample indicates that increased focus on infiltrating flood reduction may be a concern for the City.

The results of this survey provide a "snap-shot" of resident perceptions and behaviours. A longitudinal survey, where a similar survey and survey administration procedure is applied again in the future, would provide an indication of the changing levels of awareness and perceptions that are likely to exist in the neighbourhood. Applying a longitudinal survey approach would also allow for the investigation of the effectiveness of City of London education programs over a period of time.

Flooding associated with sump pumps remains a specific concern, as the disconnection of foundation drains and the installation of sump pumps are recommended as a flood reduction measure. Thus, identifying the reasons for flooding from sump pumps should be a topic of future surveys. Questions in future surveys should relate to the knowledge of maintenance procedures for sump pumps, whether the sump pump system installation was inspected by the City, the existence of emergency backup power, and the pump type (e.g., pedestal vs. submersible). Further surveys should also investigate homeowner awareness of maintenance practices for backwater valves.

Reflecting pervious surveys (ICLR, 2004; Sandink, 2007), a low awareness of insurance coverage for basement flood was identified in this study. Surprisingly, almost a quarter of residents who had experienced sewage flooding in the past could not indicate whether or not they had insurance coverage. An investigation of insurance coverage awareness, including how insurance coverage is communicated to homeowners and the reasons for the low level of awareness, is warranted based on the findings of this study. Further, a more nuanced investigation of insurance coverage should be included in future surveys, including how insurance coverage for sewer backup changed after respondents made sewer backup claims or whether respondents are receiving discounts or other incentives if they have installed flood mitigation measures in their homes.

Considering the primary point of contact for many homeowners when seeking to buy insurance coverage or seeking information on insurance coverage is their insurance broker, identification of communication and education issues associated with insurance brokers should be a focus of future study. Insurance brokers can play several roles in basement flood coverage and reduction awareness. For example, brokers may take initiative to collect and distribute information about basement flood reduction to their customers, and must also explain the details of home insurance coverage to their clients. Further, the varieties of coverage available for water damage and the fact that sewer backup may be sold as part of its own "sewer backup" endorsement or as part of a "water escape" endorsement may cause confusion amongst insurance customers, especially if water damage endorsements are referred to as "flood" endorsements (Sandink *et al*., 2010). Thus, an understanding of how information on basement flood coverage is passed to insureds through brokers serves as a subject for further study.

Appendix A: Subsidy program summaries

Municipality (Name)	Measures	Funding availability	Notes
London (Sump Pump, Sewage Ejector, and Storm Private Drain Connection Grant Program)	• Weeping tile disconnection • Backwater valve • Sewage ejector (in lieu of backwater valve) • Storm Private Drain connection	• 75% up to $1,875 for weeping tile disconnection when connected to main drain inside of basement • 75% up to $2,650 for weeping tile disconnection when connected to main drain outside of building • 75% up to $575 for backwater valve • 75% up to $1,525 for sewage ejector • 75% up to $3,775 for Storm Private Drain Connection	• Funding also available for condominium corporations and non-profit housing co-operatives • Available for those who have experienced flooding caused by surcharging of sanitary or storm sewers • Available to those at risk of flooding from surcharging storm of sanitary sewers • Permits and inspections required
Brantford (Basement Flooding Prevention Grant Program)	• Installation of sump pump with battery backup • Weeping tile disconnection • Backwater valve • Connection of weeping tiles to sump pit • Downspout disconnection	• $3,000	• Available to homes that have documented recurring storm or sanitary sewer back ups as a caused by sewer surcharging • Downspouts must be disconnected where appropriate • Professional installation of backwater valve required • Permits, inspections required for backwater valve installation • Homes reviewed by city staff to identify relevant flood reduction measures • Priority given to homeowners who experienced flooding between June 1, 2010 and December 31, 2010 • Priority given to homeowners with recurrent sewer backups • Program not implemented if disaster relief provided by another level of government (e.g., ODRAP)

Municipality (Name)	Measures	Funding availability	Notes
Ottawa (Residential Protective Plumbing Program)	• City protective plumbing evaluation of home • Measures deemed appropriate based on home evaluation • Measures may include backwater valve, disconnection of weeping tiles and installation of sump pumps, disconnection of downspouts from weeping tiles	• 100% up to $4,000 for basements that have experienced sewer backup • 50% of the cost of work up to $2,500 for homes with no sewer backup history but located in risk areas (i.e., historically flooded areas) • Homeowners are eligible for 100% grant assistance if their home is directly adjacent to a property that experienced a backup, including semi-detached homes where other side of building experienced sewer backup • Special grants available for flat-roofed buildings and in instances where a sealed sump pump system is required	• Available to residences that have experienced a sewer backup or are located in an area at risk of sewer backups • Insurer or city documentation of sewer backup event required for historical sewer backups or sewer backups in neighbouring properties • Inspection by City program representative, consultant hired by City
Halton Region (Basement Flooding Prevention Subsidy Program)	• Weeping tile disconnection and sump installation • Disconnection/ redirection of downspouts • Installation of mainline backwater valve	• 50% if the invoiced total to a maximum of $1,800 for weeping tile disconnection and sump system • 50% to a maximum of $250 for downspout disconnection/redirection • 50% to a maximum of $675 for backwater valve	• Weeping tiles and downspouts must be disconnected from sanitary sewer • Household Drainage Survey must be conducted by regional representative • Post-installation inspections required • Among other requirements, applicants must agree to inform future purchasers or leasers of their property of the existence and maintenance requirements of flood reduction measures
St. Catharines (Flood Alleviation Program)	• Backwater valve • Sump pump system • Downspout disconnection	• $3,000	• Pre-work site inspection, including City representatives • Downspouts must be disconnected from sanitary system
City of Welland (Sewage Water Alleviation Program)	• Backwater valve installation • Foundation drain disconnection and sump system including backup power • Downspout disconnection	• $3,000	• Foundation drain disconnection • Downspout disconnection • Pre-work inspection by City representatives • Available for homes with sewer backups since July 31, 2004

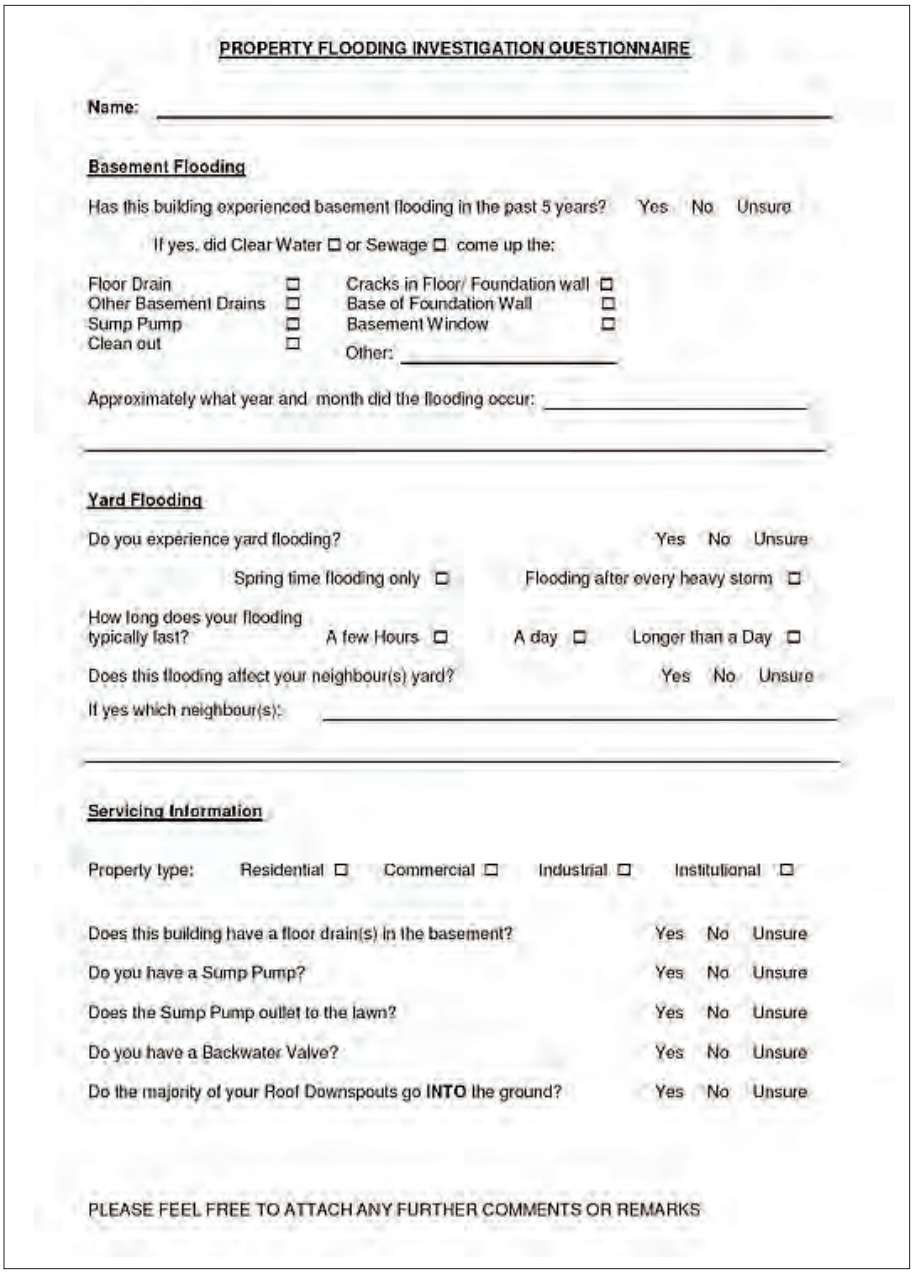
Municipality (Name)	Measures	Funding availability	Notes
City of Vaughan (Back-water Valve Installation Subsidy Program)	• Backwater valve installation	• 50% to a maximum of $750 for backwater valve	• Site assessment carried out by licensed plumber or drain contractor • Available to those who have installed backwater valves since August 19, 2005 • Historical sewer backup events are not a prerequisite • Downspouts must be disconnected from City sewer system wherever possible • Professional installation • Permits and inspections • Measures must be completed before applicant applies for subsidy program
Region of Peel and City of Mississauga	• Household drainage survey • Backwater valve installation • Downspout disconnection	• 50% to a maximum of $675 for backwater valve • 100% of cost for disconnection of downspout from sanitary sewer to a maximum of $1,000	• Homeowners who reported damage to the Region of Peel or City of Mississauga due to the August 4, 2009 rain event • Other homeowners added to waiting list for potential supplementary program • Household drainage survey conducted by municipal representatives • Disconnection of downspouts • Downspout disconnection includes requirements for 2% yard slope, that water not affect neighbouring properties or directly drain on sidewalks or driveways, and that sewer standpipe be sealed
City of Saskatoon (Flood Protection Program)	• Assessment by selected plumber • Backwater valve(s) installation • Sump pump system • Permit costs	• $3,000	• Available to property owners who have experienced sewer backup or are at risk of experiencing a sewer backup • No application process – properties are selected by the City • All basement plumbing must be protected with backwater valves • Disconnection of weeping tiles and sump installation where water does not negatively affect neighbouring properties, streets, sidewalks, etc.

Municipality (Name)	Measures	Funding availability	Notes
City of Greater Sudbury (Preventative Plumbing Subsidy)	• Backwater valve(s) installation • Sump pump system	• 50% to a maximum of $1,000 for a backwater valve • 50% of the cost to a maximum of $1,250 for a sump pump system • 50% to a maximum of $2,250 for a backwater valve and sump system	• Residential, commercial, industrial, institutional and non-profit properties are eligible • Site assessment by licensed plumber • Where possible, downspouts and weeping tiles must be disconnected • Property must have been flooded on July 26, 2009, at sometime in the past, or must be located in flood prone area • Plumbing inspections • In 2010, program targeted to property owners flooded during July 26, 2009 rainfall event. In 2011, priority given to property owners who have experienced flooding in the past, followed by those who occupy risk areas.
Hamilton (Protective Plumbing Program (3P))	• Backwater valve • Sump pump (in conjunction with backwater valve) • Downspout inspection and disconnection • Sewer lateral inspection and repair	• $2,000 • Additional $1,500 if sewer lateral was affected by roots from a City owned tree (funds are available through existing sewer lateral management program) • Loans may be available for eligible costs that exceed the program grant maximum of $2,000	• Not available to all Hamilton homeowners • First phase of program targets residents who have experienced sewer backup. Later phases will provide funding to those who occupy areas that have a history of flooding. • Professional installation, permits • Post-installation inspections • Eligibility requires sewer backup during one of 13 flood events that occurred between August 19, 2005 and September 28, 2010. • Residents are notified of their eligibility for the program by mail, and can also apply independently
City of Edmonton (Backwater Valve Subsidy Program)	• Backwater valve	• $1,200	• Priority is given to those who have experienced sewer backup; if funds available, homeowners who have not experienced sewer backup and are in specific at-risk neighbourhoods can apply • Available to dwellings built before 1989 (Backwater valves have been required in new homes since 1989) • Subsidy available for both inline (branch) and mainline backwater valves

Municipality (Name)	Measures	Funding availability	Notes
Durham Region (Basement Flooding Loan Program)	• Sump pump • Backwater valve	• $3,000 interest-free loan	• Installation by licensed plumber • Inspections after installation • Available for those who experienced sewer backup flooding in specific neighbourhoods in the region
City of Niagara Falls (Weeping Tile Removal Assistance Program)	• Weeping tile disconnection from sanitary sewer • Sump pump disconnection from sanitary sewer • Backwater valve • Weeping tile investigation	• 100% to a maximum of $3,000 for weeping tile disconnection • 100% to a maximum of $500 for backwater valve • 100% to a maximum of $400 for weeping tile inspection	• Specific sump design conditions are outlined, including battery backup system
Winnipeg (MB) (Basement Flooding Protection Subsidy Program)	• In-line backwater valve • Sump pit drainage system	• 60% of invoiced cost up to $1,000 for in-line backwater valve • 60% of invoiced cost up to $2,000 for sump pit drainage system • 60% of invoiced cost up to $3,000 for both sump system and backwater valve	• Subsidy not available to homes that were required by building or plumbing codes to have backwater valves and/or sump systems (homes built since 1979 were required to have backwater valves; homes built since 1990 were required to have sumps) • Available for sumps/backwater valves installed on or after May 1, 2010 • Homes may require more than one in-line backwater valve • Available to all pre-1979 homes

Sources: City of Brampton, 2010; City of Edmonton, 2010; City of Hamilton, 2010; City of London, 2010; City of Niagara Falls, 2010; City of Greater Sudbury, 2010; City of Ottawa, 2010a; City of Ottawa, 2006; City of St. Catharines, 2010; City of Toronto, 2010; City of Vaughan, 2009a, 2009b; City of Welland, 2009; City of Winnipeg, 2011b; Durham Region, 2009a,b; Halton Region, 2010; Region of Peel, 2010a,b,c.

Appendix B: Summer, 2009 City of London survey



PROPERTY FLOODING INVESTIGATION QUESTIONNAIRE

Name: _____

Basement Flooding

Has this building experienced basement flooding in the past 5 years? Yes No Unsure

If yes, did Clear Water ☐ or Sewage ☐ come up the:

Floor Drain	☐	Cracks in Floor/ Foundation wall	☐
Other Basement Drains	☐	Base of Foundation Wall	☐
Sump Pump	☐	Basement Window	☐
Clean out	☐		

Other: _____

Approximately what year and month did the flooding occur: _____

_____

Yard Flooding

Do you experience yard flooding? Yes No Unsure

Spring time flooding only ☐ Flooding after every heavy storm ☐

How long does your flooding typically last? A few Hours ☐ A day ☐ Longer than a Day ☐

Does this flooding affect your neighbour(s) yard? Yes No Unsure

If yes which neighbour(s): _____

_____

Servicing Information

Property type: Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐

Does this building have a floor drain(s) in the basement? Yes No Unsure

Do you have a Sump Pump? Yes No Unsure

Does the Sump Pump outlet to the lawn? Yes No Unsure

Do you have a Backwater Valve? Yes No Unsure

Do the majority of your Roof Downspouts go **INTO** the ground? Yes No Unsure

PLEASE FEEL FREE TO ATTACH ANY FURTHER COMMENTS OR REMARKS

Appendix C: City of London basement flooding brochure

Why isn't the City fixing my drainage problem?

Drainage standards have changed over the years. On private property, renovating to meet current drainage standards is the responsibility of the homeowner, similar to bringing a home's electrical and plumbing systems up-to-date. Where large scale neighbourhood flooding problems exist, the City has undertaken multi-million dollar projects to reduce the severity of basement floodings.

In many circumstances, only improvements completed on private property will reduce the chance of flooding. These types of improvements must be undertaken privately by the homeowner.

How much is this going to cost?

Each situation will be different. You should contact a master plumber to assess the potential cause of flooding and provide a cost estimate. While repairs on private property are the responsibility of the homeowner, the City of London offers a subsidy to qualifying homeowners to improve home drainage systems. Please refer to the city's *Basement Flooding Subsidy Program* pamphlet for more details.

For more information, or to obtain a copy of the *Basement Flooding Subsidy Program* pamphlet:

- Phone 519 661-2500 Ext. 2334;
- Visit City Hall, 6th Floor, 300 Dufferin Avenue, London; or
- View our website, **www.london.ca** and enter "Basement Flooding" in the **Search** field.

Environmental & Engineering Services Department

London CANADA

Protect Your Basement

Basement Flooding Guide

to help homeowners identify causes of basement flooding and improve drainage conditions.

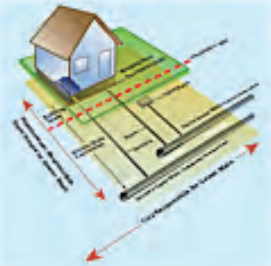
Environmental & Engineering Services Department

London CANADA

Protect your home and possessions by understanding what causes basement flooding.

Basement flooding is a serious problem that affects residents in many municipalities, including the City of London. Basement floodings generally occur during snow melts and heavy rainfall and can cause serious damage and inconvenience. There are two systems involved in basement flooding:

1. **Overloaded home drainage systems**
2. **Overloaded City sewer systems**



Working together – Home drainage and City sewer systems

No municipal drainage system can guarantee every house complete protection against basement floods. Working together, we can help prevent flooding and reduce costly upgrades to City systems.

City sewer systems:

Sanitary (wastewater) sewer – The sanitary sewer receives wastewater from toilets, bathtubs, sinks, and laundry machines through your home pipes. The sanitary sewer is located under the street and is connected to the nearest sewage treatment plant.

Storm (rainwater) sewer – The storm sewer is located under the street and carries surface water from lawns and streets, and groundwater from weeping tiles and foundation drains, through pipes to local rivers.

Home drainage systems:

Weeping tile/foundation drains – Weeping tiles are pipes with drainage holes located underground around the basement foundation to prevent groundwater from entering the basement. Weeping tiles should be connected to the sump pit; however, in older homes they may be connected to the sanitary sewer or storm sewer.

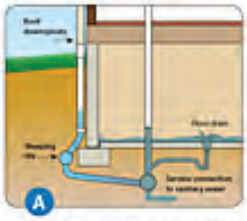
Downspouts – Typically, downspouts carry rainwater from your roof directly onto the ground surface. In older homes, downspouts may be connected to your weeping tiles or directly to the storm sewer.

Sump pit/pump – A sump pit is dug into your basement floor and collects natural groundwater from the weeping tiles. The sump pump moves the water from the sump pit to the ground surface or to the storm sewer.

Backwater valve (flap port) – A backwater valve is a device that prevents sewage from backing up into your basement from the City's sanitary sewer. The backwater valve automatically closes if sewage backs up from the sanitary sewer. Regular cleaning of the backwater valve is the responsibility of the homeowner.

What is causing my flooding?

There are a variety of causes of basement flooding. The following cases describe a number of common flooding situations that can occur in London homes:



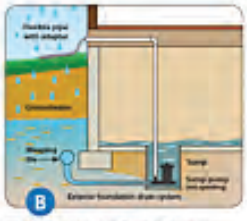
Weeping Tiles and/or Downspouts Connected to the Sanitary Sewer

During heavy rainfall, the water entering the downspouts may cause the weeping tiles to overflow. If your weeping tiles are connected to the sanitary pipes, this may cause rainwater or sewage to back up into your home.

Solution

Disconnect weeping tiles and downspouts from the sanitary sewer system

Rainwater should not be entering the sanitary (wastewater) sewer system. Have a qualified plumber disconnect your weeping tiles and downspouts from the sanitary sewer system. Install a sump pump and backwater valve to send the rainwater to the ground surface or to the storm (rainwater) sewer system.



Malfunctioning Sump Pump

If your home is equipped with a sump pump, it may have malfunctioned – causing your basement to flood.

Solution

Replace your sump pump

Ensure that your sump pump is properly maintained. If your sump pump has malfunctioned in the past, consider contacting a qualified plumber and having it replaced.

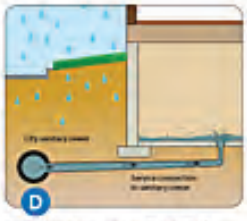
Surface Water Causing Basement Flooding

Basement flooding can occur when there is water ponding around your foundation walls and/or your weeping tiles are not working or are not existent.

Solution

Smart landscaping

Check that the ground around your house is sloping away from your foundation wall. This reduces the possibility of water entering through cracks in your foundation or overloading the weeping tiles. Direct your downspouts where water can be easily absorbed, such as your lawn or flower bed.



City Sanitary Sewer Pipe Full

If the City's sanitary sewer pipe is full due to large amounts of rainwater from various sources – such as private weeping tiles or from neighbour's homes – then sewage can back up into the basement.

Solution

Flood-proofing devices

Homes prone to flooding should have sump pumps and backwater valves to prevent rainwater or sewage from backing up into the basement. Talk to a qualified plumber about the best way to flood-proof your basement before any device is installed. Each installation is different and some devices require a plumbing permit. Be sure to get at least three estimates before hiring a plumber.

Check your local Yellow Pages or Better Business Bureau for a list of suppliers and contractors. Hardware, home improvement, plumbing centers and suppliers offer information and equipment for do-it-yourself installations.

Appendix D: Initial contact letter

Institute for Catastrophic Loss Reduction
Building resilient communities

June 1, 2010

Information about a Basement Flooding Survey this summer

Dear London Homeowner,

Every year, residents in cities across Canada suffer damage to their property and home, and suffer emotional and financial stress because of basement flooding. To help address this serious problem the Institute for Catastrophic Loss Reduction (ICLR) has teamed up with the City of London to survey residents in the Sherwood Forest Neighbourhood of London to find out about their thoughts and experiences with basement flooding.

We are asking for your help even if your basement has never flooded.

This summer, we will ask for your help by completing a survey about basement flooding. A survey will be hand-delivered to your home by a researcher in either June or July. The researcher will ask if you can fill out the survey at your front door. If you are not home a survey package will be left on your door step that will include a postage paid envelope so you can return the survey at your convenience. We will also ask if a researcher can look at your eavestrough downspouts.

If you own a home in London but rent it out, please forward this letter to your tenants or let your tenants know about the survey.

If you are able to assist us with our survey, you will help us better understand basement flooding issues. This information will be used by the City of London to reduce basement flooding risk in London, and by ICLR to help reduce basement flooding in other Canadian communities. We will ensure your confidentiality if you respond to the survey and information about your particular home will never be published.

If you have any questions about the survey, please contact Dan Sandink of ICLR or Kyle Chambers of the City of London.

Sincerely,

Dan Sandink
Manager, Resilient Communities & Research
Institute for Catastrophic Loss Reduction
dsandink@iclr.org
416-364-8677 ext. 3212
www.iclr.org

Kyle Chambers
Wastewater & Drainage Engineering
Division
City of London
kjchambe@london.ca
519-661-2500 ext. 5854

Institute for Catastrophic Loss Reduction
210-20 Richmond Street East, Toronto, Ontario, M5C 2R9
p: 416-364-8677 f: 416-364-5889

Appendix E: First drop cover letter and questionnaire

Institute for Catastrophic Loss Reduction
Building resilient communities

A survey on your home, your community and basement flooding

Dear London Resident,

Every year, residents in cities across Canada suffer damage to their property and home, and suffer emotional and financial stress because of basement flooding. To help address this serious problem the Institute for Catastrophic Loss Reduction (ICLR) and the City of London are surveying residents in the Sherwood Forest Neighbourhood of London to find out about their thoughts and experiences with basement flooding. You or the owner of your home may have received a letter about this survey earlier in June.

We are interested in your input even if your basement has never flooded.

Enclosed in this package is a survey with 22 questions, which should take about 10 or 15 minutes to fill out. If you could help us by filling out the survey and returning it in the postage paid reply envelope, we would be extremely grateful. This survey has been hand-delivered to your home because we think your opinions and experiences are important and valuable.

The information you provide will be used by the City of London to reduce basement flood risk in your neighbourhood and in London, and by ICLR to help reduce basement flooding in other Canadian communities. We will ensure your confidentiality and any information you provide about your particular home will never be published.

We greatly appreciate your help with our survey. If you have any questions or comments, please contact Dan Sandink of ICLR or Kyle Chambers of the City of London.

Sincerely,

Dan Sandink
Manager, Resilient Communities & Research
Institute for Catastrophic Loss Reduction
dsandink@iclr.org
416-364-8677 ext. 3212
www.iclr.org

Kyle Chambers
Wastewater & Drainage Engineering
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Institute for Catastrophic Loss Reduction
210-20 Richmond Street East, Toronto, Ontario, M5C 2R9
p: 416-364-8677 f: 416-364-5889

Institute for Catastrophic Loss Reduction

Basement Flood Reduction Survey

Part A: General Questions

1. **Are you 18 years of age or older?** YES: ☐ NO: ☐

2. **Do you own your home?** YES: ☐ NO: ☐

3. **How many years have you lived in your current home?** _____ Years

4. **Has your basement ever flooded?**

   ☐ YES ☐ NO ☐ DON'T KNOW

   If YES, what was the month and year of your most recent basement flood event?
   Month: _____ Year: _____

   In your most recent flood event, did CLEAN WATER ☐ or SEWAGE ☐ enter your basement through (check all that apply):

Floor drain	☐	Cracks in basement floors or walls	☐
Other basement drains (e.g., toilet, sink)	☐	The base of the basement wall	☐
Sump pump	☐	Basement window or door	☐
Sewer clean out	☐	DON'T KNOW	☐

   Did flood water enter your home in another way? Please explain: _____
   _____

5. **Did you report your most recent basement flood event to the City of London?**

   ☐ YES ☐ NO ☐ My basement has never flooded

6. **Did you make an insurance claim for your most recent flood event?**

   ☐ YES ☐ NO ☐ My basement has never flooded

7. **In your opinion, on a scale of 1 to 6, how likely is it that your basement will flood in the next 10 Years?**

   Extremely Unlikely ☐ ☐ ☐ ☐ ☐ ☐ **Extremely Likely**
   1 2 3 4 5 6

8. In your opinion, on a scale of 1 to 6, how likely is it that your basement will flood during the next major rainstorm or snowmelt event?

Extremely Unlikely	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	Extremely Likely

9. Do you have insurance coverage for sewer backup?

☐ YES ☐ NO ☐ DON'T KNOW

If NO, why don't you have insurance coverage for sewer backup?

☐ I didn't know it was available ☐ It was cancelled ☐ I chose not to buy it

OTHER: _____

_____

10. Do you know how to reduce your chances of having basement flooding?

☐ YES ☐ NO

Part B: Knowledge of City of London Programs

11. Have you ever read, received or downloaded basement flood information, pamphlets or brochures from the City of London?

☐ YES ☐ NO

12. Have you ever visited the City of London's Basement Flooding webpage?

☐ YES ☐ NO

13. Have you ever attended a City of London public meeting about basement flooding?

☐ YES ☐ NO

14. Have you ever read, received or downloaded basement flood reduction information materials from organizations <u>other than</u> the City of London?

☐ YES ☐ NO

<u>If YES</u>, what organizations' material did you read?

_____

_____

15. Have you heard of the <u>City of London's Basement Flood Grant Program</u>, which provides a partial grant for homeowners to install backwater valves, sewage ejectors or sump-pumps and provides some financial assistance to repair private drain connections?

☐ YES ☐ NO

Part C: Information Preferences

16. Would you like more information about how to reduce basement flooding?

☐ YES ☐ NO

17. How would you like to receive information and who should provide it?

	The City of London	My Insurance Company or Broker
Pamphlets and brochures mailed to my home	☐	☐
Some brochures that tell me a few different things about flood reduction	☐	☐
One handbook that tells me everything I need to know about flood reduction	☐	☐
Web sites	☐	☐
Newspaper advertisements	☐	☐
TV commercials	☐	☐
Public information meetings and open houses	☐	☐

OTHER: _____

_____

Part D: Basement Flood Reduction Plumbing

Image #1 is a backwater valve.

Image #2 is a backwater valve after it's installed. There is usually a cover over the valve.

Backwater valves are in the basement floor, usually located near the basement wall that is closest to the City street.

18. Does your home have a backwater valve?

☐ YES ☐ NO ☐ DON'T KNOW

<u>If your home has a backwater valve</u>, were you responsible for its installation or was it already there when you moved into your home?

☐ I was responsible for its installation ☐ It was already installed when I moved in

<u>If you were responsible for its installation</u>, which of the following applies to you?

☐ I installed it **myself** ☐ I hired a **licensed plumber** ☐ I hired a **licensed contractor** ☐ I hired someone but didn't know their qualifications ☐ OTHER

<u>Sump-Pit and Sump-Pump</u>
The pictures on the right are sump-pits and sump-pumps. These are located in the basement floor, close to the basement wall.

19. Is there a sump-pit and sump-pump in your basement?

☐ YES ☐ NO ☐ DON'T KNOW

If your home has a sump-pit and sump-pump, where does it pump water to?

☐ The surface of the ground outside my home ☐ Into my sewer connection ☐ Into the laundry tub or other internal plumbing ☐ DON'T KNOW

OTHER: _____

_____

If your home has a sump-pit and sump-pump, were you responsible for its installation or was it already there when you moved into your home?

☐ I was responsible for its installation ☐ It was already installed when I moved in

If you were responsible for its installation, which of the following applies to you?

☐ I installed it **myself** ☐ I hired a **licensed plumber** ☐ I hired a **licensed contractor** ☐ I hired someone but didn't know their qualifications ☐ OTHER

Sewage Ejector

A sewage ejector system often looks similar to a sump-pit and sump-pump, and is also located in the basement floor. However, the sewage ejector pump will run every time you use the plumbing in your basement (including flushing toilets, emptying a bath tub, taking a shower, emptying a sink, etc.).

20. Does your home have a sewage ejector system to reduce the chances of sewer backup?

☐ YES ☐ NO ☐ DON'T KNOW

If your home has a sewage ejector system, were you responsible for its installation or was it already there when you moved into your home?

☐ I was responsible for its installation ☐ It was already installed when I moved in

If you were responsible for its installation, which of the following applies to you?

☐ I installed it **myself** ☐ I hired a **licensed plumber** ☐ I hired a **licensed contractor** ☐ I hired someone but didn't know their qualifications ☐ OTHER

21. If you installed a backwater valve, sump-pump or sewage ejector system, did you apply for a partial grant through the City of London's Basement Flood Grant Program?

☐ YES ☐ NO ☐ DOESN'T APPLY TO ME

If you did apply, did you receive money from the program?

☐ YES ☐ NO

Part E: Downspouts

Eavestrough downspouts that are connected to the sewer system often look like this:


Eavestrough downspouts that aren't connected to the sewer system often look like this:


22. Are any of your eavestrough downspouts connected to the municipal sewer system?

☐ YES ☐ NO ☐ DON'T KNOW

Part F: Address

PLEASE PROVIDE YOUR HOME ADDRESS SO THAT YOUR HOME WILL NOT BE CONTACTED AGAIN ABOUT THIS SURVEY.

Address: _____

Part G: Visit Request

To help us in our research on basement flood reduction, we would like to have your permission for a researcher to visit your home and visually inspect eavestrough downspouts around the outside of your home.

Would you give us permission to visit your home and visually inspect your downspouts?

☐	☐	☐
Yes, a researcher can come and visually inspect my downspouts.	**No**, please do not visit my home.	This does not apply to me.

If you would like to set up an appointment for a researcher to look at your downspouts, please provide your telephone number so we can contact you.

First name: _____

Telephone number: _____

PART H: Additional Feedback

23. Would you like to share anything else about basement flooding in the City of London?

_____
_____
_____
_____
_____
_____

Thank you for helping us with our survey!

Appendix F: Second drop cover letter

Institute for Catastrophic Loss Reduction
Building resilient communities

An <u>additional</u> basement flood reduction survey package

Dear London Resident,

Earlier this summer a research assistant dropped a survey off at your home that asked about your opinions and experiences with basement flooding. As far as we know, we have not received a response from you. If you could help us by filling out and returning the survey, we would find your input extremely valuable.

We are interested in your input even if your basement has never flooded. Basement flooding includes any amount of unwanted water that enters your basement, especially if it enters through your sewer connections, or enters during or after heavy rainfall events. **<u>No</u> information about your individual property or home will be made public or reported to any insurance company.**

If you have already mailed back your survey or have chosen not to respond, please accept our sincere thanks and ignore this survey package.

Enclosed in this package is a survey with 22 questions, which should take about 10 or 15 minutes to fill out. If you could fill out the survey and return it in the <u>postage paid reply envelope</u>, we would be extremely grateful.

The information you provide will be used by the City of London to reduce basement flood risk in your neighbourhood and in London, and by ICLR to help reduce basement flooding in other Canadian communities.

We greatly appreciate your help with our survey. If you have any questions or comments, please contact Dan Sandink of ICLR or Kyle Chambers of the City of London.

Sincerely,

Dan Sandink
Manager, Resilient Communities & Research
Institute for Catastrophic Loss Reduction
dsandink@iclr.org
416-364-8677 ext. 3212
www.iclr.org

Kyle Chambers
Wastewater & Drainage Engineering Division
City of London
kjchambe@london.ca
519-661-2500 ext. 5854

Institute for Catastrophic Loss Reduction
210-20 Richmond Street East, Toronto, Ontario, M5C 2R9
p: 416-364-8677 f: 416-364-5889

Appendix G: Reminder post card

September 16, 2010

Earlier this summer a survey on resident experiences and opinions about basement flooding was hand-delivered to your home in the Sherwood Forest neighbourhood of London. The survey was a joint project of the Institute for Catastrophic Loss Reduction and the City of London.

If someone from your home has already returned a survey, please accept our sincere thanks for your help. If not, please help us by filling out a survey and returning it in the postage paid envelope included in the survey package. You may have received a second survey over the summer, but please fill out and return only one survey. We greatly appreciate your help with this project.

If you did not receive or have misplaced your survey package, let us know and we'll send another right away.

Sincerely,

Dan Sandink

ICLR
dsandink@iclr.org
416-364-8677 ext. 3212

Kyle Chambers

City of London
kjchambe@london.ca
519-661-2500 ext. 5854

Appendix H: Flooding dates (ordered by year)

Month	Year	n	%
	1990	1	0.5%
March	1992	1	0.5%
May	1992	1	0.5%
April	1997	1	0.5%
July	1997	1	0.5%
	1997	1	0.5%
July	1998	1	0.5%
	1998	2	1.0%
April	1999	1	0.5%
January	2000	1	0.5%
June	2000	2	1.0%
September	2000	1	0.5%
	2000	3	1.4%
August	2001	1	0.5%
March	2002	1	0.5%
Apr	2003	1	0.5%
	2003	1	0.5%
March	2005	1	0.5%
April	2005	1	0.5%
January	2006	1	0.5%

Month	Year	n	%
February	2006	2	1.0%
March	2006	1	0.5%
May	2006	1	0.5%
September	2006	1	0.5%
	2006	2	1.0%
February	2007	1	0.5%
April	2007	3	1.4%
June	2007	1	0.5%
November	2007	1	0.5%
December	2007	1	0.5%
Spring	2007	1	0.5%
January	2008	3	1.4%
February	2008	1	0.5%
March	2008	2	1.0%
April	2008	5	2.4%
May	2008	2	1.0%
June	2008	1	0.5%
August	2008	2	1.0%
September	2008	2	1.0%
December	2008	6	2.95

Month	Year	n	%
	2008	3	1.4%
January	2009	1	0.5%
March	2009	2	1.0%
April	2009	3	1.4%
May	2009	37	17.7%
June	2009	5	2.4%
July	2009	4	1.9%
August	2009	1	0.5%
October	2009	3	1.4%
November	2009	1	0.5%
December	2009	2	1.0%
	2009	6	2.9%
January	2010	5	2.4%
February	2010	2	1.0%
March	2010	4	1.9%
April	2010	6	2.9%
May	2010	9	4.3%
June	2010	16	7.7%
July	2010	3	1.4%
August	2010	1	0.5%
No response		32	15%
Total		209	100%

Appendix I: Open ended responses

The City should fix this problem in our neighbourhood and not be asking "what the chances are that it might happen again".

I don't think downspout inspection is the problem, my sewer backup insurance coverage has been dropped. I think the City of London knows the problem so fix it please.

The problem in my area is the San sewer on our street is only 8"… and houses down stream of us have their weeping tiles tied into the sanitary sewer which met the building code prior to 1986 or 1987. Every time we have an extreme rainfall or snow melt i.e. more than 1" of rainfall in an have or snow melt the sewer (8" dia) cannot handle the excessive water which then backs up through our san sewer. I have had 2 floods in Jan/Feb2008 and 1 in May 2009. Our insurance company have not cut off sewer backup or flood damage. The previous owner of this house also had 2 floods sometime around 2000.

My insurance rates have gone up dramatically due to flooding. The City of London is at fault. City should pay for my backwater valve plus insurance hike. Sewer drains connected to water drains that is why we are flooded always, doesn't have anything to do with downspouts. City messed up when sub division was established. Cut corners to save money. I'm one of many annoyed and frustrated residents.

My sump expels all the time anywhere from once an hour to every 10 minutes depending on rain and weather… last town meeting about it early studies were showing that development and construction off Gainsborough and further up Wonderland towards Fanshawe Park Road was going to negatively affect the water table in my area. I certainly hope this isn't the case.

Sump pumps run constantly in our neighbourhood all day. Everyday. Our neighbour's front yards are often flooded and swampy – our backyard is often very moist.

Not a big fan of sump pump pits in a house. Seems that routing outside water into the house which in turn is directed back out of the house is not a good system, especially if it is subject to mechanical failure.

When I say flooding as far as my home I referring to water on the floor which can be cleaned up fairly fast.

I understand there have been people/homes on my street that had flooding including sewage backup.

Would like to know if flooding reported in the past as I have only owned my home for 1 year and previous owner failed to inform me of the basement flooding problem. Not sure where the backwater valve should be installed in my home. Do I need sump pump, backwater valve and a sewage ejector? not sure if I can afford to do all 3; not sure how great a risk for flooding I have but have noticed even with a heavy rain that the soil against my house till is dry as a bone and water doesn't soak into it as it is clay. Is it possible to have someone come to my home and advise the best course of action to prevent basement from flooding? Money is tight and would like to participate in program as grants are available but need to know where to start. Thanks for your help in this matter... XXX.

My home is a raised XXX. This style, on my street, does not seem to get flooded like those homes with deeper basements.

Needs to be corrected immediately. People involved should be compensated (since their insurance will no longer cover any flood damage!)

The attitude of the City of London staff is not good. The constant denial of responsibility and blaming the homeowner entirely is wrong.

I would like my daughter to receive this survey. She lives at XXX. She would be very interested in filling it out as she has the opposite of what this house has. This house was built in 1984 and I am the original owner.

When we bought our house five years ago we were told about the flood and the burm that had been built on Gainsborough Rd to take of the problem. We were also told about the sump pump and backflow valve and were told it wouldn't happen again. When we experienced the huge sewer backup in January 07 we were very surprised. We had insurance coverage and then we had one more sewer backup in April 08 it cost us $800 out of pocket plus the loss of our flood insurance. After the first flood in January our insurance company put us on a flood insurance where we were covered for $25,000 damage but we had to pay extra for it. Now we have an alarm system in our home with a flood censor but still no flood insurance so every time it rains we hope for a dry basement. If it floods again with no insurance we will not be able to fix it as we just don't have that kind of money available.

The city should be taking care of infrastructure as top priority to prevent basement flooding…

I have flooded 4 times! Please help! I am open to any advice…

Why is it every time we got hit by a Flood or Sewer Backup it is always the same houses. Many of these have back flow valves and sump pumps.

The problem is inadequate sewer/sanitary lines for the area. A city problem period! They say they can't afford to remedy the problem for a while – Budgetary issues! Well don't we all have financial problems especially since they keep hiking our taxes – for what? but they toss our… in other non-essential…

Just a point to ponder – in new subdivisions does the developments practice of stripping off the top soil until there's a think covering left contribute to flooding? Are new subdivisions inspected to confirm the land has been properly sloped and graded to minimize flooding?

After heavy rains we get water sitting at back edge of our property for a few days…

I have not experienced a flood while owning my home. I did notice a water stain on the cement floor and a puddle after our last rain storm (early June). Water stain started/ended at bottom of basement wall and ended/started at floor drain. Concrete floor is painted white. Water stain/mark is yellow.

The researcher already checked the downspouts when the survey was dropped off…

Problem was fixed with landscaping and fixing foundation. Problem was minor leakage in basement.

We changed the landscaping to direct water away from the outer side of the house and this corrected our problem that only occurred in the most serious storms or when the snow was melting.

The city should be solely responsible for cost related to resolving flooding issues. As previously stated – the city gave permits for housing development in the area. This was a marshy-clay area. Clay does not absorb water well when dry and cracked. Soil for gardens lawns has been added year after year but the majority of land is lumpy clay. I have spoken to many people who knew the land in its natural state – unbelievable! New post holes were dug and set in cement 1 year ago for the fence had shifted and broken. In that year – the post are no longer aligned. The ground shifts in the clay H_2O soaked spring. The ground shifts enough to move and buckle my shed from 2' away the fence to <8" at present. The buckled metal shed now leaks each rain. We bought this home in 1991. The house was situated on the property – property graded so rainfall drained from the foundation. The mistake we made was not to inquire about the "ground" soil. In the spring, it was soon evident the ground way clay. Soupy and wet in the spring – poor absorption of water. Clay/H_2O mix on surface – once summer – the ground "cracks" it is so dry. When rain does fall absorption remains poor. That is when the water runs down the street or now in may case toward the house foundation! The house is raised… The back entrance is opened aside from a slanted roof and railings… I have placed the front downspout that runs close to the front door in a precarious position. It is directed to flow down the asphalt to prevent further "pooling" at the entrance. The rain water does not run on to the street. It bypasses the front door, runs down the driveway midway and runs onto the front lawn due to the cracks and bulges in the asphalt… I know of families in the area who cannot purchase insurance ANYWHERE because of previous floods…

My basement flood was minor – not really flood by a small leak that drained in the laundry room but did wet the floor since we were out of town for a couple days when it happened.

Provide a backup (battery) sump pump to guarantee minimum flooding with sump pump failure.

First, best step is to extend downspout at least 3-4 m from buildings.

Yes – please provide: contacts for companies that install sump pumps and sewage backhaul services and the grant program

I was told by my insurance company that a backwater valve could create hydrostatic pressure that could cause a pipe to break and leak through my basement floor which would not be covered by insurance.

From 1985-1999 No floods. Hmmmm… From 2000-2009 9 floods – way more houses. I now have a backwater valve and sump pump. No floods as of yet… No insurance – cancelled by insurer. Lots of sump pumps in my area but I don't see many discharging. Many have been re-plumbed to drains inside houses. (illegally?)

City needs to build a bigger sewer pipe; Stop home construction until then.

Had a crack in the foundation fixed in 2006 when minimal leakage was detected.

Insurance has increased because of neighbourhood flood issues and claims.

When there is a real downpour we still may flood even with a sump pump and back up pump. London needs to upgrade the sewer systems when necessary. Also they need to suction sewers in the street more frequently then they seem to do.

Proper foundation depth and property grading were not done on this court. Proper concrete pouring and backfilling techniques were not done! I paid over $10,000 to correct concrete and grading problems! Sump pumps bring in water and expel it just like a re-circulating system! What a waste! Plumbing inspection was not proper.

1990 flood was due to sump pump failure…

All properties at the rear of our house drain into our yards. Our sump pump runs continually and everyone's hose runs out above ground onto the road to drain into 2 catch basins. In winter, our street is permanently iced over 6" deep at times and often our lines freeze causing sump pump motors to cease from overheating.

The excess water in our backyards (Brandy Lane Crt) is a direct result of the completion of Aldersbrook Rd. (18 yrs. ago). Original homeowners on our court did not have water issues for 5 years…

I feel very strongly about having an ugly black hose running out of my house. It is a nuisance in spring, summer and fall when I want to cut my grass. The water that accumulates and floods and freezes on our court is an extreme hazard when walking. I feel strongly that the city of London should never permit houses to built this way. I also feel that property values are greatly reduced because of this. It is the only think that I wish I could change about my house. I have also noticed a large population of "European crane fly larva" in my front yard as well as back yard due to all the extra moisture in the soil.

Settlement between houses… No storm PDC's in clay soil… Lot Grading approvals/compliance…

I think if they drained into the city sewers that would be better as they can easily freeze up in the winter…

We previously lived at XXX Paperbirch Cr. for 15 years. During that time there were no flooding issues. It has no sump pump, no backwater valve. Our current backyard seems to be quite wet, almost swamp-like in the spring due to the clay base. In fact a cherry tree and lilac I planted drowned earlier this year. We've had no water in the basement which is somewhat surprising.

In 20 years we have never had a basement flooding issue. Has the developments to the west tied into the storm water system causing the recent neighbourhood problems?

The reason for this problem is that the sewage drains are backed up in this city.

My basement has had water come in twice when the sump pump failed.

Stop allowing houses to be built unless you (the city) are prepared to increase the size of the sewage system. When the pipes are full the water has to go somewhere.

I would like information on how my home's resale value is affected by flooding, having a sump pump and backwater valve installed and living in a flood prone zone. When we bought the house on one told us that this area of the city was flood prone.

The only time we have water in our basement is if it rains a lot, we sometimes (very rare) have water come in our laundry room – but it drains right away – only makes a small puddle on the ground that can be cleaned up with a towel.

Not really. It seems that the City is already paying attention to flood management in current development projects.

I have not experienced flooding, but occasionally have a mild sewage smell coming up through the basement floor drain.

Not at this time, except that maybe the city should be more careful about clearing areas for development and more concerned about preservation of wet lands, natural flood zones, woods, etc.

We sit on a hill, there is no problem with basement flooding.

Is the researcher going to give a report on my downspouts?

We have never had a sewer backup problem thank goodness!! But over the years our water drainage problems increased. Our street is on a hill and… a neighbour up the street put in a new patio or changes something in their yard or eavestroughs it makes a difference to the water flow. Fortunately, our basement seems to be able to handle it even without a sump pump but the below ground level back door and drain were a bad design idea which we now have to live concerned with all the time. Thank you for your time and input into the situation...

My understanding is that my flood occurred because of extreme sewer debris the City of London had neglected to remove.

Sewer grates are often covered with leaves and when rainfall is heavy the sewer can't take it away fast enough. Sewer grates are quite a distance from our home for the water to run to.

The area in which I live the foundations are just over 30 years old. They were built with precast walls with (holes) for construction. A number of homes have had the holes crack and the water gets in. My old neighbour had to have three sides fixed due to flooding in the basement.

Used the City's Grant program, but it was difficult – took 2 tries to get the money. Hope that it won't be used against you. Too little, too late. The City should have acted years ago.

Thanks for being concerned about this. I know many of our neighbours have had flooding problems.

The drains and sewer pipes in our area were not big enough to handle the rain run off after the subdivision is grown larger.

When I attended meeting I felt that the city kept cutting people off when voicing their concerns. They only seemed to push back responsibility to the homeowner. Yet they admit that pipe diameter is too small and all new pipes are much larger to handle population in area. I understand that they were done to spec. at the time but that does not resolve problem now with increasing pop. in area!

Subsidy program in London is not good, regarding as to who can perform work under program guidelines it is restricted to plumbers, other can do this work but are unable thus the city gives a monopoly to a trade, this is unfair practice.

Received flood reduction info from the City of Sudbury.

The water came in near the back wall and only because my daughter was here we were aware – something was going to be done about the grade level at the back but it never was. Thorne Property rep came and looked at it.

Our problem stems from the design of our area where water from the street and yards behind us are to flow via our swales to the front of the house.

This flooding started two years ago. Previous to this date my basement was completely dry.

For financial reason can't afford to install a sump pump.

I have no problem with basement flooding, however I much appreciate the City's concern and offered help.

Happens two times and the City do nothing to solve the problems – there are now too many new houses linked to this system in my street.

Weeping tile spot required to fix cracks. London water wells over flowed, new my… same night my repaired crack flooded again. Crack only leaks after overwhelming rains. Usually in Spring. Even small floods can have a huge impact. My finished basement TV room enjoyment was (XXX) reduced the last two summers.

Yes – my semi-detached neighbour's home has had problems with basement flooding. I feel I could be at risk because my home is attached to his. What can I do to prevent this from occurring in my basement?

I haven't had any sewer backup at all so far.

I had water come in so I had a contractor redo my window wells and I put in drainage trench. No more problems… just another rate payer wondering how many more consultants my property taxes are paying for.

Some financial help with grading would be appreciated. My sump hose has to go uphill before it goes downhill to the storm sewer street drain. This line sometimes gets frozen in winter and is a potential source of flooding if I do not constantly break up the ice in the line.

Inconsistent delivery of hydro in heavy rainfall periods means loss of function in SUMP PUMP. Please improve hydro service.

Part of my complex has had a problem with flooding and have sump pumps however my unit is more elevated and I have had no problem.

This unit is in part a housing cooperative. If the City has a drainage expert to… downspouts and site drainage for the entire complex, I would like to be contacted so we can use his/her expertise.

Many units have flooded in this area so we worry about it but are renters so can do very little about it.

I live in a condominium complex. You may visually inspect the downspout at the front anytime – no appointment needed. The downspout at the back goes into my neighbour's courtyard, so I would have to say no to that unless you had their permission. Sorry about the delay in returning the form.

The walls of the basement – the cracks were filled in – no more water in basement. Was only a little.

Run off water comes from Blanchard through my property into my road (Limberlost).

I am not sure of the system that exists at this home, I would appreciate if somebody an come in, have a look and advise me about it.

I live in London Housing. When I reported the sewer backup up the informed me someone would be out in 4-5 hours this was not acceptable as far as I'm concerned. I ended up cleaning myself with a lot of bleach.

Why hasn't housing ensured that the worker they hired to fix my cracks in the basement walls, came to do his job. I have been having basement flooding for months.

I am not sure how I can be helpful as my basement has not flooded!!

There is a storm drain at the end of my driveway on the city street at the curb. In all the 18 years I have lived here, I have never seen city workers come to clean it. Certain times of the year when it gets plugged (i.e. ice in winter/leaves in fall) I clean it myself but I wonder who will clean it when I can't any longer as I am aging.

When we purchased our home fifteen years ago the issue or concern of flooding did not come up. Now there has been considerable development in our area and we are noticing more problems with standing water, slow water drainage on our street and water in our basement.

This neighbourhood seems to have a history of basement flooding. In my area, homes on the other side of the street seem to be most affected.

I also paid for a licensed contractor to install an exterior drainage system to ensure downspout near front entrance has water exit close to street and not house.

The water that has flooded my basement in the past two years came up form the sewer. It came in and out so fast we didn't…

I want to know (and willing to pay) if there is a device that can be used in case there is no electricity to pump the water out of the basement.

I had catastrophic basement flooding in my last house in Stoneybrook. Please caution people not to do window wells for their basements.

Yes, I'm a new comer in Canada a lot of people like me our/style of life back home is very different so I event don't know where or how the pipes in my home. I did buy it the way it is for all the new comer we need a program to introduce how everything in house works in this type of weather and rainstorm fence, plumber, electricity everything here work very different. I'm afraid to touch.

We were OK until additional subdivision were built all around us. Now several people have had flooding, the system cannot handle the larger volume. All new homes should be repaired to have the items mentioned installed. Existing homes on flood danger zones should have them installed free.

I have also had sewage come up through the floor drain. I have had cracks in foundation wall and these have been repaired. The plumber that installed the backwater valve after the last flood told me I was not eligible therefore I have delayed putting in a sump pump because of the cost. I had 16 inches of water in my basement my recent flood.

I have had two floods in the same year. My thought is that someone hasn't done the job correctly in "planning" the city sewers as this whole neighbourhood has had floods for years. How is the City going to fix the sewers to accommodate the growth for the old homes and new homes in this area? I feel like the City is trying to pass the buck onto us to fix it. Additionally, your grants aren't enough money to fix the problem as I checked out… I didn't bother applying considering the funding amount.

Our home is a 4 level back split – the lower level flooded in 2008 and we had the crack in the wall fixed by advanced basements. (invoice enclosed). This was the north side of the house – April 2010 we had another flood in the next level up (family room) south side of the home – we had a contractor dig on the outside of the wall but they could not find any crack in the wall. We are still experiencing some seepage when it rains heavily…

Yes we do have a 'sump pump'. It all depends on the City to prevent power loss during a "rain storm". All these preventative measures and reading materials are great. What is your input on assuring us of your backup plan during a power loss.

There is no info on City of London Website re: Basement Flood Grant Program!!

I believe the sanitary and storm sewers were tied together. The City should have been held accountable for the costs. We relieved very extensive damage and paid our insurance deductible.

Flooding was due to poor design of having a basement door to outside at the bottom of a stairwell. … landscaping drained rain into stairwell, drain got plugged by one leaf. Stairwell filled with water until 6' of water pushed in and filled basement. Horrible design.

We purchased this home on Oct 31, 2009. XXX runoff and heavy rain showers our sump pump ran constantly. I was fearful of this go had a second sump pump hooked up on 12V battery power. This second pump is hooked up to kick in should the primary pump fail or the power goes off.

Who are the morons that grant too many building permits to underserviced areas? City is responsible 100% for design flaws in municipal drain systems. Minor water damage in my home has been stopped by tiling the backyard; removing an abandoned fireplace flange; and re grading. Many homes on this street have foundation cracks – City inspectors bribed in the 70's?

During this last major rain event my neighbour came in and was monitoring sump pump/Found about a foot of wetness/water around the floor drain (of which I installed a drain check-valve) as well as the sump pit was full to the top and pump was running continually – neighbour went out to discharge point (catch basin) and found about 3' of water above catch basin. There is no doubt in my mind that if there were a power failure at the time of the event, my batter back-up would be drained quickly and I would have been flooded (just this past year). Also with the information that my neighbour had provided about the amount of water above my catch basin, the storm system was not able to handle this amount to take it away or there is restrictions in the system. Therefore, City should be investigating the system, i.e., how much sediment/debris in storm pipes and is flushing required, bigger storm pipes? Or installation of storm holding tank and where to put it. Flow study during rainy seasons is a good way to model what is happening in the system This is a good start to see problem areas. Has this already been done? What is the city doing about it?

We had several block flood – units 32-36 several times, 42-47 most recent. Getting backflow and ejector systems instead – have (XXXX) and added downspouts to (XXXX) help as well…

Mould problem in house from previous flooding – in walls and floors.

A computer spellcheck program was applied to the above responses. Further, in some cases, responses were summarized or truncated by the author.

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