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The Perceptions of the Real Estate Sector on Pluvial Flooding in London, Ontario

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A thesis submitted in partial fulfillment of the requirements for the Master of Arts degree in Geography and Environment

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Abstract

The frequency and intensity of pluvial flooding events are increasing in London, Ontario resulting in basement flooding of residential homes. While London has made a number of improvements to its sewer infrastructure to address this issue, their ongoing focus has been to assist homeowners through a grant program as they recognized that increasing awareness of pluvial flood risk and mitigative measures will increase the resiliency of the community. Real estate sector professionals are ideally positioned to discuss the risks and mitigative measures with homeowners before the purchase of a home. Through online surveys and structured telephone interviews, this thesis investigated the perceptions of real estate agents, appraisers, and home inspectors on pluvial flooding in London, their view of homeowners' awareness, and of the process of disclosing this information during the home purchasing process. Through the Multiple Listing Service and the Seller Property Information Statement, information about the basement flooding risk should be disclosed so that a buyer receives all known risks and mitigative measures of a house.

KEYWORDS: Pluvial flooding, Basement flooding, Real estate sector, Pluvial flood risk, Homebuyer/owner, Perceptions, Mitigation, Awareness, Disclosure

Lay Summary

Heavy rain events are becoming more common across Canada as warm oceans lead to more water evaporating into the air resulting in more intense precipitation events as clouds move over land. An extreme rainfall event that occurs independently from a body of water and floods an urban area is known as pluvial flooding. Basement flooding often results in areas where a municipality's sewer system is overwhelmed by a sudden increase in water enters the system and the property not having any flood preventative measures installed. In order to reduce damages impacting homeowners, owners need to be made better aware of the risks that can occur and of ways to protect themselves from water damage. This thesis investigates the perceptions of the real estate sector, specifically real estate agents, appraisers, and home inspectors, their role during the home purchasing process and their role in the process of informing homebuyers about their risk of basement flooding and ways to prevent it. Through surveys and interviews it was discovered that real estate agents, home inspectors, and the sellers are ideal to inform buyers about potential risks and ways to prevent them. Through the Multiple Listing Service and the Seller Property Information Statement, information about basement flooding risk should be disclosed so that a buyer receives all known risks of a property. Informing homeowners about pluvial flood risk and mitigative measures is crucial to create more resilient homeowners and urban communities.

Acknowledgements

Throughout this experience of writing a thesis, I would like to thank several people. First and foremost, I would like to thank the continuous support and guidance from my supervisor, Dr. Dan Shrubsole, for (once again) giving me the opportunity to do research and providing guidance through the research process. Without his assistance and involvement in every step of this process, this paper would not have been accomplished. It was a privilege and honour to work with him, and I am extremely grateful for everything he has done.

I would next like to thank my friends in the Geography and Environment department at Western. Throughout my Masters (and undergrad) I have had the pleasure of meeting such smart and kind individuals. They have encouraged and inspired me through the experience, and I could not be more grateful for all of them (you know who you are).

I would finally like to thank my Mom and Dad, who have supported me throughout my entire academic career. As fellow geographers, they have shared their wisdom and have always shown an interest in all my studies, especially my thesis. I could not have asked for a better support system.

I would also like to acknowledge the Institute for Catastrophic Loss Reduction for providing the funding for making this research possible.

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CHAPTER ONE
Introduction

1.1 Introduction

Pluvial flooding is described as the "invisible hazard" (Houston et al., 2011) as it is neither easily visible nor predictable, and can occur a considerable distance from a surface water body, such as a lake or river. It is directly caused by extreme rainstorms with rainfall rates that exceed the capacity of the urban drainage system and can occur in areas that have not been previously prone to flooding (Blanc et al., 2012; Bulti & Abebe, 2020; Nicklin et al., 2019). Pluvial flooding often occurs in the form of storm or wastewater sewer backup or groundwater infiltration that enters a house through the foundation. It usually occurs in basements, and has occurred in several of Canada's major urban centres, including Edmonton, Saskatoon, Winnipeg, Toronto, Montreal, Moncton, and London, as well as several smaller communities, causing significant financial and other impacts (Sandink et al., 2010; Thistlethwaite & Henstra, 2017). Almost no Canadian urban community is immune to pluvial flooding (Sandink, 2009). The purpose of this thesis to the investigate how, during the home purchase process, homeowners might be better informed about the risk of pluvial flooding, and if and how the house is currently protected from pluvial flooding. With this knowledge, potential homebuyers could know what additional measures might further reduce the pluvial flood hazard.

Existing flood management policy in Canada prioritizes riverine (fluvial) flood damage, which can pose a risk to human life as well as cause significant flood damages. Table 1.1 outlines several significant fluvial flood events that have occurred in Canada since the late 1990s and the associated damages with each event. Fluvial flood events

typically occur in the winter and spring months when the snow and ice are melting, or during very severe thunderstorms at any time of year. Damages from a fluvial flood events are significant as they can lead to occupants having to evacuate their homes. Historically, there has been a larger focus on fluvial flooding while ignoring the costly damages that are often associated with pluvial flooding (Douglas et al., 2010; Mobini et al., 2021).

Table 1. 1: Fluvial Flood Events in Canada		
Date	**Event**	**Damages**
January 9 1997	Saugeen River flood.	Mayor of Durham declared a state of emergency for to flooding of the Saugeen River. Around 200 residents evacuated, some businesses and schools closed, sewer backup (Government of Canada…, 2013).
March 28-April 15 1998	Clyde, Ottawa, Mississippi, rivers overflowed. Over 15 rivers in Quebec also flooded.	States of emergency were declared in Lanark highlands, Village of Kearney, Township of Drummon, Morth Elmsley, Beckwith Township, Carlton Place, and Mississippi Mills. Estimated cost of damages total $27,741,685 (Government of Canada…, 2013).
May 19 2004	Attawapiskat, ON River flood.	1,700 people from the James Bay Cree FN community were evacuated by air. Estimated total cost of damages was $5,700,000 (CAD) (Government of Canada…, 2013).
April 14th, 2008	Moira River flood in Belleville, ON.	Water from the Moira River flooded dozens of homes and shut down roads causing a state of emergency. Around 50 homes were flooded, wells were tainted with floodwater, and 18 individuals evacuated (Government of Canada…, 2013).
March 24 2012	Kashecchewan and Fort Albany, ON.	Rapid snowmelt and early ice break up caused flooding along the Albany River. 269 residents were evacuated. Estimated total cost of damages was $6,700,000 (CAD) (Government of Canada…, 2013).
February 16 2018	Grand River, ON.	Combination of heavy rainfall and melting snow caused the river levels to rise rapidly. Up to 2,200 homes and 4,900 residents were evacuated (Government of Canada…, 2013).
February 19 2018	Upper Thames River flood in London, ON.	Increased snow melt and rain caused significant record breaking flood event. Parking lots and parks were submerged by the flood waters (UTRCA, n.d.).
April 15 2019	Seasonal flooding on Albany River, Kashechewan, ON.	Evacuation of Kashechewan FN (2,500) (Government of Canada…, 2013).
November 2021	Flooding of the Fraser Valley.	Heavy rain in the fall caused smaller rivers to overflow turning corn fields into swamps (Schmunck, 2021).
November 14, 2022	Coldwater River flood in Merritt, B.C.	The Coldwater River overflowed and the city's wastewater treatment plant failed. 7,000 residents were forced to evacuate (CBC/Radio Canada, 2022).

Pluvial flood damages can also cause significant damages such as flooded homes and businesses and road closures. Table 1.2 describes pluvial flooding events that occurred in Canada from 2000 through 2021. Pluvial flood events primarily occur in the summer, spring, and fall, but they can also occur in winter. In general, it is more difficult to predict a pluvial flood event as they can occur throughout the year and there are many other factors that when combined with a high rainfall event result in a flood event.

Table 1. 2: Pluvial Flood Events in Canada		
Date	**Event**	**Damages**
April 20-21, 2000	Extreme rainfall event in Southern Ontario.	In Windsor, 95mm of rain fell in 24 hours, 70mm of rain in London, 50mm in Sarnia, and 40mm in Toronto. Sewers were backed up and roads washed out, many power outages occurred[1].
May 28th, 2009	Extreme rainfall event in London, ON.	95 basements in the Sherwood Forest region flooded due to surcharging of the sanitary sewers near the properties during the rainfall event[2].
July 26th, 2009	Extreme rainfall in Hamilton and Toronto.	Rainfall of 110mm in two hours caused 7,000 basements to flood and road closures. Parts of Lakeshore Boulevard in Toronto were submerged. Total estimated damages cost $173,312,00[1].
September 10 2014	Extreme rainfall event in London, ON.	Streets flooded in Queens avenue, Clarence St, and parts of Southdale road. Roads closed for cleanup after a tree toppled onto hydro wires causing power outages[3].
June 22-23, 2015	Extreme rainfall event in Southern Ontario.	Estimated cost of $29,188,000. Flooding in London overwhelmed the sewer system and caused damage to residential and commercial properties due to basement flooding[1].
February 24th, 2016	Extreme rain in ON, QC, NB, NS, PEI, and NL.	Heavy rain resulted in 51mm of rain in Hamilton, 36mm in Lennoxwille (QC), and 68mm in Gray River (NL). Flooded basement were recorded in Cornwall ON, over 50 homes in QC were damages by flooding[1].
June 25-24th, 2016	Extreme storm in AB, SK, MB, and ON.	Southern SK experienced heavy rain, flooding occurred in MB, Thunder Bay Ontario experienced 50mm in three hours. Estimated total cost of $35,523,00[1].
June 27th, 2016	Extreme rainfall in Kenora, ON.	Over 109mm of rain over a 2 day period and declared a state of emergency. The main road into the city was flooded and closed[1].
July 8th, 2016	Extreme rain in Southern Ontario.	Heavy rain (over 35mm) and strong winds were experienced in London, Whitby, and Ajax. Estimated total cost of $47,063,00[1].
September 29th, 2016	Extreme rain in Windsor/Tecumseh.	Significant flooding at Windsor airport reporting 78mm in 24 hours. Tecumseh reported 190mm of rain including flooded basements and road closures[1].
August 28th, 2017	Extreme rain in Windsor.	140-200mm in Riverside-Tecumseh and 285mm in Lasalle. Thousands of basements flooded resulting in over $173 million in insurance payouts[1].
August 7th, 2018	Extreme rainfall event in Toronto.	70mm of rain fell in Toronto (some areas measured 120mm). People were stranded in cars and caused over $80 million in insured losses[1].
April 18, 2019	Extreme rain in ON, QC, and NB.	Combination of heavy rain and snow melt. In QC, 154.5mm of rain fell in April. 10,000 people evacuated with 6000 homes flooding[1].
August 1-3 2020	Extreme rainfall event in London, ON.	Milbank Drive had at least a dozen cases of flooded basements. Water entered the home from the drains. Damaged drywall, flooring, carpeting, displaced families[4].
September 20-22, 2021 (Brown, 2021)	Extreme rainfall event in London, ON.	Many roads were flooded and closed. Hundreds of London Hydro customers were without power. Logged about 130 basement flood complaints[5].

[1] Government of Canada…, 2013; [2] *London…, n.d.;* [3] *Flood Reported…,* 2014; [4] Irvine, 2020; [5] Bogdan, 2021

In the future, the socioeconomic impacts of urban flooding events are expected to increase in number and intensity with increasing population growth, expanding development in flood prone urban areas, and more frequent severe weather associated with climate change (Chakraborty, Thistlethwaite, & Henstra, 2021). Many municipalities across Canada are working to reduce urban flood problems by replacing and updating aging sewer systems and adding additional capacity to existing systems, as well as creating incentive programs to lessen the impact on homeowners (Sandink, 2009). However, improving sewer systems is a very expensive and time-consuming process (Sandink, 2009). According to the Institute for Catastrophic Loss Reduction (ICLR), Canadian municipalities spent approximately $19.2 (CAD) per capita on the replacement and maintenance of municipal sewer networks (Kesik & Seymour, 2003, p. 11). In comparison, municipalities spent approximately $317 per capita on police services (Conor et al., 2020). While these types of expensive infrastructure works are important in achieving a more resilient municipality, they do not guarantee the elimination of the pluvial flood risk. Effective action is also required and can be achieved at the individual property-owner level (Davids & Thaler, 2021).

Fortunately, as indicated in Table 1.3, there is a wide range of actions that homeowners can take, which can play an important role in the reduction of urban flood risk and associated damages (David & Thaler, 2021; Sandink, 2009). Private homeowners can adopt measures to reduce the impact of flood damage and reduce the risk of flood water from entering their home (Rözer et al., 2016). A simple solution to minimize flood damage would be to remove valuable items from the basement to the first floor (i.e., an “unfinished basement”) (David & Thaler, 2021) or to install a backwater

valve, which prevents sewage flowing into the basement (*Backwater valve,* n.d.). However, since pluvial flooding is the "invisible hazard", many homeowners are unaware of the pluvial flood risk (Davids & Thaler, 2021 cited Thistlethwaite et al., 2018) and as such homeowners may not implement mitigation measures and/or be aware of grant subsidy programs created by the municipal government to reduce pluvial flood damages.

Table 1. 3: Homeowner Mitigation Measures	
Mitigation Measure Category	**Types of Mitigation measures**
Sump pump/plumbing	• Keep floor drain clear (Evans & Feltmate, 2019). • Repair and replace deteriorating pipes and appliances (Evans & Feltmate, 2019) • Install sump pump (Sandink, 2013). • Test sump pump and install backup power and alarm system (Moudrak and Felmate, 2020). • Install and maintain backwater valves (Sandink, 2013; Moudrak and Felmate, 2020).
Furniture and Electronics	• Elevate electronics off the floor and store valuables in watertight containers (Moudrak and Felmate, 2020). • Ensure furniture items in basement have non-absorbant surfaces up to 12" off the floor (Evans & Feltmate, 2019).
Floors/condition of walls	• Seal cracks in basement floors (Sandink, 2013; Sandink, 2011). • Cover earth floors with minimum 6mm moisture barrier and seal edges (Evans & Feltmate, 2019).
Hazardous Materials	• Remove hazardous materials from the basement to eliminate risk of spreading (Evans & Feltmate, 2019).
Landscaping	• Landscape around the house to maintain a positive grade and increase permeable surfaces (Moudrak and Felmate, 2020) • Keep up with tree maintenance and remove any trees close to the foundation, and storm/sanitary sewer laterals (Felmate et al., 2017) • Keep garden beds away from the foundation (Evans & Feltmate, 2019). • Keep snow piles 1m away from foundation, window and vents (Evans & Feltmate, 2019). • Impermeable/permeable walkways and driveways that direct water away from the foundation (Evans & Feltmate, 2019). • Lot grading, backfill and swales (Sandink, 2013).
Downspout/eaves troughs/sewer	• Extend downspout and sump pump discharge pipes >2m away from foundation walls (Moudrak and Felmate, 2020) • Extend splash pads (Sandink, 2013) • Install a sewage ejector system (Sandink, 2013) • Maintain and repair of sewer laterals (Sandink, 2013) • Disconnect downspout from municipal sanitary and combined sewer (Sandink, 2013) • Remove debris from eavestroughs and catch basins (Moudrak and Felmate, 2020). • Install rain barrels with diverters and overflow discharge pipes to divert water away from the foundation (Evans & Feltmate, 2019). • Remove blockages from storm sewer grates (Sandink, 2011).
Foundation/Windows	• Install plastic covers over basement window wells (Moudrak and Felmate, 2020) • Seal cracks in foundation walls (Sandink, 2013) • Seal potential overland flood entry points (Sandink, 2013) • Disconnect foundation drain/weeping tile (Sandink, 2013)

More than 95% of Canadian homes do not have backwater valves installed (Kovacs, 2022). This low rate of installation indicates that there is a need to increase

Canadian homeowner's awareness of the risk of and measures to mitigate pluvial flooding. This increased awareness can be achieved by nurturing a culture of preparedness among Canadians. A culture of preparedness involves being in a constant state of readiness to ensure the public is ready for any disaster since some can occur without warning, such as a pluvial flood event (Cooper, 2019). An important first step to create a preparedness culture is to provide information to prospective homebuyers about pluvial flood mitigative measures to increase their knowledge and awareness. The more knowledge one has, the more confident they become to be able to reduce damages because they are aware of mitigative measure to reduce the overall impacts.

Increasing public awareness about pluvial flood risk can help better protect homeowners from damages caused by heavy rain events. To achieve this, discussions about pluvial flood risk should occur with homeowners during the homebuying process before a flood event ever occurs. The home purchasing process involves several steps including: selecting a real estate agent; choosing a budget and exploring mortgage options; selecting desirable homes; making an offer; getting a home inspection; and completing the transaction (McNutt, 2022). Key participants in the real estate sector (specifically real estate agents, appraisers, and home inspectors) are in a unique situation where they learn many aspects about a home including the price and features of the property, which they report to the buyers to help with their home purchasing decision. During these discussions, the real estate sector perhaps can potentially influence homebuyers' perceptions on the flood hazard (Shrubsole & Scherer, 1996).

The Multiple Listing Service (MLS) is a database that contains information on real estate properties that accredited real estate agents can access. It provides an inventory

of listings for real estate agents to store property listings with potential buyers/renters based on their criteria. After the realtor inputs a buyer's criteria, the MLS will generate properties for the real estate agent to consider. The MLS provides the buyer's agent with all the information on a certain property (Chen, 2022). The selling agent's role is to make the seller's property appealing on the MLS. The MLS system is not only an advertisement of real estate properties, but also provides realtors with written disclosures on the property. The MLS on one property includes the price, year built, address, lot size, whether there is a garage, type of flooring, number of bedrooms and bathrooms, whether there is a fireplace, the mode of heat and A/C, if there is a pool, the type of roof, and more. Agent remarks on the MLS are notes made by realtors for realtors only on a certain property (*What's Allowed in Public…,* 2022). At present, there is no detailed information related to if a home has experienced previous basement flooding or information regarding any mitigative measures against pluvial flooding a house may have. A fundamental question and a major step towards developing a culture of preparedness concerns the desirability and feasibility of providing this information. For instance, the presence of backwater valves and many other measures identified in Table 1.3 could be easily noted on the MLS listing. Doing so could enhance rather than detract from the value of a house.

The actors involved in the home purchasing process have a moral, legal, and professional obligation to aid homebuyers by disclosing all known defects they have discovered or were informed about. However, it may not be visibly evident that there has been a past flood event in a home, as some damages can be easily hidden by a coat of paint, in the structure of the home and by furniture. There are clearly ways in which the real estate sector can better inform all homebuyers about the potential risk that pluvial

flooding can have and mitigative measures. Disclosing this information can decrease flood damages, and the associated inconvenience and stress suffered by homeowners/occupants, and increase the flood resiliency among homeowners (Davids & Thaler, 2021).

1.2 Research Context

This study will provide context into the perceptions of the real estate sector on pluvial flooding, specifically: their views of pluvial flooding and its significance; as well as their view of homeowners' perceptions; where to obtain information of pluvial flooding; and who they believe is responsible for the disclosure of pluvial flood risk information to buyers. As of now, there is little known about how, when and whether the real estate sector discloses pluvial flood information to potential buyers. This research addresses this gap. While the perceptions of actors in the real estate sector regarding pluvial flooding have not been frequently researched (Kaiser et al., 1987, Shrubsole & Scherer, 1996), they can provide insight into the current practice and how it can be improved.

There is a paucity of information on pluvial flooding, also referred to as urban flooding in the literature (Mobini et al., 2021; Nicklin et al., 2019; Rosenzweig et al., 2018), especially in North America. Most available literature on pluvial flooding originates in Europe or the United Kingdom. A study by Rosenzweig et al. (2018) maintained that pluvial flooding has received minimal attention in research in the past for several reasons. The first is that pluvial flooding is assumed to be a 'solved' problem as there are well-established sewer designs, operations, culverts, and pumps for flood prevention in cities, and many pluvial flood events result from the failure to implement

and maintain these systems. However, conventional engineering is based on past climate trends, which are not adaptive to withstand the increased amount of precipitation events associated with climate change. Additionally, new development can alter landscapes and can lead to increased flooding when the new development exceeds the capacity of the current sewer infrastructure (Mailhot & Duchesne, 2009).

Second, pluvial flooding may be perceived as a minor problem, with minimal damages associated with it. However, recent experience has shown that pluvial flooding causes a wide range of damages that can become very expensive to fix (Rozenweig et al., 2018; Rözer et al., 2016). Documented examples around the world include in July 2011 a severe rainstorm with 135.4mm of rainfall within 24 hours that hit the city of Copenhagen with insurance claims costing around $1.2 billion CAD (Wójcik et al., 2012). A pluvial flooding event occurred in the City of Beijing in July 2012 when rainfall rates of 170mm were reported in less than a 24-hour period and causing over $2.49 billion CAD in losses (Wang et al., 2013). More locally, in 2013 the City of Toronto experienced approximately 126mm of recorded rain (Pearson International Airport) with more than 4,700 basements flooding and costing the city $1 billion (CAD) (*Staff Report…,* n.d.).

Third, pluvial flooding is frequently ignored from flood frequency assessments, which are based on observations made over certain time periods relating to river stages, lake levels or tidal elevation. Surcharging conditions are monitored by several local stormwater management authorities within their drainage networks. However, these data are rarely made available for intercity comparison or assessing the impact of climate change. It is also difficult to track precipitation events that cause pluvial flooding (Blanc

et al., 2012; Rodriguez et al., 2012; Rözer et al., 2016), because they are frequently short-lived 'cloudburst' events that occur over isolated areas (Rozenweig et al., 2018). As a result, the historic record of pluvial flood events is mostly comprised of municipal service requests and social media posts, which can be influenced by the biases associated with these sources, such as the non-reporting by homeowners (Rosenzweig et al., 2018 cited: Downton et al., 2005; Wang et al., 2018). The lack of reliable records makes it difficult to assess pluvial flood risk, the trends over time, and the effectiveness of mitigation measures (Rozenweig et al., 2018).

While there is some research on pluvial flooding available (many recently completed within the past few years), adding to the literature can bring more attention to pluvial flooding which can create opportunities for the sharing of more information to the public about risks that can impact them. The results of this study can also inform provincial and municipal governments, and other policy makers, including the real estate sector, to initiate actions to create more resilient communities.

1.2.1 Pluvial Flooding Background

Global warming is causing more frequent and intense storms (Brockhoff et al., 2019), which greatly impact cities across the globe. The Insurance Bureau of Canada (IBC) reported an average $422 million (CAD) a year across Canada for severe weather-related losses during the period 1983-2008 (*Severe weather…,* n.d.). Severe weather across Canada in 2022 alone caused $3.1 billion (CAD) in insured damage, which includes those caused by pluvial flooding (CatIQ) (*Severe weather…,* n.d.). The majority of this loss was due to water-related damages (*Severe weather…,* n.d.). Severe weather contributes to local flood events (Kundzewicz et al. 2014; Rözer et al., 2016) resulting in

the displacement of people, impacts on economic activity, damages to the environment (Al-Habsi et al., 2014), and disruption to transportation and trade infrastructure (IPCC, "Climate Change, impacts, adaptation, and vulnerability"). Modelling conducted by the IBC confirms that as many as 1.8 million Canadian households are at a very high risk of pluvial flood damage in the future (Meckbach, 2016; Thistlethwaite & Henstra, 2017).

There are three types of flooding that can occur as a result of global warming including: coastal, fluvial, and pluvial flooding. Coastal and fluvial flooding are more well known and may have more devastating impacts than pluvial flooding. However, their frequency is lower than pluvial flooding, which continues to increase as a result of climate change and urbanization (Flores & Crompvoets, 2020). According to Westra et al. (2014), rainfall-derived flooding is one of the most costly and dangerous natural hazards worldwide.

Pluvial flooding is a result of a complex interaction between natural processes and the built environment. It is often caused or intensified by a failure of flood defense mechanisms, drainage infrastructure or other anthropogenic causes (Dawson et al., 2008; Rözer et al., 2016). While this is not a new kind of flooding, it is occurring more frequently and is becoming an increasing threat to property owners (Falconer et al., 2009).

Pluvial flooding events cause basement flooding in cities throughout Canada. Basement flooding can occur when there is overland flooding, infiltration flooding, sewer backup, or a combination of two or all three types (Sandink, 2009). Stormwater management has improved immensely in Ontario since prior to 1980 where the primary objectives were: (i) to provide flood protection in urban areas; (ii) to engage surface

efficient drainage off the land through the storm sewer system to the nearest body of water; and (iii) to convey sanitary sewage to a water treatment plant located at the nearest body of water (*Stormwater Management Planning...,* 2005). In contrast, current flood management involves a more integrated management planning process, as well as it considers climate change, low impact development, and the water budget (*Stormwater Management Planning...,* 2005). Municipal engineers and planners create overland flow pathways to help transport stormwater and snowmelt away from structures. Municipal sewer systems are normally constructed to withstand rainstorms that occur on average once every five years; however, older areas of a city might have been designed to handle storms that occur just once every two years (Sandink, 2009). Furthermore, many older established areas were not constructed with overland flow routes and rely exclusively on underground pipes, which frequently combine sanitary and stormwater/flows in one pipe. Overland flooding can occur when rainfall exceeds the capacity of underground pipes, or when a rainstorm exceeds the capacity of overland flow routes (Sandink, 2009). Water will flow into areas where it would not normally flow including basements through openings, such as windows, doors, vents and reversed sloped driveways (Sandink, 2009). Groundwater levels can increase, due to rain or snowmelt and infiltrate into basements through cracks in the foundation walls and floors. When municipal sanitary, combined, or storm sewer systems receive more water than they can handle, sewer backup can occur (Sandink, 2009). The excess water causes the sewer to surcharge and force water back through home sewer lateral pipes and cause sewage to backup into the home through basement drains, toilets and sinks (Sandink, 2009). An increased amount of runoff in the sewer system can create high pressures around basement floors and the foundation, which

can lead to structural damages to the home (Sandink, 2009). Fixing these damages is costly.

1.2.2 Role of Municipalities

Municipal governments can play an important role in managing basement flood risk (Thistlethwaite & Henstra, 2017) by updating and improving stormwater management infrastructure (Sandink & Robinson, 2022). Basement flooding is frequently caused by poor or outdated municipal water drainage systems, highlighting the need for continuing to ensure that the capacity of drainage systems' capacity is not exceeded. Stormwater management policy design standards rely on static past flood experiences regardless of the higher exposures and vulnerabilities that increase the risk of the system becoming overwhelmed (Thistlethwaite & Henstra, 2017). Although new housing in Canada is now has separate sanitary and storm systems, many older areas of cities and towns still have combined systems (Sandink & Robinson, 2022). Older areas with combined systems are more prone to basement flooding during a heavy rain event due to the combined pipes becoming more easily overwhelmed with sanitary waste and stormwater. Pluvial flooding events are occurring more frequently across Canada in many municipalities resulting in homeowners experiencing flooded basements and impacting municipalities financially (Thistlethwaite & Henstra, 2017).

For the purpose of this research, the City of London, Ontario was selected because it illustrates the problems and challenges facing many Canadian municipalities. Many London homeowners have reported that their basements have been flooded, and many of these occurred as a result of recent pluvial flooding caused during intense and heavy rain events. For example, in 2015, flooding from a 43.5mm rain event overwhelmed sewer

systems and caused damage to residential and commercial properties due to basement flooding with an estimated cost of damage was $29,188,000 (Government of Canada…, 2013). Similarly, due to a heavy rain event in 2021, many roads were flooded and closed, as well as hundreds of London Hydro customers were without power. Around 130 complaints were logged about flooded basements during this event (Bogdan, 2021).

Due to the large amount of pluvial flooding events impacting homeowners across the City, the City of London has taken action to reduce basement flooding. The Basement Flooding Grant Program, established in 2013, was designed by the City to provide financial compensation to residential homeowners, condominium corporations, and to non-profit housing co-operatives built prior to 1985, who have experienced basement flooding associated with sanitary sewer surcharge (*Basement flooding grant program…,* n.d.). Homes in London built between 1920 and 1980 have weeping tiles connected to the City's sewer system resulting in excess water in the City's system that can result in water backflow into the residence basement (Scherr, 2021). According to the Drainage By-law–WM-4, new homes in London are required to not connect the weeping tile from the City's system or to remove an existing connection (City of London…, 2021). The grant covers 90% of the construction costs to disconnect their weeping tiles from the City sewer system and to install a sump pump and backwater valve (*Basement flooding grant program…,* n.d.). These measures are intended to decrease the homeowners' risk of basement flooding and the cost of repairs. In order to successfully disconnect all weeping tiles from the City's system and to decrease basement flooding in residential areas across London, individual action is required to take part in this program (*Basement flooding grant program…,* n.d.). Without the participation of homeowners, this program would not

be successful and basement flooding will continue to occur. Therefore, increasing public awareness and participation is vital for this program, and the home purchase process is an opportunity to contribute to a heightened awareness.

In addition to having experienced recent pluvial flood events and developing a grant subsidy program for homeowners, London was chosen given it was proximate to the researcher's home, which was particularly important during the restrictions associated with the COVID pandemic.

Although one municipality has been selected for this study, the findings and methodology may be transferable to many other municipalities and cities across Ontario and elsewhere that are experiencing pluvial flooding.

1.3 Research Questions and Objectives

The primary research question of this study are: (i) *what is the current practice of informing potential homebuyers about pluvial flood risks and mitigation measures, and* (ii) *how might it be improved?* To answer these questions, a series of other questions must be investigated:

(1) What are the perceptions of the real estate sector regarding the nature and significance of the pluvial flooding risk in London Ontario?

(2) How well informed is the real estate sector about mitigation measures and their effectiveness?

(3) Where does the real estate sector obtain information about pluvial flood risk and mitigation measures?

(4) How and when in the purchase process are homebuyers informed of pluvial flood risk?

(5) What are the views of the real estate sector about who should inform and when should homebuyers be informed of previous pluvial flood events and future risks?

(6) What should and could be done to better inform potential homebuyers about the risks of pluvial flooding?

Answers to these questions were investigated using surveys and interviews of realtors, appraisers, and home inspectors, and a review of documents of the City of London pertaining to its homeowners grant programs.

1.4 Thesis Format and Organization

This thesis is in the format of an integrated article composed of two manuscripts with original research and one narrative review. The narrative review analyses important human dimensions associated with pluvial flooding. The first manuscript reviews the survey and interview results in respect of the perceptions of the real estate sector in the City of London on pluvial flooding and discusses the findings. The second manuscript describes the sources of information available about pluvial flooding and the current practice regarding disclosure of pluvial flooding information.

This thesis is separated into five chapters, including this one. Chapter two describes the literature on the human dimensions of pluvial flooding. Chapters three and four are composed of the manuscripts investigating the surveys and interviews completed on the real estate sector to answer the research questions. Chapter five provides a conclusion and synthesis of the findings in the study, future research, limitations, and final thoughts.

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CHAPTER TWO

The Human Dimensions of Pluvial Flooding: A Narrative Review

2.1 Introduction

Flooding is one of the most common natural disasters that can disrupt life, impact infrastructure, and can cause loss of life (ICLR, n.d.). Heavy and intense rainfall events are occurring more frequently all around the world, due in large part to climate change and increased levels of development in food-prone areas, which have resulted in more flooding events (Kundzewicz & Pińskwar, 2022; Netzel et al., 2021b; Prodanovic & Siminovic, 2007; Trenberth, 2011; Westra et al, 2014). In general, there are three main types of flooding: coastal, fluvial (river), and pluvial.

Coastal flooding includes flooding of coastlines along oceans, inland seas, and lakes. It occurs as a result of several factors including: high winds, storm surge, the combination of high estuarine flows and tides, seiches, and tsunami caused underwater seismic activity and undersea landslides (ICLR, n.d.), and urbanization (Gallien et al., 2018). Sea level rise caused by climate change will increase coastal flooding for decades (ICLR, n.d.). In Canada, there is projected to be an increase in flooding along the Atlantic and Pacific coasts. Previous studies suggest that mean sea levels could rise by one metre or more by 2100, which would have severe impacts on coastal environments, ecosystems, infrastructure, economies, and coast lines (Nicholls, 2004). However, coastal risk can be generally modelled and predicted and although insurance for this type of flooding is limited, Canadians living along coastal areas may be eligible for insurance coverage as well as government-sponsored disaster relief (*Options for Managing Flood Costs…*, 2019).

Fluvial flooding (or river/riverine flooding) occurs when water overflows riverbanks onto the surrounding areas due to high levels of water in a river, creek or stream (ICLR, n.d.). Urbanisation within a watershed and in proximity to rivers often change the land cover from vegetation to impervious surfaces, which can increase river flows, leading to more floods (Owrangi et al., 2014). Recently, the largest river in British Columbia (Owrangi et al., 2014), the Fraser flooded causing roads to collapse and hundreds of people were stranded. This intense flood event was very rare for the area that only experiences seasonal flooding from the Fraser River. Heavy rain overwhelmed small rivers and creeks that had a low flood risk (Schmunck, 2021). In general, fluvial flooding is predictable and can be modelled and mapped based on flood return intervals throughout a watershed. The cost of fluvial flooding insurance can be unaffordable or unavailable for some homeowners and these characteristics will likely continue in the absence of mitigating measures that significantly decrease the flood risk (*Options for Managing Flood Cost*…, 2019). Disaster relief is available to homeowners after serious events have occurred.

More recently, pluvial flooding has become more frequent worldwide (Falconer et al., 2009), resulting in adverse effects on humans, economies, and the environment (Chen et al., 2021). According to the ICLR (n.d.), pluvial flooding is heavy rainfall-related flooding that is independent of an overflowing body of water. The magnitude of pluvial flooding greatly depends on the amount and timing of precipitation, ground, and soil conditions (e.g., whether the ground is dry or saturated, pervious or impervious, frozen or thawed) (ICLR, n.d.), and drainage storage capacity infrastructure (Brockoff et al., 2019).

Extreme downpours often lead to localized flooding, especially if heavy rains occur over a relatively short time frame (Rosenzweig et al., 2018), overwhelming drainage systems.

Pluvial flooding can impact ones' health (physically and mentally) and can be very expensive to restore damages and it is, therefore, important to understand the impacts, perceptions, and responses of humans on pluvial flooding. Individual homeowners can play a fundamental role in making communities more resilient to pluvial flooding damages. Resilient communities are defined as communities with the "capacity to absorb stress or destructive forces through resistance or adaptation, the capacity to manage or maintain certain basic functions and structures during disastrous events, the capacity to recover or 'bounce back' after an event" (Twigg, 2007, p. 6). Promoting resilient communities means strengthening communities and enhancing their health in a way that will reduce the negative impacts of daily and extreme challenges (*What is community resilience…, 2022)*. Becoming more resilient and adapting to the impacts of heavy rainfall events involves individuals, government and insurers working together. To adapt to the changes and improve systems for the future (Rosenzweig et al., 2018), Canada needs to build a culture of preparedness that engages individuals, businesses, institutions and all levels of government to invest in flood mitigation and spread awareness of potential disasters. Increasing awareness of the impacts of flooding and understanding mitigation options and strategies are crucial to building resiliency.

This paper is a narrative review on the impacts, perceptions and responses of humans on pluvial flooding. Since it is a recent issue, there is limited published literature available on pluvial flooding and its impacts on humans. This paper will focus on pluvial

flooding, and other relevant studies focused on fluvial flooding as the impacts are similar to pluvial flooding (Sandink, 2011), and other hazards in order to gain insight on pluvial flooding.

Several databases were used for this narrative review, including SCOPUS, Web of Science, and JSTOR. SCOPUS and JSTOR were used as they cover scholarly literature from many disciplines (*Home - about JSTOR, n.d.; The best academic*…, 2019). SCOPUS also provides academic journal rankings and author profiles, which can be useful when deciding whether specific articles are relevant (*The best academic*…, 2019). Web of Science was also used for a similar reason - it also contains research papers for many different academic disciplines. Web of Science is the most widely used database which provides access to abstracts, bibliographic information, and cited references from journals, in which one can find additional articles that have cited previously published works. The cited reference allows one to find articles that have cited previously published works (Li et al., 2017).

2.1.1 Basement Flooding Causes and Mitigation Measures

Pluvial flooding is caused by several factors working together: very large rainfall events that lead to inundation of streets and buildings and the failure of drainage systems (Chen et al., 2010; Rözer et al., 2016) that occurs in a local area (Muthusamy et al., 2020). As a result, pluvial flooding will often lead to the flooding of basements. Water can enter the home through uncovered basement windows and seep in through cracks in wall and floor. Poor lot grading and blocked or clogged foundation drains or weeping tile systems can also contribute to basement flooding (Sandink, 2009).

Mitigation measures to reduce the amount of water entering basements and the associated damage occurs at different geographic scales. For example, local governments can provide flood risk information and/or subsidy programs to individual homeowners to encourage them to install devices, such as a backwater valve, sump pumps, window well coverings, placing extensions on eavestrough downspouts, and installing a splash pad (Moudrak and Felmate, 2020). Disconnecting a property's weeping tile from the City's sanitary or storm sewer system and installing a sump pump can reduce the chances of backups occurring in basements (Sandink, 2009). Homeowners can also maintain their property by clearing debris from the eaves and ensuring tree roots around the property to do not pose a risk to the home's foundation or sewer lateral pipes (Evans & Feltmate, 2019).

2.2 Impacts

The following impacts to humans are classified by the physical and mental health impacts, the costs of flooding damages, insurance, and the marketability of homes impacted by flood events.

In general, flood impacts on humans can be classified in at least two ways. The first is to categorize the damages as either tangible or intangible (Hammond et al., 2013). Tangible impacts can be quantified in financial terms and includes damages to property or the loss of income a business may experience if its operations are disrupted. Intangible impacts are difficult to measure financially such as the loss of life, negative impacts on mental or physical health, and impacts on the environment. The second way to classify impacts is to differentiate between direct and indirect damage (Hammond et al., 2013). Direct damages refer to any loss that is caused by physical contact of flood water with

humans, property, or the environment. Indirect damages occur well after the flood event such as an individual experiencing respiratory problems as a result of mold growth from a past flood event (Hammond et al., 2013). Both types of methods categorising damages include negative impacts on humans and their property and whether these occur during the event or in the future. There are several dimensions of these impacts –health, property damage, and marketability of a home – that are discussed in the next subsections.

2.2.1 Property Damage

Basement flooding is the most common direct damage associated with pluvial flooding and can cause damage to physical infrastructure (e.g., foundation walls and basement floors), personal belongings and contents of a home (e.g., furniture, electronic equipment, rugs, food spoilage) (Sandink, 2009). If a basement is unfinished, the damage to personal contents and belongings is limited to contents stored in the basement as well as heating and cooling equipment, and traditional water heaters.

2.2.2 Health

Health impacts from pluvial flooding can be associated with poor indoor air quality from a past flood, caused by dampness and mold growth. Black mold is a large problem for homeowners and property (Vlosky & Shupe, 2004). According to the Centers for Disease Control and Prevention (CDC), for some people, exposure to mold can cause symptoms such as a stuffy nose, wheezing, itchy eyes or skin irritations. However, for those people with existing allergies to mold or asthma, stronger reactions can include fever and shortness of breath (Centers for Disease Control and Prevention, 2022). In addition, flooding associated with sewage waste can lead to faecal-oral

transmission of disease (Sandink, 2015). Other types of disease associated with pluvial flooding include waterborne diseases, vector borne diseases, and rodent borne diseases (Hammond et al., 2013).

Injuries may occur as individuals attempt to remove themselves from the danger or return to their home and begin the cleanup process. Navigating through damaged buildings can cause contusions, cuts and sprains, and exposure to electrical power cables can cause electrical shock (Ahern et al., 2005).

Having one's home flooded can be very traumatic for homeowners and can cause many adverse health implications (Rözer et al., 2016). Many studies have examined the mental health issues that are associated with a flooding event. Mental health implications usually occur after the flooding events, where coping with recovery was very stressful and challenging (Fewtrell et al., 2008). The most common mental disorders that arise from flooding events include depression and anxiety. Studies in Europe and North America have shown posttraumatic stress disorder (PTSD) can arise after a stressful event of a catastrophic nature characterized by "intrusive memories, avoidance of circumstances associated with the stressor, sleep disturbances, irritability and anger, and lack of concentration" (Ahern et al., 2005, p. 39).

2.2.3 Financial Loss

The cost of damages and cleanup after a flood event can be substantial, to individual property owners and to other stakeholders. For example, the cleanup cost after an extreme weather event in the province Alberta in 2011 cost Parks Canada over $14 million (CAD) (Warren & Lemmn, 2014). After the 2013 flooding event in Toronto, Ontario, the City experienced a total loss revenue of $61 million (CAD) (Sandink, 2015).

In June 2013, Calgary, Alberta, experienced extreme rainfall events that caused $400 million (CAD) in municipal property damages. In the same year, Toronto experienced the most expensive disaster in the province's history with damages costing $940 million (CAD) (Mann & Wolfe, 2016). In terms of international flooding, in the Netherlands, pluvial flooding can cost 90 million Euros per year and this could increase to 200 million Euros per year, based on future predictions of more frequent periods of extreme rainfall (Forrest et al., 2021).

Repairing or replacing damaged infrastructure in a home can be expensive for individuals especially for those without home insurance coverage. The cost of damages to a home can include, as stated previously; the cost of replacing damaged items, such as furniture, personal belongings, and mechanical/electrical equipment. These costs can have a large impact on homeowners and can lead to high levels of stress.

2.2.4 Insurance

Insurance coverage for flood events can lessen the financial impact of flood damages on a home significantly. For example, according to the Insurance Bureau of Canada (2018), a flooded basement costs on average $43,000 (CAD) to repair (Evans & Feltmate, 2019). However, homeowners may not have coverage for pluvial flood events and they may not be aware of the flood related terms of their insurance policy.

Insurance coverage for sewer backup is available but most homeowners in Canada are not insured for damages caused by groundwater flooding (infiltrations) and overland flooding (e.g., stormwater flows that enter homes through windows and doors) (Sandink et al., 2010; Sandink, 2015). As well, repeated sewer backup claims may result in the limitation or discontinuation of sewer backup coverage, which can increase homeowners'

liability for future recovery costs (Applied Systems, 2013 cited by Sandink, 2015). Additionally, homeowners may experience uninsurable damages caused by infiltration or overland flooding. While provincial disaster relief may fill this gap after widespread flood events, homeowners are often incur these damages on their own (Sandink et al., 2010).

Water damage associated with household plumbing issues and basement flooding has become one of the most significant causes of home insurance claims in Canada (Sandink, 2015). The Insurance Bureau of Canada (IBC) is the national industry association representing Canada's private home, auto and business insurer. In 2012, the IBC estimated average yearly insurance payouts for water damage at $1.7 billion CAD (Sandink, 2013; Sandink, 2015). Aviva Canada, which is one of the country's largest home insurance providers, reported that 51% of claims paid to homeowner policyholders in 2013 were associated with water damage, and that the average value of water damage claims had increased from $8,944 CAD in 2003 to $20,537 CAD in 2013 (Aviva Canada, 2014 cited by Sandink, 2015). Damages from flooding associated with extreme rainfall related overland flows are typically excluded from home insurance coverage in Canadian provinces outside of Quebec. However, provincial disaster relief assistance programs may be utilized to provide coverage to homeowners affected by uninsured overland flood damage (Sandink, 2010; Sandink, 2015). Federal disaster relief is financial assistance provided by Public Safety Canada (PS) through the Disaster Financial Assistance Arrangements (DFAA). This assistance is given to provinces and territories that have been impacted by a disaster and where response and recovery costs exceed CAD $1 per capita (Burton et al., 2016). The payment is made to the province or territory rather than

the impacted individuals, business or communities. The DFAA was created in 1970s and since then the Government of Canada has contributed $6 billion to help provinces and territories return to pre-flood conditions after a disaster (*DFAA*, 2022).

Improving one's understanding of insurance coverage for water damage is important for promoting behavioural risk mitigation measures. Sandink, (2011) discovered that 45% of residents in a high urban flood risk subdivision did not know if their policies covered sewer backup. This indicates that there is a lack of knowledge about a what a home insurance policy may or may not cover. However, it seems as though flood insurance can often protect homeowners against the cost of flood damages on a home if it comes from the drain.

2.2.5 Disclosing Information during the Purchase and Sale of a House

Shrubsole and Scherer (1996) investigated floodplain regulation and the perceptions of the real estate sector in the cities of Brantford and Cambridge, Ontario, Canada. It was discovered that floodplain regulations can have potentially negative impacts on the marketability of a home. However, this effect can be small and it can vary with location, site characteristics and the length of time since the last major flood event. Palm (1981) made similar conclusions that the house prices within 'special earthquake study zones' were less compared to other areas in California. These zones were areas likely to experience earthquakes. However, Palm et al. (1983) discovered that if a property was in a landslide prone area there would be about a 17% price reduction on the property. After a natural disaster occurred, such as flooding, there seems to be a small price reduction, however not enough to have a large impact on homebuyers' decisions to purchase a home (Palm et al., 1983). As well, after an earthquake has occurred the effect

on the price of the property is generally small and short-lived. Palm's study concluded that natural hazard prone areas do not have a large negative impact on the price of a property.

The real estate sector is in a unique position where they can influence the exchange of information and the perceptions of pluvial floods and the pluvial flood risk. In Canada, there are provincial regulations regarding mandatory disclosures in a real estate transaction and therefore, they vary across the country (Henstra & Thistlethwaite, 2018). Flood risk information disclosure in Ontario involves the Seller Property Information Statement (SPIS), which includes specific questions on the property's flood risk, however this is not an adequate property disclosure statement for buyers to base their purchasing decision on (Henstra & Thistlethwaite, 2018). Disclosure of information by the real estate sector during the sale of a home's experience to previous flooding is often a question about whether the damages are latent defect or a patent defect. Latent defects are hidden and not readily apparent to a buyer in a home inspection. In these cases, a seller may not be aware of their existence and cannot be held accountable for this defect. Patent defects, on the other hand, are those flaws that are easily discoverable by buyers without disturbing the property (Lem & Bocska, 2021). If the property has flooded from a rain event in the past and the seller and realtor are aware of this, then they have an obligation to disclose this information to the buyer due to the risk being known.

Disclosing flooding information may be beneficial for knowledgeable homeowners to be able to better protect themselves against flooding in the future. Disclosing flood information can prevent homeowners from being surprised by a flood event or water damage on their property (Snyder & Kulesza, 2020). However, for

homeowners to be better able to mitigate against flood risk, they must understand their flood risk. Informed property owners in an area will further reduce the long-term damages of flooding and create a more resilient community (Snyder & Kulesza, 2020).

2.3 Perceptions

The following discussion about the perceptions of humans is organized around the following themes: (i) the magnitude of the hazard, (ii) one's experience, (iii) the roles of people in decision making, and (iv) hazard communication.

There continues to be a paucity of previous research and public information regarding the perceptions and attitudes of, specifically, the real estate sector on pluvial flooding (Kaiser et al., 1987; Shrubsole & Scherer, 1996). Studies that focused on the real estate sector and their perceptions in North America are outdated, such as the studies completed by Palm (1976; 1981) and Palm et al. (1983). Since the mid 1980s, impacts of climate change have increased and therefore, an update on these matters is warranted.

In the study conducted by Palm et al. (1983), appraisers were asked to assess the perceptions of lenders, buyers and sellers with respect to landslide-prone areas, floodplain locations, property located on a known earthquake fault trace, property located within a special studies zone, or a housing unit showing evidence of seismic landslide damage. The results showed that lenders and appraisers responded only passively to earthquake hazards, however appraisers will supply their clients with hazard information. Most lenders do no incorporate earthquake hazard into their lending policy, however there is a minority that will go 'above and beyond' to supply this information to their clients. The majority of lenders did not believe that an earthquake was a likely cause of large-scale mortgage default since earthquakes were not perceived as a dangerous risk. As well, if

appraisers and lenders do not perceive an earthquake as being important, then it may be safe to say that they do not perceive flooding an important issue. If a real estate sector professional does not perceive something to be an important issue or a risk to buyers, they may not initiate a conversation about it with the buyers on how to go forward.

2.3.1 Magnitude of Hazard

It is understood generally that if the nature of a risk is low, people will not perceive it as a threat. Mann & Wolfe, (2016) compared perception data on two studies: swine flu risk and Toronto's urban flooding risk. The results indicated that there was a clear difference between the nature of the two risks, as the public experiences more fear and anxiety towards swine flu risks whereas flooding does not evoke the same emotions (Mann & Wolfe, 2016). Anxiety towards a risk only indicates a statistical change to risk perceptions when participant's perceptions are influenced by social change or worldview defense. Flooding alone is not viewed as a serious risk and therefore people are not worried about its social or world implications compared to the swine flu. Flooding may be seen as a large risk if it is paired with a large global scale problem, such as climate change, which could signal to people that it will be a recurring and ongoing hazard. This study concludes by indicating the importance of social dimensions into risk management, and the role that citizens play in decreasing flood risk may influence individuals' flood risk perceptions (Mann & Wolfe, 2016).

Rözer et al. (2016) noted that the overall public awareness of pluvial flooding is low. People do not believe pluvial flooding is a risk and they underestimate the risks with low probabilities of occurrence. As an "invisible hazard", homeowners are often unaware

of the risks associated with this hazard, and as a result, are unprepared to deal with pluvial events and how to mitigate against the damages (Netzel et al., 2021b).

According to Siegrist and Gutscher (2006), fear of a flood played an important and influential role in making people who had been previously affected by flooding more aware of the risk and damage potential relative to those with no previous experience. The negative emotions experienced by people after a large hazard are more likely to increase risk perception, however positive emotions have the opposite effect and decrease risk perception. However Mann & Wolfe (2016) argued that fear of death from a large hazard does not influence the perceptions of flooding or preparedness.

2.3.2 Previous Experience with Flooding

Perceptions are heavily influenced by experience (Kunreuther et al., 1978; Owusu et al., 2015; Pagneux et al., 2010; Rözer et al., 2016; Thistlethwaite et al., 2018), emotions, and feelings (Bradford et al., 2012). Individuals whose homes flooded are more likely to have more knowledge and awareness of the impacts of flooding, compared to those who have had no experience (Pagneux et al., 2010).

A study conducted by Vlosky & Shupe (2004), examined the perceptions and attitudes of real estate agents, homeowners and home builders on the issue of mold, a large health problem for many homeowners who have experienced pluvial flooding. This study showed that the most informed actor about mold was the homebuilder, while homeowners were the least well informed (Vlosky & Shupe, 2004). This indicates that homeowners must rely upon people who are knowledgeable about hazards and who can also relay this information to them (Vlosky & Shupe, 2004). The general lack of knowledge by homeowners is also evident in other hazards, such as pluvial flooding

(Vlosky & Shupe, 2004). The lack of knowledge on hazards, means that they have not experienced that hazard before, and can influence ones' perceptions of the hazard. If a person does not have experience with a hazard, then they have low perception on it as they might not know the outcome of the hazard and the damages it can cause.

Those people who have experienced a previous flood event are more likely to be proactive to mitigate against the risk of flooding and purchase flood insurance to increase resiliency. However, attitudes towards insurance companies can negatively influence prevention behaviour (Siegrist & Gutscher, 2006). Those homeowners who believe that their insurance companies will pay for any damages showed less prevention behaviour than people who relied less on the insurance companies according to a study by Siegrist & Gutscher (2006).

The public perceive risk in a different manner than the scientific community and public authorities. Thus, understanding how the public perceives risk is crucial in determining how appropriate flood-related information should be disseminated to the public. It must be done in a manner that will increase public trust in authorities leading to a better ability to respond to floods and increased resilience (Bradford et al., 2012).

2.3.3 Roles of Stakeholders in Decision Making

The roles that specific stakeholders play in decision making can impact the perception of homeowners on pluvial flooding. By educating homeowners located in flood prone areas, they will learn how to better prepare and protect themselves against the impacts of flooding. These actions might improve the precautionary behaviour of communities (Siegrist & Gutscher, 2006).

There are many stakeholders who can be effective communicators of flooding risk to homeowners. Netzel et al. (2021a), noted that "weather experts and enthusiasts, public institutions, media agencies, and politicians" can play a key role in hazard discussions. In general, well-known established agencies are the most important actors for risk communication (Netzel et al., 2021a).

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)" (Sandink, 2011, p. 1). However, there may be a lack of effective communication or miscommunication between citizens and government officials regarding hazards. For example, experts in Switzerland have created maps that indicate the risk of flooding, however, most people are unaware of these maps and there are no consistent policies to communicate the risk depicted on the maps to the public (Siegrist & Gutscher, 2006).

According to the IBC (2019), several property and causality (P&C) insurers started offering new products that cover residential overland flooding in 2015, and market uptake has been increasing. The IBC is also working with federal and provincial governments, as well as organizations focused on flood-related issues, to advance a whole-of-society approach to reduce flood risk for Canadians. For example, the IBC is a member of the National Advisory Council on Flooding and co-chairs a working group on the financial management of floods with Public Safety Canada. The working group will be providing options to federal, provincial and territorial ministers for managing the financial costs of flooding on high-risk properties. The insurance industry and

governments can reduce flood risks by taking the following steps: “educating and empowering consumers to mitigate, improving land-use planning, making targeted infrastructure investments, improving building codes, sharing data, and preserving and restoring wetlands” (IBC-2019-Facts, 2019, p. 51).

Due to the role that real estate agents can play with a homebuyer, they can be an important conveyor of environmental hazard information (Palm et al., 1983). Thus, real estate agents, or other professionals in the real estate sector can also play a role in impacting homebuyers’ perceptions of pluvial flooding during the home purchasing process. Appraisers can point out defects or other factors in housing valuation, which can influence buyers by deterring them from purchasing a home with potential risks (Palm et al., 1983). Home inspectors can identify actual 'defects’ in a home, such as physical water damage, the absence of a backwater valve or down spouts that are too close to the foundation, and recommend how these might be overcome.

2.3.4 Risk Communication

Communicating flood risk to the population at risk is central for flood risk management and the implementation of mitigation measures to reduce damages. Flood risk communication involves informing the public about the risk, ways of protection and personal safety measures (Hagemeier-Klose & Wagner, 2009). It is important that the design of risk communication programs put a strong emphasis on the needs of the population at risk, since there are many forms of a ‘population’. This idea ensures that the selected population understands the information being communicated to them (Dransch et al., 2010). There is a wide range of ways to communicate risk to a population including “warning labels on consumer products, interactions with government officials, industry

representatives, the media and members of the public" (Covello et al., 1986 p. 171). The messages should balance the what (e.g., home protection, emergency supplies, emergency plans) with the why (e.g., everyone is at risk of flooding; take care of yourself and others; floods can be very serious resulting in the loss of homes, possessions, time at your job and you and your family's health) (Heldsinger-Klose et al., 2018). Choosing the right communication strategy requires balancing complex multiple objectives (Covello et al., 1986; Dransch et al., 2010) that may include the "population's 'right to know'; the duty to protect public health; the costs of unnecessarily alarming people, and the possible repercussions of premature or delayed action" (Covello et al., 1986, p. 176-177).

According to Barker and Macleod (2019), Kankanamge et al. (2020), and Netzel et al. (2021a), social media can be an effective method for flood risk communication. Most of the general public have some form of social media, such as Facebook, Instagram, and Twitter, and they can allow for communication outside the traditional form of media, such as TV and radio (Heldsinger et al., 2018). Netzel et al. (2021a) examined the role that Twitter can play in risk communication. Twitter can offer the opportunity for two-way communication during a heavy precipitation or actual flood event. Their results indicated that Twitter can be used to send out warnings to the public, and also suggested that stakeholders increase their use of social media to share information about risks related to heavy precipitation events (Netzel et al., 2021a). Although the messages sent via social media were primarily warnings, having links to other sites that provide information on flooding and mitigation measures can be very beneficial. In the Dutch city of Arnhem, citizens took photos and videos of pluvial floods in 2014, 2016, and 2017, and shared them on social media. Videos provided information on the flooding of streets,

speed of water and the scale of potential damage and disruption. By sharing this information online, citizens were acting as knowledge gatherers and knowledge verifiers by providing information that could be used by public authorities to improve and verify their flood models (Forrest et al., 2019). However, there are limitations to using social media as a communication tool. For example, not everyone in a society uses or has access to technology required for social media, and these people may not receive important flood warning and evacuation information.

Flood maps are beneficial because they show the extent and probability of flooding to homeowners and buyers. According to Handmer (1980), fluvial hazard maps are important for the implementation of a range of flood mitigation measures. An important purpose of flood maps is that they comminate risk to the public (Henstra et al., 2019). Flood maps used for risk communication seek to raise public awareness about flood impacts, impart flood preparedness advice, and more (Henstra et al., 2019). Handmer (1980) examined the flood mapping component of the Canadian Flood Damage Reduction Program. Data were collected on attitudes about floods before and after viewing maps (Handmer, 1980). This study concluded that there was an increase in flood awareness after viewing the maps, although this increase could not be attributed solely to viewing the maps or that the public will understand the information contained in a flood map (Handmer, 1980). Handmer (1980) also indicated that public flood maps can be seen as too advanced to communicate information to the general public, therefore, the terminology needs to be consistent and understandable. The general population needs simpler and more intuitive presentation of the information presented on a flood maps with

explanations of technical terms and important aspects of risk communication (Henstra et al., 2019; Snel et al., 2019).

2.4 Responses

Actions that homeowners can take can play a significant role in the reduction of urban flood risk (Miguez et al., 2009; Sandink, 2011). There are many mitigation measures, particularly within the house and adjacent property that homeowners can undertake. Local, provincial and federal governments can also implement mitigation measures on a larger scale, such as distributing flood protection information to citizens creating flood maps (see Appendix D for list of stakeholders and their associated flood mitigative measures), and contributing to the cost of major sewer works. Similarly, the real estate sector, conservation authorities and relevant not for profit organizations can also implement mitigation measures to further prevent flood damage in the community. Having an understanding and awareness of all adjustments (or mitigation measures) that can be made before a geographical event can better prepare individuals for the risk. The Range of Adjustments Theory, developed by Gilbert White, argues that unwise decisions made by the public can result from misperception or unawareness of the total range of choice that can theoretically solve a flood hazard problem. Therefore, it is important to make all participants in the management of the pluvial flood hazard of the range of options one can take to reduce damages by examining how alternatives are perceived and known (Wescoat, 1987) (Table 1.3).

Previous flood experience, knowledge, sense of responsibility and trust in public flood risk reduction can all influence a homeowner's decisions to implement pluvial

flood risk reduction measures. The following responses of people to a hazard are classified by their preparedness, previous experience with the hazard and socioeconomic status. Although, precautionary behaviour is low before a flood event, the solution to decrease flood damage and risk is to increase protective responses in homeowners to ensure they are better protected from flood events (Thistlethwaite et al., 2018). This could be because of the lack of flood experience and knowledge about the flood hazard (Rözer et al., 2016).

2.4.1 Preparedness

Preparedness can be described in technical, social, economic and institutional dimensions (Raaijmakers et al., 2008). The technical dimension refers to individual or collective technical actions intended to reduce the material damage due to flooding. Examples include changing the interior and exterior design of buildings, or temporal measures, such as the instillation of emergency equipment and temporary reinforcement. The social dimension refers to actions taken by individuals before, during, and after a flood event, and largely depends on a person's skills and knowledge of dealing with the effects. Local authorities should have proper evacuation schemes, emergency supplies and qualified people – both paid staff and volunteers – to deal with the flood. The economic dimension refers to the reduction of the financial risk to individual homeowners affected by a flood, typically achieved through home/flood insurance and/or disaster relief. Insurance, for example, can greatly motivate individuals to implement measures at reducing loss (Kron, 2002). The institutional dimension refers to the design and communication of an action plan in case of flooding. This can be in the form of

measures such as, evacuation schemes and training of emergency staff (Raaijmakers et al., 2008).

Understanding why individuals who are “at risk” are typically underprepared and over-exposed to the flood hazard is important to improve risk communication. Certain behaviours can potentially alter their exposure and/or vulnerability to hazards, and private initiatives can significantly reduce flood damage and thereby contribute to flood risk reduction. In risk research, flood risk perception is as an important factor for developing effective flood management strategies. How households perceive and understand flood risk shapes their judgement and their actions in preparing for and responding to flood events (Grahn & Jaldell, 2019). Kunreuther (2006) indicated that preparedness levels for a disaster is often low for a low-probability high-consequence events, such as Category 4 hurricanes. Due to their low probability of occurrence, individuals frequently deny a risk exists or believes the damage potential is minimal (Kunreuther, 2006). Risk reduction measures by individuals are typically implemented after the disaster has happened (Kunreuther, 2006). As mentioned earlier, the real estate sector can play a role in helping homeowners to prepare homeowners for risk by providing information on the pluvial flood risk as well as mitigative measures and government or insurance programs available to homeowners.

When preparedness increases, individuals and groups are more capable of controlling the negative consequences of a risk. Preparedness requires awareness and the readiness to limit loss (Raaijmakers et al., 2008). However, a study conducted in the Greater Manchester area in the United Kingdom investigating pluvial flood events in

2004 and 2006 showed that people were not well informed or prepared before, during and after the events (Rözer et al., 2016).

Governmental involvement can include the financing of investment in permanent and temporary dikes and flood pads, the provision of information about flood forecasts and the co-ordination of evacuation (Buckland & Rahman, 1999). These changes reflect a growing resources base from which government can increase awareness of the need for more organized disaster preparedness (Buckland & Rahman, 1999). In Manitoba, flood emergency committees, comprised largely of municipal leaders, organizes individual community preparedness and response, and acts as an intermediary for provincial government action through Manitoba Emergency Management Organization (MEMO). This indicates that organized plans carried out through local governments can help citizens be more prepared for a flooding event.

Awareness and preparedness can be directly influenced by public policy. Policies would address measures such as educating and informing citizens, and technical protection measures (Raaijmakers et al., 2008).

2.4.2 Previous Experience with Flooding

Much of the research into flood experience and behaviour emphasizes that flood experience matters. Having previous experience with flooding can prompt homeowners to be more willing to protect their home against the damages from the next pluvial flood event (Thistlethwaite et al., 2018). Grothmann & Reusswig (2006) reported that past flood experience explains 10%-20% of the "variance" observed in protective behaviours. Past experience does trigger preventative actions, however, personal experience may not elicit protective responses (Grothmann & Reusswig, 2006). Owusu et al. (2015) reported

that flood severity in addition to frequency contribute to whether or not individuals will take protective measures (Thistlethwaite et al., 2018).

Weinstein (1989, p. 46) suggests three major routes from experience to protective behaviour: "societal attention after events striking a large number of people; victim-directed influence such as tailored education about ways to prevent future damage, and intraindividual response (e.g., victim's perception of risk)." However, responses to damage experience may be limited for several factors: the damage may be perceived as minimal, mitigation measures may be seeen as ineffective, and the impact of experience may reduce over time. Weinstein (1989) discovered that experience does not always increase self-protective behaviour (Osberghaus, 2017). A study conducted by Osberghaus (2017) discovered that households with flood experience were more active in implementing mitigation measures afterwards a flood event than those with no experience. Homeowners who have not dealt with a hazard before may not be aware of their risk or risk reduction measures.

2.4.3 Socioeconomic Status

One's socio-demographic status can have impacts on protective behaviours as well (Thistlethwaite et al., 2018). A lack of resources, such as money, time and social support can prevent individuals from carrying out protective behaviours (Thistlethwaite et al., 2018).

There may be a relationship between one's income and their response to pluvial flooding. Those with lower income may not instal any mitigation measures or instal inadequate mitigation measures. Low-cost mitigation options are typically implemented by homeowners after flood events, rather than more costly structural measures for flood

barriers (Osberghaus, 2017). Those in lower economic classes are less likely to prepare for disasters or acquire insurance due to high cost. However, they may have greater material losses relative to income and face more challenges during the response, recovery and reconstruction stages (Thieken et al., 2007). Fox-Rogers et al. (2016) suggested that government funding could be redirected from one-way information campaigns to direct implementation assistance for those who lack necessary skills, and that communication efforts should focus at increasing citizens self-efficacy.

In a study conducted by Pagneux et al. (2010), it was discovered that ones' level of education does not have a significant effect on the knowledge and understanding of the population. Burton & Kates (1963) discovered similar results noting that there is little or no significant effect in hazard perception by the few generalized indicators of level of social class or education that have been tested against hazard perception (Burton & Kates, 1963). It seems as though ones' education level does not impact ones' responses to pluvial flooding, however, there were studies that contradicted these conclusions. There is a positive effect of flood experience on mitigation measures within highly educated heads of households (college degrees) according to Osberghaus (2017). Households with higher education seem to be more responsive to flood experience in terms of implementing new mitigation measures than less educated household heads (Osberghaus, 2017). As well, those with higher education and income have been found to be more aware of their flood risk (Burningham et al., 2007). This research would be important as it could help with the development of appropriate risk communication strategies (Burningham et al., 2007). However, further research needs to explain this phenomenon fully.

2.5 Conclusion

This narrative review investigated the human dimensions of pluvial flooding, specifically the impacts, perceptions, and responses of humans on pluvial flooding. The largest impacts on humans include: the physical impacts, health impacts, cost of flooding, insurance, and the sale and purchase of homes impacted by flood events. Physical impacts include any damage that has occurred inside and outside a home, whereas the health impacts include any diseases, injuries, and mental health implications to individuals. The cost of flooding is associated with the large financial cost (to homeowners and municipalities) to repair damages from a pluvial flooding event. To reduce the cost of a flood event, insurance can lessen the financial impact of flood damage. However, some insurance coverages may not cover overland flooding and damages associated with overland flows. Finally, pluvial flooding may have a slight decrease in the price of a home although this decrease down not impact the decision to purchase. Disclosure from the real estate sector may be beneficial to homebuyers by providing them information about pluvial flooding and mitigation measures.

The largest impacts on the perceptions of individuals on pluvial flooding include: magnitude of hazard, experience, roles of decision makers and hazard communication. In general, the perceptions of pluvial flooding are very low, which can be related to the magnitude of the hazard. The risk factor from pluvial flooding is perceived as low (viewed as a low magnitude hazard), and therefore the perception is low. Having experience with a hazard can increase ones' perceptions since they will have more knowledge and awareness of the hazard and its damages. The specific roles of stakeholders, such as the government, insurance companies, and the real estate sector can

increase homeowners' perceptions by providing information and therefore increasing their awareness and knowledge. Finally, the use of social media and flood maps can potentially be a method to provide hazard communication to individuals, and therefore increasing awareness, although there are negative aspects of both.

The largest impacts on human responses to pluvial flooding include ones' preparedness, experience and socioeconomic status. Being more prepared means that an individual is more likely to implement mitigation measures to protect their home. As well, the more experience one has with a hazard, the more knowledge they will have of the risk and mitigation measures associated and is therefore more likely to implement the measures. Finally, ones' income and education can determine their response to a hazard. Lower income individuals are less likely to implement measures as they may not be able to afford them, and they have more to lose. It is possible that higher educated individuals are more likely to implement mitigation measures since they may have more knowledge of the hazard.

With pluvial flooding events occurring more frequently all around the world due to climate change (Netzel et al., 2021b), there is a need to increase community and individual resiliency to decrease the damages caused by the hazard. Pluvial flooding impacts humans in many ways and it is therefore, important to understand the human aspects and dimensions of pluvial flooding. Understanding and responding to human dimensions of pluvial flooding will aid in creating more resilient communities, which can help reduce the impacts that pluvial flooding can have on households, government, and insurance companies.

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CHAPTER THREE

Manuscript 1: Perceptions of the Real Estate Sector on Pluvial Flooding

3.1 Introduction

Pluvial flooding, often referred to as urban flooding, is a serious, emerging and ongoing problem for homeowners in Canada (Sandink, 2011). Several events have occurred in large and small communities across Canada, such as Edmonton, Saskatoon, Winnipeg, Toronto, Montreal, and Moncton (Sandink, 2009). Between 2013 and 2021, property and casualty insurers reported approximately $2 billion CAD in personal property sewer back up claims during flood events (Sandink & Robinson, 2022). It is evident that pluvial flooding is a significant problem across the country and requires attention.

Pluvial flooding occurs when an intense rain event causes flooding that is independent of an overflowing body of water (ICLR, n.d.). Extreme rain events and other factors that result in flooding are difficult to predict, and since pluvial flooding can occur in any urban area it is often described as an "invisible hazard" (Netzel et al., 2021). Pluvial flooding occurs when intense rain events exceed the ability of the stormwater system to manage the flows, resulting in flood water entering buildings via: "overland flow; infiltration/seepage; sewer surcharge/backup, and internal/building-specific plumbing and drainage system failures" (Sandink & Robinson, 2022, p. 1).

Many municipal governments in Canada have been working to reduce urban flooding problems, and often replace old and inadequate sewer infrastructure. However, since this approach is very expensive and can take several years to complete, other solutions must be considered and implemented. While municipal governments can take

extensive actions to reduce basement flooding caused by a pluvial flooding event, these actions will not necessarily reduce all pluvial flood risk (Sandink, 2009). Over the past 20 years, the experience of the City of London illustrates how many municipalities have dealt with this issue. In 2013, the City of London planned on updating the sewer infrastructure by installing larger sewers to increase the storage capacity of the pipes due to the recent extreme rainfall event on Blanchard Crescent, however this was a very expensive and long term project (*City of London initiative…,* 2015). Instead of a $10 million project to expand sewer lines, the city implemented a $460,000 pilot project to disconnect weeping tiles from 32 houses on Blanchard Cres and replaced them with sump pumps (*The London Free Press*, 2014). It was determined that by engaging with affected homeowners and by providing some financial assistance of up to $6,800 (Scherr, 2022) to install mitigation measures in individual homes, it was possible to make significant progress in reducing the pluvial flooding risk in the City of London at a much lower cost.

Previous literature surrounding the perceptions of pluvial flooding are limited, as floodplains and fluvial floods are a more common hazard to research (Ludy & Kondolf, 2012; Owusu et al., 2015; Siegrist & Gutscher, 2006; Wells et al., 2015). There is also a lack of literature on perceptions of home inspectors, and specifically their views about basement flooding (or other hazards). This research contributes to this need for knowledge. Citing the work of Miguez et al. (2009) and Turley, (2002), Sandink (2011) maintained that actions taken by individual homeowners can play an important role in reducing the amount of: (i) flood waters entering the home, and (ii) the amount of water that runs off from the home/property into the municipal sewer system. The more aware a homeowner is of the flood risk, the more likely effective remedial actions will be taken.

Sandink (2011) also discovered that residents who lived in a neighbourhood for a greater period of time were more aware of flood reduction measures relative to those who were new to an area. It is important to increase perceptions and awareness of pluvial flood risk to help homeowners reduce the impact a flood event can cause. Informing buyers during the home purchasing process of pluvial flood risks could serve to increase awareness on this invisible hazard. This awareness could increase the potential for all members of a community to become more resilient against flooding.

The home purchasing process involves several steps such as: (i) is homeownership right for you?; (ii) are you financially ready to own a home?; (iii) financing your home; (iv) finding the right home, and (v) making an offer and closing the deal. This process includes a number of real estate professionals, who provide services, assistance, and advice on a range of issues to buyers. These professionals include: realtors, lenders, lawyers, insurance companies, appraisers, home inspectors, and land surveyors (*Homebuying Step by Step…,* 2021). This study examines the perceptions and roles of realtors, appraisers and home inspectors given they have a direct knowledge of the home and are guided by professional standards of practice.

This analysis is divided into two parts between the two manuscripts of this thesis (i.e., Chapters 3 and 4). The methods are the same for both papers as they both involve the same study population. This manuscript describes the responses of these real estate professionals to a number of important questions:

- how informed are they about pluvial flooding and its impacts in the City of London;
- how familiar are they about mitigation options for pluvial flooding?, and

- the sector's perception of how homebuyers view the issue of pluvial flooding and its impacts.

3.2 Methods

This paper seeks to understand the perceptions and knowledge of real estate agents, appraisers, and home inspectors on pluvial flooding. To achieve this, online surveys and structured interviews were conducted with real estate agents, appraisers, and home inspectors in London, Ontario over a six-month period, from November 2021 to April 2022. I am a 23 year old women born in Canada. I have a bachelor's of arts and I am currently a Masters student at Western. As a researcher I am aware of my privilege and access to certain resources and work on being aware of my own biases and how they may shape the research. However, I am not a homeowner and do not have personal experience with purchasing and owning a home. Therefore, the conclusions from the manuscripts are solely based on findings, secondary research, as well as suggestions from those around me with experience.

3.2.1 Site Selection

Initially, the site selected for this study was Edmonton, Alberta because they recently provided pluvial flood risk maps on the City's website. The research objective was to conduct surveys and interviews within the real estate sector in Edmonton to understand their perceptions, impacts and acceptability of this activity. However, due to COVID-19, travel during the summer of 2021 was challenging and undesirable. Therefore, a more local location was selected.

Academic and pragmatic considerations prompted the selection of London, Ontario as the case study area. Many municipalities across Canada, including London, have experienced an increase of frequency and intensity of rainfall events over that past two decades and therefore London can illustrate the experience for other Canadian communities. For example, the experiences in other communities include a severe pluvial flood event in the City of Toronto in July of 2013 causing 4,700 basements in the Etobicoke community to flood (*Staff Report…,* n.d.) and several rain events in the City of Edmonton in 2004 and July of 2012 (*City-wide…*, n.d.).

3.2.2 Participant Selection

The real estate sector was chosen as the study group for this project, specifically real estate agents, appraisers and home inspectors in London. Initially, bank loan officers were also contacted to participate in this study, however, there were no responses from this group and a decision was made to remove their group from the study population.

The real estate sector can make decisions that can constrain or enable the options of those buying and selling real estate (Shrubsole & Scherer, 1996). According to Palm et al. (1983), real estate agents can be beneficial as gatekeepers, which is a term to refer to an individual who plays a powerful role in allocating resources. Real estate agents, appraisers and home inspectors can play an important role as gatekeepers to inform homebuyers of flood risk information and mitigative measures due to their roles in the home purchasing process.

The real estate process involves several stages such as the selection, purchase, appraisal, inspection, and closure. In order to understand the perceptions of the real estate

sector, it is necessary to investigate the actors within this process. Each of the study groups are now examined.

3.2.2.1 Real Estate Agents

Real estate agents are usually required by homebuyers to aid in the home purchasing process because of their inexperience. Home buyers and sellers are often unfamiliar with the home purchasing process and therefore require guidance. If potential buyers are new to an area, they are more likely to rely on the real estate agent to indicate the best location to buy in. During a typical home purchasing process, buyers will hire realtors (selling agent) to locate potential properties for the buyer (Shrubsole & Scherer, 1996) using the Multiple Listing Service (MLS). The MLS is a database of all available real estate properties for sale/rent. It provides reliable information about the specifics of a property and realtors will use the database to find properties for potential buyers (Chen, 2022). As of now, there is no information regarding hazard mitigation measures or whether or not the home has experienced a hazard event in the past, however this information may be beneficial to potential buyers. The listing agent on the other hand represents the seller and aids in the pricing and selling of a property (Weintraub, 2021).

Real estate agents provide information on neighbourhoods, and they may intentionally or unintentionally provide information that limits the search of prospective buyers by advertising to clients the social character of neighbourhoods and the likelihood of property resale (Palm, 1976). This indicates that real estate agents can persuade potential homebuyers in terms of where to purchase a home based on the information they share. There is little information provided to real estate agents on how they should deal with informing buyers about pluvial flood risk and mitigative measures.

In Ontario, the provincial government writes the rules that realtors, brokers, and brokerages must follow, and Real Estate Council of Ontario (RECO) enforces these rules. The Real Estate and Business Brokers Act, 2002, is the legislation that realtors, brokers, and brokerages must comply with. The RECO website helps match buyers and sellers with local realtors through their database. Real estate agents in Ontario are required to complete specific courses in order to practice as a registered real estate agent. Humber College provides realtor courses to all potential realtors in Ontario, including: Post registration Phase (3 courses); Real Estate Essentials; Residential Real Estate Transactions, and Commercial Real Estate Transactions. There are also further education courses that realtors are mandatory which include a RECO Update course, and two electives (*What is mandatory continuing education (MCE),* 2021). There are currently no electives on climate change related hazards, such as pluvial flooding, and how they may impact houses and homeowners/buyers.

3.2.2.2 Appraisers

The goal of an appraiser is to provide an estimate of the value of a property. An appraisal may be requested or required for reasons such as to facilitate the transfer of ownership of real property, to help prospective sellers determine selling prices or prospective buyers decide on offering prices, to establish a basis for the exchange or reorganization of real property or for merging the ownership of multiple properties (Appraisal Institute, 2013). Most appraisers must follow a professional code of practice. For example, the Appraisal Institute of Canada is a leading real estate property valuation in Canada and members demonstrate a high level of professionalism and honesty, establish trust in the public's interest, and provide high quality services. The AIC grants

the use of designations AACI (Accredited Appraiser, Canadian Institute) and CRA (Canadian Residential Appraiser). The AACI and CRA designation are given to those who have completed the study programs and fulfilled all the professional requirements of the AIC, guided by the Institute of Canada's Canadian Uniform Standards of Professional Appraisal Practice (CUSPAP). Specifically, AACI members are qualified to offer valuation and consulting services and expertise for all types of property. While CRA members are qualified to offer valuation and consulting services and expertise for individual, underdeveloped residential sites, and dwellings containing not more than four self-contained family units (*Designations* n.d.). The Canadian Uniform Standards of Professional Appraisal Practice (CUSPAP) was first introduced in January 2001 and is a set of standards of practice that appraisers in Canada must follow.

Appraiser courses focus on market data, financial documents, depreciation, mortgage financing, and statistical modelling in valuation (*Property assessment/appraisal,* n.d.). The AIC and its partners offer seminars and webinars for members to need their continuing professional development requirements. These courses are a part of the AIC mandatory Continuing Professional Development (CPD) Policy. This is designed to "ensure that members maintain and enhance their knowledge and skills in their area of practice throughout their career, and to ensure candidate members progress through the designation process and meet the academic requirements for designation" (*Continuing Professional Development Policy*, 2020, p. 3).

A typical appraisal report would identify the property being appraised and include information about the site and its improvements. Factual information such as the square footage of the buildings on the site and subjective information, such as the aesthetics of

the area would be included. The report would also identify the objective of the appraisal and provide a definition and calculation of values. The main objective of an appraisal is the production of this value estimate.

3.2.2.3 Home Inspectors

Buyers, and sometimes sellers hire home inspectors to identify problems, either before listing or putting a contract on the house or at least prior to closing. A home inspection is non-invasive visual assessment of a residential dwelling and any attached structures (*Home inspection standards of practice* n.d.). It also examines specified systems and components of the dwelling that are described in a standard of practice for home inspectors (*Home inspection standards of practice* n.d.). The purpose of a home inspection is to provide a potential homebuyer or home seller with information about any defects in the home or specified systems so that the parties can make informed decisions (*Home inspection standards of practice* n.d.).

Components of inspections include roofing, exterior, structure (basement, foundation), insulation, ventilation, attic, fireplaces, interior, doors, and windows. The report also includes household systems, such as electrical, heating, cooling and AC, and plumbing. However, there are specific exclusions from home inspections, such as the methods, materials and costs of corrections, market value of the property, presence of birds, flora, fauna, mold, mildew or asbestos as well inspections will not identify concealed or latent defects (*Home inspection standards of practice* n.d.).

In Canada, home inspectors are required to follow The National Standards of Practice, which are a set of guidelines for inspectors, as well as the Canadian Association of Home and Property Inspectors (CAHPI) Code of Ethics. These Standards of Practice

were created to provide guidelines for home and property inspectors regarding both the inspection and the creation of the report, and to define certain terms relating to the home inspections to ensure consistent interpretation (*2012 National Standards of Practice,* 2012). Home inspectors in Ontario are required to complete education courses through an Ontario community college, private college or an out of province equivalent. The Ontario Association of Home Inspectors (OAHI) provides optional continuing education courses for members for those who are interested in upgrading their knowledge of the profession or the public (*Currently available training courses…,* n.d.).

3.2.3 Research Methods

The research protocol, which was submitted to the Non-Medical Research Ethics Board (NMREB) in mid-August 2021 and approval was provided in October 2021 (see Appendix A1 for Ethics Approval). An initial recruitment email containing a Letter of Information was sent that month to 155 prospective participants to participate in the research through an online survey link (See Appendix A2 for recruitment email and Appendix A3 for the survey Letter of Information). Since there was a low response rate to the first invitation to participate, several rounds of recruitment emails were sent out. While it would have been ideal to survey all professionals on the list, the acceptance rate remained low. This may be explained, in part, by the COVID-19 lockdown that began at the start of 2021. In total, nine home inspectors, seven appraisers, and 10 real estate agents completed an online survey from November 2021 to April 2022 (see Table 3.1 for response rate). Of the 26 real estate professionals who completed the online survey, 12 participated in a telephone interview, of which five real estate agents, three appraisers, and four home inspectors (see Table 3.2). After several participants agreed to participate

in an interview, another recruitment email was sent out along with an interview Letter of Information (See Appendix A4 for interview recruitment email and Appendix A5 for the interview Letter of Information). The rest of the interviews took place between December 2021 and April 2022 ranging from 30 minutes to one hour. The results from the interviews with the real estate professionals provided a more in depth understanding of the perceptions of the respondents on the nature and significance of pluvial flooding and its impacts on homeowners/buyers in the City of London.

A final semi-structured interview was completed with Kyle Chambers, Divisions Manager, Sewer Engineering at the City of London to discuss the findings from the thesis and the Basement Flooding Grant Program. This interview was conducted over approximately 40 minutes by telephone in April 2023.

Although generalizations about the study population cannot be made due to the low number of responses, the participants identify major issues and opinions. Data saturation refers to when the respondents are all coming to similar conclusions and no new information is being obtained (Fusch & Ness, 2015; Mwita, 2022). Reaching data saturation is important in order to effectively respond to the research questions and to ensure the findings are valid. Hennink & Kaiser (2022) argued that interview saturation is specifically obtained between the 9th and 17th interview. Overall, data saturation was not obtained during the surveys and interviews for the real estate agent and appraiser groups, as there was a low response rate and different themes and responses discussed. The home inspectors were reporting similar responses, and therefore data saturation was reached for this group, indicating that the study population can represent the larger population of

home inspectors in London. Although data saturation was not obtained for some study groups, this study can provide insights into the perceptions of the real estate sector.

Table 3. 1: Survey Response Rate

Respondent	**# of Invitations Sent**	**# of Responses (Response Rate%)**
Real estate agents	106	10 (9.4%)
Appraisers	53	7 (13.2%)
Home inspectors	26	9 (34.6%)

Table 3. 2: Interview Response Rate

Respondent	**# of survey participants**	**# of Interviews (Response Rate %)**
Real estate agents	10	5 (50%)
Appraisers	7	3 (42.8%)
Home inspectors	9	4 (44.4%)

3.2.3.1 Survey Questionnaire Design and Distribution

The survey questionnaires were divided into several sections: background and experience; nature and significance of pluvial flooding; information sources about pluvial flooding; awareness of mitigation measures and their effectiveness; and disclosure. The questionnaires were nearly identical for all three groups, however there were some questions that were specific to their role in the home purchasing process.

The survey was designed to enable participants to complete it within 10-15 minutes. Participants were assured their information would be kept safe and stored on a password protected computer for seven years, then destroyed. A letter of information was sent out to participants along with the online survey link and description of the project. The survey questionnaires were created on Qualtrics XM and the survey links were sent out by email. Qualtrics was the survey platform used as it is a safe and secure program

and is user friendly for participants. The online survey invited the participants to participate in a telephone interview. Participants who selected 'Yes' were contacted to schedule the telephone interview. Online surveys have several advantages, including a fast response and processing time (Van Selm & Jankowski, 2006), fewer unanswered questions, online programs aid in the organization of the data, overall better responses to open-ended questions (Bryman et al., 2019), and they can reach large numbers of a population. However, online questionnaires have some disadvantages, including a low response rate, the population is restricted to individuals with an online presence, there may be concerns about confidentiality and anonymity, and the possibility of receiving multiple replies (Van Selm & Jankowski, 2006; Bryman et al., 2019).

Surveys are undertaken by the respondent without a researcher present, and there is no one to explain questions; therefore, the questions must be easy to understand and interpret. Formatting and length of the online survey is also important to ensure it is easy to follow and does not take up a lot of the user's time (Van Selm & Jankowski, 2006; Bryman et al., 2019).

3.2.3.2 Real Estate Agent Survey Questionnaire

Appendix B1 contains a copy of the survey questionnaire for the real estate agents studied. Real estate agents in London were chosen from the Real Estate Council of Ontario (RECO) online database which provides a list of all real estate agents in Ontario who are registered with RECO. Realtors with published emails were selected. A recruitment email which provided a survey link and a Letter of Information outlining the study was sent to the realtors. Questions that were specific to the realtors questionnaire

included what they believe attract and detract buyers to London, as well as whether or not there are any courses available on pluvial flooding for them to take.

3.2.3.3 Appraiser Survey Questionnaire

Appendix B2 contains a copy of the survey questionnaire for the appraisers studied. Appraisers in London were chosen from the Appraiser Institute of Canada Database, that provides a list of all appraisers in Canada registered with the AIC. The search for appraisers on the AIC started by locating all appraisers in London, Ontario. All appraisers with public emails that were employed in London were sent the same email as the real estate agents with the appraiser survey. Questions that were specific to the appraiser questionnaire included how they deal with pluvial flooding in their appraisal reports and if they have had any training to incorporate basement flooding in the report.

3.2.3.4 Home inspector Survey Questionnaire

Appendix B3 contains a copy of the survey questionnaire for the home inspectors who participated in the research. Home inspectors located in London were chosen from the International Association of Certified Home Inspectors and the Canadian Association of Home and Property Inspectors. All home inspectors in London with public emails were sent a recruitment email such as the one sent to real estate agents and appraisers. Questions that were specific to the home inspector questionnaire included what they look for during an inspection and if they specifically look for pluvial flood damages to a home.

3.2.3.5 Interview Questionnaire Design and Distribution

A study conducted by Shrubsole & Scherer (1996) investigated the perceptions of real estate agents, appraisers and loan officers about floodplain regulations in Brantford

and Cambridge, ON. This current research project generally focused the questionnaires on the themes addressed by Shrubsole & Scherer (1996). The current research focused the interviews on the following topics:

- background and experience
- nature and significance of pluvial flooding
- awareness of mitigation measures and effectiveness.
- Disclosure of pluvial flood risk information and mitigation measures.

The structured interview questionnaire expands on the survey questions to obtain the reasoning behind participants survey responses. Interviews were designed to be completed between 30 minutes to an hour. Interviews were conducted on the telephone due to COVID-19 restricting in person meetings as well as being respectful of the participants' schedules and to minimize their time commitment. Telephone interviews have several advantages. First they require no travel on the part of the interviewer or respondents. Second, they can reduce bias arising from characteristics of the interviewers or interviewees due to them not seeing one another (Bryman et al., 2019). However, telephone interviews have a disadvantage, such as the interviewee cannot pick up on visual cues as to whether or not the respondent understands the questions (Bryman et al., 2019). In order to incentivise participation in the research, participants were offered a chance to win a $50 Starbucks gift card if they participated in an interview. The winners of the gift card were randomly selected after the interview process was completed, and emails were sent out to the winners congratulating and thanking them, as well as requesting a mailing address for the card.

In general, to conduct a successful structured interview, the interviewer must first create a rapport with the interviewee, which will encourage the respondent to participate and persist with the interview. Second, the interviewer must ask the questions exactly as they appear on the questionnaire, keep the question order, and record what is being said by the interviewee (Bryman et al., 2019). This is to ensure the study can be replicated in the future by other researchers using similar methods.

3.2.3.6 Real Estate Agent Interview Questionnaire

Appendix C1 contains a copy of the interview questionnaire for the real estate agents studied. Five real estate agents agreed to participate in an interview. The purpose of the interview was to obtain further insight to the online survey questions, accordingly, the questions were identical. However on the issue of disclosure a further question was added requesting what their motivating factors are to disclose pluvial flood risk information.

3.2.3.7 Appraiser Interview Questionnaire

Appendix C2 contains a copy of the interview questionnaire for the appraisers studied. Three appraisers agreed to participate in an interview. The purpose of the interview was to obtain further insight to the online survey questions, accordingly, the questions were identical. However on the issue of disclosure a further question was added requesting what their motivating factors are to disclose pluvial flood risk information.

3.2.3.8 Home Inspector Interview Questionnaire

Appendix C3 contains a copy of the interview questionnaire for the home inspectors studied. Four home inspectors agreed to participate in an interview. The purpose of the interview was to obtain further insight to the online survey questions, accordingly, the questions were identical. However on the issue of disclosure a further question was added requesting what their motivating factors are to disclose pluvial flood risk information.

3.2.4 Background of Pluvial Flood Events and Programs in London

London has experienced several pluvial flooding events many producing record rainfalls over the last two decades. Table 3.3 documents major pluvial flood events that have occurred in London over the past 20 years. The table notes that several of these events occurred in the Spring/Summer time and caused considerable damage. On May 28th 2009, a heavy rainfall event consisting of 83mm of precipitation occurred over a 5-hour period in London (Sandink, 2011). This storm was estimated as being a 1:100 to a 1:150 year event (Sandink, 2011). Forty seven complaints of basement flooding were made to the City as a result of the event (Sandink, 2011). More recently between September, 20th-23rd, 2021, 120mm of rain was recorded at London International Airport, 67mm being recorded in a single day, which broke the previous 1996 record of 54.2mm (Bogdan, 2021). This heavy rainfall event prompted 130 residents to report basement flooding complaints (Bogdan, 2021). Water levels in the Thames River rose and many low lying areas, such as parking lots and parklands were flooded (Bogdan, 2021).

Table 3. 3: Pluvial Flood Events in London Ontario		
Date	**Event**	**Damages**
April 20-21, 2000	Extreme rainfall event in Southern Ontario	70mm of rain backed up sewers and roads washed out, many power outages occurred (Government of Canada…, 2013). 397 complaints were made to the City (McNally, 2009).
June 2000	Extreme rainfall event	676 basement flooding complaints were made to the City (McNally, 2009).
January 2008	Extreme rainfall event	147 basement flooding complaints were made to the City (McNally, 2009).
December 2008	Extreme rainfall event	5 basement flooding complaints were made to the City (McNally, 2009).
February 2009	Extreme rainfall event	77 basement flooding complaints were made to the City (McNally, 2009).
May 28th, 2009	Extreme rainfall event	95 basements in the Sherwood Forest region flooded due to surcharging of the sanitary sewers near the properties during the rainfall event (Standish, 2011).
September 10 2014	Extreme rainfall event	Streets flooded in Queens Avenue, Clarence St, and parts of Southdale Road. Roads had to be closed for cleanup after a tree toppled onto hydro wires. A number of power outages were reported (*Flood Reported…,* 2014).
June 22-23, 2015	Extreme rainfall event in Southern Ontario	Estimated cost of $29,188,000 Flooding in London overwhelmed the sewer system and caused damage to residential and commercial properties due to basement flooding (Government of Canada…, 2013).
June 27-28 2015	Extreme rainfall event	Total rainfall of 92mm for the two days (Braam, 2015).
February 2018	Extreme rainfall event in London.	The City received a month's worth of rain in 48 hours (Bieman, 2018).
August 1-3 2020	Extreme rainfall event	Milbank Drive had at least a dozen cases of flooded basements. Water entered the home from the drains. Damaged drywall, flooring, carpeting, displaced families (Irvine, 2020).
September 20-22, 2021 (Brown, 2021)	Extreme rainfall event	Many roads were flooded and closed. Hundreds of London Hydro customers were without power. One neighbour on Wortley Road had a sump pump but feared for his neighbours who did not. Logged about 130 basement flood complaints (Bogdan, 2021)

The City devoted substantial effort to assess these events and associated damages, and developed a number of options to reduce the amount of water from sewer systems. They also engaged with the public, implemented some specific neighbourhood projects, and also introduced the City-wide Basement Flood Grant Program to:

- disconnect their weeping tiles from the City's system, and
- to install a sump pump and pit, and backwater valve (City of London, n.d.).

The Basement Flooding Grant Program provides a 90% subsidy to homeowners to separate weeping tiles from the sanitary sewer system and to install backflow prevention valves (CBC/Radio Canada, 2021) along with installing a sump pump and pit, and updating storm laterals. An average application consisting of sump pump exterior weeping tile disconnection, sump pump battery back-up and sanitary backwater valve installation usually costs around $6,800 (Scherr, 2022). However, the installation of a backwater valve (after initial construction) alone ranges between $2,000 to $5,000 (CAD) (*Backwater vales:…,* 2022). The goal of the program is to direct the excess water to the stormwater system on the street and not the wastewater system which can become overwhelmed, contributing to basement flooding (CBC/Radio Canada, 2021). The average annual uptake of the program ranges from 75-100 households, according to Kyle Chambers, the Sewer Divisions manager from the City of London. Since its creation, 50,000 London homes have received funds to assist in disconnecting weeping tiles to the sanitary sewer system (*City of London initiative …,* 2015).

The Basement Flooding Grant Program has gone through several changes and updates since its creation (See Appendix E for full in-depth chronology on the grant program). In 1985, the City of London adopted Policy 23(4) "City of London Sump

Pump, Sewage Ejector, and storm Private Drain Connection Subsidy." This policy provided 100% subsidy for the installation of basement flooding protection devices due to basement flooding being caused by weeping tiles being connected to the city sewer system (McNally, 2009). However, between 1985-2003 the entire budget of $1,240,000 was used up, therefore in 2003, the subsidy was reduced from 100% to 50% (McNally, 2009). According to Chambers, when the grant covered 100% of the costs people who did not need it were taking advantage of it.

In 2009, the London City Council approved By-law A.-6403-272 to provide for a "City of London Sump Pump, Sewage Ejector, and Storm Private Drain Connection Grant Program" to owners of residential properties. This program now covered 75 percent of the cost of approved installations as outlined in the guidelines attached to the by-law. The By-law revokes the City's policy 23(4) "City of London Sump Pump, Sewage Ejector, and Storm Private Drain Connection Subsidy" (McNally, 2009).

In 2013, the Council passed By-law A.7015-285 - "The Grants for Sump Pump Sewage Ejector, and Storm Drain Connection Grant Program By-law." The bylaw outlines the grant program to disconnect the weeping tiles from either the sanitary or storm sewer and install a sump pump system for disposal of weeping tile water to a suitable outlet other than the sanitary sewer system (Braam, 2013).

In 2017, during the Civic Works Committee Meeting, a report entitled "Basement Flooding Grant Program By-law Update" was created. The report recommended changes to the grants for "Sump Pump, Sewage Ejector and Storm Private Drain Connection" By-law as directed by the Municipal Council as well as others to give full effect to the intent of the program and to solve program deficiencies as experienced by London and as

evidenced in other communities (Scherr, 2017). Later in 2017, the London City Council passed By-law A.7562-160 “Basement Flooding Grant By-law” that implements the changes approved to the 2013 By-law A.-7015-285 and repeals and replaces the 2013 By-law with the updates. The main update involved increasing the grant from 75 percent to 90 percent with an increase in the grant amounts as well (City of London, By-Law No, 7562-160) in a response to inflation according to Chambers.

3.2.5 Analysis

This study is a mixed methods approach involving quantitative data from the surveys and qualitative data from the interviews, and therefore the analysis involved two processes. Initially, the survey analysis was completed by creating charts for the survey questions and responses from the graphs using tabulation and graphics features available on the Qualtrics software. Qualtrics organized all the responses gathered and created graphs to easily visualize the data, however, due to the nature of the questions, charts were created to better visualize the data.

The interview analysis was executed by analyzing the notes made from the interviews and similar responses were categorized together and highlighted. Notes were taken in order to save time and to highlight key quotations from respondents.

The analysis completed for this manuscript and the next manuscript follows the questions from the interview questionnaire and examines the responses the interview participants had to the questions. Some quotes were used that were provided by the respondents and they were used to support the survey responses and provide value to the responses.

3.3 Results

The results section of this paper is organized into five subsections relating to the previously discussed research questions. The first describes the profile of the real estate professional respondents. The second describes the respondent's previous experience with pluvial flooding, and subsequent sections describe their perceptions of pluvial flooding risk, their perceptions of the impacts caused by pluvial flooding for homeowners/buyers, and the responses' perceptions of homebuyers' views of pluvial flood risk.

3.3.1 Profile of Real Estate Sector Respondents

The 10 real estate agent respondents have been practicing in the City of London residential real estate market over several years, ranging from seven to 46 years, and all except one were employed on a full-time basis. All agents who responded to the question regarding number of sales, indicated that they sold more than 30 homes over the past twelve months, and that at least 50% of the sales were based on unconditional offers. Based on their level of experience, the realtors interviewed have extensive knowledge of the London area.

All seven appraiser respondents were accredited with the Appraiser Institute of Canada (AIC), and had an appraisal designation of either Canadian Residential Appraiser (CRA) or Accredited Appraiser Canadian Institute (AACI) with some earning an additional designation of Professional Appraiser (P.App), which is used by professionals with the AACI designation. All accredited appraisers are required to comply with the Appraisal Institute of Canada in valuating homes especially for visible defects

(*Designations,* n.d.). The appraisers have practiced primarily in the City of London over a range of six to 30 years. The greatest number of inspections completed in the past year was 500 while some participants answered that "there minimal due to COVID," with 5%-95% of the appraisals being completed for single family residences. The appraisers have a good knowledge of the London residential property market.

All nine home inspector respondents were Certified Home Inspectors and include accreditations through various provincial and national organizations including the Ontario Association of Home Inspectors and the International Association of Home Inspectors. Members with the accreditations are required to have completed core home inspector courses that further their knowledge on home defects and ways to identify them. The inspectors' experience in the City of London ranged from one to 29 years. Around five respondents indicated that 50%-75% and more of their inspections over the past 12 months were undertaken for residential transactions that included purchase conditions that included a satisfactory home inspection. The other four respondents indicated that less than or 24%-49% of their inspections over the past 12 months were undertaken for conditional residential transactions that included conditions for an inspection. Of the seven inspectors who responded to the question regarding the percentage of inspected homes over the past 12 months have had pluvial flood damage, all seven indicated that less than 24% or less had damages**.** All inspectors have a good knowledge of the London area housing stock.

3.3.2 Real Estate Sector Pluvial Flood Experience

The online survey results indicate that 46% of the real estate professionals (six out of ten realtors, two out of seven appraisers, and four out of nine home inspectors) have experienced a pluvial flood event in their own homes (see Table 3.4). The interviews yielded a similar result with 42% of respondents (two real estate agents, one appraisers, and one home inspector) having experienced a pluvial flood event. The flooding experiences by the survey respondents included the following impacts: damaged flooring and carpet, damaged personal belongings including entertainment systems and furniture, home/structural damages, financial implications, failed sump pump; and health implications.

Table 3. 4: Experience with Pluvial flooding and the Implementation of Mitigative Measures

	Survey Responses				*Interview Responses*			
Professionals	**Personal Experience with Pluvial flooding**		**Have they implemented Mitigation Measures**		**Personal Experience with Pluvial flooding**		**Have they implemented Mitigation Measures**	
Real Estate Agents	YES	6	YES	5	YES	2	YES	2
			NO	1			NO	0
	NO	4	YES	3	NO	3	YES	2
			NO	1			NO	1
Appraisers	YES	2	YES	1	YES	2	YES	1
			NO	1			NO	1
	NO	5	YES	2	NO	1	YES	0
			NO	3			NO	1
Home Inspectors	YES	4	YES	3	YES	2	YES	1
			NO	1			NO	1
	NO	5	YES	3	NO	2	YES	0
			NO	2			NO	2

Approximately 65% of the survey respondents (17 of the 26 respondents) and 50% of interviewees (six out of 12 respondents) have mitigation measures in their home to protect their property from damages caused by pluvial flooding.

Of the 46% of survey respondents (12 respondents) who experienced a pluvial flood event, nine installed mitigation measures in their home, while three have not. Of the other 14 survey respondents who do not have an experience with a pluvial flood event, eight have mitigation measures, while six do not.

All but two of the interviewed real estate professionals who had personal experiences with impacts from a flooding event caused by a heavy rainfall have installed flood mitigation measures in their homes. Interviewees who chose to invest in mitigation measures indicated that they wanted to avoid the potential loss of personal items stored in their basements and to prevent damages to their home and furnishings. In one case, an appraiser owned a rental property that had "an unfinished basement that floods regularly" and "it was too costly to do work outside to prevent future flooding". The decision to not finish their basement in itself is a mitigation measure as it minimizes damage losses and clean-up costs when the basement does flood. One home inspectors' reason for not installing mitigation measures even though they had experienced a pluvial flood event were due to the low degree of flooding and resultant impacts were minor and therefore not a "cause for any concern" to warrant the installation of mitigation measures.

The survey respondents installed a range of mitigation measures inside their homes, including backwater valves, floor drains and sump pumps. Exterior mitigation measures noted by the respondents include: the installation of rain barrels; disconnection of downspouts from the weeping tile system; adding extensions on the downspouts to direct water away from building foundations; installation of water proofing membranes and window wells; improvements to the grading of their property; adding more permeable surfaces to prevent water pooling around the home; improvements to the

roofing system; and the clearing of gutters and eavestroughs. Interviewees echoed these responses, with one respondent indicating that they installed a backup sump pump in case of failure of the primary sump pump.

According to Pagneux et al. (2010), Johnston et al. (1999), Dominey-Howes et al. (2004) and Jackson (1981), people who have had previous direct experience with a hazard increases their awareness and knowledge. Since the majority of respondents to the surveys and interviews have had to deal with pluvial flooding in their homes and have adopted a range of mitigative measures, this finding is particularly significant for this study. This first-hand experience means that respondents should be more aware of the losses associated with pluvial flooding, and need for and benefits of providing timely information to prospective homebuyers. Results from this study have determined that there is no significant correlation between personal experience with pluvial flooding and how the respondents answered that later survey/interview questions.

3.3.3 Real Estate Sector Perception of Pluvial Flooding Risk

According to the Institute for Catastrophic Loss Reduction (ICLR) (n.d.) and Rozer et al., (2016), the risk of fluvial and coastal flooding are more readily apparent to prospective buyers because they can see the home's proximity to a water body. In contrast, pluvial flooding risk is more difficult to assess because the risk is unrelated to body of water (ICLR, n.d.). Unless a previous flood event was revealed by the sellers or the real estate sector professionals through inspections revealing evidence of water damage during the purchasing process, buyers would need to seek information from other sources to judge whether the home could be at risk of pluvial flooding. There is also no

information contained within the MLS database about previous flooding or mitigative measures in a house or on the property.

As seen in Table 3.5, although 31% of the survey respondents chose a neutral response to the question of whether they perceive pluvial flooding to be a serious risk, 50% of the survey respondents believed it is a serious risk. Only five respondents (19%) indicated that they 'somewhat disagreed' that pluvial flooding is a serious risk. Notably no respondents fully disagreed that pluvial flooding is a serious risk.

Table 3. 5: Do you believe pluvial flooding is a serious risk to homeowners or property in London?

	Real estate agents	**Appraisers**	**Home inspectors**	**TOTAL**
Disagree	0	0	0	**0**
Somewhat disagree	3	0	2	**5**
Neither agree or disagree	2	4	2	**8**
Somewhat agree	2	2	3	**7**
Agree	3	1	2	**6**
TOTAL	**10**	**7**	**9**	**26**

One realtor and one appraiser interviewed believed that pluvial flooding is a serious risk to homeowners explained that the frequency and intensity of heavy rain events are increasing and water damage to homes can be very expensive to repair. One inspector indicated that pluvial flooding is a common hazard that can impact any home and is therefore a serious risk. Most inspectors agreed that the level of risk depends on the location of the house, the physical house itself, and the surrounding landscape ("grass absorbs water while solid paved surfaces are impermeable").

The realtors and appraisers who stated that pluvial flooding was not a serious risk to homeowners indicated that mitigation measures are commonly already installed in homes, especially in new builds. If not already installed, respondents also noted that there are many measures that can be added to existing homes to prevent damages. Further, they noted that homeowners can update their insurance coverage to ensure they can recover replacement and reparation costs from damages caused by pluvial flooding. A key issue is when and who should provide that type of advice to prospective homebuyers.

According to the majority of professionals surveyed, pluvial flooding can be a serious risk to homeowners in London due to the increased frequency of extreme rain events over the recent past. However, the majority of those interviewed (specifically realtors and appraisers) believed that in their experiences pluvial flooding was not a serious risk to homeowners given the existence of mitigation measures and potential for insurance coverage.

3.3.4 Aspects of Pluvial Flooding and Their Significance

There are many impacts of pluvial flooding that can affect homeowners, including financial, health, home damage, and marketability of the home. According to the results from the survey, the respondents indicated that every type of impact associated with pluvial flooding can have a significant effect on homeowners and homes (Table 3.6). These findings are consistent with the interview results.

Table 3. 6: Rate the significance of different type of impacts associated with pluvial flooding and how they might affect an average homeowner/house.									
	Real estate agents			**Appraisers**			**Home Inspectors**		
	Sig	Neither	Not	Sig	Neither	Not	Sig	Neither	Not
Overall Impact	6	3	1	3	2	2	7	0	2
Financial	9	1	0	5	1	1	7	1	1
Health	6	1	3	3	3	1	7	1	1
Home damage	8	2	0	2	0	5	7	1	1
Marketability	5	4	1	3	3	1	9	0	0
Other	0	0	0	0	0	0	0	0	0
Total:	**34**	**10**	**5**	**16**	**9**	**10**	**28**	**3**	**5**

All realtors, appraisers and home inspectors interviewed agreed that the financial impact of pluvial flooding to a homeowner can be significant. Water seeping into a house can result in severe damage to the structure and its contents, particularly in finished basements which could require either replacement or repairs to flooring and walls, heating, ventilation and air conditioning systems, appliances and personal belongings. Personal belongings include sound/entertainment systems, furniture, and stored family memorabilia.

According to one home inspector, insurance companies are finding that their most expensive claims arise from water damage. For example, in 2018 the Insurance Bureau of Canada (IBC) indicated that water damage causes $2 billion in losses every year for Canadians (IBC-2019-Facts., 2019). However, not all water damages are recoverable through a homeowner's policy. According to the Insurance Bureau of Canada (IBC), there are generally three kinds of water coverage insurance packages. The first is a basic water coverage for 'typical events' and is available in all home, condo or tenant policies. It covers water damage caused by common 'equipment failures', such as burst pipes,

malfunctioning taps, improper connections and hot water tank leaks. The second is an optional additional level for sewer backup coverage, which is available to most homeowners and tenants for water damage caused by the backup or escape of water or sewage from a sewer, septic system or sump pump. The final is overland water coverage to address water damage caused by water entering the property due to overflow of any body of fresh water (i.e., lakes and rivers, snowmelt, and rainstorms), sudden accumulation or run-off of surface waters, including torrential rainfall or spring thaw, or sudden and accidental entrance through basement walls, foundations or floors of groundwater. This third level of coverage may not be available to all homeowners and tenants, although this coverage would potentially benefit homeowners that have experienced a pluvial flood event. Overland coverage may cost a homeowner approximately $10-$30 CAD each month, which may deter some owners from purchasing this coverage (*Overland Water Insurance…*, n.d.). It is noted that individual insurance companies will have their own specific coverage options, which may vary by location and the risk assessment (IBC, 2017). A 2004 Institute for Catastrophic Loss Reduction (ICLR) survey revealed that close to 70% of Canadian homeowners incorrectly believed that overland flooding is covered under typical homeowners' insurance policies (ICLR, 2004 cited by ICLR, 2010). This indicates that public awareness of water coverage on home insurance policies is low and that people assume they are protected, which might lessen their concern about pluvial flood risk. Thus, there is a pressing need to better inform homeowners about the risk, the range mitigative measures available and what their insurance policies cover and do not cover relative to pluvial flooding.

Realtors, appraisers and inspectors also agreed that a homeowner's physical and mental health could be impacted by a pluvial flood. Most respondents indicated that physical health impacts are less common and typically not as severe as mental health impacts. Several home inspectors and appraisers indicated that the presence of mold can cause serious health issue to the respiratory system, particularly if left untreated. According to Mendell et al. (2011, p. 748) mold can cause "asthma, shortness of breath, wheezing, coughing, respiratory infections, bronchitis, allergic rhinitis, eczema, and upper respiratory tract symptoms." On the other hand, the respondents agreed that mental distress could be significant when dealing with the aftermath of a flood event as the reparation of damages to the home and personal belongings can be expensive and disruptive. One home inspector indicated that; "pluvial flooding can cause stress to people as there can be bedrooms or kitchens in the basement." If the water damages are very severe, the homeowners may be displaced and forced to relocate for a considerable time period until repairs are completed, adding to a person's mental stress.

The third aspect that impacted homeowners significantly according to all groups was the damage to the home, particularly from a cost perspective. Finished basement reparations following a flood event can be very expensive. One inspector indicated that damages to a basement can "cost a homeowner up to $40,000". Water can also damage the foundation of the home which can be extremely expensive to repair. Some respondents did not think that damage to a home from a pluvial flooding event impacted homeowners significantly. One appraiser indicated that homeowners would likely avoid the potential for costly repairs, stating "if a homeowner was aware that the basement floods, they may not finish their basement," and the homeowners could install mitigation

measures as; “there are many preventable measures,” according to the same appraiser, to avoid or limit damage.

The fourth impact of pluvial flooding discussed with the respondents was the marketability of a home. Responses varied as to whether they felt that this impact is significant to the homeowner. The most common response from real estate agents and appraisers was that the risk to pluvial flooding was not a significant consideration by potential homebuyers as one real estate agent said; “people do not care about pluvial flooding.” Only one realtor indicated a belief that a home would not sell if it was discovered that the home had flooded in the past. Another realtor indicated “for what you paid for the home, it will decrease when you sell it.” Therefore, if an area was known to experience flood events, property values could decrease. This view is consistent with Palm et al. (1983), who indicated that there may be a small price reduction on homes that have experienced a hazard such as flooding in the past. The home inspectors had varied responses. Those respondents who agreed that marketability is significantly impacted indicated that if buyers knew about past flooding, they may not want to purchase the home, even if the previous owner may have covered up evidence of past water damage. On the other hand, one inspector indicated that marketability is not significantly impacted because “homebuyers just want to purchase a home and are therefore buying without any conditions or inspections.”

3.3.5 Perception of Real Estate Sector of Buyers’ Views about Pluvial Flooding

As shown in Table 3.7, 10 survey respondents (38%) agreed that in their experience, buyers express some degree of concern or were very concerned about pluvial flooding and damages associated with it. Of this group, six respondents (23%) had some

concern and four (15%) indicated that buyers were very concerned about pluvial flooding and the potential damages. Eight respondents (31%) had minor concern and only two respondents (specifically, home inspectors) indicated that buyers did not express concerns about pluvial flooding and damages. Six respondents (23%) were neutral on this question.

Table 3. 7: What level of concern do buyers express to you about pluvial flooding and the damages associated with it?

	Real estate agents	**Appraisers**	**Home inspectors**	**TOTAL**
No concern	0	0	2	**2**
Minor concern	5	1	2	**8**
Neither concerned or unconcerned	1	4	1	**6**
Some concern	3	1	2	**6**
Very concerned	1	1	2	**4**
TOTAL	**10**	**7**	**9**	**26**

The interview results were generally consistent with the survey responses on buyers' concerns about pluvial flooding with 33% noting that it was a concern. The explanation from the real estate agents interviewed indicated that it is generally known that London experiences flooding, and many homeowners are not concerned because "it just happens". This finding is consistent with the results of a study by Risa Palm (1981), which concluded that real estate agents felt home buyers were not concerned with 'special study zone location' (sites of earthquakes), because they believe that buyers are fatalistic about events beyond their control and accepted that California experiences earthquakes (Palm, 1981 p. 80). One real estate agent clarified the lack of concern on the part of buyers by saying that unless buyers had their own experiences with flooding as well as knowledge of the location and frequency of flooding in an area, typically buyers are not concerned about flooding. This agent stated "it is difficult to answer why buyers

feel this way but they usually become concerned if it becomes an issue, but if it does not become an issue then it is not a concern."

Most of the appraisers interviewed indicated that buyers are not concerned about pluvial flooding and the associated damages. They indicated that buyers know that they can mitigate against future damages and therefore do not consider flooding to be of concern. However, one appraiser indicated that "buyers are concerned about pluvial flooding, especially the long-term effects of mold."

The majority of the home inspectors interviewed agreed that buyers are generally concerned with pluvial flooding, and noted concerns, such as mold growth, as well as the fact that home insurance may not cover potential damages. According to the home inspectors, there were several explanations why some homeowners did not raise concerns about pluvial flooding. One inspector noted that the level of concern can depend on when they conduct the inspection, stating that "inspections occur the majority of the time when the homebuyers have already moved in the home or they have already purchased the home and therefore, it is not a large concern to them." A second inspector argued that because of the low frequency of pluvial flooding events, some buyers are not concerned. Another inspector indicated that the London rental market is very hot as there are a lot of students in need of housing. Investors will therefore buy due to the large amount of renters willing to rent anything. According to the London St. Thomas Association of Realtors (LSTAR), homes are in high demand in London but there is a lack of available homes, and therefore, many buyers will just purchase a home even though there may be some defects. "Despite the fact that slightly more new listings came on the market, there were only 0.5 months of inventory available at the end of January," said 2022 LSTAR

President Randy Pawlowski. He further explained “in other words, at the current pace of sales, the entire listing inventory of LSTAR could be liquidated in just two weeks, something that we have never seen before” (*Home Prices Jump in January*, n.d.).

The respondents were asked how buyers react to information that the home they are interested in purchasing had experienced pluvial flooding in the past. The question specifically requested respondents to indicate whether the buyers were no longer interested in the property, whether they offered a lower price than the asking price, and if there was a significant impact on their interest in the home (see Table 3.8). Overall, real estate agents surveyed indicated that buyers did not generally react to pluvial flooding information for instance only 30% indicated buyers were no longer interested in the property and only 30% offered a lower price than the asking price. This may be due to the fact that the real estate agents surveyed indicated that there are other factors that will influence a buyer’s decision on a home (e.g., the location, size of home, affordability). On the other hand, home inspectors indicated that buyers had significant reactions when they discovered a house they were interested has flooded in the past, with 60% indicating that buyers were no longer interested in the property. In terms of the price reduction, eight respondents (three real estate agents, one appraiser and four home inspectors) suggested that the price reduction was typically in the range of 15-20%. It is noted that one appraiser indicated that the reduction can depend on the market. One real estate agent surveyed also noted that “there is no rule of thumb here percentage wise especially in a high demand market that we are in presently. They are just happy to have purchased a home, and when a seller discloses previous flooding issues agents are to disclose the issue

and any remedy to the buyer/buyer's agent. We all take that into consideration when pricing the home for the market."

Table 3. 8: In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?

	Real estate agents			Appraisers			Home inspectors		
	Yes	**No**	**NR**	**Yes**	**No**	**NR**	**Yes**	**No**	**NR**
Homeowners were no longer interested in the property	3	6	1	2	2	3	6	0	3
Offered a low price relative to asking price	3	6	1	1	2	4	4	0	5
No significant impact on prospective buyers interest in the home	3	3	4	1	2	4	1	2	6
Other	0	0	0	0	0	0	0	0	0

The majority of real estate agents and appraisers interviewed agreed that buyers do not react when they discover that a property they are interested in has flooded in the past. Two realtors indicated that some buyers will try to identify the frequency of events in an area and if they find events are frequent, they may become concerned about how it will affect them. On the other hand, one appraiser indicated that buyers are reactive about pluvial flooding and will investigate how to solve the problem or they are no longer interested in the home.

The interviewed home inspectors indicated that buyers usually go into denial or do not comment when they are told the home had experienced a pluvial flooding event. One inspector further added that buyers often ignore comments by home inspectors, presumably because they have plans to renovate affected areas of the home.

3.4 Conclusion

This study investigated the perceptions of the real estate sector on pluvial flooding in London, Ontario by using online survey questionnaires and structured interviews. In general, the perceptions of the real estate professionals on pluvial flooding is greatly influenced by the level of experience they have with the hazard. It was discovered that having more experience with pluvial flooding, makes one more likely to have implemented mitigation measures in their home, thus reducing the potential flood damages. However, all respondents had a good understanding and awareness of mitigation measures to reduce pluvial flood risk and most have mitigation measures in their home such as back up sump pumps and backwater valves.

Homeowners are being impacted by the increase frequency of heavy rain events in London, Ontario. These impacts associated with a pluvial flood event can range from the financial impact, damage to the home, health impact, including physical and mental health, and the impact on the marketability of the home. The results from this study revealed that the real estate sector is aware of the various impacts flooding can have on homeowners and that they can all be significantly impacted by a pluvial flood event. They also agreed that pluvial flooding can be a serious risk to homeowners in London, and this was evident based on the responses to the impacts associated with pluvial flooding. The respondents were asked how buyers' view pluvial flooding and it was discovered that they believed that buyers do have some level of concern about pluvial flooding, although this can depend on several factors such as the physical house and the property. However, it was discovered that they usually do not react when they discover a property they are interested has flooded in the past.

Pluvial flooding will continue to be a risk to homeowners given the difficult nature to predict in combination with increasing urban development and aging or overwhelmed infrastructure. In order to further protect homeowners and to continue and build communities that are resilient to climate change, it is important to increase awareness and knowledge of pluvial flood risk and its impacts. This manuscript confirmed that while there is some level of concern about pluvial flooding on the part of the real estate sector, there was no clear consensus that pluvial flooding can be a serious risk even in areas that had not previously experienced pluvial flooding. The results also showed that homebuyers tend to have a lower level of concern during the purchasing process, which was explained by some as an acceptance of the inevitable and by others that it was only a concern if it had happened to the particular buyer in the past. Accordingly, there is an opportunity that the real estate sector can provide pluvial flooding risk information during the home purchasing process before the homebuyer purchases the home to ensure they are not only receiving information about past flood events but also about the risk in general to homeowners in urban communities.

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CHAPTER FOUR

Manuscript 2: Pluvial Flooding Information and Awareness: A Case Study of the Real Estate Sector in the City of London

4.1 Introduction

There are many available, affordable and effective options for homeowners to mitigate against pluvial flood losses. Water seeping into a house can cause a great deal of damages ranging from ruined personal memorabilia to damaged furniture, floors, walls, and the structure of the house. A health hazard may develop if mold grows in a damp post-flood basement environment. Mitigation measures, if implemented, can prevent and certainly reduce the financial costs of damages and repair, and the health hazard. The most important mitigation measures are arguably taken by individual homeowners and these can be complemented by measures taken by other stakeholders, such as all levels of the government, home builders and renovators, the real estate and insurance industries, local conservation authorities, and more (Appendix D). Figure 4.1, which was produced by the Institute for Catastrophic Loss Reduction (ICLR) (Sandink, 2009), shows the various mitigation measures a homeowner can take to prevent basement flooding. For example, installing a backwater valve, extending the downspout, and installing window well covers.

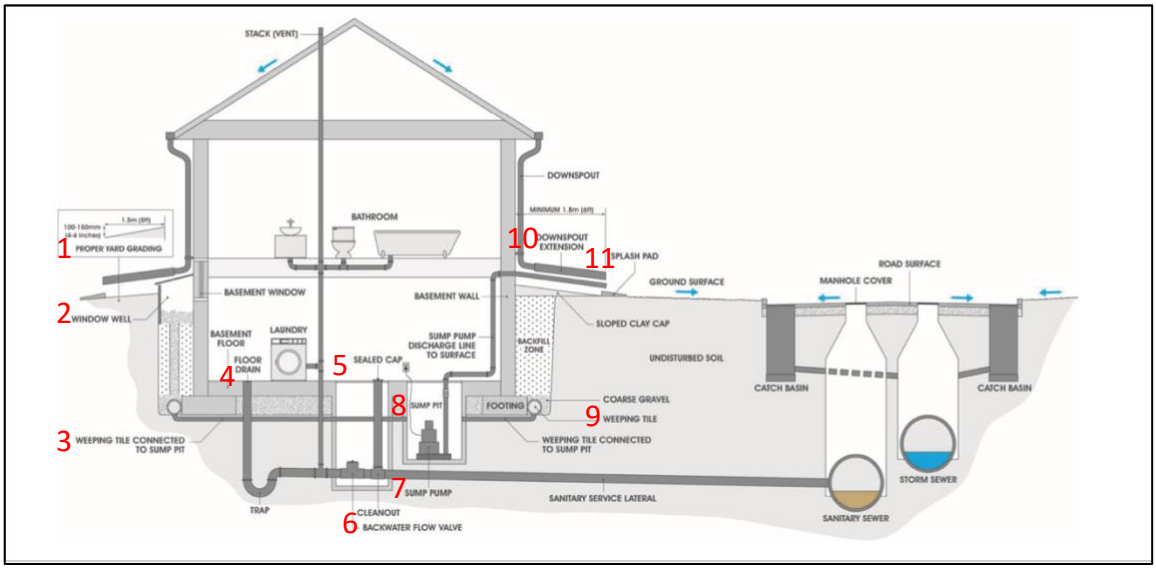

Figure 4. 1: Basement Flood Mitigation Measures

Note: Basement flood home mitigative measures including: 1. Maintaining proper grading, 2. Installing window wells, 3. Connecting weeping tile to sump pump, 4. Installing a floor drain, 5. Sealed cap, 6. Installing backwater valve, 7. Installing a sump pump, 8. Installing a sump pit, 9. Installing a weeping tile, 10. Extending the downspout, and 11. Installing a splash pad (adapted from the ICLR, Sandink, 2009).

The federal/provincial/municipal governments are finding ways to reduce flood risk due to the rising cost such as providing flood maps, and updating national building codes. Conservation authorities can support local municipalities and support green infrastructure. Many municipalities, such as London, provide grants for homeowners to undertake specific mitigative measures. Builders can follow the building codes to create more resilient homes. Insurers can not only provide information to homeowners and encourage them to implement mitigative measures through the insurance premiums and/or claims limits and restrictions. Real estate actors are in a unique position to inform buyers about the risk of pluvial flooding as well as what types, if any, mitigative measures are present in an existing home.

Clearly, homeowners have many options to mitigate pluvial flooding damage to their home. However, if they are not aware of mitigation measures or sources to get this information, they may be vulnerable to future damages. Increasing public awareness of pluvial flooding is important to encourage the introduction of private precautionary measures (Netzel et al., 2021) that protect property against pluvial flooding. A major problem is a lack of risk awareness in Canadians (Thistlethwaite et al., 2017). Therefore, it is crucial that homeowners are made aware of the risk of a pluvial flood event, the mitigation measures that have been installed in a home and the range of mitigative measures that are available to them to prevent damages. This information can be more effective if this information was exchanged to new homeowners as a new and ongoing 'normal business practice' during the sale of a home (Thistlethwaite et al., 2017). The real estate sector is well positioned to provide information to buyers during the home purchasing process. Providing pluvial flood risk information and mitigations measures can influence their home purchasing decision and buyers can better prepare them for a potential flood event. Therefore, it is important to understand the role of the real estate sector in the disclosure information and where they are sourcing this information from to ensure buyers are receiving useful and factual flood risk information and mitigative measures. Providing this information could reduce pluvial flood damages in Canada caused by a severe weather event, which were $3.1 billion (CAD) in 2022 in insured damages (*Severe weather…,* n.d.).

Armed with this information, a person making an offer to purchase a home can adjust the amount of the purchase to incorporate the estimated cost of a backwater valve (prices range between $2,000 to $5,000 (CAD) (*Backwater vales:…,* 2022)) and/or the

timing of their move into a home in order that installation of a backwater valve as well as other minor and major renovations (e.g., painting the home, install flooring, carpets, kitchen or other renovations of the home). Alternatively, the presence of a backwater valve or other mitigative measures may prompt a purchaser to offer their maximum budgeted amount on a house.

Given the extent and magnitude of the pluvial flood problem, a range of solutions have been adopted by Canadian municipalities. The City of London, which has experienced several pluvial flood events (see Table 4.1 below), has invested almost $11 million into separating combined sewer systems in the downtown between 2019-2022 and combined sewer systems are no longer constructed (*Sewers and Wastewater*, n.d.).

Table 4. 1: Pluvial Flood Events in London, Ontario

Date	Event	Damages
April 20-21, 2000	Extreme rainfall event in Southern Ontario	70mm of rain backed up sewers and roads washed out, many power outages occurred (Government of Canada…, 2013).
May 28th, 2009	Extreme rainfall event	95 basements in the Sherwood Forest region flooded due to surcharging of the sanitary sewers during the rainfall event (Standish, 2011).
September 10 2014	Extreme rainfall event	Streets flooded in Queens Avenue, Clarence St, and parts of Southdale road. Roads had to be closed for cleanup after a tree toppled onto hydro wires. A number of power outages were reported (*Flood Reported…,* 2014).
June 22-23, 2015	Extreme rainfall event in Southern Ontario	Estimated cost of $29,188,000. Flooding in London overwhelmed the sewer system and caused damages due to basement flooding (Government of Canada…, 2013).
August 1-3 2020	Extreme rainfall event	Milbank Drive had at least a dozen cases of flooded basements. Water entered the home from the drains. Damaged drywall, flooring, carpeting, displaced families (Irvine, 2020).
September 20-22, 2021 (Brown, 2021)	Extreme rainfall event	Many roads were flooded and closed. People were without power. Logged about 130 basement flood complaints (Bogdan, 2021)

The City also created “The Basement Flood Grant Program”, which is designed to incentivise and assist property owners with the installation of mitigation measures to reduce basement flood risk to their individual property as well as to reduce the amount of extraneous flow into the City sanitary sewer system, which can benefit the larger community. The City may pay the owner up to 90% (City of London, By-Law No. 7562-160) of the construction costs which can include one or all of the following: disconnection of weeping tiles from the city’s sanitary (and if required storm) systems; installation of a sump pump pit and pump; and installation of a back water valve. As seen in Table 4.2, maximum grants are set out for each mitigation measure taking into consideration the existing connections within the home. Table 4.2 also highlights that the grant amounts for each mitigation measure well compensates the estimated actual amount of the mitigation measure construction for all works except for the backwater valve. The grant covers only a small amount if the backwater valve is retrofitted into the home. The estimated price of installing a backwater valve in an existing home is ~$2,000-$5,000 (Smythe, 2022), however the grant only covers $1,600 (Scherr, 2022). Since backwater valves are a very effective flood prevention, the grant amount should be increased.

In order to qualify for the grant program, each applicant must meet the following criteria: “the property has experienced basement flooding, or is in an area of the City that could be prone to basement flooding; the property has weeping tiles and they are directly connected to the sanitary to storm sewer; the applicant must be the owner of the property; once approval form the City has been received in writing you many hire a licensed plumber or drainage contractor of your choosing to complete the works; the work must not have started prior to receiving grant approval in writing; must not have other

outstanding depts to the City of London; and must execute an appropriate liability release document" (*Flooding,* n.d.).

Table 4. 2: City of London Mitigation Measure Grant Estimated vs Actual Amount

Estimated Actual cost	**Maximum Grant Amount**	**Mitigation Measure Construction**
~$2,500-$5,000 for the equipment and instillation (*Sump pumps and your home...*, 2022).	$3,100	Sump pump and pit (interior weeping tile disconnection) (Scherr, 2022).
~$2,500-$5,000 for the equipment and instillation (*Sump pumps and your home...*, 2022).	$3,900	Sump pump and pit (exterior weeping tile disconnection) (Scherr, 2022).
N/A	$2,200	Disconnect additional weeping tiles for a building if weeping tiles previously drained to the sanitary system or drained by gravity to the storm sewer. This cost is per additional weeping tile connection and must be done in conjunction with the above 2 measure (City of London, By-Law No. 7562-160).
~$600-$1,200 for parts and instillation (Wallender & Pelchen, 2022).	$1,300	Sump pump battery back-up system (Scherr, 2022).
N/A	$3,900	Sump pump and pit to replace private catch basin that was previously drained to sanitary system (Scherr, 2022).
~$2,000-$5,000 to retrofit (Smythe, 2022)	$1,600	Backwater valve (Scherr, 2022).
~$150-$2,000 depending on the horsepower, and instillation fees (*How much does an ejector…,* n.d.).	$5,500	Sewage ejector and associated plumbing modifications (Scherr, 2022).
N/A	$9,000	Construction of storm lateral, from City sewer main to dwelling unit (storm private drain connection and storm building sewer) (Scherr, 2022).
N/A	$3,000	Construct of a storm lateral on private property (storm building sewer) (Scherr, 2022).

This manuscript focuses attention on two major considerations. First, the respondents' major sources of pluvial flood and pluvial flood mitigative measures are identified, and a brief assessment of their web-based information is made. The

assessment involved examining and making note of all pluvial and basement flooding information on the websites. This information was critiqued based on the ease of navigation, the language, whether or not it was tailored to homeowner issues, the availability of visual tools (vides, pictures, Infograph's), and if it explained technical terms. This section provides the basis for a discussion based on the perceptions about where they obtain information about pluvial flooding, its impacts and mitigative measures, and if and how they share this knowledge to prospective home buyers. The second part of this manuscript compares the total range of adjustments at the home level to pluvial flooding against the adjustments that are subsidized by London's Basement Flooding Grant Program. Implications arising from this analysis are identified and explained.

4.2 Methods

The methods used in this research are similar to those applied in the previous manuscript (refer to section 3.2). In this manuscript, mitigation measures covered by the City's Basement Flooding Grant Program are compared with the total range of adjustments available to homeowners (Table 4.2). The table was developed based on the literature that has identified the adjustments to mitigate basement flooding that results from a pluvial event, and comparing this list to the adjustments that are eligible for funding through London's Basement Flooding Grant Program. The following are the key aspects of the methods relevant to this paper:

- In total, nine home inspectors, seven appraisers, and 10 real estate agents completed an online survey. Of the 26 real estate professional who completed

the online survey, 12 participated in a telephone interview including: five real estate agents; three appraisers, and four home inspectors.

- The themes explored in the survey and interview questionnaire include: respondents' knowledge on information sources about pluvial flooding; their awareness of mitigation measures and the effectiveness of mitigation measures, and their thoughts on disclosure of pluvial flood risk information and mitigation measures.
- Refer to Appendix B1, B2, and B3 for the survey questionnaires, and Appendix C1, C2, and C3 for the interview questionnaires.

4.3 Results

The following section of this manuscript describes the available pluvial flood information sources. The reliable sources discussed are The City of London website, the Upper Thames River Conservation Authority website, the Insurance Bureau of Canada, the Institute for Catastrophic Loss Reduction, and independent real estate websites. The results from the survey and interviews are divided into three sections: (i) where does the real estate sector obtain information about pluvial flooding and its mitigation; (ii) when and who should and could disclose information to prospective homebuyers about previous flooding events and the pluvial flood risk a house may be subject to; and (iii) if and how improvements to the disclosure process can be made. The second section has subsections: Mapping and Professional Development Courses under information sources. Disclosure of pluvial flood risk by the Home Inspector and Disclosure of pluvial flood risk by the seller are under the Disclosure section.

4.3.1 Available and reliable sources of information about pluvial flooding

This section examines the main various sources of reliable web-based information about pluvial flood or basement flood information that the author is aware of and likely to be accessed by potential home buyers during their search for information about important hazards and mitigative measures a home can have. For individuals seeking information about pluvial flooding and mitigation measures in London Ontario, these are believed to be the most reliable options:

- The Upper Thames Conservation Authority (UTRCA),
- The City of London,
- The Institute for Catastrophic Loss Reduction (ICLR),
- The Insurance Bureau of Canada (IBC), and
- other real estate websites.

4.3.1.1 The Upper Thames River Conservation Authority

Conservation authority websites, such as the UTRCA, provide the public with reliable and accessible information on rain events in a section entitled 'Flood Bulletins' on their homepage. The Bulletins update the public on precipitation amounts during a flood event (past and present), whether or not flooding may occur in areas surrounding a river from a rain event, and the general condition of the Thames River. The terminology issued in their flood bulletins on Twitter during a flood event is consistent with conservation authorities across Ontario and in line with other agencies (*Flood bulletins definitions,* 2021). The UTRCA website also contains 'icons' on their homepage during heavy rain events, which include watershed conditions statement, flood watch, and flood warning (*Flood bulletins definitions,* 2021). An interactive Regulated Area Screening

Map is available online that outlines regulated areas which are areas that are affected by flood hazards, erosion, wetlands, and areas surrounding wetlands (*Conservation authorities act gelation (section 28), 2022*).

UTRCA's Twitter has a page to update the public on flooding as it may be occurring in the Thames River watershed. Twitter can be an effective method to communicate risk to the public according to Netzel et al., (2021). Messages are used predominantly for flood warnings. The public may also distribute this information by retweeting or mentioning trustful stakeholders, such as the media, weather networks, and public institutions (Netzel et al., 2021). The UTRCA shares flood messages with the public as well as with municipal flood coordinators and other agencies around the watershed (including: municipal flood coordinators, local first nations, county and health unit flood coordinators, neighbouring conservation authorities, ministry of natural resources and forestry flood casting centre, local police and fire departments, and local school boards) (*Flood bulletins definitions,* 2021). The board of directors include elected officials and other members from the community appointed by municipalities who share information and reports from the UTRCA with the other agencies.

The UTRCA has implemented a Community Precipitation Monitoring Program, which is designed to improve public knowledge on rain events, climate change trends, and droughts. Participants measure and record daily precipitation levels using the online Community Collaborative Rain, Hail, and Snow Network Platform (CoCoRaHS). Individuals can then go to the CoCoRaHS Mapping System, and select their city to see the precipitation levels from the morning as well as notes on the event (*Community Precipitation Monitoring Project,* 2022).

4.3.1.2 The City of London

The City of London website includes a page devoted to flooding information, which contains advice to homeowners who experience flooding in their basement as well as information on pluvial flood prevention methods. Prevention methods that homeowners can implement on their properties noted on this website are: weeping tiles that are connected to a sump pit and sump pump; sump pumps, and back water valves. Weeping tiles are underground pipes with perforations located around the basement foundation. These pipes capture rainwater that seeps into the ground and takes it away from the foundation walls to prevent groundwater entering the home. The installation of sump pump pits helps to protect the foundations of homes by receiving water from the weeping tiles. Pumps are installed to discharge the water to the storm sewer or the ground surface, as approved by the City (*Flooding*, n.d.). The website also contains information about the Basement Flooding Grant Program as mentioned previously, the website contains information regarding, the purpose, who is eligible, as well as the bylaw.

The City of London's goal is to eliminate connections to sanitary water pipes, a practice that was most commonly used in London prior to 1985. Backwater valves are a device that can be installed on the internal or external plumbing to prevent water from backing up into a basement but should only be installed if the weeping tile and sump pumps are disconnected from the sanitary sewer (*Flooding*, n.d.). Table 4.3 compares the mitigative measures outlined by the City's grant program to the full range of choice that homeowners can take.

Table 4. 3: Total Range of Homeowner Adjustments Measures vs. those supported by London's Program (2023)		
Mitigation Category	**Total Homeowner Range of Adjustment**	**Adjustments that are subsidized by… [4]**
Sump pump/plumbing, incl. backwater valve installation	Test sump pump and install backup power and alarm system[1].	Install sump pump battery backup system.
	Install and maintain backwater valves[1,2]. See 6 in Figure 4.1.	Install backwater valves
	Keep floor drains clear[3].	
	Install sump pump[2]. See number 7 in Figure 4.1.	Install sump pump/pit.
	Repair or replace old pipes and appliances[3].	
Furniture and Electronics	Elevate electronics off the floor and store valuables in waterproof containers[1].	
	Ensure basement furniture has non-absorbent surfaces up to 12" off the floor[3].	
Floors/Walls	Seal cracks in basement floor[2, 5].	
	Cover floors with moisture barrier and seal edges[3].	
Hazardous Materials	Remove hazardous materials from the basement to eliminate risk of spreading[3].	
Landscaping	Landscape around house, keep a positive grade and increase permeable surfaces[1]. See 1 in Figure 4.1.	
	Keep up with trees maintenance and remove any close to the foundation, and storm/sanitary sewer laterals[6].	
	Keep garden beds away from the foundation[3].	
	Keep snow piles 1m away from the foundation, windows and vents[3].	
	Extend downspout and sump pump discharge pipes >2m away from the foundation walls[1].	
	Impermeable/permeable walkways and driveways that direct water away from the foundation[3].	
	Lot grading, backfill and swales[2].	
	Extend downspouts sump pump pipes >2m aware from foundation walls[1]. See 10 in Figure 4.1.	
Downspout/Eaves troughs/sewer	Extend splash pads[2]. See number 11 in Figure 4.1.	
	Install a sewage ejector system[2].	
	Maintain and repair sewer laterals[2].	Construct storm lateral on private property, and from sewer to home.
	Disconnect downspout from municipal sanitary and combined sewer[2].	
	Remove debris from eavestroughs and catch basins[1].	
	Install rain barrels that have diverters and overflow discharge pipes to divert water[3].	
	Remove blockages from storm sewer grates[5].	
	Install plastic covers over basement window wells[1]. See number 2 in Figure 4.1.	
Foundation/Windows	Seal crack in foundation walls[2].	
	Seal potential overland flood entry points[2].	
	Disconnect foundation drain/weeping tiles[2].	Disconnect weeping tiles from sewer.

[1] Moudrak and Felmate, 2020; [2] Sandink, 2013; [3] Evans & Feltmate, 2019; [4] *Flooding* n.d.; [5]Sandink, 2011; [6] Feltmate et al., 2017.

While reviewing the literature on mitigative measures homeowners can take to better protect their home, it is apparent that there are many options. The City's program covers a small number of mitigation measures that homeowners can implement, and they do not cover the behavioural changes such as landscaping a property. Although the program covers a few mitigative measures, the program covers the most expensive and important adjustments that homeowners can do such as the instillation of a backwater valve.

City of London residents can report basement or outdoor yard flooding on the "Flooding" page of the website. The form to report the event requests information on the location and source of the flooding (e.g., drains, windows, doors, walls, malfunctioning sump pumps). This section of the website includes a City map that identifies reported flooding locations although individuals may only see this map if they are reporting a basement flood event in their home.

4.3.1.3 The Institute for Catastrophic Loss Reduction

The ICLR is an independent, not-for-profit research institute affiliated with Western University, which undertake multidisciplinary disaster prevention research and communication funded by the Canadian insurance industry. The Institute'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" (*About Us,* 2022).

The ICLR provides information on various disasters (e.g., floods, wind, earthquakes, wildfires) that significantly impact Canadian homeowners, municipalities, insurers, and small businesses. They specifically have a section of their website dedicated to homeowners (as well as municipalities, insurers, and small businesses) who are interested in learning more about hazards. The ICLR publishes several booklets and infographs detailing how homeowners can protect homes from specific hazards. The flooding infographs for homeowners describe mitigation measures such as how to install and maintain sanitary backflow protection, disconnect downspouts where direct rainwater safety ware from properties, ensure sump system is operating, ensure proper lot grading, and removing valuables from basement. Videos are also available to homeowners on site grading, rainfall, infiltration, backwater valves, and weeping tiles. There are also links to basement flood research. The basement flood publications include information on protecting your home from basement flooding including, sump pump systems, backwater valves, flood mapping in Canada, and how cities are adapting to extreme rainfall. The booklets and infographs are designed to help homeowners become more aware and prepared for disasters that are occurring more frequently due to climate change (*Flood,* 2021).

4.3.1.4 The Insurance Bureau of Canada

The IBC is the national industry association representing Canada's private home, auto, and business insurers. The Bureau works to increase public knowledge a range of "home, auto, and business insurance; works with the insurance industry and governments to help shape decisions around legislative changes, auto reforms, climate change adaptation, and helps education the public on natural catastrophes; promotes competitive,

sustainable auto insurance markets improve awareness of issues relating to road safety, and help advance balanced financial, operational and market conduct regulations" (*About Us,* n.d.b). The companies that are members of the IBC represent the majority of the Canadian property and causality (P&C) insurance market (*About Us*, n.d.b).

In the *Water* section under the *Disaster* drop down menu on the home page, the IBC includes ways to prepare for water-related damages including having a detailed home inventory; take precautions throughout the home and property if flooding is common; create a disaster kit, and create a 72-hour emergency plan (*Water,* n.d.). There is also information regarding insurance coverage for overland and sewer back up flooding and tips on how to start the claim process with several links to other helpful sources and resources (*Water,* n.d.).

The IBC outlines six common causes of basement flooding: improperly disposing waste in sinks or toilets; tree roots causing blockages in waterlines; overwhelmed sewers; frozen water pipes; vandals blocking sewer lines, and illegal hook-ups that allow excess water into the lines (*Home flooding mitigation techniques,* n.d.). Along with the common causes, there is also a plethora of information regarding basement flooding mitigation measures. The measures range from simple tasks like removing obstructions from flood drains to ensuring there is proper grading around the property as well as recommending actions to take when water enters the home. Recommendations are also provided on grading, backwater valves, rain barrels, and downspouts (*Home flooding mitigation techniques,* n.d.).

Grading can help when the soil around a home becomes displaced, exposing parts of the foundation to rain and snow (*Grading,* n.d.). Maintaining a slope away from the

house can correct the displacement that occurs over time (*Grading,* n.d.). Other ways to help improve drainage on a property include: disconnect downspouts from the sewer system; add a concrete splash pad under the downspout; create a depression between houses to redirect stormwater away, and install a backwater valve (*Grading,* n.d.). Backwater valves are placed into the sewer lateral to a home and closes if sewage backs up from the main line. Some insurers may require a homeowner to install a valve, especially if the home has suffered substantial sewer backup damage in the past (*Backwater valve,* n.d.).

Downspouts are pipes that drain rainwater from the roof to the ground away from the house (*Downspouts,* n.d.). This water usually enters the storm sewer system, combined system, or is diverted into the ground (*Downspouts,* n.d.). Disconnecting downspouts can reduce the risk of basement flooding from sewer backup, reduce the chances of flash flooding in rivers, and can increase the availability of water for lawns and gardens if it is collected in a rain barrel (*Downspouts,* n.d.). Rain barrels help water from seeping into basements and they provide water for maintaining lawns and gardens. A typical residential rain barrel can hold approximately 200 liters of water (*Rain barrels,* n.d.). A single heavy rainfall event can produce more than 2,300 liters coming off an average roof (*Rain barrels,* n.d.).

Most older areas in London will experience more flooding as a result of the combined sewer systems during a heavy rainfall event (Sandink & Robinson, 2022). The IBC discusses the importance of this type of water coverage and recommends that homeowners install backflow prevention device or valve if permitted, especially for homeowners living in low-lying areas with combined sewer systems. Backflow valves

can be useful as they can prevent sewage in an overwhelmed system from backing up into a basement (*Sewer backup,* n.d.).

4.3.1.5 Individual Real Estate Sites on Pluvial Flooding

Real estate professionals often provide information that is beneficial to homebuyers on their websites relating to advice on home insurance options, how to budget, and how to apply for a mortgage. RE/MAX has online blog posts on their webpage outlining many aspects about the home purchasing process. In 2021, there was a blog titled "Is it Worthwhile to Finish a Basement?" which gives homeowners questions to consider when it comes to finishing a basement. One question homeowners must consider is: "Is your basement water tight?" Before finishing a basement homeowners need to make sure (if there is past water damage) the basement will stay dry. This may be costly but vital to finish a basement to ensure it stays dry and protects the basement finishings and contents during heavy rain events (RE/MAX Canada, 2021). Another blog from 2022 titled: "Flood Insurance in Canada: Is Your House in a Flood Zone?" investigated what flood insurance is. It describes the importance of flood insurance, what it can cover, and suggested homebuyers review this issue with their insurance provider, especially during the home purchasing process. The insurance provider may be able to advise whether the home under consideration is located in an area that has past flooding claims (RE/MAX Canada, 2022).

The Tru Home RE/MAX site in the City of Edmonton, has a blog titled "Will my Edmonton Home Flood?" This article provides the interactive surface ponding and surcharge depth maps created by the City. This article informs the reader about the maps to help inform the public if they are in an area that may flood during a heavy rain event,

as well as information on how to understand drainage systems, historical flooding, future direction, understanding river levels, steps to take, and how to protect a home (*Will My Edmonton Home Flood?,* n.d.).

The Ontario Association of Home Inspectors (OAHI) is another real estate site that contains a small amount of information about pluvial flooding resulting in basement flooding. There is a blog on the website titled "Five ways to get your home ready for fall". The blog advises that due to the large and extreme temperature change from summer to fall, homeowners should prepare their homes for the coming winter. This blog suggest homeowners should cleanup the exterior of the property by removing debris and tools, being aware of water as it can cause flooding in basements, being safe by preventing slips on ice in the winter, inspecting winter equipment to ensure it is functioning, and finishing exterior renovations. This blog suggests filling in holes and spaces in the retaining walls, flowerbed, and driveways to prevent basement flooding, as well as ensuring the ground around the foundation is sloping away (OAHI BLOG, 2018).

Similarly, the American Society of Home Inspectors (ASHI) has a spring maintenance checklist for homeowners. This list includes removing debris from eavestroughs, downspouts and from around the house, ensuring the air conditioning unit outside is ready for summer, clearing lawns before lawnmowers are used, and checking inside the house for water damages (especially in the attic, crawl space, and basement.) (*Spring Maintenance*, n.d.). There is also another resource for homeowners called "Structure" that discusses foundation materials and how to maintain foundations, and to schedule a home inspection. This article indicates that it is important to keep water away

from the foundation by cleaning gutters, extending downspouts, and ensuring the foundation slopes away from the house (*Structure,* n.d.).

4.3.1.6 Summary: Available and Reliable Sources

In general, the City of London, ICLR, and IBC websites provide a substantial amount of information to the public on the impacts of rain events, mitigation measures, and programs to help better protect homes. These sites would be the most beneficial to homeowners in Ontario. The UTRCA provides information regarding past and present rain events and how the amount of rain impacts the Thames River levels. As of now, the UTRCA does not provide pluvial flood risk maps, however there is an interactive online floodplain map available on the website outlining regulated areas that are prone to flood hazard, erosion, and wetlands. Some information about pluvial flooding is also available on some real estate agent and home inspector websites, including ways to help homeowners better protect their homes against water, especially in the basement.

Pluvial flood information may be difficult for the general public to find. Those who are not knowledgeable about pluvial flooding, may not know where to look for information compared to those who are more knowledgeable or who have had experience with flooding. For example, one appraiser interviewed found it a challenge to obtain pluvial flooding information. They typically search local government websites for zoning information and any relevant planning reports and also search for flood maps from conservation authorities. One concern noted was that "there is a lack of funding for mapping and the maps that are available are usually outdated." Pluvial flood maps are not as common and are difficult to find and create compared to floodplain maps which indicate properties that are located in proximity to bodies of water that are likely to flood.

Pluvial flooding is difficult to forecast and monitor as the events are usually driven by localized and fast moving rainfall events and therefore, government officials are challenged in the creation of accurate and up to date maps can be a challenge for officials (Rözer et al., 2016). Pluvial flood maps also change quickly following the completion of sewer works that significantly increase capacity and are constantly being updated as a result (*Flood & Erosion Hazard Mapping*, 2021). The sudden changes may cause the public and professionals to question the utility of maps, and decrease their support for undertaking mapping exercises. There are also many issues that combine create pluvial flooding, such as intense and/or heavy rain event, old or poorly maintained sewer systems, and design/maintenance issues in the home and property level, which make the extent and level of pluvial flooding difficult to predict.

4.3.2 The Real Estate Sectors' Information Sources on Pluvial Flooding

There are several information sources about pluvial flooding risk that are available to the public (refer to Table 4.4). Survey respondents were given the option to select multiple sources: "during certification;" "during ongoing required professional development;" "conservation authority's websites;" "local government websites;" "ICLR/IBC;" and "other." Conservation Authority websites are reviewed by 50% (13 out of 26 respondents) of survey respondents when searching for pluvial flood information. 46% (12 out of 26 respondents) of survey respondents obtained pluvial flood information during the course of their professional development. About 31% of survey respondents indicated that they obtain their information during the certification, while another 31% indicated information is gathered through local government websites. Only a few of the

survey respondents (12%) indicated they obtain pluvial flood information from the ICLR or the IBC.

The survey was designed to allow respondents to select more than one source as their response to this question. Other sources that were mentioned by the appraisers include: through personal experience, owner interviews, Multiple Listing Service (MLS) listings, online searches for news articles, public information sources (although they indicated that "they are not reporting on pluvial flooding"). One home inspector mentioned they obtain their information from the American Society of Home Inspectors (ASHI), the Ontario Association of Home Inspectors (OAHI) and the Canadian Association of Home and Property Inspectors (CAHPI). Two real estate agents indicated that there were "too many sources to list" while the other indicated that they "did not hear of them until now."

Table 4. 4: Where did/do you Obtain Information about Pluvial Flooding?

	Real estate agents	**Appraisers**	**Home Inspectors**	**Total**
During Certification	2	2	4	**8**
During Ongoing required professional development	6	1	5	**12**
Conservation Authority's website	5	6	2	**13**
Local government website	2	3	3	**8**
ICLR/IBC	1	0	2	**3**
Other	2	4	1	**7**

The interviews confirmed the findings arising from the survey of real estate professionals that most obtain their information about pluvial flooding from their own personal experiences including: reading news coverage of extreme rain and flooding events; discussions with clients; and discussions with other professionals involved in the

real estate process about specific rain events. One realtor and several appraisers indicated that they researched government and agency websites, such as conservation authority and the City of London website. Typically, the information they look for on those sites include notices about rain events and maps showing flood prone areas.

There were a wide range of responses from home inspectors as to where they obtain pluvial flood information. One inspector only searched for information in cases where there are visible signs of water damage in a home, and they did not specify their information sources. This home inspector was not specific with their responses, and it became clear that they were not very familiar with pluvial flooding and the risks it can pose to homeowners. Others were more proactive by enrolling in continuing educational courses and some obtained information from personal experience. One inspector had little knowledge of pluvial flooding as they seemed to only discuss the risks and damages caused by fluvial flooding. The training event mentioned by one inspector was a three-day event where flood management experts share their experience and knowledge.

The City of London's website contains a good amount of information to homeowners about mitigative measures and a comprehensive list of information about the Basement Flooding Grant Program. This information is easily accessible and useful to homeowners as it is easy to find understandable. The information is designed to help homeowners in London better protect their homes and is written in lay terms. The UTRCA on the other hand has minimal information about mitigative measures. Their focus is on fluvial events. The UTRCA releases tweets on their Twitter account to update the public on heavy rain events and how they are impacting the Thames River levels. Of note is the CoCoRaHS program, which engages with the public whose participation can

make them more aware of rain events in their area and it can further connect them to seek out stakeholders or other information sources who can provide more information on pluvial flooding. As well, the interactive map outlining regulated areas in London that are subjected to flood hazard, erosion, and wetlands can potentially benefit homeowners interested in learning if their home is subject to flooding. However, this map is not directly created for homeowners use and may be difficult to interpret. The map shows regulated areas in London however, homeowners would have to review the Conservation Authorities Act – Regulation (Section 28) to understand what the regulated areas are. Instead the UTRCA should create homeowner friendly maps with similar information.

The ICLR is a highly informative source for information about pluvial flooding and mitigative measures. The information is designed and organized to address the issues that affect a range of stakeholders. Research articles are also available for those who want further information regarding the specific hazard. The website is very easy to navigate and find relevant information suitable to the user, however, the ICLR is not well known. No interview respondents mentioned the ICLR as a resource. The IBC is another effective source of information on pluvial flood and mitigation measures. This site contains information about heavy rain events and the need to better protect homeowners from the risks. Information on the site is tailored towards homeowners and is designed to be easy to interpret.

Real estate sites can provide some information in the form of online blogs about ways to keep water out of homes. This information is minimal and difficult to find if one is not directly looking for the specific blog articles. Unfortunately, there are only a few real estate agent and home inspector websites that have pluvial flood related information

including RE/MAX, OAHI, and the ASHI. Tru Home RE/MAX in Edmonton has flood risk map information (completed by the City) on their site which can greatly benefit homeowners purchasing in the City. Although the amount of pluvial flooding information on real estate websites is not extensive, even a small amount of information can prompt homebuyers to think about the impacts water can have on a home.

Providing better information to realtors, appraisers and inspectors can make them better equipped to advise clients on how to protect their homes. According to Palm et al., (1983), the real estate sector, specifically real estate agents and appraisers would be the appropriate professionals to inform buyers about hazard risks, as they can highlight the relevant factors in the housing valuation (Palm et al., 1983). The surveys indicated that six of the 10 real estate agents, four of the seven appraisers, and seven of the nine home inspectors thought there is a need to provide better information to the real estate sector about pluvial flooding.

According to the survey results (Table 4.5), 15 of the 26 respondents (58%) indicated that maps of pluvial flood risk zones should be available online to provide better information to real estate professionals. Approximately 30% (10 out of 26 respondents) indicated that government/ authority websites can improve the quality of information to real estate professionals in London. Providing information in the agreement of purchase and sale, according to seven respondents can also provide information to the real estate professionals buyers.

Table 4. 5: Ways to provide better information to real estate professionals.				
	Real estate agents	**Appraisers**	**Home inspectors**	**Total**
Maps of pluvial flood risk zones that are available on the web	6	3	6	**15**
Flyers sent to homeowners in pluvial flood risk areas by the city	0	1	2	**3**
Better information on government/authority websites	5	2	3	**10**
In the agreement of purchase and sale	1	2	4	**7**

The majority of the interview respondents believed that there is a need to improve the information available to their professions. There were several suggestions offered by respondents. One real estate agent suggested that agents should "pass information down to younger agents," this will provide the younger generation of realtors with experience information from older realtors. Another suggestion from an appraiser was to provide training courses to those in the real estate sector. Providing information through online newsletters or webinars was also suggested to create easily accessible information. One appraiser suggested that although cost may be an issue, there should be opportunities to purchase insurance reports on homes that have had a pluvial flood event. Although the options mentioned by the respondents could benefit homeowners, they are very informal which makes it more difficult to enforce professionals to uphold and it cannot assure effective delivery of the information. Instead, more formal disclosure should be implemented such as providing flood risk information and mitigative measures on the MLS. This ensures all potential homebuyers are given the same information of the risk and solutions of a property

4.3.2.1 Mapping

"Flood maps serve as critical-decision making tools in flood mitigation, land use planning, emergency management, and general public awareness," according to Natural Resources Canada. It was suggested by home inspectors and appraisers interviewed and 15 survey respondents that pluvial flood maps should be available to indicate areas that have flooded from a rain event as to increase the information available to the public on pluvial flooding. Providing the public with urban (pluvial) or riverine (fluvial) flood risk maps can increase uptake of actions but only if this information is delivered by trusted community leaders, family, or friends (Evans & Feltmate, 2019; Owusu, 2015), and can fill in information gaps on flood risk (Votsis & Perrels, 2015). Handmer (1980) discovered that flood maps can be beneficial to communicate flood risk to individuals and awareness of flood risk increased after viewing the maps however, this increase could not be ascribed to the maps (Handmer, 1980). It is important to ensure that pluvial flood risk maps are presented to the public in way that is easily understandable and updated to ensure the information being shown is relevant. The scale of the map is also important as pluvial flooding maps will require a large scale (Tyrna et al., 2017), between 1:1,000 and 1:25,000 (Natural Resources Canada, 2018) or an interactive map to show meaningful insights about individual properties. It is unknown what the exact scale pluvial flood maps should be created at, however this scale can be used as a guideline for future pluvial flood risk maps.

The City of Edmonton has been recognized on the national stage for its leading flood mitigation plan (*Breaking news from Edmonton, Canada & the world – edmontonjournal,* 2021). The City has created online, "worse-case scenario," interactive maps showing the level of water accumulation that has occurred during a heavy

rainstorm. The interactive maps allow the user to zoom in and out of the maps making it easier to locate individual homes on streets impacting by rain. Recent severe storms have overwhelmed the drainage systems and flooding household basements and City officials realized that the proactive response would be to create a study of urban flood mitigation measures, thus creating the flood maps (*City-wide flood mitigation strategy,* n.d.). To create the maps, officials used high resolution topographic maps of the flat table-lands high above Edmonton's river valley. These data were matched with sewer data and they ran computer simulations of 1-in-100 year flash flood events, which have a one percent chance of happening each year. These maps include a surface ponding map and a surcharge depth map, and were created due to increased extreme rainfall events and drainage system. A surface ponding map indicates how deep the water would be on a street during a worst case severe rainstorm, while a surcharge depth map indicates how full the City's pipes would be during an intense rain event (*Will my edmonton home flood?,* n.d.). According to an article in the Edmonton Journal, Edmonton was forced by Postmedia's Freedom of Information request to disclose its maps to the public (*Flood maps highlights points of concern in Edmonton – edmontonjournal*, 2016).

4.3.2.2 Professional Development Courses

Professional course curricular materials relating to pluvial flooding and climate change can be of benefit for real estate agents to enable the dissemination of more accurate information to buyers. The majority of realtors interviewed agreed that courses should be available on pluvial flooding and climate change. All real estate agents in Ontario must be registered with the Real Estate Council of Ontario (RECO), the body that is responsible for the enforcement of provincial laws that regulate the profession. The

initial step to secure registration in RECO is the successful completion of Pre-Registration Phase of the Real Estate Salesperson Program delivered by Humber College (consisting of five courses, four exams and two simulation sessions) over a maximum of 24 months. Starting in 2019, Humber College was the sole provider of real estate education in Ontario (*Humber College Archives*, 2018).

The program material includes an introductory course on the fundamentals of real estate and the role of a sales person and their obligations under the *Real Estate and Business Brokers Act, 2002* and its associated regulations, including the Code of Ethics. Three courses focus on residential as well as commercial transactions, including working with both buyers and sellers through the process of listing, advertising and completing agreements of purchase and sale. The final course is intended to help students launch their career as a real estate agent. Simulation sessions are conducted to explore a range of transaction issues with experienced real estate professionals (*Estate*, n.d.).

Following the completion of the first registration cycle, realtors are required to complete the Mandatory Continuing Education (MCE) program within every two-year registration cycle, consisting of the RECO Update Course, and two MCE elective courses. A review of the course material described online indicates that most relate to ethics, financial reporting and mortgage issues (*What is mandatory continuing education (MCE)*, 2021). There were no courses currently described by RECO that relate to pluvial flooding and climate change issues and it was unclear whether the simulation sessions touched on these issues. It was suggested by a realtor that one of the electives in this program could be about climate change and pluvial flooding. One agent noted that "the more information we learn and know, the better service we can provide to the public." On

the other hand, another realtor indicated that the courses should focus on other subjects as they didn't consider flooding to be a "large issue".

The Appraisal Institute of Canada's CUSPAP are mandatory reporting standards. The appraisers interviewed indicated there are no specific courses on pluvial flooding and they have not been educated on how to specifically incorporate basement flooding into appraisal reports. While there are no direct requirements addressing evidence of pluvial flooding risk or actual damages, appraisal reports are required to include a wide range of information on the property that should address any visible signs of pluvial flooding. Among many other requirements, the reports must include: a description of the property; known detrimental conditions relating to external, building, site and infrastructure, natural and climate conditions, and the nature and extent of inspections of the property by the appraiser (AIC, 2022). In line with this requirement, one appraiser stated that they include information about the history and the environment of the home in their report, which may reveal information about past flood events. A second appraiser indicated that courses addressing inspections of properties provided guidance on how to adjust valuations for detrimental conditions, which they believed could include impacts from basement flooding. One survey question asked the appraisers how often they do each of the scenarios listed. As seen in Table 4.6, appraisers surveyed were asked specific questions relating to how often they undertake each scenario. Although the results are mixed, the majority of appraisers will either 'Always', 'Often', or 'Sometimes' undertake each scenario.

Therefore, it appears that appraisers are not specifically trained to look for evidence of basement flooding, however, they have the tools and knowledge to address any basement flooding impacts that they might be made aware of either through an inspection or through other sources of information.

Table 4. 6: How Often do Appraisers do each item below?

Field	Always	Often	Sometimes	Seldom	Never	NR
If a single family residence has suffered water damage in the basement, attempt to determine specific details of the flooding.	3	2	0	0	1	1
If a single family residence has water damage in the basement in the past, note this fact in the appraisal report.	3	2	0	0	1	1
If a single family residence has suffered water damage in the basement, identify whether each of the comparable sales has also been subject to pluvial flooding.	0	0	3	1	2	1
If a single family residence has suffered pluvial flooding in the past, determine the effect of the possibility of this on the value of residence.	2	1	1	1	1	1
If a single family residence is located in an area in London, that has experienced flooding from a rain event, note this fact in the appraisal report.	2	0	2	1	1	1

On the topic of mitigation measures, the general consensus from the interviews was that appraisers need to "stay in their lane" when it comes to suggesting resolutions to problems in a home. They will report their findings about defects to their client, but as one appraiser noted "we need to be careful when suggesting mitigation measures to

buyers because we do not want to judge them as inferior." Although several appraisers surveyed who had experience with a pluvial flood event indicated that they will suggest the listed mitigation measures seen in Table 4.10 further down, to their clients.

All home inspectors interviewed indicated that, in their experience, they have been effectively trained in detecting damages resulting from water, but not specifically in terms of the assessment of pluvial flooding risk to a specific home. This was evident as one home inspector was not aware of what pluvial flooding was prior to the interview. Most agreed that continuing education in this area would be beneficial to their profession and ultimately to their clients. The Ontario Association of Home Inspectors (OAHI) has a list of available continuing education courses on their website for members. These courses are only available to inspectors that have complete entry-level training though an accredited Ontario community college, Ontario private career college or an accepted out of province equivalent. Upon review of the course available, of the 35 courses only two discussed water proofing, or snow and rain loads (*List of available courses subject to demand*, n.d.). No courses were specifically designed to deal with pluvial flooding.

There is a paucity of courses on flooding or the implications of climate change available to the real estate sector. There is an online course available through "OntarioLearn" for home inspectors, insurance brokers, real estate agents, municipal engineers, developers and other specialists to help owners address the threat of basement flooding. OntarioLearn contains the largest collection of online post-secondary courses in North America. They work with the 24 Colleges in Ontario to provide easily accessible courses, programs and services online (*Start your academic journey,* n.d.). The course is called *Home Flood Risk Assessment Training Course* and it was developed as a

collaborate effort among Fleming College, Seneca College and the Intact Centre on Climate Adaption at the University of Waterloo. This course provides these stakeholders with the fundamental training required to complete a visual assessment of overland, infiltration and sewer backup flood risks, communicate opportunities to reduce these risks and identify where further investigation is needed (*Home Flood Risk…,* 2019). This course is an effective way to distribute information to real estate professionals to allow them to provide important information of flooding and other climate change implications to homebuyers. Perhaps this should be incorporated into other real estate sector courses or should be a mandatory course for all realtors, appraisers, and inspectors during their training.

4.3.3 Disclosure

As seen in Table 4.7, 16 out of 26 respondents (62%) who completed the surveys believed homeowners become aware of flood risks in their home after a flood event. These results align with the interview findings, which also indicated that the majority of homeowners do not discover their home is susceptible to flooding until after a flood event occurs. This finding is consistent with the studies completed by Thieken et al. (2007), Douglas et al. (2010), Logan (2017), who maintained that awareness of a hazard comes after the event occurs. Based on the responses to this question, it appears that pluvial flooding risk or past exposure is not typically disclosed in the City of London market to the homebuyer during the home purchasing process. According to Shrubsole and Scherer (1996) disclosure of floodplain information was also lacking in the early stages of the home purchasing process. According to Yeo (2004), the timing of disclosure is significant because adverse impacts can be reduced when the awareness of the

community is high. If a meaningful reduction in pluvial flood damages and associated emotional stresses is to be achieved, information on the pluvial flood risk and mitigative measures already installed in a home must be provided to prospective homeowners in a transparent manner early in the home purchasing process.

Table 4. 7: When do homeowners become aware of flood risks in their home?

	Real estate agents	**Appraisers**	**Home inspectors**	**Total**
After a flood event	7	5	4	**16**
After a purchase	2	1	2	**5**
During the home purchase	1	0	1	**2**
Never	0	0	1	**1**
No Response	0	1	1	**2**

As seen from the data in Table 4.8, fifteen respondents (58%) believed that the home inspector usually discloses pluvial flood risk information along with mitigation measures to the buyer. However, in some cases where the real estate market is very active, homebuyers may purchase a home without conditions and may not get a home inspection and therefore disclosure of this information may not occur. Around 35% (9 participants) of the respondents indicated that real estate agents usually disclose pluvial flood risk information. No respondents believed bank loan officers or the buyer's lawyer disclose pluvial flood risk information. Other stakeholders that were mentioned by four real estate agents were the seller, the neighbour after closing, no one, and that "it depends." Two appraisers indicated "mother nature" and the current owner discloses. One home inspector indicated the neighbours disclose this information.

Table 4. 8: Who Usually Discloses Pluvial Flood Risk Information?				
	Real estate agents	**Appraisers**	**Home Inspectors**	**Total**
Real estate agents	4	3	2	**9**
Home inspectors	7	2	6	**15**
Bank Loan Officers	0	0	0	**0**
Appraisers	2	0	0	**2**
Buyers Lawyer	0	0	0	**0**
Insurance Companies	5	1	2	**8**
Municipal Government	0	1	1	**2**
Conservation authority	1	2	0	**3**
Other	4	2	1	**7**

There were a range of responses from the interviews as to which stakeholder in the buying process usually discloses pluvial flood risk to homebuyers from the interviews, including home inspectors, insurance companies, real estate agents, lawyers, sellers, and no one, as the buyer is responsible to do their own research. Most of the interview respondents suggested that either home inspectors or real estate agents or both typically disclose this information, while others suggested multiple stakeholders could do so. There is no consensus among industry professionals as to who they believe discloses pluvial flood information. As previously discussed, it is difficult to detect past pluvial flood events and difficult to predict future pluvial flood events. What is required is a timely disclosure of the flood risk and mitigative measures implemented on a house prior to an offer to purchase. Opportunities to provide this will be explored in the concluding chapter.

Insurance companies can potentially disclose pluvial flood risk information and mitigative measures to buyers due to their extensive knowledge of weather-related risks.

However, this contact typically occurs after the offer purchase of a house has been accepted. Insurance companies deal with claims from individuals who have suffered from climate change impacts such as fires, floods, and earthquakes, they are very aware of the changing weather. They encourage policy holders to provide information on mitigative measures to homeowners and encourages them to adopt measures through a reduction in the insurance premium and/or coverage available. Premiums may be less expensive if a home has mitigation measures installed as this can result in less risk of a claim which insurance companies have to pay.

Their websites have valuable information on pluvial flooding for the public. For example, the insurance company Co-operators, has a rainproofing checklist from homeowners available online for the public. This checklist includes several ways to prevent water from entering the home and ways to protect individual assets. This includes making sure the ground around the foundation slopes ways, clearing storm drains, and choosing elevated basement furniture. Co-operators also has a Taskforce on Climate-related Financial Disclosures (TCFD), which enables stakeholders to better understand a property's exposure to climate related risks and carbon related assets. One enhancement that Co-operators provides compared to other insurance companies in Ontario is that they have an easy-to-use water risk assessment to provide a personalized risk assessment for properties across the country. Individuals can input an address and the assessment will inform the individual of the water/septic/sewer flood risk and the overall flood risk indicating whether these risks are low, medium, or high, as well as provide links to how to prevent water damage and information on water coverage.

Approximately 65% of respondents (17 respondents) from the surveys (six realtors, four appraisers, and seven home inspectors) indicated that there is a need to clarify who should inform buyers of pluvial flood risk information and mitigation measures but there is no consensus on who that should be and no agreement that this disclosure should occur prior to the offer to purchase is made.

Of the 17 respondents who agreed that there is a need to clarify who should disclose pluvial flood risk to buyers, eight respondents (47%), as seen in Table 4.9, believed the information should be disclosed by the real estate agent. One real estate agent and one home inspector indicated that other individuals such as the current homeowner should disclosure pluvial flood risk information. This is inconsistent with the results from the interviews, which indicate that the home inspector or the seller should disclose this information to buyers. As stated earlier, there is no guarantee a home inspector would be hired in every home purchase, which is a major shortcoming of this response.

Table 4. 9: Who Should Disclose Pluvial Flood Risk Information?

	Real estate agents	**Appraisers**	**Home Inspectors**	**Total:**
Real estate agents	1	2	4	**8**
Home inspectors	1	0	0	**1**
Bank Loan Officers	0	0	0	**0**
Appraisers	0	0	0	**0**
Buyers Lawyer	1	0	0	**1**
Insurance Companies	0	0	0	**0**
Municipal Government	2	0	1	**3**
Conservation authority	0	2	0	**2**
Other	1	0	1	**2**

All realtors and appraisers interviewed, indicated there was no need to clarify who should disclose this risk information to buyers. However, the home inspectors agreed that there is a need to clarify who should disclose information to buyers. One inspector indicated that this is very important because homeowners have a low level of knowledge on pluvial flooding. Inspectors believe that home inspectors or the sellers should disclose this information to buyers.

4.3.3.1 Disclosure of Pluvial Flood Risk by the Real Estate Agent

According to the RECO, "latent defects are not obvious and may be challenging to discover, even by a home inspector or other expert. Examples of latent defects include a basement that floods during heavy rainfalls, a major structural problem, hidden fire damage or mould" (*What must you disclose when selling a Home?* 2022).

Section 21 of the Real Estate and Business Brokers Act, 2002 Code of Ethics Regulation (2022), addresses the real estate agent's responsibility for disclosure, as follows:

> **21.** (1) A broker or salesperson who has a client in respect of the acquisition or disposition of a particular interest in real estate shall take reasonable steps to determine the material facts relating to the acquisition or disposition and, at the earliest practicable opportunity, shall disclose the material facts to the client. O. Reg. 580/05, s. 21 (1)

(2) A broker or salesperson who has a customer in respect of the acquisition or disposition of a particular interest in real estate shall, at the earliest practicable opportunity, disclose to the customer the material facts relating to the acquisition or disposition that are known by or ought to be known by the broker or salesperson. O. Reg. 580/05, s. 21 (2).

Accordingly, real estate agents have a legal obligation to disclose any fact they are aware of (or patent defects) with respect to the real estate transaction that might reasonably affect a person's decision to buy or sell a property. When it comes to patent defects (those readily discoverable by purchaser or inspector), the onus is on realtors. When it comes to latent defects, (those not easily detectable by inspection) the onus is not on realtors (Lem & Bocska, 2021). Realtors are obligated to disclose that flooding occurred in a home only if they are made aware that flooding had occurred, by the seller or other reliable source of information or by an inspection that reveals water damage. As seen in Table 4.10, all realtors interviewed and the majority of the surveyed realtors, who also had experience with a pluvial flood event will suggest pluvial flood risk mitigation measures to their clients if there has been a known past flooding event, and even if the buyers are not concerned about pluvial flooding.

4.3.3.2 Disclosure of Pluvial Flood Risk by the Home Inspector

The role of home inspectors includes identifying the condition of a home to a buyer or seller so they can make informed decisions. All of the inspectors interviewed advised that they look for damage to the home that may have been caused by water from a basement flood event. In addition to researching the history of the home, the indicators

they look for while undertaking a physical inspection include: water residue on trim; existing moisture; efflorescence; spalling; silt and sand, and rotting. Following the discovery of any of the indicators, the inspectors surveyed and interviewed who also had experience with a pluvial flood event will inform the buyers and discuss the risks and mitigation measures (Table 4.10).

Table 4. 10: Have you suggested any of the following pluvial flood mitigation measures to prospective homebuyers?

	Real estate agent			**Appraisers**			**Home inspectors**		
	Yes	**No**	**NR**	**Yes**	**No**	**NR**	**Yes**	**No**	**NR**
Back water valves	8	0	2	3	2	2	7	0	2
Back up sump pump	8	1	1	6	0	1	6	0	3
Seal cracks in floor walls	8	1	1	3	2	2	6	0	3
Disconnect downspouts from weeping tiles	4	0	6	4	1	2	6	0	3
Lot grading	6	3	1	4	1	2	6	0	3
Other	0	0	0	0	0	0	0	0	0

However, as stated earlier, some buyers are not undertaking inspections as they are purchasing without any conditions on the home. These buyers will therefore not benefit from the expertise that home inspectors can provide on the issue of past pluvial flood events or future pluvial flood risk. *The Canadian Association of Home and Property Inspectors 2012 National Standards of Practice* and *The International Standard of Practice for Performing a General Home Inspection and The International Code of Ethics for Home Inspectors* (2013) states that the home inspector is not required to identify concealed defects/latent defects or to determine the condition of systems that are not accessible during an inspection. Home inspections are limited to accessible and

visually observable areas of the property. If the water damage from a past flood has been resolved or is hidden well, the home inspector may not notice it.

4.3.3.3 Disclosure of Pluvial Flood Risk by the Seller

Sellers on the other hand have firsthand knowledge of any past pluvial flood events experienced in their home and therefore could disclose all known information about any such past events. Thistlethwaite et al. (2017) concluded that over 90% of homeowners agreed that the seller of the property should be required to disclose flood risk. However, given their motivation to not deter purchasers' and sell their home at the highest price, there is a possibility that they may not disclose information about past flood events. A 2001 proceeding from the Superior Court of Justice of Ontario *Swayze et al. v. Robertson* (2001), indicates that sellers can easily omit information about flooding history. Dr Swayze and Dr Wall purchased a property from Mr. Robertson in 1998. Dr Swayze and Dr Wall completed a home inspection and the inspector discovered two separate sections in the basement showing evidence of possible water seepage. Mr. Robertson claimed that there was no history of any water, cracks, etc, in the basement and there were no structural problems. Evidence provided by Basement Systems revealed that they attended the Robertson home to examine the basement in February of 1997 and concluded that there was a problem with the basement foundation and provided a quote of $1,600 to repair the foundation. Mr. Robertson originally accepted the opinion, however he subsequently cancelled the order for repairs. Although Mr. Robertson was made aware of past flooding problems and the serious risk posed for flooding because of the foundation issue, he chose not to disclose this information on the Vendor's Listing Information Document – now called the Seller's Property Information Statement (SPIS).

In his decision, Justice J. LaForme found in favour of the Dr Swayze and Dr Wall, indicating that Mr. Robertson knowingly made a false claim indicating that there were no structural or water problems in the basement and there was no history of that. The decision of the Justice relied on the Vendor's Listing Information document as a warranty that remains in effect beyond the date of the Purchase and Sale Agreement. The finding acknowledged the damages suffered by Dr Swayze and Dr Wall, awarding all costs associated with the foundation repairs, carpet replacement and air duct cleaning. No award was granted on the mental suffering, discomfort and loss of quiet enjoyment claim as virtually no evidence was provided to support the claim and the Statement of Claim did not set out any claim for general damages. It is noted that there were no claims against any of the professional stakeholders involved in the transaction between the Robertson's and the plaintiffs *(Swayze et al. v. Robertson*, 2001).

Section 20 of the Real Estate and Business Brokers Act, 2002 Code of Ethics Regulation (2022), addresses the SPIS as follows:

> **20.** If a broker or salesperson has a seller as a client and knows that the seller has completed a written statement that is intended to provide information to buyers about the real estate that is available for acquisition, the broker or salesperson shall, unless the seller directs otherwise,
>
> (a) disclose the existence of the statement to every buyer who expresses an interest in the real estate; and

(b) on request, make the statement available to a buyer at the earliest practicable opportunity after the request is made. O. Reg. 580/05, s. 20. (See Appendix F regarding the changes that will come into effect in April 2023)

According to this research, there is no single designated professional involved in the home buying process who has a legal requirement to disclose pluvial flood risk, but if a property has experienced basement flooding due to rain events and the seller is aware of this information, the seller is required to disclose this on the SPIS if they completed one. The SPIS is a document provided by the seller to the brokerage/broker/salesperson to convey information concerning the property. This form includes general questions such as how long the seller has owned the property, as well as environmental questions such as has the property ever flooded. The SPIS can disclose possible flood risks known by the seller to the buyer, however there is no legal requirement for the sellers to complete and provide the SPIS as part of the real estate transaction (*Property seller information agreement…,* 2022). As well, the mitigative measures implemented in the home, such as a backwater valve, could be disclosed on the SPIS along with the potential flood risks. Including information of the potential risk as well as the mitigative measures may balance out and can have a minor impact on the home by making it more marketable.

However, the SPIS can be difficult to complete as the questions may be difficult and too ambiguous to understand. It can be ambiguous specifically with the use of some words such as "problems" or "defects." The seller will require help from their real estate agent and potentially an inspector to fill out the form. As well, some real estate agents

support the use of the SPIS while others, including many lawyers argue that sellers should not complete it (Ritson & Shanks, 2017).

4.3.3.4 Motivating Factors to Disclose Pluvial Flood Risk Information

It was discovered from the interviews that there are a few motivating factors to entice sellers and real estate professionals to disclose pluvial flood information and mitigation measures to buyers. The main motivating factor is to avoid litigation. If the realtor/appraiser/inspector disclose all known information, they will not be at risk for a lawsuit from the buyer later on. However, many responses from realtors and appraisers included the fact that people will disclose this information out of the "goodness of their heart" and given the desire to do a good job by providing all known information about a property before purchase.

The seller has been identified as an important actor in the disclosure of pluvial flood risk process. However, in order for the seller to disclose this information on the SPIS, they must be motivated to do so. This may involve other real estate professionals such as real estate agents communicating the consequences if the seller does not disclose all known information on a property. As mentioned earlier, there can be consequences such as a large financial compensation if it was discovered they withheld information on the SPIS from the buyer.

4.4 Conclusion

It is clear that the available information on pluvial flooding is extensive if one knows where to look for this information. A number of information sources about pluvial flooding were cited by the respondents, including municipal government, conservation authority websites, and personal and professional experience. However, some sources

such as the City of London and UTRCA are in need of more information on all mitigative measure that homeowners can implement. Along with the sources of information mentioned, there are several other sources of pluvial flood risk information that was not mentioned by the respondents of this survey. This indicates that there are many resources available to the public, however most are likely unaware of their existence.

The IBC is a sponsor of *Unflood Ontario* to increase awareness of flood risk to the public in the form of advertisements on TV. In 2019, the Durham, Toronto and Niagara Community Foundations with The Small Change Fund created Unflood Ontario to help inform more people about the benefits of natural infrastructure to reduce flooding damages (*About Unflood Ontario,* n.d.). The Small Change Fund helps communities across Canada improve the environment, reduce poverty and support reconciliation with Indigenous Peoples (*About – small change fund,* n.d.). Another site is FloodSmart Canada. FloodSmart Canada is a project of Partners for Action at the University of Waterloo to empower Canadians to take action to prepare for flooding (*About Us.*, n.d.a). Their website includes information and resources on flood, flood risk, and emergency preparedness. This site is very beneficial as it provides information on flood preparedness for businesses, communities, Indigenous communities, and homeowners and renters. The homeowners and renters section of the website includes mitigation measure to protect individuals, types of flood insurance (i.e., overland flood insurance, sewer backup insurance, insurance for renters), shareable infographs on flooding preparation and risks, and what to do if you have a flood.

The majority of respondents thought that the industry would benefit if pluvial flooding information was made more easily accessible so that they could better serve

their clients. Respondents suggested a number of ways in which pluvial flooding information could be enhanced, including continuing education courses on pluvial flooding or climate change; publication of pluvial flood risk maps; and the development of other on-line resources which could be more easily accessible. New homeowner resources should be shown on the front webpage of municipal and real estate websites, and perhaps through weather networks before an extreme weather event occurs. Checklists, such as the ones provided by Co-operators are a good idea as they are in layman's terms and are designed for homeowners. These suggestions could also provide the real estate sector participants with the additional knowledge and potential motivation to advise all homebuyers about the risk of pluvial flooding along with the mitigation measures that could protect their homes from future damages.

According to the results from the surveys and interviews, real estate agents, home inspectors, and the sellers should be primarily responsible to disclose pluvial flood risk information and mitigation measures. However, all professional respondents have a legal and/or professional obligation to disclose defects to homebuyers which are either explicitly revealed to them (by sellers or other sources) or are easily visible in a home. Given pluvial flood impacts are most likely latent defects, or not clearly visible, there is no guarantee that previous pluvial flood experience and risk information will be shared with homebuyers during the home purchasing process. While home inspectors have an obligation to uncover defects that are not seen by the buyer, and to inform them of actions they can take to reduce future damage, if the home buying market is very active, buyers may not hire a home inspector.

Disclosure needs to happen early in the home purchasing process, before the purchase occurs and should be conducted in a transparent way. This is to ensure all homebuyers interested in a property are receiving all the information about a home before the decision to purchase. The MLS should have flood risk information and mitigation measures on it. This way, the information would always be there for all realtors to disclose to the buyers interested in the property.

Along with the MLS, the SPIS should also contain information on flood risk and mitigative measures installed in the home for potential homebuyers. Having the information on the mitigative measures may help 'balance' having the more negative flood risk information on the SPIS resulting in a positive response from potential buyers. Real estate agents need to walk buyers through the home purchasing process and make them aware of the SPIS. They can suggest to the buyer to request the SPIS from the seller in order to obtain more information on the home and its past, including past flood events (if disclosed), making them more aware of hazards that may impact the home. The SPIS could also be mandatory for sellers to fill out and should be disclosed at the beginning of the home purchasing process and made available to all buyers who are interested in the property.

The Basement Flooding Grant Program created by the City of London covers 90% of the cost of the instillation of mitigative measure in homes that are at risk of basement flooding. Overall, the program partially covers the instillation of a backwater valve, sump pump and pit, sump pump battery back-up, construction of storm laterals, disconnection of weeping tiles from the City's system, and sewage ejector modifications. After further review of each grant amounts compared to the estimated cost of the specific

works, the grant for a backwater valve is very low and should be increased. This program can be beneficial for homeowners who are concerned about basement flooding that do not have any mitigative measures in their home. However, according to sewer divisions manager Kyle Chambers, the program is more reactive as homeowners usually take advantage of the program after a flood event. Although some homeowners can be proactive if their neighbours have signed up. Chambers indicated that educating the public on the program is very important however the City has to be sensitive as to not stigmatize neighbourhoods due to the negative consequences that can arise from it. In the past educating the public has been done through public events with brochures and pamphlets. In the future social media and videos could potential be more effective at conveying and promoting information on the grant program for homeowners. Homeowners should be informed about this program prior to purchase of a home, potentially by their realtor because if a new homeowner signs up for the program and are able to delay their move into a new home until mitigative measures are installed, then the new homeowner is not inconvenienced by any of the renovations. Although real estate professionals do not reach out to the City to learn more about the grant program, Kyle Chambers, agreed that having seminars for the real estate sector to educate them on basement flooding and the grant program would greatly benefit their clients who they would relay the information to.

While comparing the total amount of adjustments homeowners can do, the program only offers a small amount. The program is designed to fund expensive and complicated adjustments which can be very beneficial for homeowners at risk, however, it does not fund behavioural changes that may protect homeowners even more in the

future. Behavioural changes are considered as those simple adjustments made by homeowners every day to reduce their flood risk, such as landscaping and clearing out eavestroughs. Changing behaviours can start with increasing awareness and education about the risk bust most importantly, promoting adjustments. Rather than providing homeowners with hazard information, promoting adjustments can better prepare individuals for potential future risks by providing actions one can take.

There continues to be a need to educate the public on various risks that can impact themselves and their homes, especially new buyers do to their low level of experience with the home purchasing process. Having actors in this process to help guide and advise and inform buyers can increase their knowledge and awareness of home buying and owning responsibilities.

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CHAPTER FIVE

Synthesis and Conclusion

This chapter will incorporate the findings from the two manuscripts regarding the perceptions of the real estate sector on pluvial flooding in London, Ontario. Practical recommendations will be provided to address any deficiencies or issues raised in the research. The limitations of the study will be discussed along with suggestions for areas of further study.

5.1 Strengths and Limitations of the Research

This research had several areas of strength that contributed to the findings. One strength included that this study used a mixed methods approach by gathering qualitative and quantitative data. The surveys identified the important bones and the interviews put some meat around it. In other words, the interview data provides the human behaviour and reasoning behind the responses from the survey. For instance, in the survey an appraiser indicated that they do not disclose pluvial flood risk information to homebuyers during the home purchasing process. During an interview with the same appraiser, it was discovered that they do not disclose this information because they believe it is not their responsibility and they do not want to overstep their role within the home purchasing process.

Another strength is that those who agreed to participate in this study were most likely those who were interested in the issue thus their responses are likely to be more meaningful. While this is also a respondent bias and precludes generalizations to be made, their responses are from people who are likely sympathetic to the need for

improvements in the provision of information during the home purchasing process. Those who did respond to the survey and interviews had a general idea on what pluvial flooding is and its risks and mitigations measures. Several interview respondents were very interested in pluvial flooding and were aware of the events that had occurred in London and around Ontario.

The primary limitation of this study was the low response rate from the participants. 209 real estate professionals in London were initially contacted to participate in this study. 12.4% or 26 participated in the online survey and of those 26, 12 participated in the interviews. Bank loan officers in London were initially contacted along with the real estate agents, appraisers, and home inspectors, however, there was only one bank loan officer who participated in a survey and therefore it was decided to remove this group from the study. Multiple rounds of recruitment emails were sent out to the real estate professionals in London and the responses rate remained low. This may have been due to lack of interest in participating, or the individuals were too busy to participate. The housing market in January was very active due to the high demand for homes and the low inventory, thus resulting in real estate professionals having less time to participate (*Home Prices Jump in January*, n.d.). Although there was a low number of participants compared to the amount of professionals initially emailed for this study, due to timing, a decision was made to stop gathering research, resulting in data saturation not being achieved for the realtors and appraisers. This means that the conclusions about those two groups made in this study cannot make generalizations about the chosen population to study. Overall, these strengths and limitations should be taken into consideration when

determining the advisability, feasibility and the appropriateness of the academic and practical findings and implications from the research.

5.2 Summary of Findings

This has been an exploratory study to the responses of real estate agents, appraisers, and home inspectors in London, to pluvial flood risk and the provision of information about risk and mitigative measures. Manuscript 1 examined the perceptions of pluvial flooding by real estate agents, appraisers and home inspectors who participated in the study and how they believe homebuyers view pluvial flood risk. Manuscript 2 examined the same participants focussing on their knowledge and awareness of mitigation measures, pluvial flood risk information sources, and their view of the disclosure of pluvial flood risk information as well as mitigative measures.

5.3 Manuscript 1 Findings and Recommendations

The first significant finding from Manuscript 1 concluded that the respondents believed pluvial flooding is a risk to homeowners in London and can impact them significantly. Due to pluvial flooding being a serious risk to homeowners, it is prudent to ensure homeowners are made aware of the risk as well as measures to reduce the risk. Creating a greater awareness can be achieved by producing easy to understand and current pluvial flood risk maps that are accessible to real estate professionals and the general population. According to Handmer (1980), flood maps can be beneficial to communicate flood risk to individuals and can increase overall flood awareness. In terms of mitigating the risk, information about mitigative measures must be shared by real estate professionals and the insurance industry during the home purchasing discussions.

The second finding from the first manuscript concluded that the more experience one has with pluvial flooding, the more likely they are to have implemented mitigation measures. Those who have not had any experience are most likely unaware of the and would not implement mitigation measures. Accordingly, increased awareness of pluvial flood risk and mitigation measures as noted above could be achieved through the creation of pluvial flood risk maps that map out areas that may suffer from a pluvial flood. Mapping can be a useful tool to insurance companies and the real estate sector to share with homeowners to inform them about the risks of pluvial flooding and mitigative measures. Along with flood risk maps, all homeowners in London who have experienced a basement flood in their home should report the occurrence on the City of London website. Although it is not possible to mandate this reporting, London should consider providing incentives to homeowners to report an event such as increasing the grant amount for the mitigative measures they could receive from the Grant Program. As well, municipalities such as the City of Toronto specifically advise homeowners to report events. This website states that if homeowners do not report a flood event, it may impact their ability to have a claim processed successfully (City of Toronto, 2022). Local governments and authorities should be working together and with the community to mitigate all possible risks to the public.

The final significant finding from the first manuscript concluded that the real estate sector has an overall good awareness of pluvial flooding risk and its mitigative measures. Given their role in guiding homeowners through the home buying process, they are in an ideal position to inform their clients about the risk that they may encounter and ways to protect their property from water damage. Increasing overall awareness and

knowledge on a hazard can decrease damages and help create more resilient communities.

5.4 Manuscript 2 Findings and Recommendations

The first significant finding from the second manuscript concluded that the respondents are aware of many resources such as the City of London and the UTRCA that discuss pluvial flooding, however the respondents were not utilizing a number of more potentially beneficial resources. Not-for-profit organizations such as Unflood Ontario and the Institute for Catastrophic Loss Reduction (ICLR) and insurance companies such as Co-operators, provide comprehensive information about pluvial flooding, basement flooding, and mitigation measures to the general public. The information includes easy to use interactive tools which are designed to assess the risk of pluvial flooding at specific municipal addresses. It would be helpful for the City of London and the UTRCA websites to include links to those more beneficial sources for homeowners to explore if they are interested. Given new homeowners' reliance on real estate professionals, realtor and other real estate professional websites could also have links to these sites for homeowners. As well, it would be beneficial for the not-for-profit organizations and the City to connect and collaborate with the real estate sector to increase education and help spread information about pluvial flooding more effectively.

The final finding from the second manuscript discovered that there was no single real estate professional who is responsible for the disclosure of pluvial flood risk information to homebuyers. A past pluvial flood event resulting in a basement flood is considered a latent defect as the damages may not be visible and there is a strong likelihood that there would be resistance on the part of homeowners to disclose past

events. There is clearly a lack of structure in the law of disclosing hazards to potential buyers and there needs to be a consistent way to provide pluvial flood risk information to buyers. The MLS is a good tool that could be used to inform other realtors about defects in a property. The realtor remarks section on the MLS of a property could be enhanced to include information regarding flood risk information and any mitigative measures the home has installed such as a backwater valve. The presence of standard wording such as; "Has the basement flooded in the past: YES or NO" and "Describe any installed basement flooding mitigation measures" (e.g. backwater valves and sump pumps).

Along with including flood risk information and mitigative measures on the MLS, this information should also be provided on the Seller Property Information Statement (SPIS). If the SPIS form is filled out, a past flood event must be disclosed on the form by the seller, and if requested, given to the buyer. Although the SPIS is not mandatory in Ontario, the buyers' real estate agent should advise the buyer to request the form to ensure they have all known information about the home before purchase. It should also be made mandatory to include any flood mitigation measures installed in a home, such as the presence of a backwater valve or a sump pump/pit, on the SPIS.

The MLS and the SPIS are documents that are familiar to the real estate community. The inclusion of standardized wording in the MLS and in the SPIS will bring pluvial flood issues to the forefront of the discussions between homebuyers and the real estate professionals and will increase the overall awareness of pluvial flooding into the community.

5.5 Policy Recommendations

The first recommendation based on the findings of the research is to encourage discussions about pluvial flooding risk and mitigation measures during the home purchasing process. Specifically, it is recommended that the SPIS be used in all transitions by sellers who would provide to all potential buyers. Currently one tool used to communicate information about a home's history and potential defects is through the SPIS. This tool is however voluntary in Ontario. It is noted that the Thunder Bay Real Estate Board has made the SPIS mandatory for all residential transactions, such that if it is not submitted to the board within 48 hours of listing a home, the board will remove the listing from the MLS. The London St. Thomas Association of Realtors (LSTAR) could follow this practice for sellers to fill out and supply all potential homebuyers. Making the form mandatory ensures that potential buyers receive all known information about a home, its potential defects, and mitigation measures installed. The real estate agent if also obligated to discuss risks and mitigative measures identified in the SPIS with their clients. Similarly, it is recommended that the MLS also includes mitigative measures installed in a home. The MLS is a system used by realtors that contains information about a property. This system can be updated to include an option to input mitigation measures installed in a home such as a backwater valve and sump pump. Including this information will inform the realtors who will then communicate this information with their clients. Disclosing mitigation measures to potential buyers can potentially increase the value of a property as it will reduce the risk of a flood event.

The second policy recommendation is to make it mandatory for new homes to install backwater valves and sump pumps (especially if the home is below the water table) during construction. The City of Ottawa updated their Sewer Design Guidelines to

make the installation of a backwater valve mandatory for all new home construction (Schepers, 2010). Similarly, the City of Toronto council made a decision in 2007 to require backwater valves in new homes (Toronto Plumbers, 2019). It is recommended that the City of London follow the example of these cities by updating the building codes to include that during the construction of new residential dwelling, a backwater valve (and sump pump) must be installed. This would ensure new homes are prepared before an event occurs and may decrease the cost of retrofitting these systems in a home later on. While the grant program can protect older homes, this new policy will ensure new homes are more resilient against potential flooding.

There are a number of recommendations to promote best practices in the disclosure of pluvial flood risk and mitigation measures during the home purchasing process. Although not a policy recommendation, it is recommended that real estate websites provide checklists for homeowners about pluvial flood risk and mitigation measures, as well as links to beneficial sources. These measures would serve to increase homeowner knowledge about hazard risks and mitigative measures, as they are initiating the home purchasing process. While homeowners are looking for realtors or other real estate professionals on their websites, it is recommended that there be options to view checklists made for homeowners that outline what new homeowners must know before purchasing a home. It is recommended that the checklist mentions the risks of basement flooding and ways to prevent a flood event in a home.

Finally, it is recommended that mandatory climate change and associated hazard courses be introduced into the real estate professional education. For example, the realtor program run through Humber College can include climate change courses in their

curriculum. These courses will discuss the impacts of climate change and their mitigation measures that homeowners can install to reduce their risk. Creating these courses will increase the real estate sector knowledge and encourage then to initiate more of these discussions. The professionals can use this information to inform their clients about their risk, potential risk, and mitigative measures.

5.6 Implications of the Research

The general findings from this study indicate that the participants have a good general knowledge about pluvial flooding as well as its risks and mitigation measures. The study also demonstrated that the current practice of informing buyers about pluvial flooding is inconsistent. It is apparent that buyers require additional information and assistance from a variety of sources in order to be able to make the best decisions in respect of the purchase of a home. According to the findings, if concerns of pluvial flooding are not raised, professionals are not proactively providing information about the prospect of pluvial flood risk. Given the reliance that buyers place on the real estate professionals who are representing their interests, the best practice in this professional/client relationship would be to ensure the professionals are sharing their knowledge of the hazard and mitigative measures, whether or not visible water damage or other defects are evident. Sharing knowledge on homeowners flood risk and mitigation measures will aid in creating a culture of preparedness that will encourage homeowners to be prepared for any hazard, even if there is little risk. This culture is important to reduce the impact flooding can have on homeowners and communities across the country.

5.7 Future Research

From the contributions of this research, a number of opportunities for future research were discovered. First, a similar study to this should be conducted with a larger sample of real estate professionals. This sample could include other actors such as loan officers who were excluded from this study, or insurance companies. Insurance companies have knowledge of hazards that can potentially impact homeowners, however, homeowners communicate primarily with insurance brokers rather than insurance representative. Insurance brokers sell insurance to homeowners by finding the best policy and coverage for the clients (*What is an insurance broker?...*, 2022). Future research could examine how insurance brokers communicate pluvial flood risk and mitigation measures with homeowners.

Another study should examine homeowners and their perception of pluvial flooding. The objective of this study was not to examine homeowners knowledge on the subject. However, future studies should examine their awareness of pluvial flooding, and especially in London, and their awareness of the Basement Flooding Grant Program. The Grant program can be very beneficial to homeowners who participate in it and therefore understanding if homeowners in London are aware of the programs is important. In order for the program to be effective at reducing pluvial flood events, many homeowners are required to participate in the program. The more houses disconnecting downspouts from their weeping tiles, the less amount of water entering the City's sewer system, reducing the chances for the system to become overwhelmed and flood from a rainfall event. The City should be made aware, if homeowners are not aware and if they are not, then there needs to be better information provided to the public.

Other municipalities can be examined using the methods used in this study to examine the various ways they are reducing flood risk and damage. Municipalities such as the City of Toronto have basement flood protection programs and have experienced several pluvial flood events recently resulting in severe damages. As well, other cities across the country could also be examined using similar methods such as the City of Edmonton. Edmonton has experienced several pluvial flooding events and as a result, have created basement flood maps of the city. According to the findings from this study, pluvial flood maps can be beneficial to the public to inform them about areas that are likely to experience a pluvial flood. As well, the RE/MAX website in Edmonton that provides links and information about the pluvial flood maps were created to encourage homebuyers to be aware of areas prone to flooding during a heavy rain event. It would be interesting to examine the public's perception of the maps and how it impacts their awareness and level of preparedness of pluvial flood risk.

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Appendix A1: Ethics Approval

Western Research

Date: 22 October 2021

To: Dr. Dan Shrubsole

Project ID: 119674

Study Title: The Perceptions of the Real Estate Sector on Pluvial Flooding in London, Ontario

Short Title: Perceptions of the Real Estate Sector on Flooding in London

Application Type: NMREB Initial Application

Review Type: Delegated

Full Board Reporting Date: 05/Nov/2021

Date Approval Issued: 22/Oct/2021 21:43

REB Approval Expiry Date: 22/Oct/2022

Dear Dr. Dan Shrubsole

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the WREM application form for the above mentioned study, as of the date noted above. NMREB approval for this study remains valid until the expiry date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

This research study is to be conducted by the investigator noted above. **All other required institutional approvals and mandated training must also be obtained prior to the conduct of the study.**

Documents Approved:

Document Name	Document Type	Document Date	Document Version
Appraiser_Survey_Questionnaire	Online Survey		
BankLoanOfficer_Survey_Questionnaire	Online Survey		
End of Study Letter	End of Study Letter	30/Jul/2021	1
Inspector_Survey_Questionnaire_clean	Online Survey	12/Oct/2021	CLEAN
Realtor_Survey_Questionnaire_clean	Online Survey	12/Oct/2021	CLEAN
Appraiser_Interview_Questionnaire_clean	Interview Guide	12/Oct/2021	CLEAN
BankLoanOfficer_Interview_Questionnaire	Interview Guide	12/Oct/2021	CLEAN
Inspector_Interview_Questionnaire_clean	Interview Guide	12/Oct/2021	CLEAN
Realtor_Interview_Questionnaire_clean	Interview Guide	12/Oct/2021	CLEAN
Study_Phone_Contact_Clean	Recruitment Materials	20/Oct/2021	CLEAN
Interview Email Contact_clean	Recruitment Materials	20/Oct/2021	CLEAN
Study_Email_Contact_Clean	Recruitment Materials	20/Oct/2021	CLEAN
Letter of Information and Consent_Interview_clean(2)	Verbal Consent/Assent	20/Oct/2021	CLEAN
Letter of Information and Consent_Survey_clean(2)	Implied Consent/Assent	20/Oct/2021	CLEAN

Documents Acknowledged:

Document Name	Document Type	Document Date	Document Version
TRAC Response Template - Qualtrics - 2021 renewal	Technology Review document		

No deviations from, or changes to the protocol should be initiated without prior written approval from the NMREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

Appendix A2: Survey Recruitment Email

Email Script for Recruitment

Invitation to participate in a research study on the perceptions of real estate sector in London to pluvial flooding

Hello,

We have received your email address from the RECO/Appraisers Institute of Ontario Database/Google search. You are being invited to participate in a study that is being conducted by Emilia Cameron and Dan Shrubsole at Western University, because of your role as a professional in the real estate sector (either a real estate agent, appraiser, bank loan officer, or a home inspector). Briefly, the study focusses on the perceptions of the real estate sector on pluvial flooding (flooding from a heavy rain event) in London, ON. Given your professional understanding and experience, it will be very helpful for me to understand your role and perceptions of flooding, including the disclosure of flooding information. I hope you are able to take 10 minutes to fill out a survey about your experience and perceptions of pluvial flooding in London. At the end of the survey there will be an invitation to participate in a 30 minute interview with myself to discuss your answers further. If you wish to participate in an interview, you be entered in a draw to win a $50 Starbucks gift card.

Attached is a document with more information about the project and your role.

Please use this code to enter at the beginning of the survey: (individual code)

If you would like to participate in this survey please click on the link below to access the survey link.

Thank you,

Emilia Cameron
Graduate Candidate
Western University

Appendix A3: Survey Letter of Information

Letter of information for a research study on the perceptions of real estate sector on Pluvial Flooding in London, Ontario.
Principal Investigator: Dan Shrubsole

My name is Emilia Cameron and I am a Master's student at the Western University. I am conducting a research thesis on the current practice of informing potential homebuyers about pluvial flood risk and mitigation measures in London, ON, and if and how it might be improved. You are being invited to participate in this research study because of your employment in the real estate sector in London.

Pluvial flooding is a long-standing issue in Canada. The flooding of basements due to storm and/or waste sewer overflow is an emerging issue associated with pluvial flooding. The occurrence of basement flooding is expected to increase due to climate change. Since London has experienced serious basement flooding for many years, more recently in August 2020. During this event over a dozen basements in the neighbourhood of Westminster were flooded following a heavy rain event of 3 days with 81 mm of rain in total. For this reason, London has been selected as a case study. Maps of flood plains adjacent to major water courses have been published and regulations to control development within these areas have been established by the Toronto Conservation Authority. However, these maps are solely based on proximity to bodies of water, not heavy rain events.

The purpose of this study is to investigate the perception of residential real estate sector (real estate agents, appraisers, bank loan officers, and home inspectors) about their knowledge of pluvial flooding, how important these considerations are in home owner's decision to purchase a home in London, how they inform potential buyers about the flood hazard a home may be exposed to, and how flood-related information provided to potential homeowners might be improved. Basement flooding has become a more recent problem and is significantly contributing to flood damages. In the City of Edmonton Alberta, basement flood areas have been mapped. I would like to explore the perspective of residential real estate sector in London about the desirability and feasibility of, need for and alternatives to this approach to inform potential homeowners of the basement flood risk and the current practice of disclosing pluvial flood hazards to potential home purchasers. I hope to identify ways in which the communication of flood hazards to potential homeowners, particularly the emerging basement flood hazard, can be improved. This study is being funded by The Western University to help offset the costs of conducting this research.

There are no known or anticipated risks or discomforts associated with participating in this study. As well, you may not directly benefit from this study, but the information gathered can benefit society as a whole, as it can better prepare homeowners about pluvial flooding during the home purchasing process. If you decide to participate in the study, you will be asked to fill out a 10 minute online survey with a series of questions about your experience, the nature and significant of pluvial flooding, where you gain your information, your level of awareness of mitigation measures, and disclosure. Qualtrics will be used to collect the survey results which will be in Ireland. Qualtrics will keep the data safe, however nothing over the internet is ever 100% safe. Click **here** for the link to the privacy policy. To begin the survey you will need to enter the 4 digit individual code given to you in this email. There will also be an implied consent question, which will go over what your information will be used for and your privacy. Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate in

the survey, you have the right not to answer individual questions or to withdraw from the study at any time. If you choose not to answer a question, there will be a "prefer not to respond" option, and you may withdraw at any point during the survey without any consequences. You may also withdraw from the survey at any point by exiting out of the survey link and your data will be destroyed. There will only be a few people who have access to your data including the master list where your contact information will be stored, this includes myself, the PI, and representatives of The Western University Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research. The master list is a document that contain your name, email, company name, job title, phone number, and personal ID code. These identifiers will be used to track participation, linking survey and interview data, as well as, allowing the researcher to contact those who wish to participate in a phone interview. Your data collected will solely be used for this research project and will be kept on a password protected computer for 7 years and then it will be destroyed.

You may be entered into a draw to win a $50 Starbucks gift card if you participate in a phone interview. At the end of the survey, there will be an invitation to participate in a follow-up interview. If you participate in an interview, you will be put into a draw and with winner will be randomly selected to win a gift card. The interviews will take about 20-30 minute and will be conducted over the phone. You are under no obligation to respond to me. By consenting to participate in this study, you are agreeing that your data can be used beyond the purposes of the present study be either the current researchers. You will not be identified on the pdf or in the thesis, and all statements that you make will be anonymized.

If you wish to receive a copy of the final thesis, please send myself an email.

You do not waive any legal rights by consenting to this study.

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics (519) 661-3036, 1-844- 720-9816, email: ethics@uwo.ca. This office oversees the ethical conduct of research studies and is not part of the study team. Everything that you discuss will be kept confidential.

If you have any questions about the project, please feel free to contact myself or my thesis supervisor, Professor Dan Shrubsole. Thank you for your time and consideration of this invitation.

Choosing "I agree" at the beginning of the online survey is an indication of your consent to participate.

This letter is yours to keep for future reference

Emilia Cameron
Graduate Student
Department of Geography and Environment
Western University

Appendix A4: Interview Recruitment Email

Email Script for Interview

Subject Line: Invitation to participate in an interview on the perceptions of real estate sector in London to pluvial flooding

Hello (participants name),

Thank you for completing the online survey on the perceptions of the real estate sector on pluvial flooding in London, ON. As well as selecting 'Yes' at the end of the online survey, indicating that you are willing to participate in an interview. This email is regarding setting up a mutually convenient time to conduct an interview. The interview process will take around 20-30 minutes and will be conducted over the telephone. The phone call will occur in a private location and I will be the only one conducting it. You may skip any questions asked and you may also withdraw from the interview at any point without consequences.

Please let me know which day and time works best for your schedule.

Attached is a document with more information about your role during the interview. Please read it over it before the interview.

Thank you,

Emilia Cameron
Graduate Candidate
Western University

Appendix A5: Interview Letter of Information & Verbal Consent

Letter of information for a research study on the perceptions of real estate sector on Pluvial Flooding in London, Ontario.
Principal Investigator: Dan Shrubsole

My name is Emilia Cameron and I am a Master's student at the Western University. I am conducting a research thesis on the current practice of informing potential homebuyers about pluvial flood risk and mitigation measures in London, ON, and if and how it might be improved. You are being invited to participate in this research study because of your employment in the real estate sector in London.

As stated in the Letter of Information for the online survey, the purpose of this study is to investigate the perception of residential real estate sector (real estate agents, appraisers, bank loan officers, and home inspectors) about their knowledge of pluvial flooding, how important these considerations are in home owner's decision to purchase a home in London, how they inform potential buyers about the flood hazard a home may be exposed to, and how flood-related information provided to potential homeowners might be improved. Basement flooding has become a more recent problem and is significantly contributing to flood damages. In the City of Edmonton Alberta, basement flood areas have been mapped. I would like to explore the perspective of residential real estate sector in London about the desirability and feasibility of, need for and alternatives to this approach to inform potential homeowners of the basement flood risk and the current practice of disclosing pluvial flood hazards to potential home purchasers. I hope to identify ways in which the communication of flood hazards to potential homeowners, particularly the emerging basement flood hazard, can be improved. This study is being funded by The University of Western Ontario to help offset the costs of conducting this research.

If you decide to participate, this phone interview will be 20-30 minutes long and will contain questions similar to the online survey, however they will be more in depth. You can decline to answer any question. There will be no consequences for withdrawing at any point in the interview and the notes made during the interview will be destroyed. If you participate in an interview, you will be put in a draw for a chance to win a $50 Starbucks gift card. The winner will be randomly selected and I will send out an email updating the winner. The winner will then receive the gift card by mail. However, selecting 'Yes' to participate in an interview at the end of the online survey does not obligate you to participate in an interview. You are under no obligation to respond to me. Notes from the interview will be scanned into a pdf document and stored on a secure sever at Western for 7 years. By consenting to participate in this study, you are agreeing that your data can be used beyond the purposes of the present study be either the current researchers. You will not be identified on the pdf or in the thesis, and all statements that you make will be anonymized.

There will only be a few people who have access to your data including the master list where your contact information will be stored, this includes myself, the PI, and representatives of The Western University Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research. The master list is a document that contain your name, email, company name, job title, phone number, and personal ID code. These identifiers will be used to track participation, linking survey and interview data, as well as, allowing the researcher to contact those who wish to participate in a phone interview. Your data and contact

information collected will be used for this research project and will be kept on a password protected computer for 7 years and then it will be destroyed.

If you wish to receive a copy of the final thesis, please send myself and email.

You do not waive any legal rights by consenting to this study.

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics (519) 661-3036, 1-844- 720-9816, email: ethics@uwo.ca. This office oversees the ethical conduct of research studies and is not part of the study team. Everything that you discuss will be kept confidential.

If you have any questions about the project, please feel free to contact myself or my thesis supervisor, Professor Dan Shrubsole. Thank you for your time and consideration of this invitation.

This letter is yours to keep for future reference

Emilia Cameron
Graduate Student
Department of Geography and Environment
Western University

Verbal Consent Script
(for interview)

Consenting to participate in an interview means that your responses will be used for the thesis. All data gathered will be completely anonymous. Your participation in this study is voluntary, You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time there will be no consequences. The data collected will be kept on file for the next 7 years and will then be destroyed after the 7 years. There will only be a few people who have access to your data, this includes myself, the PI, and representatives of The Western University Non-Medical Research. You are allowed to skip any question. Participating in this interview also makes you eligible to win a $50 Starbucks gift card. It is expected that there will be 5-10 participants. If you win the draw, you will be notified by an email and will be given your prize by mail.

Do you agree to unidentifiable quotes shared in the dissemination of the results?

Have you received all of the LOI information?

Have all your questions and concerns been answered?

Do you agree to participate in the interview?

Appendix B1: Real Estate Agents Survey Questionnaire

Background/Experience: Respondent #

1. How many years have you been a real estate agent?

   _____ years

2. How many years have you been working as a real estate agent in London?

   _____ years

3. Over the past 12 months, have you been employed as a Full-time or Part-time basis as a realtor? (please check your response)

   - o Full-time
   - o Part-time

4. About how many homes have you sold in the past 12 months? (please circle your response)

   1-9 10-19 20-29 30-39 >40

5. What percentage of purchasers placed unconditional offers on the homes you have sold in the past 12 months?

   - o >24%
   - o 25%-49%
   - o 50%-74%
   - o <75%

6. In your experiences what features do you believe attract people when purchasing homes in London? (please specify attraction)

   a. Locational factors: _____
   b. Lot factors: _____
   c. Physical house factors: _____
   d. Pricing factors:_____
   e. Other (please specify):_____

7. In your experiences what features do you believe detract people when purchasing homes in London? (please specify detraction)

   a. Locational factors: _____
   b. Lot factors: _____
   c. Physical house factors: _____

d. Pricing factors:_____
e. Other (please specify):_____

8. Have you ever owned/rented a home that has experience a flood from a rain event?

   Yes/No

   a. If yes, what types of damages did you suffer? (please check all that apply)
      - damaged flooring/carpet
      - damaged personal belongings (entertainment system, furniture, etc.)
      - home/structural damages (e.g. damaged walls, windows, foundation)
      - financial (e.g. had to pay significant deductible or no insurance coverage)
      - health (e.g. mold in basement, mental health, impacts from contaminated water, personal injury)
      - if house owned and you sold a home was the resale price was lower than expected
      - other:_____

9. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

   Yes/No

   a. if yes, what are the mitigative measures? (please list below)

   b. Did you install any of these?

      Yes/No

Nature and Significance of Pluvial Flooding:

10. In your experience with prospective buyers, what extent of concern have they expressed about pluvial flooding, and the damages associated with it? (please circle your response)

No concern	Minor concern	Neither concerned or
unconcerned	Some concern	Very concerned

11. Do you believe pluvial flooding is a serious risk to homeowners or property in London? (circle your response)

Disagree Somewhat disagree Neither agree nor disagree Somewhat agree Agree

12. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house (please circle your response)

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

a. Are you able to refine the significance of different types of Impacts on homeowners in the following:

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

a. Any impacts that were not mentioned above please list here and indicate the level of concern using the above scale:_____

Where do you obtain information about pluvial flooding:

13. Where did/do you obtain information about pluvial flooding? (please check all that apply)
    - o during certification
    - o during ongoing required professional development by the MLS
    - o conservation authority's website
    - o Local government websites
    - o Institute for Catastrophic Loss Reduction (ICLR)/Insurance Bureau of Canada (IBC)
    - o other sources (please specify source of information): _____

14. Do you believe there is a need to provide better information to real estate agents about pluvial flooding?

    Yes/No

    a. if yes, how might this be achieved? (please check all that apply)
        - o maps of pluvial flood risk zones that are available on the web

- flyers sent to homeowners in pluvial flood risk areas by the city
- better information on government/authority websites
- in the agreement of purchase and sale
- other sources/types of information (please specify):_____

Awareness of Mitigation Measures and Effectiveness:

15. In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?
    - was no longer interested in the property **Y/N**
    - offered a low price relative to asking price **Y/N**
        - if yes, how low relative to asking (%):_____
    - no significant impact on prospective homebuyer's interest in the home **Y/N**
    - Other (please specify):_____

16. Have you suggested any of the following pluvial flood mitigation measures to prospective homebuyers?
    - back water valves **Y/N**
    - back up sump pump **Y/N**
    - seal cracks in floor and walls **Y/N**
    - disconnect downspouts from weeping tiles **Y/N**
    - lot grading **Y/N**
    - others (please specify):_____

Disclosure:

17. In your experience when do homeowners become aware of flood risks of a home? (please check one)
    - before purchase
    - during purchase
    - after purchase
    - after a flood event
    - never

18. Who usually provides this information to the potential homeowner? (please check all that apply)
    - real estate agent
    - home inspector
    - bank loan officers
    - appraiser
    - buyer's lawyer
    - insurance companies
    - municipal government
    - conservation authority
    - other (please specify):_____

19. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    Yes/No

    a. If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? (please check one)

- o real estate agent
- o home inspector
- o bank loan officers
- o appraiser
- o buyer's lawyer
- o insurance companies
- o municipal government
- o conservation authority
- o other (please specify):_____

I hope to supplement this survey with an in depth interview based on the questions in this survey. If you would like to participate in a 30-minute interview and a chance to win a $50 Starbucks gift card, then please leave your name and email below. I will email you to arrange a mutually convenient time and to discuss further details.

Name:_____

Realty Agency Name:_____

Email:_____

Appendix B2: Appraiser Survey Questionnaire

Background/Experience: Respondent #

1. How many years have you been an appraiser?

_____ years

2. How many years have you been working in London?

_____ years

3. What is your appraisal designation?

_____

4. Have you ever owned/rented a home that has experience a flood from a rain event?

   Yes/No

   - If yes, what types of damages did you suffer? (please check all that apply)
     - damaged flooring/carpet
     - damaged personal belongings (entertainment system, furniture, etc.)
     - home/structural damages (e.g. damaged walls, windows, foundation)
     - financial (e.g. had to pay significant deductible or no insurance coverage)
     - health (e.g. mold in basement, mental health, impacts from contaminated water, personal injury)
     - if house owned and you sold a home was the resale price was lower than expected
     - other:_____

5. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

   Yes/No

   - if yes, what are the mitigative measures? (please list below)

   - Did you install any of these?

     Yes/No

Recent Home Inspection Activity and Responses to Pluvial Flooding:

6. Approximately how many home inspections have you done over the past year?

Number_____

- How many/what percentage of these appraisals were for single family residences?

Number_____ or _____%

7. When making a single family residence appraisal, what site characteristics do you consider as very influential on value? Please list the five most important characteristics.
    1.
    2.
    3.
    4.
    5.

8. Please circle a number on the scale provided to show how often you do each of the items below. 1=Always, 2=Often, 3=Sometimes, 4=Seldom, 5=Never

If a single family residence has suffered water damage in the basement, attempt to determine specific details of the flooding.
1 2 3 4 5

If a single family residence has water damage in the basement in the past, note this fact in the appraisal report.
1 2 3 4 5

If a single family residence has suffered water damage in the basement, identify whether each of the comparable sales has also been subject to pluvial flooding.
1 2 3 4 5

If a single family residence has suffered pluvial flooding in the past, determine the effect of the possibility of this on the value of residence.
1 2 3 4 5

If a single family residence is located in an area in London, that has experienced flooding from a rain event, note this fact in the appraisal report.
1 2 3 4 5

Nature and Significance of Pluvial Flooding:

9. In your experience with prospective buyers, what extent of concern have they expressed about pluvial flooding, and the damages associated with it? (please circle your response)

   No concern Minor concern Neither concerned or unconcerned Some concern Very concerned

10. Do you believe pluvial flooding is a serious risk to homeowners or property in London? (circle your response)

Disagree Somewhat disagree Neither agree nor disagree Somewhat agree Agree

11. Do you think that homeowners and properties experience significant negative impacts from pluvial flooding?

    Yes/No

12. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house (please circle your response)

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

- Are you able to refine the significance of different types of Impacts on homeowners in the following:

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

- Any impacts that were not mentioned above please list here and indicate the level of concern using the above scale:_____

Where do you obtain information about pluvial flooding:

13. Where did/do you obtain information about pluvial flooding? (please check all that apply)
    - during certification
    - during ongoing required professional development
    - conservation authority's website
    - Local government websites
    - Institute for Catastrophic Loss Reduction (ICLR)/Insurance Bureau of Canada (IBC)
    - other sources (please specify source of information): _____

14. Have you received any training on how to incorporate pluvial flooding into an appraisal report?

    YES/NO

15. Do you believe there is a need to provide better information to appraisers about pluvial flooding?

    Yes/No

    - if yes, how might this be achieved? (please check all that apply)
        - maps of pluvial flood risk zones that are available on the web
        - flyers sent to homeowners in pluvial flood risk areas by the city
        - better information on government/authority websites
        - in the agreement of purchase and sale
        - other sources/types of information (please specify):_____

Awareness of Mitigation Measures and Effectiveness:

16. In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?
    - was no longer interested in the property **Y/N**
    - offered a low price relative to asking price **Y/N**
        - if yes, how low relative to asking (%):_____
    - no significant impact on prospective homebuyer's interest in the home **Y/N**
    - Other (please specify):_____

17. Have you suggested any of the following pluvial flood mitigation measures to prospective homebuyers?
    - back water valves **Y/N**
    - back up sump pump **Y/N**
    - seal cracks in floor and walls **Y/N**
    - extend downspouts **Y/N**
    - lot grading **Y/N**

- others (please specify):_____

Disclosure:

18. In your experience when are homeowners made aware of flood risks of a home?
    - before purchase
    - during purchase
    - after purchase
    - after a flood event
    - never

19. Who usually provides this information to the potential homeowner? (please check all that apply)
    - real estate agent
    - home inspector
    - bank loan officers
    - appraiser
    - buyer's lawyer
    - insurance companies
    - municipal government
    - conservation authority
    - other (please specify):_____

20. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    Yes/No

    - If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? (please check one)
        - real estate agent
        - home inspector
        - bank loan officers
        - appraiser
        - buyer's lawyer
        - insurance companies
        - municipal government
        - conservation authority
        - other (please specify):_____

I hope to supplement this survey with an in depth interview based on the questions in this survey. If you would like to participate in a 30-minute interview and a chance to win a $50 Starbucks gift card, then please leave your name and email below. I will email you to arrange a mutually convenient time and to discuss further details.

Name:_____

Company Name:_____

Email:_____

Appendix B3: Home Inspector Survey Questionnaire

Background/Experience: Respondent #

1. How many years have you been a home inspector?

   _____ years

2. How many years have you been working as a home inspector in London?

   _____ years

3. What percentage of inspections have you done in the past 12 months that have been part of a conditional offer?

   - >24%
   - 25%-49%
   - 50%-74%
   - <75%

4. What percentage of homes have inspected over the past 12 months, had pluvial flood damages?

   - >24%
   - 25%-49%
   - 50%-74%
   - <75%

5. Have you ever owned/rented a home that has experience a flood from a rain event?

   Yes/No

   a. If yes, what types of damages did you suffer? (please check all that apply)
      - damaged flooring/carpet
      - damaged personal belongings (entertainment system, furniture, etc.)
      - home/structural damages (e.g. damaged walls, windows, foundation)
      - financial (e.g. had to pay significant deductible or no insurance coverage)
      - health (e.g. mold in basement, mental health, impacts from contaminated water, personal injury)
      - if house owned and you sold a home was the resale price was lower than expected
      - other:_____

6. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

   Yes/No

   a. if yes, what are the mitigative measures? (please list below)

   b. Did you install any of these?

      Yes/No

7. Do you specifically look for damages caused by flooding during your inspection?

   Yes/No

   a. if yes, what damages do you look for?

Nature and Significance of Pluvial Flooding:

8. In your experience with clients who are looking to purchase a home, what extent of concern have they expressed about pluvial flooding, and the damages associated with it? (please circle your response)

No concern	Minor concern	Neither concerned or unconcerned
Some concern	Very concerned	

9. Do you believe pluvial flooding is a serious risk to homeowners or property in London? (circle your response)

Disagree Somewhat disagree Neither agree nor disagree Somewhat agree Agree

10. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house (please circle your response)

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

   a. Are you able to refine the significance of different types of Impacts on homeowners in the following:

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

b. Any impacts that were not mentioned above please list here and indicate the level of concern using the above scale:_____

Where do you obtain information about pluvial flooding:

11. Where did/do you obtain information about pluvial flooding? (please check all that apply)
    - during certification
    - during ongoing required professional development
    - conservation authority's website
    - Local government websites
    - Institute for Catastrophic Loss Reduction (ICLR)/Insurance Bureau of Canada (IBC)
    - other sources (please specify source of information): _____

12. Do you believe there is a need to provide better information to home inspectors about pluvial flooding?

Yes/No

a. if yes, how might this be achieved? (please check all that apply)
    - maps of pluvial flood risk zones that are available on the web
    - flyers sent to homeowners in pluvial flood risk areas by the city
    - better information on government/authority websites
    - in the agreement of purchase and sale
    - other sources/types of information (please specify):_____

Awareness of Mitigation Measures and Effectiveness:

13. In your experience, if a potential homebuyer became aware that the home had experienced pluvial flooding previously, how did they respond?
    - was no longer interested in the property **Y/N**
    - offered a low price relative to asking price **Y/N**
        - if yes, how low relative to asking (%):_____

- no significant impact on prospective homebuyer's interest in the home **Y/N**
- Other (please specify):_____

14. Have you suggested any of the following pluvial flood mitigation measures to prospective homebuyers?
    - back water valves **Y/N**
    - back up sump pump **Y/N**
    - seal cracks in floor and walls **Y/N**
    - disconnect downspouts from weeping tiles **Y/N**
    - lot grading **Y/N**
    - others (please specify):_____

Disclosure:

15. In your experience when do homeowners become aware of flood risks of a home? (please check one)
    - before purchase
    - during purchase
    - after purchase
    - after a flood event
    - never

16. Who usually provides this information to the potential homeowner? (please check all that apply)
    - real estate agent
    - home inspector
    - bank loan officers
    - appraiser
    - buyer's lawyer
    - insurance companies
    - municipal government
    - conservation authority
    - other (please specify):_____

17. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    Yes/No

    a. If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? (please check one)
        - real estate agent
        - home inspector
        - bank loan officers
        - appraiser
        - buyer's lawyer
        - insurance companies

- municipal government
- conservation authority
- other (please specify):_____

I hope to supplement this survey with an in depth interview based on the questions in this survey. If you would like to participate in a 30-minute interview and a chance to win a $50 Starbucks gift card, then please leave your name, company name, and email below. I will email you to arrange a mutually convenient time and to discuss further details.

Name:_____

Company Name:_____

Email:_____

Appendix C1: Real Estate Agent Interview Questionnaire

Verbal consent has been acquired
YES NO

Background/Experience: Respondent #

1. How many years have you been a real estate agent?

   _____ years

2. How many years have you been working as a real estate agent in London?

   _____ years

3. Over the past 12 months, have you been employed as a Full-time or Part-time basis as a realtor?

   - Full-time
   - Part-time

4. About how many homes have you sold in the past 12 months?

   1-9 10-19 20-29 30-39 >40

5. What percentage of purchasers placed unconditional offers on the homes you have sold in the past 12 months?

   - >24%
   - 25%-49%
   - 50%-74%
   - <75%

6. In your experiences what features do you believe attract people when purchasing homes in London?

   - Locational factors: _____
   - Lot factors: _____
   - Physical house factors: _____
   - Pricing factors:_____
   - Other:_____

7. In your experiences what features do you believe detract people when purchasing homes in London?

    f. Locational factors: _____
    g. Lot factors: _____
    h. Physical house factors: _____
    i. Pricing factors:_____
    j. Other:_____

8. Have you ever owned/rented a home that has experience a flood from a rain event?

    - If yes, what types of damages did you suffer?

9. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

    - if yes, what are the mitigative measures?

    - Did you install any of these?

Nature and Significance of Pluvial Flooding:

10. In your experience with prospective buyers, what extent of concern have they expressed about pluvial flooding, and the damages associated with it?

    - Explanation rationale: Why are they concerned or not concerned?

11. Do you believe pluvial flooding is a serious risk to homeowners or property in London? And why?

12. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house.

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?:

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

a. Are there any other impacts that were not mentioned above, but may affect homeowners and can you rate their level of concern and why?

Where do you obtain information about pluvial flooding:

13. Where did/do you obtain information about pluvial flooding?

14. Do you believe there is a need to provide better information to real estate agents about pluvial flooding?

    - if yes, how might this be achieved?

15. Do you think there should be courses for real estate agents that discuss flooding and other implications of climate change?

Awareness of Mitigation Measures and Effectiveness:

16. In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?

17. Have you suggested any pluvial flood mitigation measures to prospective homebuyers? If so, why did you suggest them and what did you suggest?

Disclosure:

18. In your experience when do homeowners become aware of flood risks of a home?
    - before purchase
    - during purchase
    - after purchase
    - after a flood event
    - never

19. Who usually provides flood risk information to the potential homeowner?

20. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    - If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? And why do you believe they are the best option?

21. What do you believe are the motivating factor/s in ones' decision to disclose pluvial flooding information to homebuyers?

Other Comments:

Appendix C2:Appraiser Interview Questionnaire

Verbal consent has been acquired
YES NO

Background/Experience: Respondent #

1. How many years have you been an appraiser?

_____ years

2. How many years have you been an appraiser working in London?

_____ years

3. What is your appraisal designation?

4. Have you ever owned/rented a home that has experience a flood from a rain event?

- If yes, what types of damages did you suffer?

5. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

- if yes, what are the mitigative measures?
- Did you install any of these?

Recent Home Inspection Activity and Responses to Pluvial Flooding:

6. When making a single family residence appraisal, what site characteristics do you consider as very influential on value? Please list the five most important characteristics.

1.
2.
3.
4.
5.

7. Please indicate how often you do each of the items below

- If a single family residence has suffered flooding in the past, do you attempt to determine specific details of the flooding?

- If a single family residence has suffered flooding in the past, do you note this fact in the appraisal report.

- If a single family residence as suffered flooding, do you identify whether each of the comparable sales has also been subject to flooding.

- If a single family residence has suffered flooding in the past, do you determine the effect of the possibility of flooding on the value of residence.

- If a single family residence is located in an area that has experienced flooding from a rain event, do you note this fact in the appraisal report.

Nature and Significance of Pluvial Flooding:

8. In your experience with prospective buyers, what extent of concern have they expressed about pluvial flooding, and the damages associated with it?

- Explanation rationale: Why are they concerned or not concerned?

9. Do you believe pluvial flooding is a serious risk to homeowners or property in London? And why?

10. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house (please circle your response)

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?:

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

b. Any impacts that were not mentioned above please list here and indicate the level of concern using the above scale:_____

Where do you obtain information about pluvial flooding:

11. Where did/do you obtain information about pluvial flooding?

12. Have you received any training on how to incorporate basement flooding into an appraisal report?

13. Do you believe there is a need to provide better information to appraisers about pluvial flooding?

a. if yes, how might this be achieved?

Awareness of Mitigation Measures and Effectiveness:

14. In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?

15. Have you suggested any of the following pluvial flood mitigation measures to prospective homebuyers?

Disclosure:

16. In your experience when are homeowners become aware of flood risks of a home?

17. Who usually provides this information to the potential homeowner? (please check all that apply)

18. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    a. If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? And why do you believe they are the best option?

19. What do you believe are the motivating factor/s in ones' decision to disclose pluvial flooding information to homebuyers?

Other Comments:

Appendix C3: Home Inspector Interview Questionnaire

Verbal consent has been acquired
YES NO

Background/Experience: Respondent #

1. How many years have you been a home inspector?

_____ years

2. How many years have you been working as a home inspector in London?

_____ years

3. What percentage of inspections have you done in the past 12 months that have been part of a conditional offer?

- >24%
- 25%-49%
- 50%-74%
- <75%

4. Have you ever owned/rented a home that has experience a flood from a rain event?

a. If yes, what types of damages did you suffer?

5. Regardless of whether you have previous experience with flooding in your home, does your current home have preventative/mitigation measures against future flooding?

a. if yes, what are the mitigative measures?

b. Did you install any of these?

Nature and Significance of Pluvial Flooding:

6. In your experience with prospective buyers, what extent of concern have they expressed about pluvial flooding, and the damages associated with it?

a. Explanation rationale: Why are they concerned or not concerned?

7. Do you believe pluvial flooding is a serious risk to homeowners or property in London? And why?

8. Rate the significance of different types of impacts associated with pluvial flooding and how they might affect an average homeowner/house.

Overall Impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Financial impact: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?:

Health (physical injury & mental health): Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Home damage: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

Purchase/sale of home: Very Insignificant Insignificant Neither significant or insignificant Significant Very Significant

Can you explain the nature of that impact?

a. Are there any other impacts that were not mentioned above, but may affect homeowners and can you rate their level of concern and why?

Where do you obtain information about pluvial flooding:

9. Where did/do you obtain information about pluvial flooding?

10. Do you believe there is a need to provide better information to home inspectors about pluvial flooding?

a. if yes, how might this be achieved?

Awareness of Mitigation Measures and Effectiveness:

11. In your experience, if a potential homebuyer became aware that a home had experienced pluvial flooding previously, how did they respond?

12. Have you suggested any pluvial flood mitigation measures to prospective homebuyers? If so, why did you suggest them and what did you suggest?

Disclosure:

13. In your experience when do homeowners become aware of flood risks of a home?
    - before purchase
    - during purchase
    - after purchase
    - after a flood event
    - never

14. Who usually provides flood risk information to the potential homeowner?

15. Do you see a need to clarify/improve who should inform potential homebuyers of the pluvial flood risk?

    a. If yes, who do you believe should have clear responsibility for informing potential homebuyers of the pluvial flood risk? And why do you believe they are the best option?

16. What do you believe are the motivating factor/s in ones' decision to disclose pluvial flooding information to homebuyers?

Other Comments:

Appendix D: Stakeholder Mitigation Measures Chart

Other Stakeholder Mitigation Measures	
Stakeholder	**Mitigation Measure**
Local/Provincial Government	• provide up to date flood risk maps and property level flood risk information through a free online portal (Moudrak and Felmate, 2020). • adapt recognized best practices for flood resilience in policy and regulations, land use, urban planning and in design requirements for existing and new developments (Moudrak and Felmate, 2020). • distribute home flood protection materials to residents through property tax mailings and online channels to encourage the use of simple actions to reduce the risks of basement flooding (Moudrak and Felmate, 2020). • collaborate with partners such as the Red Cross, who have trained staff and volunteers to promote flood resilience measures with door to door campaigns, events and online learning opportunities (Moudrak and Felmate, 2020). • incorporate flood resilience measures into government asset management plans and long term financial planning, establish funding programs to offset the costs of flood resilience retrofits to homeowners (Moudrak and Felmate, 2020). • ensure that flood forecasting and warning systems are in place and provide sufficient time to deploy flood protection measures in case of flood emergency (Moudrak and Felmate, 2020).
Federal Government	• provide up to date and forward looking flood risk maps and property level flood risk information through free online portals (Moudrak and Felmate, 2020). • co-operate with other jurisdictions to assess natural infrastructure assets at the watershed scale, in relations to the role they play in mitigating flood risk (Moudrak and Felmate, 2020). • requires a climate lens for infrastructure projects (Moudrak and Felmate, 2020). • update national building code of Canada to reflect methods of reducing flood risks that were accepted during the development of national guidelines and standards (Moudrak and Felmate, 2020).
Developers/builders	• use nationally recognized best practices for flood resilience in homes (Moudrak and Felmate, 2020). • when designing new subdivisions, maximize the amount of open natural space that will be permanently protected (Moudrak and Felmate, 2020). • participate in professional training about adapting to climate change and reducing flood risk(Moudrak and Felmate, 2020).
Insurance Brokers	• participate in professional training about flood protection (Moudrak and Felmate, 2020). • when clients are buying or renewing insurance, inform them about practical ways to reduce the risk of basement flooding, as well as about the available flood insurance coverage (Moudrak and Felmate, 2020).
Lenders	• develop incentives to encourage homebuyers and owners to retrofit their homes to be more resilient to flooding (Moudrak and Felmate, 2020).
Brokers	• participate in professional training about home flood protection offered through Mortgage Professionals Canada (Moudrak and Felmate, 2020). • educate clients who are recuring or renewing mortgages about practical ways to mitigate flood risks at home (Moudrak and Felmate, 2020).
Real Estate Agents	• participate in professional training about home flood protection (Moudrak and Felmate, 2020). • give clients information about property flood risks and practical ways to protect their homes (Moudrak and Felmate, 2020).

Other Stakeholder Mitigation Measures	
Stakeholder	**Mitigation Measure**
Home Inspectors	• participate in training about flood protection offered through the Canadian Association of Home and Property Inspectors and Carson Dunlop (Moudrak and Felmate, 2020). • include an assessment of flood risks in home-inspection reports, and educate clients about how to mitigate (Moudrak and Felmate, 2020).
Landscaping	• offer clients advice about landscaping practices that would help to mitigate and reduce stormwater runoff (Moudrak and Felmate, 2020).
Commercial real estate owners and managers	• use nationally recognized best practices for flood resilience. (Moudrak and Felmate, 2020). • educate tenants about steps they can take to minimize the potential for property damage, business disruptions and loss of life (Moudrak and Felmate, 2020). • integrate flood resilience into commercial asset-management plans and long-term financial planning (Moudrak and Felmate, 2020).
Conservation and watershed authorities	• assess the role that natural infrastructure plays in reducing flood risks and providing economic benefits. Work with local community groups, businesses and governments to publicize these benefits (Moudrak and Felmate, 2020). • continue to protect existing natural infrastructure assets and prioritize restoration in areas with the greatest potential benefit (Moudrak and Felmate, 2020). • continue to support local governments in managing flood and erosion hazards, and with flood forecasting and warning services (Moudrak and Felmate, 2020). • publicly disclose existing data about flood risks, and assessments of the condition of flood control structures within the purview of conservation authorities (Moudrak and Felmate, 2020).
Environment non for profit	• assess the role that natural infrastructure plays in reducing flood risks and providing economic benefits. Work with local community groups, businesses and governments to publicize these benefits (Moudrak and Felmate, 2020). • continue to protect existing natural infrastructure assets and prioritize restoration in areas with the greatest potential benefit (Moudrak and Felmate, 2020).
Neighbourhood associations	• educate residents about available flood risk maps and no cost or low cost risk reduction actions using door to door campaigns, events and online learning opportunities. Send home protection materials to residents in the mail (Moudrak and Felmate, 2020). • educate residents about incentive programs that may be available through local governments and utilities to limit their flood risk (Moudrak and Felmate, 2020). • learn about local flood forecasting and warning systems and help residents prepare emergency plans and emergency kits (Moudrak and Felmate, 2020).
Local Utility companies	• distribute home flood protection materials to residents through utility bill mailings and online channels such as emails, newsletters, and social media (Moudrak and Felmate, 2020). • engage with local businesses as well as owners and managers of industrial and commercial real estate about initiatives they can take to reduce their risk of flooding and related property damage (Moudrak and Felmate, 2020). • develop incentives for utility customers to retrofit their properties to increase flood resilience; offer credits for actions that reduce stormwater runoff (Moudrak and Felmate, 2020).
Institutional Investors	• identify the most material physical climate risks that can affect the performances of companies within a given industry sector. If flooding if a material risk, inquire whether appropriate steps have been taken to mitigate it (Moudrak and Felmate, 2020).

Other Stakeholder Mitigation Measures	
Stakeholder	**Mitigation Measure**
Professional regulatory bodies	• establish, monitor and enforce standards of practice for flood assessments that take into account the changing climate (Moudrak and Felmate, 2020). • provide continuing education opportunities to support members in offering professional services that consider flood risk reduction and climate adaptation best practices (Moudrak and Felmate, 2020).

Appendix D Reference List

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Appendix E: Basement Flooding Grant Program Chronology Chart

Basement Flooding Grant Program Chronology		
Date	**Document/Event**	**Comment**
January 21, 1985	City of London Adopts Policy 23(4) City of London Sump Pump, Sewage Ejector, and storm Private Drain Connection Subsidy	Due to a number of severe storms in the mid 1980s, City staff found the cause of basement flooding was from surcharges as a result of poor lot grading allowing surface water to infiltrate into the weeping tile systems of homes which were connected directly by gravity to the sanitary sewer systems (McNally, 2009a). As a result, the City determined that all homes in subdivisions registered after January 1, 1985 had the weeping tile systems directed into a sump pit inside the basement with the flows to be discharged via a sump pump to the surface of the ground (McNally, 2009a). Policy 23(4) provides 100 percent subsidy for the installation of basement flooding protection devices (McNally, 2009a).
1985 to 1999	City of London experiences several significant rain events	Most notable rain events occurred in 1993 and 1996 (McNally, 2009a). Policy 23(4) was revised to add a subsidy to cover the cost of directing flow from the weeping tiles to a private storm drain connection instead of the ground. The addition of this work became the norm for all applications (McNally, 2009a).
April 2000	City of London storm and Basement Flooding Complaints	397 complaints were made to the City (McNally, 2009a).
June 2000	City of London storm and Basement Flooding Complaints	676 complaints were made to the City (McNally, 2009a).
2003	Changes introduced to City Policy 23(4)	The City of London Budget for the subsidy in policy 23(4) prior to 2003 was $1,240,000 (McNally, 2009a). The entire budget amount was used up between the period 1985 to 2003 (McNally, 2009a). Due to challenging financial conditions the Wastewater and Treatment Service Area was facing, and the abuses in the program covering works that were not necessary or installed properly, the subsidy was reduced from 100% to 50% (McNally, 2009a).
2003 to 2006	Policy 23(4) Budget and Amount of Budget used	Annual Budget of $300,000 was set out for the period 2003 to 2006 (McNally, 2009a). The actual usage of funds for each year dropped significantly given the subsidy was reduced from 100% to 50% (McNally, 2009a). The amounts used for each year was: 2003 - $58,400; 2004 - 0; 2005 - $16,400; 2006 - 4,500 (McNally, 2009a).
January 2008	City of London storm and Basement Flooding Complaints	147 basement flooding complaints were made to the City (McNally, 2009a).
December 2008	City of London storm and Basement Flooding Complaints	5 basement flooding complaints were made to the City (McNally, 2009a).
February 2009	City of London Extreme rainfall event and	77 basement flooding complaints were made to the City (McNally, 2009a).

	basement flooding complaints	
May 2009	Extreme rainfall event London	Sherwood Forest flooding (Standish, 2011).
July 20, 2009	Environment and Transportation Committee Report: "Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law".	The report recommends that Policy 23(4) be revoked and that a new by-law replace the policy. The recommended By-law introduces changes of: increasing the grant from 50% to 75% (McNally, 2009a); removing the date of home construction as a condition; and, including non profit housing cooperatives (to be treated the same as residential condominiums). All homes that experience or are likely to experience basement flooding are eligible regardless of construction date. The previous policy only related to homes constructed before 1983 and units part of condominium corporations before 1985 (McNally, 2009a), given the City changed the building requirements to eliminate the ability to connect weeping tiles (foundation drains) to the sanitary system, and instead use sump pumps to pup the weeping tile flows to either the ground or to a storm sewer private drain connection. The City concluded that homes regardless of the construction date can experience basement flooding. The City report noted that the 25% (McNally, 2009a) share to be paid by the homeowner would likely reduce or eliminate unnecessary installations as only residents will 'real' issues would take part in the program. The report includes the pamphlet available to public entitled "Basement Flooding Guide" to provide knowledge to the public about the causes of basement flooding and about the subsidy program (McNally, 2009a).
July 27, 2009	Environment and Transportation Committee Report: "Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law".	The report builds on the July 20, 2009 report by recommending to increase the upset list amounts from the precious City Policy 23(4) which were last adjusted in February 2003 (McNally, 2009b).
August 24, 2009	Environment and Transportation Committee Report: "Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law".	The report builds on the July 20 and 27, 2009 reports by recommending the number of quotations required for the works, based on the total estimated cost, as follows: minimum of 3 quotes for costs above $10,000; minimum of 2 quotes for costs for $5,000 to $10,000; 1 quote for costs below $5,000 (McNally, 2009c).
August 31, 2009	London City Council approved By-law A.-6403-272 to provide for a City of London Sump Pump, Sewage Ejector, and Storm Private Drain Connection Grant Program to owners of residential properties	The by-law implements the City's Sump Pump, Sewage Ejector, and Storm Private Drain Connection Grant Program to cover 75 percent of the cost of approved installations as outlined in the guidelines attached to the by-law in respect of properties that have experienced or are likely to experience basement flooding caused by surcharging in the sanitary or storm sewer (Bill No. 204., 2017).
September 13, 2010	Environment and Transportation	The report updates City Council on the status of the grant program. In November 2009, City staff invited all drain

	Committee Report: "Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law Update".	layer and plumbing contractors licensed to perform work within the City to presentations that provided an overview of typical basement flooding scenarios and outlined the details and requirements on the new grant program (McNally, 2010). City staff also created a communication plan to best provide information about the grant program to the general public. Their work included: updating the City website; publishing and distributing a brochure the Basement Flooding Guide which includes information about the subsidy program which was sent by mail to all recipients of water and London Hydro bills; creating an advertisement on the local television network throughout 2010 (McNally, 2010). Staff have also partnered with the ICLR to discuss best practices on educating the public and they worked together on a downspout disconnection program (McNally, 2010).
October 17, 2011	Built and Natural Environment Committee Meeting: Report titled "Insurance Bureau of Canada ("ICB"): Municipal Flooding Risk Assessment Initiative"	The report provides, for City Council approval, a Non-Disclosure Agreement with the IBC to participate in a Municipal Flooding Risk Assessment Initiative. The study involved working with 20 municipalities, including London to create and test a new flooding risk assessment tool (known as the Municipal Risk Assessment Tool or MRAT) (Standish, 2011a). The IBC recognizes that their existing tools are not adequate and that more accurate assessments of risk are required given the fact that the costs of flooding claims exceed fire claims (Standish, 2011a).
November 14, 2011	Built and Natural Environment Committee Meeting: Report titled "Foundation Drain Disconnection to Mitigate Basement Flooding"	This report was prepared to address excessive inflow and infiltration of storm water into the City of London's sanitary sewer systems from private foundation drain connections during severe wet weather events. The report reviews and recommends an lnflow and lnfiltration (l&l) reduction strategy which includes targeted, mandatory foundation drain disconnections for homes located in areas that are prone to basement flooding, using the Sherwood Forest area as a case study (Standish, 2011b).
August 22, 2012	Civic Works Committee Meeting Report entitled "Foundation Drain Disconnection to Mitigate Basement Flooding"	The report provides an update to City Council on the pilot project mitigation strategy for the Sherwood Forest area which includes targeted foundation drain disconnections for homes located on Blanchard Road and Blanchard Crescent (Braam, 2012). The conclusion of the report states as follows: *"Disconnection of foundation drains will allow the City to remove extraneous inflow and infiltration at the source, thereby redirecting storm water flow to where it is supposed to be – in the storm sewer, rather than attempting to upsize the sanitary sewer to convey and treat both sanitary and storm water flows. This method is far more cost effective, especially in the long term, than alternative sewer storage/upsizing. It is also much more effective at reducing basement flooding risk" (*Braam, 2012 p. 2).
June 11, 2013	City Council approval of By-law No. W.-5546-203	https://pub-london.escribemeetings.com/Meeting.aspx?Id=3f7c2670-6948-48c7-a146-e8d4fa6bb354&Agenda=PostMinutes&lang=English

		The By-law authorizes the Sherwood Forest Flooding Remediation Project No. ES2680
September 9, 2013	Civic Works Committee Meeting Report entitled "Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law - Proposed Amendment"	Report recommends changes to By-law No. A-6403-272 to increase the grant amounts to reflect actual costs required to cover 75 percent of the works, and to expand the program to include a private storm drain connection on private property (Braam, 2013).
September 17, 2013	London City Council passes By-law A.7015-285 - "The Grants for Sump Pump Sewage Ejector, and Storm Drain Connection Grant Program By-law"	The by-law outlines the grant program for residential dwellings to disconnect the footing tiles from either the sanitary or storm sewer and install a sump pump system for disposal of weeping tile water to a suitable outlet other than the sanitary sewer system (Braam, 2013).
September 10, 2014	Extreme rainfall event London	
December, 2014	Report entitled "Cities Adapt to Extreme Rainfall - Celebrating Local Leadership" prepared by the ICLR	The report provides 20 case studies of various Canadian local municipalities' efforts to reduce the risk of loss and damage from extreme rainfall (Kovacs et al., 2014).
June 23, 2015	Extreme rainfall event London	
July 20, 2015	Civic Works Committee Meeting Report entitled "Update on Rainfall Event of June 23, 2015"	The report addresses both the June 23rd and 27th-28th rainfall events which impacted the entire City and included both basement flooding and surface flooding (Braam, 2015a). As of July 2nd, 381 flooding calls were logged with the City (Braam, 2015a). The report concludes that flooding caused through drains is less difficult and costly to address, while the surface flooding issues require larger infrastructure improvements and replacements (Braam, 2015a).
October 6, 2015	Civic Works Committee Meeting Report entitled "Flooding Matters - Terms of Reference"	The report recommends the establishment of a Working Group and the Terms of Reference for the Working Group - with the mandate of providing recommendations to City Council for a proposed plan for mitigation of flooding of private property and basements through measures within the City's jurisdiction as well as public initiatives. The report also outlines a series of issues and questions for the Working Group to consider including: communication; capital budget sustainability; education and promotion; incident management response; and, insurance company coordination (Braam, 2015b).
December 1, 2015	Civic Works Committee Meeting: Report entitled 'Flooding Matters Work Plan Proposal"	The report proposes a Work Plan framework to guide the Working Group in a phased approach to deliver outcomes for mitigation of the extreme weather events and resulting basement flooding, focusing on Homes, Hotspots and Programs (Braam, 2015c).
June 8, 2016	Civic Works Committee Meeting: Report entitled "Flooding Matters Work Plan Phase I (Investigation)	This report provides information to City Council on the Phase I investigative works that addressed Home, Hotspots and Programs and recommends communication enhancements immediately for the flooding issues being

		experienced as a result of extreme volumes of rainfall in short periods of time (Braam, 2016a).
July 18, 2016	Civic Works Committee Meeting: Report entitled Flooding Matters Phase II	The report recommends approval of a list of immediate delivery actions and also a further report on moderate delivery action items as outlined in the Appendices to the report. The seventeen immediate delivery items include: raising the discussion about basement flooding; connecting the discussion to insurance protection; and supporting present and proactive programs. The further six moderate delivery items require further study and more resources than are currently available (Braam, 2016b).
October 4, 2016	Civic Works Committee Meeting Report entitled "Foundation Drain Disconnection to Mitigate Basement Flooding"	The report provides an update on the foundation drain disconnection program following the success of the Sherwood Forest area work in 2013 and the identification of five areas for disconnection (Old South, Glen Cairn, Lockwood Park and White Oaks). The report outlines the criteria for the City to undertake the work within the areas identified including minimum of 60 percent buy in for the area to be eligible (Braam, 2016c).
December 12, 2016	Civic Works Committee Meeting: Report titled "Flooding Matters Phase II – Progress Report"	The report provides an update on the City of London's progress with respect to initiatives identified in the July 26, 2016 Council meeting resolution arising out of the July 28, 2016 staff report dealing with the City's flood mitigation program (Scherr, 2016).
March 2, 2017	City Council Resolution: "Basement Flooding Grant Program By-law"	Resolution requests a report to Civic Works Committee to introduce changes to Bylaw No. A-7015-285 to increase grants from 75 percent to 90 percent for demonstrated installation costs (to an upset limit) with remaining 10 percent to be provided by means of a loan to the homeowner with a repayment period of up to 10 years through their municipal taxes (Scherr, 2017).
May 9, 2017	Civic Works Committee Meeting: Report entitled "Basement Flooding Grant Program By-law Update"	The report recommends changes to the Grants for Sump Pump, Sewage Ejector and Storm Private Drain Connection By-law to give full effect to the intent of the program and to solve program deficiencies (Scherr, 2017). Other changes were proposed to "increase resident uptake in the program, alleviate frustrations that customer have had with the program, and to minimize future customer grievances stemming from works completed through the program" (Scherr, 2017). In addition to the increase in grant from 75% to 90%, the recommendations of the Committee include: residents will only be able to obtain grants for sump pump installations if they also install backwater valves; the addition of sump pump battery backup installation in the grant program; the addition of grants to properties with a reverse grade driveway where the private drains are connected to the city's sewer; an expansion of scope to fund alarms on backwater valves that would record activity to be shared with the City to monitor issues in areas of concern to the City (Scherr, 2017).
May 16, 2017	London City Council passes By-law A.7562-160— "Basement Flooding Grant By-law"	This by-law implements the changes approved to the 2013 By-law A.-7015-285 and repeals and replaces the 2013 By-law with the updates (City of London, By-Law No, 7562-160).

February 2018	Extreme rainfall event London (Bieman, 2018)	
December 4, 2018	Civic Works Committee Meeting Report entitled "Flooding Matters - Weeping Tile Connection Charge Feasibility Analysis"	The report concludes that the development of a specific rate for homes with weeping tile connections is likely to be effective, but would be difficult to implement, and it is anticipated to have marginal to significant social impact. Staff report indicates they propose to continue to work with the community on the many measures currently in place (Scherr, 2018).
August 1 - 3, 2020	Extreme rainfall event	A number of London properties were affected following the severe rain event over 3 days of 81 mm (Irvine, 2020).

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Appendix F: Changes Being Made in Real Estate Business Brokers Act 2002 Chart

Real Estate Business Brokers Act 2002 Changes		
In Force	**In Effect Pending**	**Differences**
Real Estate Business Brokers Act 2002 **O. Reg. 580/05 (2022)**	**Trust in Real Estate Services Act 2002 O.Reg. 357/22 (2023)**	
21. (1) A broker or salesperson who has a client in respect of the acquisition or disposition of a particular interest in real estate shall take reasonable steps to determine the material facts relating to the acquisition or disposition and, at the earliest practicable opportunity, shall disclose the material facts to the client. O. Reg. 580/05, s. 21 (1) (2) A broker or salesperson who has a customer in respect of the acquisition or disposition of a particular interest in real estate shall, at the earliest practicable opportunity, disclose to the customer the material facts relating to the acquisition or disposition that are known by or ought to be known by the broker or salesperson. O. Reg. 580/05, s. 21 (2).	**Material facts** 22.1 (1) A broker or salesperson who has a client in respect of the acquisition or disposition of a particular interest in real estate shall, (a) Take reasonable steps to determine the material facts relating to the acquisition or disposition; (b) Disclose the material facts to the client as soon as possible after the determination; and, (c) Advise the client to consider whether the material facts affect their decision to acquire or dispose of the interest. O. Reg. 357/22, s. 12.\ (2) the registrant shall make best efforts to obtain a written acknowledgement from the client indicating that the disclosure and advice mention in subsection (1) has been received and, if the client makes the acknowledgment, provide them with a copy of it. O. Reg. 357/22, s. 12.	The primary difference between the current and new regulation is that the new Regulation adds a direction to the broker/salesperson to use best efforts to obtain a written acknowledgement that disclosure was made.

Real Estate Business Brokers Act 2002 Changes		
In Force	**In Effect Pending**	**Differences**
Real Estate Business Brokers Act 2002 **O. Reg. 580/05 (2022)**	**Trust in Real Estate Services Act 2002 O.Reg. 357/22 (2023)**	
20. If a broker or salesperson has a seller as a client and knows that the seller has completed a written statement that is intended to provide information to buyers about the real estate that is available for acquisition, the broker or salesperson shall, unless the seller directs otherwise, (a) disclose the existence of the statement to every buyer who expresses an interest in the real estate; and (b) on request, make the statement available to a buyer at the earliest practicable opportunity after the request is made. O. Reg. 580/05, s. 20.	**Information statement re seller's property.** 22.3 If a broker or salesperson has a client and knows that the seller has completed a written statement that is intended to provide information to buyers about the real estate that is available for acquisition, the broker or salesperson shall, (a) Disclose the existence of the statement to every buyer who expresses an interest in the real estate; and (b) If requested, make the statement available to a buyer as soon as possible after the request is made. O. Reg. 357/22, s. 12. **Disclosure of the facts by seller's broker or salesperson.** 22.2 (1) If a seller has a legal obligation to disclose a fact to the buyer and the fact is known to the broker or salesperson who represents the seller, the broker or salesperson shall disclose the fact to every buyer who expresses an interest in the real estate. O. Reg. 357/22, s. 12. (2) The registrant shall make best efforts to obtain a written acknowledgment from each buyer who receives the disclosure under subsection (1) indicating that the disclosure has been received and, if a buyer makes the acknowledgement, provide them with a copy of it. O. Reg. 357/22, s. 12.	The primary difference between the information statement regarding the seller's property is that there is now an explicit legal requirement that the broker/salesperson must disclose any known written statement, as there is no exception if "the seller directs otherwise". In addition, the new Regulation indicates that if there is a legal requirement for a seller to disclose a fact and the salesperson also knows this fact, the salesperson must disclose to all interested buyers.

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