Lisgar District Pumping Stations Schedule "B" Municipal Class Environmental Assessment

Lisgar District Pumping Stations – Project File Report
City of Mississauga
Project # WW21011023

Prepared for:

City of Mississauga
201 City Centre Drive, Mississauga, Ontario L5B 3C1

September 20, 2022

Lisgar District Pumping Stations, Schedule "B" Municipal Class Environmental Assessment, City of Mississauga

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Prepared for:
City of Mississauga
201 City Centre Drive, Mississauga, Ontario L5B 3C1

Prepared by:
Wood Environment & Infrastructure Solutions Canada Limited
3450 Harvester Road, Suite 100
Burlington, ON L7N 3W5
Canada
T: 905-335-2353

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1.0 Introduction

1.1 Study Area

The Lisgar District is situated in the northwest corner of the City of Mississauga and is bounded by the Canadian Pacific Railway (CPR) tracks to the north, Britannia Road West to the south, Ninth Line to the west and Tenth Line to the east. It is located within the Sixteen Mile Creek watershed and surface water drains to a tributary of the East Branch of Sixteen Mile Creek (Figure 1.1).

The Lisgar District mainly consists of single-family homes which were largely built over a 25-year period starting in the early 1980s (Figure 1.2).

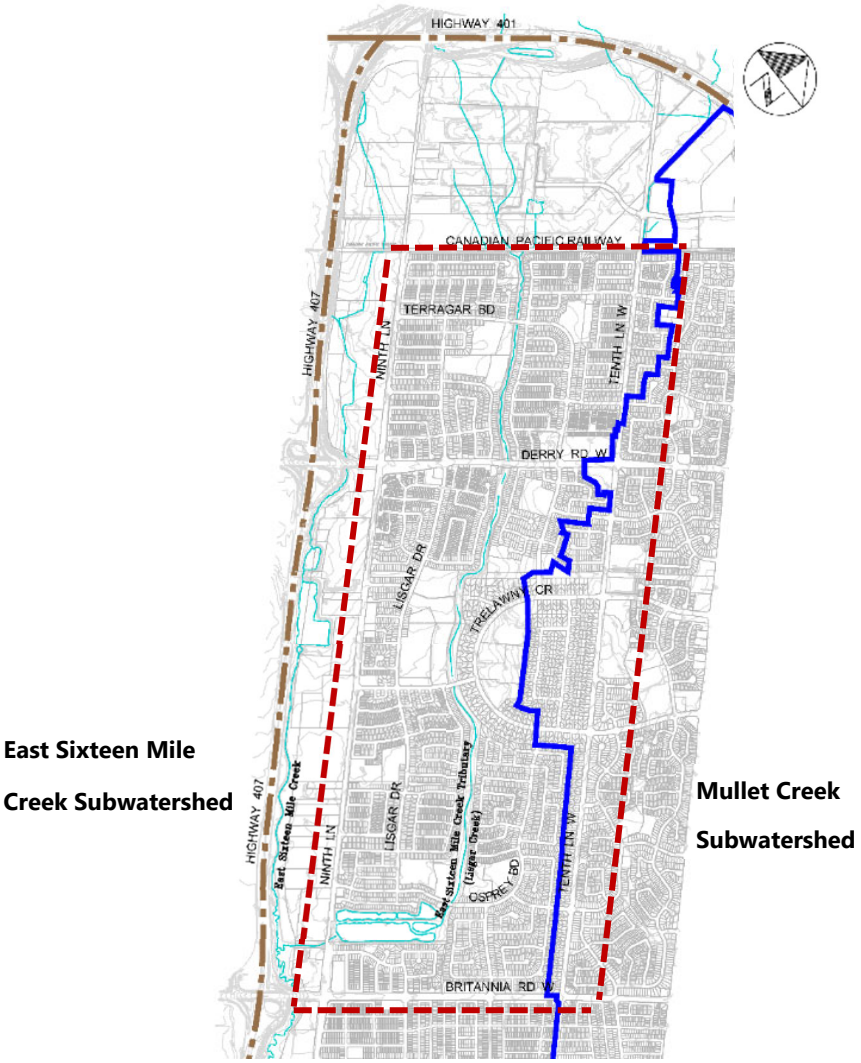

Figure 1.1. Subwatershed Map

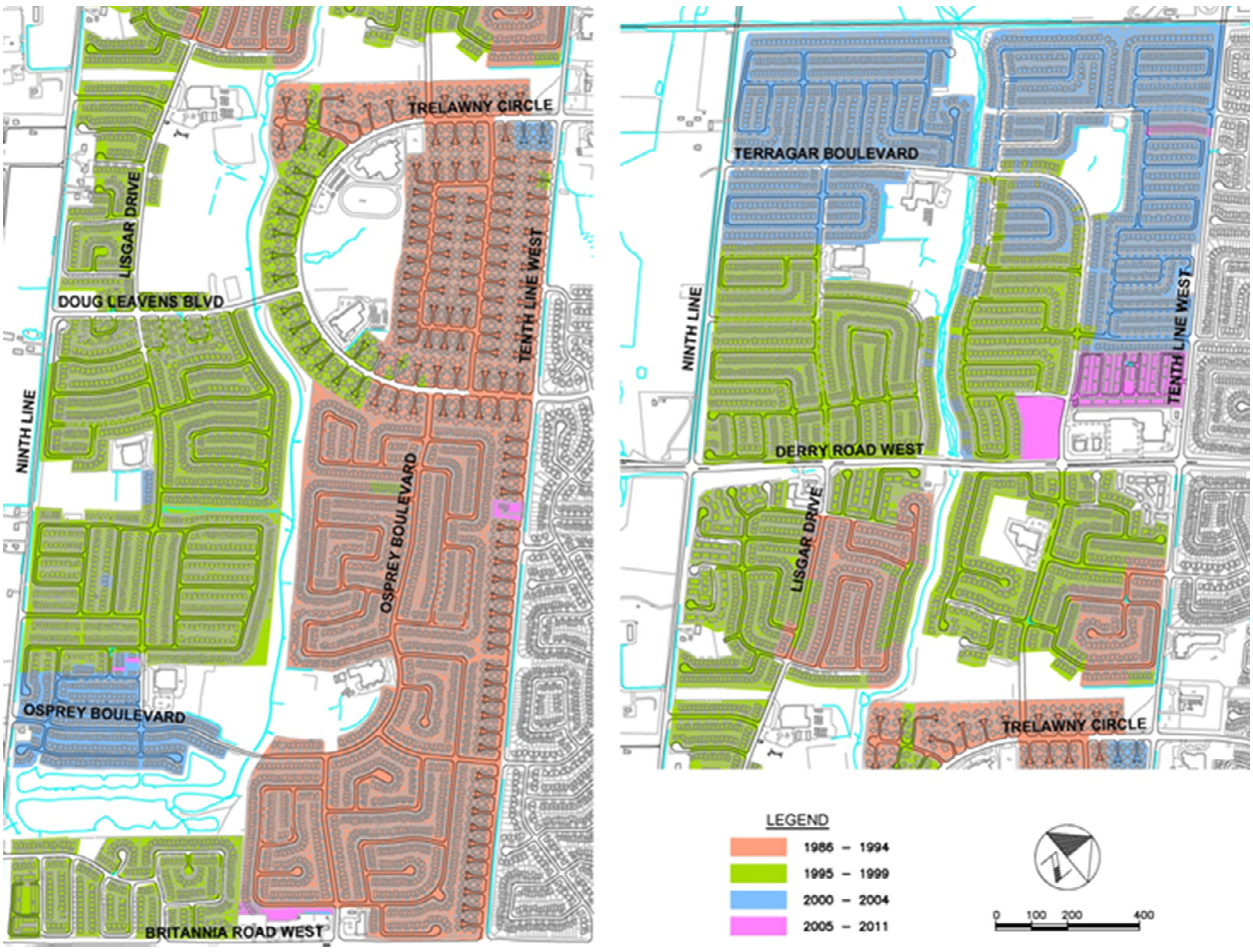

Figure 1.2. Historic Development of Lisgar

1.2 Background & Overview

Commencing in 2008, a number of homes in the Lisgar District experienced water seeping into their basements following certain rainfall events. Almost 200 homes are known to have been affected to date (2018); Figure 1.3 generally depicts the areas affected. The majority of homes were affected by the October 19/20, 2011 event (141 homes); others have been affected by subsequent events, including multiple times for many residences. Since Wood began monitoring in 2012, reported basement water infiltration events include:

- January 13, 2013 (7 homes)
- July 14, 2017 (36 homes)
- January 11-12, 20220 (41 Homes)
- August 28, 2021 (5 homes)

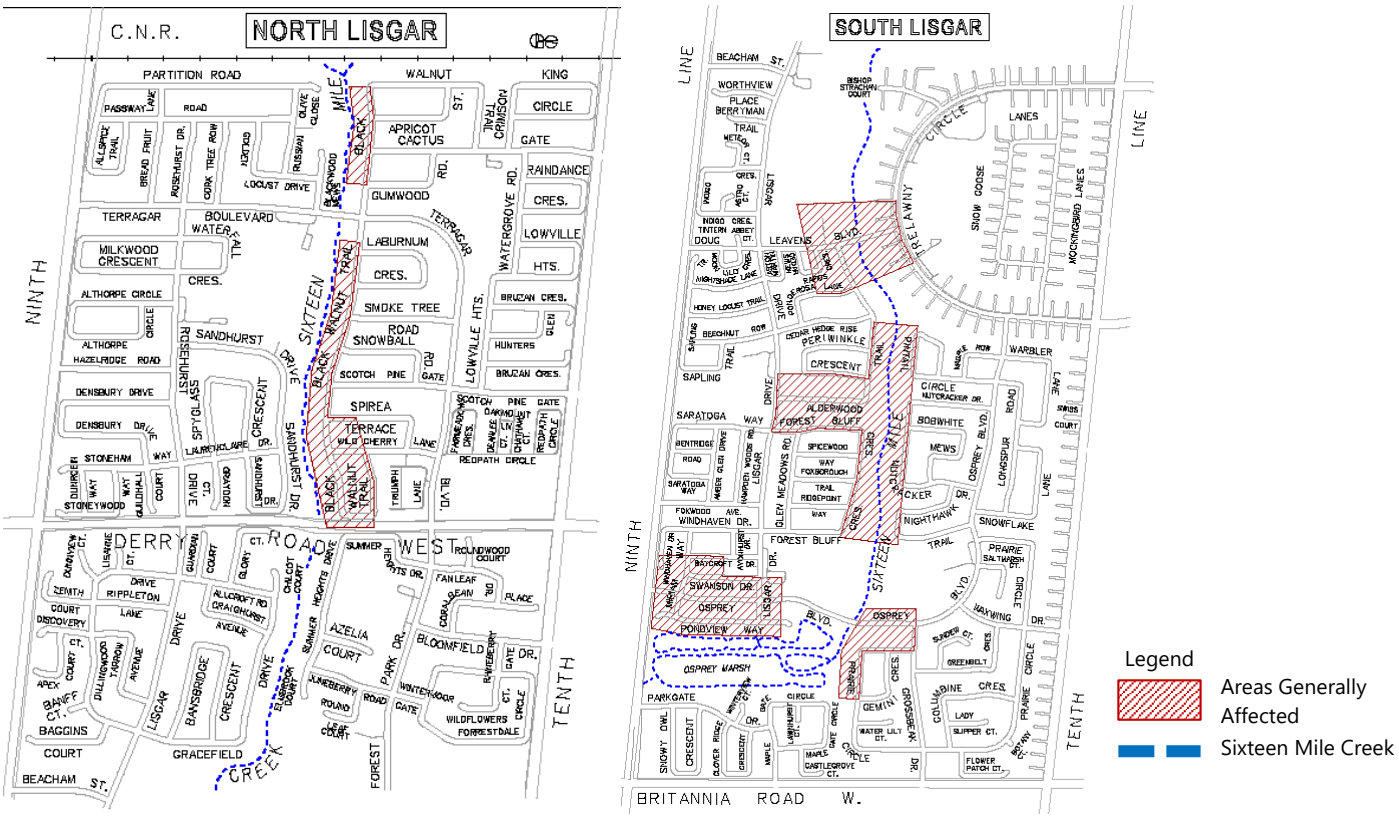

Figure 1.3. Areas Affected by Basement Water Infiltration

After becoming aware of the scale of this issue, the City undertook a number of actions, including:

- Video inspection and cleaning of the foundation drain collector (FDC) system;
- Removal of vegetation along Sixteen Mile Creek;
- Clean-out of bridge crossings and storm outfalls to Sixteen Mile Creek;
- Sealing selected Foundation Drain Collector (FDC) manholes and pipe joints;
- Adjustment to the Osprey Marsh Stormwater Pond outlet upstream of Ninth Line; and
- Putting in place a High Water Protocol (deploying temporary portable pumps during major storms).

The High Water Protocol (HWP) consists of City staff continuously monitoring weather forecasts and other weather-related information, such as High Water Bulletins from local Conservation Authorities. When unfavorable weather conditions are predicted, City staff and/or its contractors are deployed to three (3) locations within the Lisgar District with portable pumps on standby to pump water from the FDC system, if required (typically if the water level in the pipe exceeds the springline/50% of full sewer depth).

Furthermore, the City retained a consultant to conduct an investigation of the problem. Specifically, in October 2011, AMEC Environment & Infrastructure (now known as Wood Environment & Infrastructure Solutions Canada Limited (Wood)) was retained to undertake an engineering study to determine the cause(s) of basement water infiltration and recommend corrective measures.

In an effort to reduce the ingress of water into the drainage systems serving the area, impermeable collars were constructed across storm sewer outfalls in the fall of 2014 at two (2) locations; Scotch Pine Gate in the north (outfall to Lisgar Creek) and Pondview Way in the south (outfall to the Osprey Marsh SWM Facility). The collars were intended to prevent the backflow of surface water into the utility trench which contain the sanitary, storm and FDC systems.

After comprehensive monitoring and analysis (as outlined in subsequent sections), the engineering study related to causes, determined the problem to be primarily related to the build-up of water in the bedding material of the utility trenches that contain the storm, sanitary and FDC sewer systems.

In March 2015 the results of the engineering study were presented to the public which outlined a multi-component Mitigation Plan. The Plan recommended the following measures as the highest priorities for the City to deal with the basement water infiltration issue and reduction of sources of unintended inflow to the FDC sewer:

- Strategic lining of priority storm sewers to minimize leakage;
- Construction of a utility trench dewatering system;
- Build permanent FDC pumping stations for high flows; and
- Replace hydraulically deficient FDC pipe lengths when they reach the end of their engineered lifespan.

Following the release of the March 2015 Public Summary Report (refer to Appendix A), Wood was subsequently retained by the City of Mississauga to support the implementation (design, approvals, and construction) of the various remediation works, with the highest priority items being storm sewer lining (to reduce leakage) and the design of a utility trench dewatering system (to reduce the build-up of water in the utility trench). In addition, Wood continued to undertake monitoring of the drainage systems within the Lisgar District area to provide ongoing verification of the effectiveness of remedial measures, as they were constructed, and to also allow for further data collection in the event of FDC surcharging or basement water infiltration events, should they occur.

As part of the implementation of the Prioritized Action Plan, storm sewer lining works were completed for the highest priority area (Phase 1 - Black Walnut Trail) between December 2016 and March 2017. Extents are presented in Figure 1.4.

A second phase of storm sewer lining was planned for the next highest priority area (Doug Leavens Boulevard, Alderwood Trail, and Osprey Boulevard) for later in 2017. However, post-lining storm sewer leakage tests completed in April 2017 indicated a similar rate of leakage under post-lining conditions as under pre-lining, which was unexpected. The City of Mississauga and Wood investigated further, conducting additional testing into the leakage mechanisms, and determined a high potential for leakage from the subdrains in the catchbasins. On this basis, City staff ultimately proceeded with the installation of catchbasin sub-drain plugs along Black Walnut Trail in October and November of 2017, with a second phase of plugs (Doug Leavens Boulevard to Osprey Boulevard) installed in January of 2018. Locations are included in the 2017 Annual Monitoring Report (Wood, March 2020). The effectiveness of these plugs has continued to be evaluated over the course of 2018 and beyond.

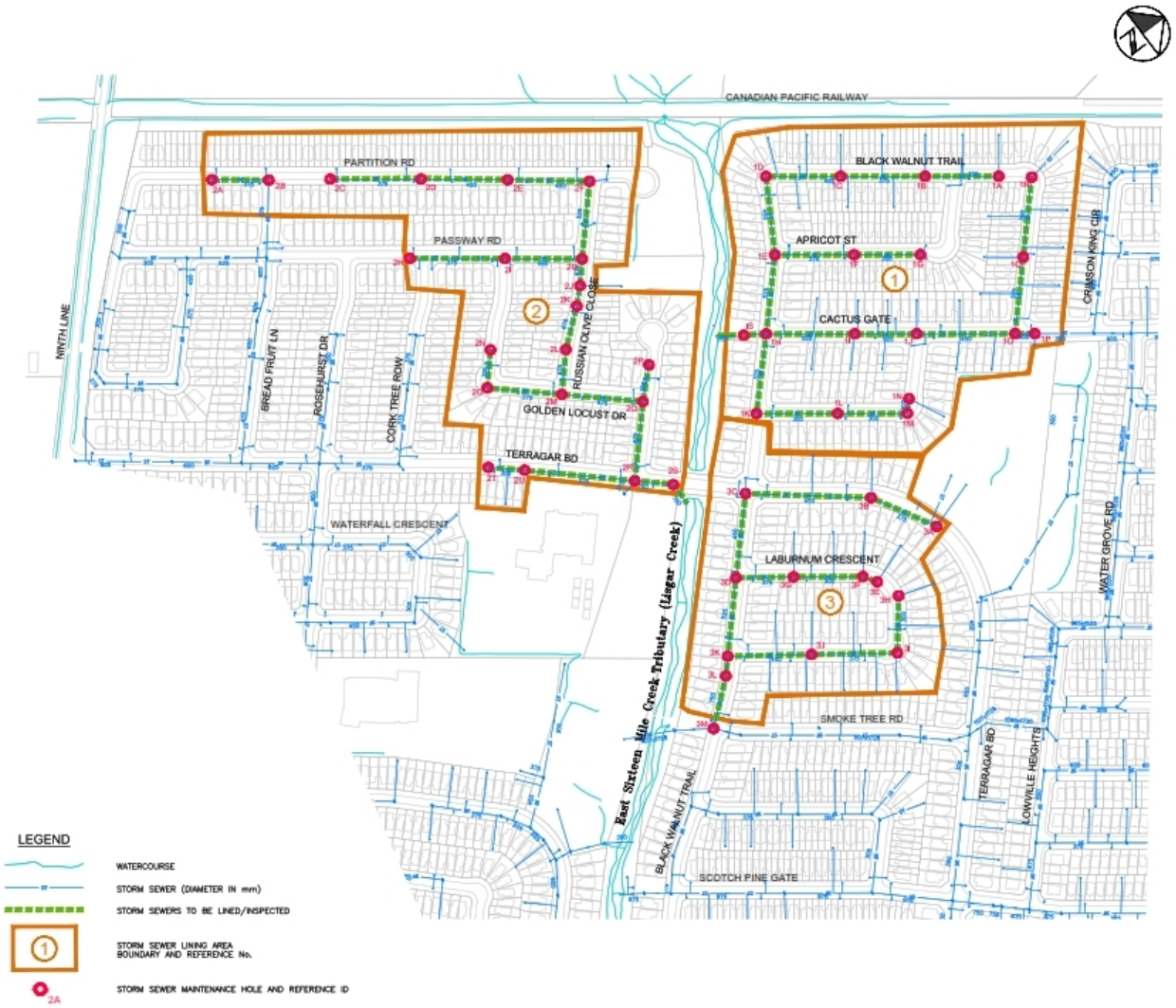

Figure 1.4. Phase 1 Storm Sewer Lining Areas

On July 13-14, 2017, between approximately 11:50 PM and 12:30 AM, a local convective (thunderstorm type) system affected the Black Walnut Trail area of the Lisgar District area. The storm event resulted in reported basement water infiltration for 35 (+/-) residences, the majority (34) located along Black Walnut Trail (1 along Golden Locust Drive). Based on post-event questionnaires completed by affected residents, the infiltrated water was generally characterized as clear, and sourced from around the perimeter of the home.

A public meeting was held on October 18, 2017 to provide the Public with an update on the ongoing works being completed for the Lisgar District Basement Water Infiltration Study, as well as to provide a characterization and analysis of the July 13-14, 2017 storm event. As part of the public meeting, an Updated Action Plan was presented. In addition to previously proposed activities (addressing roadway sub-drain leakage, utility trench dewatering system), an FDC pumping station (similar to that proposed in the March 2015 Public Report) was advanced as a higher priority mitigation measure to be assessed, planned, designed and constructed in 2018/2019.

In September 2018, a Class Environmental Assessment (EA) was completed for the Black Walnut Trail area pumping station system. The purpose of the Class EA was to identify the location and preferred approach

for a pumping station within the Lisgar District. Integrated hydrologic/hydraulic (PCSWMM) modelling software was used to assess expected rates of flow within the FDC system during storm events, and the associated effectiveness of potential pumping strategies (locations, numbers, and pump station sizing/capacities). Two (2) locations were short-listed through this process: Cactus Gate Parkette and Smoke Tree Road Parkette. The hydraulic modelling results indicated that in general, an FDC pumping system at Smoke Tree Road would be more effective at reducing FDC water levels in downstream areas than one located further upstream at Cactus Gate. However, an FDC pumping system at Cactus Gate would be more effective at reducing FDC water levels in the upstream area, and in particular removing excess flows from this area, which was indicated as having a relatively higher rate of flow contribution to the FDC system. As such, the preferred solution identified within the Class EA was the construction of an FDC pumping system at the Cactus Gate Parkette, west of Black Walnut Trail and Cactus Gate The preferred pumping approach was a combined high flow (directly from the FDC sewer) – low flow (utility trench bedding) pumping system given the associated efficiencies around construction and design, and also long-term operation and maintenance.

The construction of the Cactus Gate pumping station began in December 2019 and the pumping station was commissioned in March 2021. Since then, several major rainfall events have occurred in Lisgar District, and on August 28, 2021, a major storm event occurred. The storm event resulted in five (5) incidents of reported basement water infiltration. This was the most intense local rainfall on record within the past ten (10) years, including the aforementioned storm on July 14, 2017. A review of the effectiveness and impact of the Cactus Gate Pumping Station (ref. Wood, October 15, 2021) was completed to assess the subject storm event and the associated drainage system performance. It was concluded that the Cactus Gate Pumping station helped mitigate the impacts of the storm, along with the High Water Protocol temporary pumping which was active during that event. However, it was noted that FDC surcharging continues to occur and that additional remedial measures are needed.

Continuing from the Class Environmental Assessment (EA) completed in 2018, the current Class EA has specifically been advanced to determine the preferred locations and form of Pumping Stations within the entirety of the Lisgar District (as per Figure 1.1) as a form of master plan, to further reduce the potential for basement water infiltration. This study will determine and confirm the number of required FDC pumping stations and priority sequence for implementation within the Lisgar District as a whole.

A public meeting was held on November 19, 2021 to provide the Public with an update on the Cactus Gate Pumping Station and Monitoring Program, information regarding this Class EA, and an overview of the High Water Protocol. Two (2) Question and Answer sessions were also held with the responses compiled and released publicly thereafter (refer to Appendix G).

1.3 Class Environmental Assessment Process

Overview

This study has followed the process outlined in the Municipal Engineers Association (MEA), Municipal Class Environmental Assessment (EA), October 2000 (as amended in 2007, 2011, and 2015). The Municipal Class EA process defines mandatory principles, details of project consultation and technical requirements. A Municipal Class EA is considered a legal document which outlines municipal project recommendations and next steps, based on technical assessments, public input and consultation with technical practitioners, agencies and engagement with Indigenous Peoples and Nations.

Municipal Class EA Process

Each Municipal Class EA undertaking, depending on the scope of work and the range of predicted environmental impacts, is classified using Schedules. The Schedule to apply, typically depends on the scope

and estimated capital cost of the recommended works. Based on a review of similar forms of infrastructure (in the absence of any precedents with foundation drainage pumping stations), Wood and the City selected Schedule B as being appropriate on the basis of the required level of study and consultation for similar works (ref. Figure 1.5). The various phases of the Class EA process have been conducted by this study based on the Schedule (i.e., Schedule B: Phases 1 and 2), while Phase 5 will be conducted based on the recommendations herein being continued through to detail design and subsequently construction and monitoring.

As part of the Class EA process the following key principles are considered:

- Establish a Problem and Opportunity Statement;
- Consult with affected parties early in, and throughout the process, such that the planning process is a cooperative venture;
- Consider a reasonable range of alternatives, both functionally different "alternatives" and "alternative methods" of implementing the solution;
- Systematic evaluation of alternatives in terms of their advantages and disadvantages, to determine their net environmental effects; and,
- Provision of clear and complete documentation of the planning process followed, to allow "traceability" of decision-making with respect to the project.

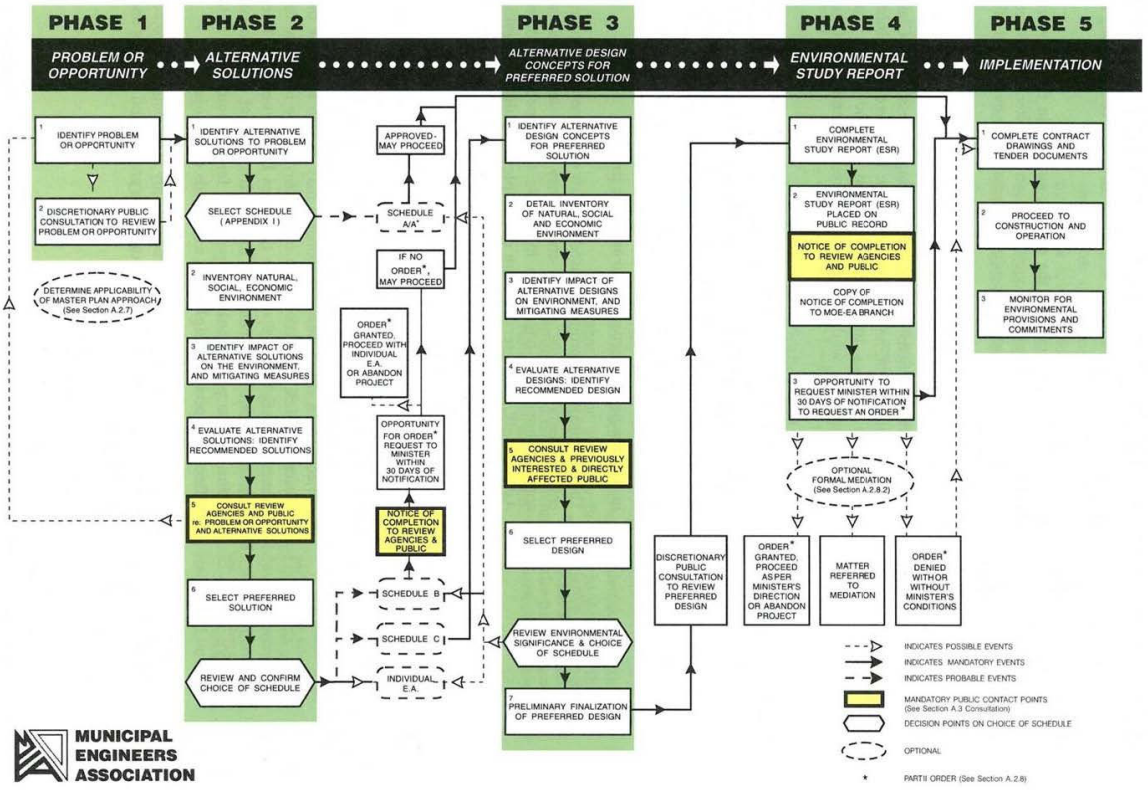

Figure 1.5. Municipal Engineers Association (MEA), Municipal Class Environmental Assessment, October 2000 (as amended in 2007, 2011 and 2015)

This Municipal Class EA was completed to determine the preferred locations and form of Pumping Stations within the Lisgar District to further reduce the potential for basement water infiltration. Through this study, multiple Pumping Station Alternatives (location and form) have been developed and evaluated by the Project Team and refined through stakeholder and public consultation. The Project Team selected a Preferred Alternative, which consisted of three locations for installing pumping stations. This Project File Report was developed to document the entire study process for review by the public, Indigenous Nations, Government Agencies, and interested stakeholders(ref. Figure 1.6).

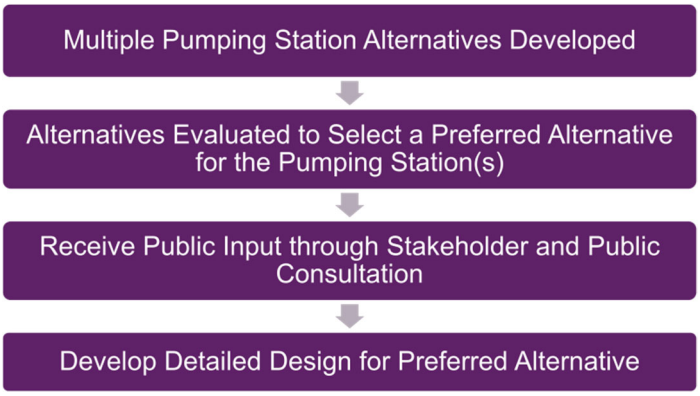

Figure 1.6. Municipal Class EA Process for Lisgar District Pumping Stations

Public and Agency Consultation and Indigenous Engagement

In accordance with the Municipal Class EA process, consultation has been undertaken with the Public and Regulatory Agencies, and engagement with relevant Indigenous Peoples and Nations. A Public Information Centre (PIC) was held on November 17, 2021; notification for the PIC was sent to stakeholders, local residents and agencies by mail. Conservation Halton (CH) provided comments regarding areas of interest or concern on the project, which was followed by correspondence between CH and the Project Team in order to address these concerns. The City received direction from the Ministry of Environment, Conservation, and Parks (MECP) regarding Indigenous Peoples and Nations that may have an interest in the project. Accordingly, letters of notice and project summaries were provided to the Mississaugas of the Credit First Nations (MCFN), Huron-Wendat Nation (HWN), Six Nations of the Grand River (SNGR) and the Haudenosaunee Confederacy Chiefs Council (HCCC).

1.4 Lisgar District Drainage Systems Overview

When agricultural or open space lands are converted to urban uses, such as residential or employment, municipal services including watermains, sanitary sewers and storm sewers are typically constructed within road allowances or public easements to support these developments. The City of Mississauga is responsible for managing all aspects of stormwater within its jurisdiction, whereas the Region of Peel is responsible for stormwater on Regional roads, as well as drinking water, wastewater and solid waste management.

Storm sewers are designed to capture surface runoff from rainfall or snowmelt and then convey this water safely to a waterbody such as a creek, river or lake. In areas with stormwater management facilities (commonly referred to as ponds), which are routinely designed to provide water quality and/or flood and erosion control, this water would first outlet into these ponds for treatment before being released to a waterbody. Where the waterbody is comparatively deep in relation to the surrounding lands, the storm sewers can be built sufficiently deep below the ground surface to concurrently capture and convey water draining from the weeping tiles around the basement foundations of homes (Figure 1.7). Alternatively, where the receiving waterbody is high (or shallow) compared to the surrounding lands and basement

foundations, the weeping tiles around the homes would not be able to drain by gravity into the storm sewers. In these circumstances, one of two systems would be required to drain the foundation around the homes:

- Sump Pumps; or
- Dedicated Foundation Drain Collector.

A sump pump is a mechanical system used to remove water captured by the weeping tiles around the basement foundations of homes that has been collected in a sump pit (basin) in the residential basement. Water from the sump pit would either be pumped to the ground surface where it would drain across the yard to the storm sewer or underground into a shallow storm sewer (however this is not currently permitted in the City of Mississauga); refer to Figure 1.8.

A Foundation Drain Collector (FDC), typically located in the same utility trench as other municipal services, is a sewer system dedicated to only collect and drain water from weeping tiles around homes to an outlet by gravity flow (Figure 1.9). The FDC system is often referred to as part of a 3-pipe system, the other two being the storm and sanitary systems. At the time of its construction in the Lisgar District, the FDC system was considered to be a preferred solution for many new areas. In fact, the textbook *Modern Sewer Design (Canadian Edition, 1980)* states: "*This system virtually eliminates the probability of back-ups into foundation drains, which have caused considerable flooding, and damage to basements*". Figure 1.10 depicts the limits of the Lisgar District within Mississauga served by an FDC system.

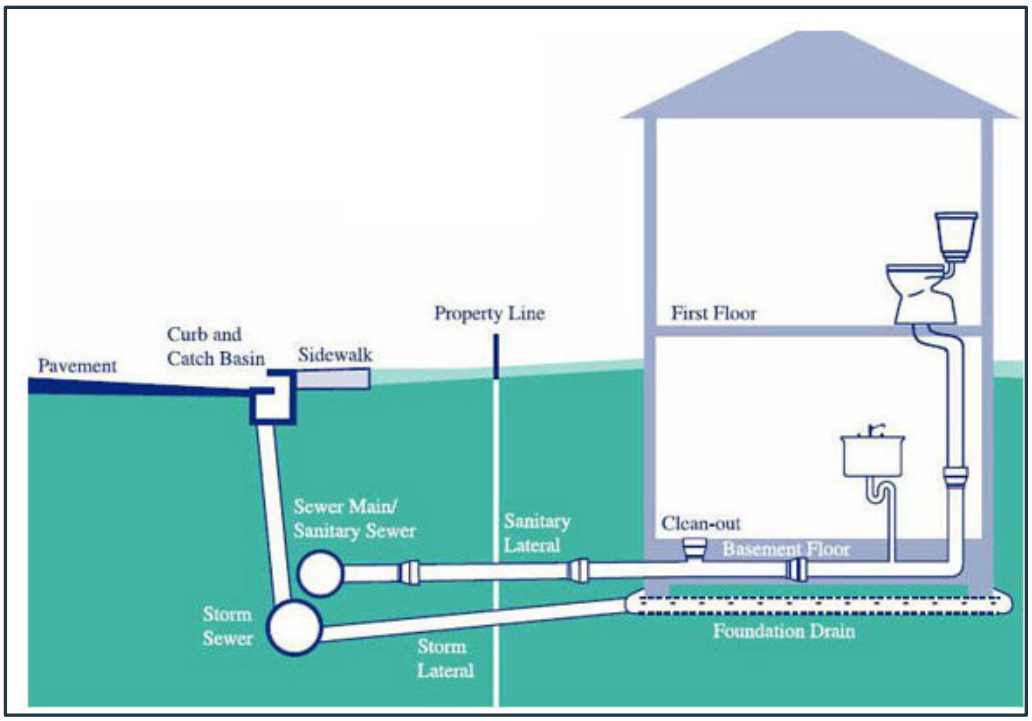

Figure 1.7. Conventional Foundation Drain Connected to Storm Sewer

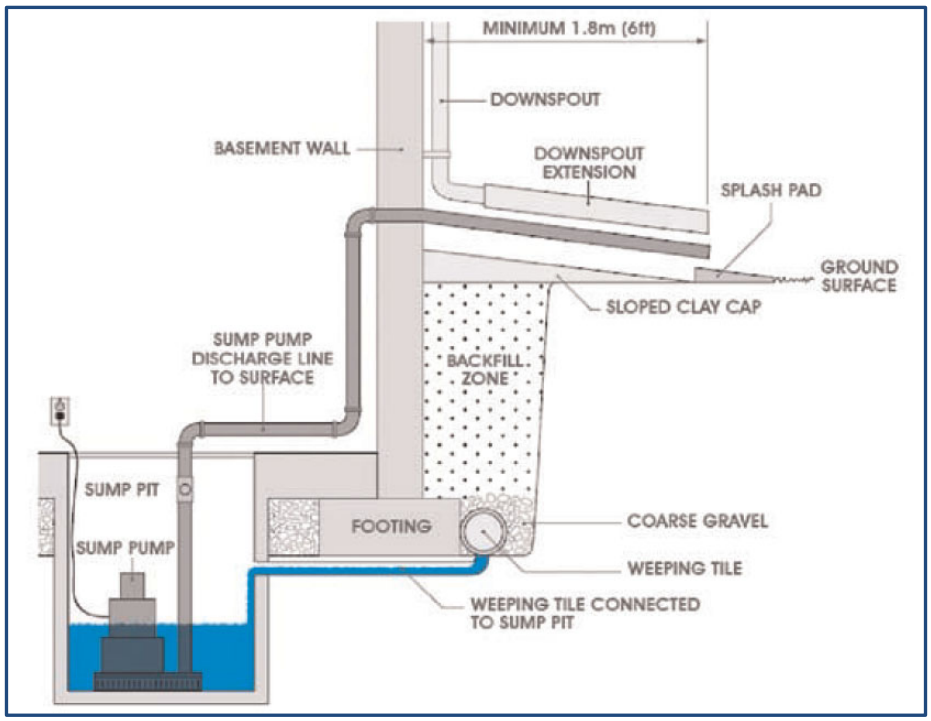

Figure 1.8. Sump Pump to Front/Year Yards or Storm Sewer

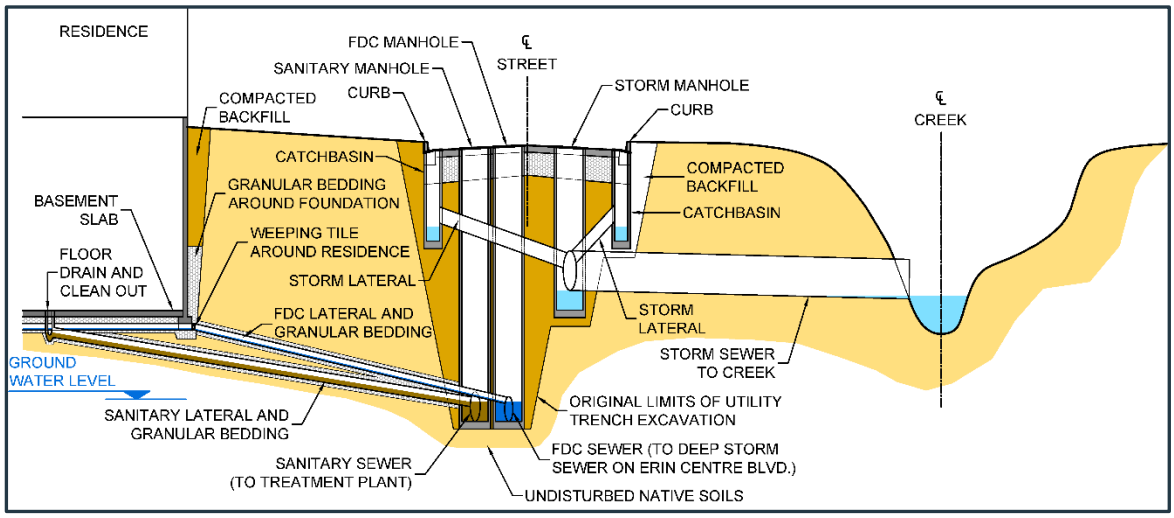

Figure 1.9. Foundation Drain Collector as found in the Lisgar District

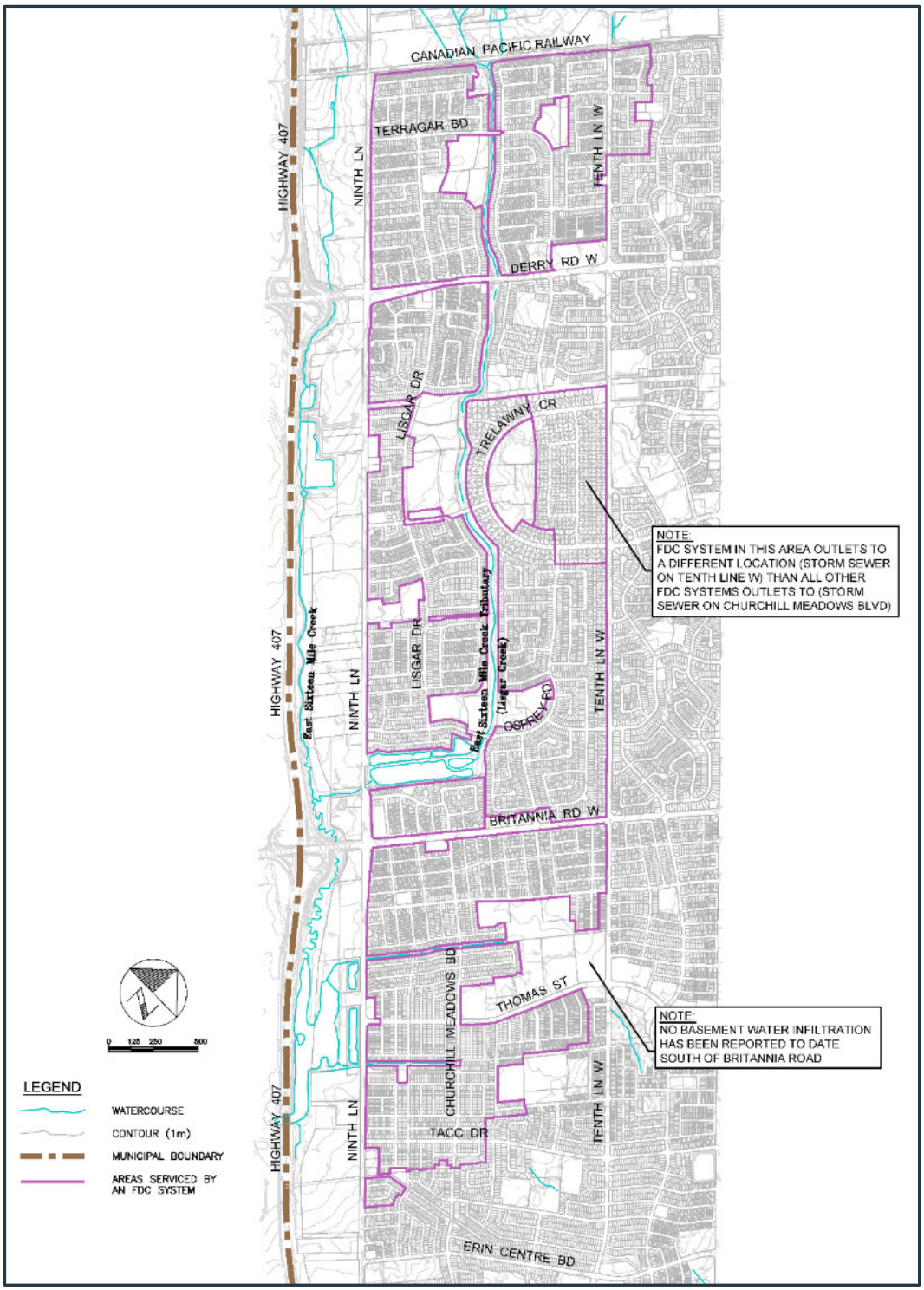

Figure 1.10. Servicing Limits of FDC System in Mississauga

Table 1.1 provides a brief summary of the advantages and disadvantages of these three distinct foundation drainage systems.

Table 1.1. Advantages and Disadvantages of Three Distinct Foundation Drainage Systems

Type	Advantages	Disadvantage
Gravity to Storm Sewer	• No additional infrastructure • Comparatively low cost • No reliance on mechanical system or power	• May back up if storm sewer is overwhelmed • Some additional cost to upsize storm sewers
Sump Pump	• Disconnected from municipal system	• Requires homeowner to operate and maintain the system • Mechanical system needs to operate to function • Relies on power
Foundation Drain Collector	• Dedicated, providing drainage for foundation only • No reliance on mechanical system or power • At the time of implementation was considered to reduce the probability of back-ups into foundation drains • Allows for smaller sized storm sewers • Successfully installed in numerous other municipalities without incident (Brampton, Vaughan, Barrie)	• Comparatively high cost to install additional deep and long pipe systems

It should be noted that the technical term 'surcharge' is often used in this report when referring to the flow conditions of sewers. This term refers to a gravity sewer that is overloaded beyond its pipe full flow capacity such that the flow is under pressure.

1.5 Problem Statement

Commencing in 2008 a number of homes in the Lisgar District experienced water seeping into their basements following certain rainfall events. To address the basement water infiltration issue, the City developed a comprehensive Action Plan in 2015. Following Public and Agency consultation, as well as additional monitoring and investigations, an Updated Action Plan was developed in 2017 based on additional information on system performance through monitoring the July 13-14, 2017 storm and various testing activities. The FDC Pumping Systems must consider several constraints and opportunities related to the drainage area served, property suitability, and the number of houses in proximity that reported basement water infiltration. The Preferred Alternative must address the Problem while balancing study area constraints and opportunities, in order to best mitigate the basement water infiltration and the interests of local residents. Two forms of mechanical pumping were recommended in 2015 and 2017 to reduce water levels in the utility trench and FDC respectively. A Class EA was completed in 2018 with the preferred approach of a combined high flow – low flow pumping system at Cactus Gate Parkette and the pumping station came into operation in 2021.

Based on ongoing monitoring results and reports of continued areas subject to basement water infiltration, additional measures are required to reduce basement water infiltration within the entirety of the Lisgar District. The current study is intended to determine the number, location and priority of pumping stations to address ongoing basement water infiltration for the overall Lisgar District as per the limits presented in Figure 1.1.

2.0 Studies and Investigations

As outlined in Section 1.2, in response to the initial reports of basement water infiltration in 2008, several works and activities were initiated by the City; these generally can be categorized as:

i. Works led by City forces directly

ii. System monitoring to collect data on drainage system performance

iii. System testing to validate theories and directly assess performance of certain components

iv. Analyses of the data to determine extent, scale and source of problem.

v. Assessments of Existing Conditions

2.1 City-Led

When the City of Mississauga first became aware of basement water infiltration, the causes of this unexpected problem were not known. In response, the City proactively undertook a number of precautionary, investigative and maintenance actions on the storm and FDC sewer systems, the tributary of the East Branch of Sixteen Mile Creek, and the Osprey Marsh Stormwater Management Pond. Table 2.1 summarizes the work completed by the City in the Lisgar District prior to March 2015. These activities are further described in the Summary Report (March 2015) for the Lisgar District Basement Water Infiltration Investigation (ref. Appendix A).

Table 2.1. City-Led Activities Completed Prior to March 2015

FDC and Storm Sewers	Video inspection and Flushing of FDC and Storm Sewer Systems
	Identifying Sewer Cross-connections
	Sealing FDC Maintenance Access Lids and Cracks
	Cleaning Storm Sewer Outfalls to Creek
	Improvements to Overland Flow Routes
	High Water Protocol
East Sixteen Mile Creek Tributary and Osprey Marsh Stormwater Management Pond	Creek Vegetation Trimming and Debris Removal
	Sediment and Vegetation Removal from Bridge Crossings and Storm Outfalls
	Creek Inspection Protocol
	Reconfiguration of Osprey Marsh Stormwater Management Pond Outlet

The City has continued to undertake additional activities following the release of the March 2015 Public Report, including continuation of the High Water Protocol (temporary pumping). A change was made to one (1) of the pumping locations, effective in 2021. In addition, the City purchased three (3) new high capacity 6" pumps which have a much greater capacity than the previously employed pumps (became active in 2020).

Further, the City has continued other supporting activities, such as FDC smoke testing (to identify cross-connections to the FDC system), ongoing CCTV inspection and flushing of the FDC system, and the ongoing sump pump subsidy to residents.

2.2 Studies and Investigations Completed Prior to the release of the March 2015 Public Summary Report

Monitoring Work

Wood initiated field monitoring activities in support of the Lisgar District Basement Water Infiltration study in late 2011 and early 2012. These monitoring activities were intended to collect data in order to better inform the understanding of the operational mechanisms of the drainage systems in the Lisgar District and help identify the source(s) of the basement water infiltration occurrences in this neighbourhood.

Monitoring was conducted for the Foundation Drain Collector (FDC) sewer system, the storm sewer system, surface water (Lisgar Creek), as well as the groundwater system. A comprehensive monitoring program has continued annually since its initiation, to collect field data needed to help understand the cause(s) of basement water infiltration and to provide guidance in finding the appropriate/preferred mitigation measures and also offer feedback on the efficacy of mitigation solutions. The monitoring work has been invaluable in allowing the Team to better understand the drainage systems' response to storm events and help lead the Team towards identifying the cause(s) of basement water infiltration and efficacy of solutions. Table 2.2 provides a summary of the monitoring work completed between 2011 and 2014. Detailed summaries are provided in the 2015 Summary Report (refer to Appendix A) which provide a year-by-year summary of activities and findings of the monitoring effort.

Table 2.2. Monitoring Work Completed between 2011 and 2015

Stormwater System Component	Findings
Groundwater:	
• Monitoring wells were installed at four main sites. • Both water level and water temperature were monitored continuously at these sites.	• Groundwater temperatures in the native soils do not vary greatly and are not affected by precipitation events. • The shallow groundwater levels in the native soils do not increase rapidly enough during precipitation events which proves that basement water infiltration is not caused by flow through the native soils.
FDC and Storm Sewer System:	
• Water level monitoring gauges were installed at various locations within the FDC and storm sewer systems. • Both water level and water temperature were monitored continuously at these sites.	• The FDC system has been observed to surcharge rapidly in response to intense rainfall events along the Black Walnut Trail area. The more downstream areas (Osprey Boulevard) tends to respond more to longer-lasting, higher duration rainfalls and saturated\frozen ground conditions. • Surcharging is most common along Black Walnut Trail and in the vicinity of Doug Leavens Boulevard and Osprey Boulevard, which is generally consistent with locations of reported basement water infiltration. • The short period of time in which the water level in the FDC system has been observed to surcharge and then quickly drop back down strongly suggests that the water is coming in from surface water sources rather than groundwater. • The water temperature data from the observed surcharge events also suggest that the water is coming from surface water sources. • Water levels in the storm sewer along Erin Centre Boulevard, which takes drainage from the FDC system, show that it is not the cause of FDC surcharging.

Stormwater System Component	Findings
Tributary and Stormwater Management Pond: • Water level monitoring gauges were installed and monitored at five different locations along the creek, and one directly within the pond. • A temporary rainfall gauge was installed for two of the earliest monitoring years.	There is nominal creek flow from the GO Station channel, and no apparent connection between these flows and FDC surcharging. • There is no apparent connection between creek flows and FDC surcharging. • There is no apparent connection between water levels within the Osprey Marsh Stormwater Management Pond and FDC surcharging.

Testing Work

To better understand the interactions between the various water sources and components of the drainage system in the Lisgar District, testing work was also undertaken through water sampling and 'in-ground' pilot projects to validate some of the theories. Table 2.3 provides an overview of these findings.

Table 2.3. Testing Work Completed between 2011 and 2015

Stormwater System Component	Findings
Water Quality Characterization: • A characterization program was completed to assess the chemical properties of the water found in: – Native soils (i.e. the groundwater); – Utility trench (i.e. where the municipal services are); – Creek; – Osprey Marsh Stormwater Management Pond; and – FDC system. • The testing was able to identify commonalities among the various different water sources, and in particular the source of the water in the FDC.	• Under expected operating conditions the quality of the water in the FDC system should show some similarities with the shallow groundwater. However, water in the FDC system water was found to be salt rich, similar to the utility trench, the tributary and the pond. This suggests that the water in the FDC system is very similar to surface water (and dissimilar to groundwater).
Storm Sewer Leakage Testing: • Storm sewer leakage testing was undertaken at three sites where basement water infiltration occurred. • The tests were comprised of: – Blocking the storm sewers and filling them with water to replicate surcharge conditions (under pressure); – Addition of a green fluorescent dye to the storm sewer; and – Monitoring of the dye concentrations and water levels in the utility trench, groundwater and FDC system.	• At all three sites, the storm sewers leaked and at two sites (Wild Cherry Lane and Scotch Pine Gate), the dye was detected in the FDC after two hours. • Tests have proven that there is a flow path from the storm sewer to the FDC through the utility trench with a response time consistent with that observed between major storm events and instances of basement water infiltration.

Stormwater System Component	Findings
Storm Sewer Outfall Collar Testing: • Impermeable concrete collars were installed in the utility trench near the outfall of the storm sewers at two locations: – Sixteen Mile Creek (Scotch Pine Gate); and – Osprey Marsh SWM Pond (Pondview Way). • These collars were installed with backflow valves that allow water from the utility trench to drain to the tributary and pond, but not in the other direction in order to attempt to limit surface water inflow to the utility trench.	• Monitoring (ref. 2015 Annual Report) indicated a limited benefit at the Scotch Pine Gate Site. A localized benefit was indicated at the Pondview Way site but this was attributable more to enhanced passive dewatering of the sewer trench to the Osprey Marsh SWM. • In both cases it was concluded that upstream storm sewer leakage was a greater factor than backflow from receiving waterbodies.

Field monitoring activities have continued in parallel annually, in order to support these activities by assessing the effectiveness of mitigation works after implementation and observed changes in drainage system performance over time.

Analysis Work

Wood has used the data collected over the monitoring periods, as well as additional information provided by the City on the FDC system and area services, to conduct a series of technical analyses as follows:

Table 2.4. Analysis Work Completed between 2011 and 2015

Monitoring Component	Findings
Groundwater Analysis • Testing work and analyses were undertaken for native soils and granular materials	• Permeability in the utility trench is up to 10 million times greater than the native soils. This has further confirmed that the utility trench is the primary linkage for surface water to reach the FDC system.
Design Check of the FDC Sewer System • Larger number of residences are currently connected to the FDC system than what was intended in the original design; This was known by the City and area developers and computer modelling demonstrated that the system could accept the higher number of connected residences. • Comparison of original design sizes and slopes of the FDC sewers with as-constructed characteristics demonstrated that some sections of the FDC trunk sewer were constructed flatter than intended, which is expected to decrease the available flow capacity.	• Deficiencies in the as-constructed design of the FDC trunk sewer system may contribute marginally to FDC surcharge, however, given the results of the FDC monitoring, these deficiencies are not considered to be a material contributor to FDC surcharging or a cause of the basement infiltration issue. • Observed FDC surcharging has also been noted in areas which are a considerable distance away from FDC sewer deficiencies, which further suggests that these deficiencies are not a material contributor to the FDC surcharging or a cause of the basement infiltration issue.

Monitoring Component	Findings
Computer Modelling of the FDC System	
• Computer modelling was completed for the FDC sewer system.	• Findings located in the March 2015 Summary Report (Appendix A).

The findings from the monitoring, testing and analysis work completed between 2011 and March 2015 resulted in the identification of the primary cause of infiltration (detailed in Section 3.0) and a Prioritized Action plan (detailed in Section 4.0). This information was presented in the Public Report at a presentation in March 2015 (Appendix A), subsequent to which, the City's focus shifted towards implementation of remediation activities, in order to work towards mitigating the identified cause(s) of the observed basement water infiltration.

2.3 Studies and Investigations Completed Following the release of the March 2015 Public Summary Report

Monitoring Work

Annual monitoring continued following the March 2015 Public Summary Report. Annual monitoring reports have been prepared to summarize these results between 2015 and 2021 inclusive. Additional gauges were added as required to support assessment of specific remedial measures, including storm sewer lining in 2016-2017 (Phase 1 – Black Walnut Trail) and 2017 (Phase 2 – Osprey Boulevard Area; subsequently cancelled). Additional monitoring gauges (FDC and utility trench) were implemented in 2021 following the construction of the permanent FDC pumping station at the Cactus Gate Parkette. Daily data are also available from the pumping station control systems. A general summary of the results of this monitoring is presented in Table 2.5; for more specific and detailed results, refer to the annual monitoring reports.

Table 2.5. Monitoring Work Completed in 2015-2021

Monitoring Component	Findings
Surface Water:	
• Surface water monitoring gauges were maintained or re-installed in key locations throughout the study area to monitor changes in both water levels, as well as water temperature. • Between 26 and 35 water level and water temperature gauges were active during this period: – Between 19 and 24 gauges in the FDC sewer system – Between 3 and 8 gauges in the storm sewer system – Between 2 and 6 gauges in the surface water system (Lisgar Creek and Osprey Marsh SWMF)	• The FDC system has been observed to surcharge rapidly in response to intense rainfall events along the Black Walnut Trail area. The more downstream areas (Osprey Boulevard) tends to respond more to longer-lasting, higher duration rainfalls and saturated\frozen ground conditions. • Surcharging is most common along Black Walnut Trail and in the vicinity of Doug Leavens Boulevard and Osprey Boulevard, which is generally consistent with locations of reported basement water infiltration. • The permanent FDC pumping station is operating as expected and runs regularly for the low flow component as well as during FDC surcharge events. The pumping station has been beneficial in reducing FDC surcharging during several major event. • FDC surcharging continues to occur despite remedial measures (storm sewer lining, catchbasin subdrain plugs, permanent FDC pumping station).

Monitoring Component	Findings
	• Extraneous inflow continues to enter the FDC system; private side connections (i.e. downspouts discharging below surface to the weeping tile) should be disconnected.
Groundwater: • Monitoring wells were maintained or installed in different zones across the study area, including: – Black Walnut Trail (Cactus Gate, Golden Locust, Scotch Pine Gate) – Alderwood Trail – Osprey Boulevard, Waxwing Drive, Prairie Circle, and Waxwing Drive	• Background groundwater monitors (within surficial soils) continue to indicate minimal response to storm events and no correlation to FDC surcharging • Utility trench water levels continue to indicate a much clearer and regular rise and fall in response to storm events • Utility trench water levels downstream of the Cactus Gate FDC pumping station indicated a localized decrease following commissioning, suggesting the pumping station is locally reducing utility trench water levels

Testing Work

Additional storm sewer leakage testing was completed following the first round of storm sewer lining in April 2017. The leakage testing indicated a similar rate of leakage under post-lining conditions as under pre-lining, which was unexpected. The City of Mississauga and Wood investigated further, conducting additional testing into the leakage mechanisms, and determined a high potential for leakage from the subdrains in the catchbasins. On this basis, City staff ultimately proceeded with the installation of catchbasin sub-drain plugs along Black Walnut Trail in October and November of 2017, with a second phase of plugs (Doug Leavens Boulevard to Osprey Boulevard) installed in January of 2018. No additional leakage testing or other direct testing work has been completed since that time.

Analysis Work

In support of the 2018 Class EA, hydraulic modelling of the FDC trunk sewer system was completed using PCSWMM. A unit hydrograph modelling approach was applied for a series of select observed major storm events which resulted in FDC sewer surcharging in order to calibrate the simulated water level responses to observed data from the FDC sewer monitoring gauges noted previously. These analyses allowed for a greater understanding of areas of relatively higher unitary inflows to the FDC sewer system, while also permitting an assessment of potential benefits of flow diversions to FDC pumping stations and estimated pump capacities. The preceding was then used as part of the detailed design effort for the Cactus Gate FDC pumping station. Further details are provided in the 2018 Class EA and the current Hydraulic Assessment Report (refer to Section 5 and Appendix E).

2.4 Summary of Potential Causes

As noted earlier, based on the comprehensive monitoring, testing and analysis work completed prior to March 2015, Wood concluded that the primary cause of the basement water infiltration relates to stormwater entering the utility trench.

As storm sewers are not built to be watertight, and due to cracks and leaks expected through aging, as well as potential other cross-connections from various drainage system components, stormwater is able to leak out during storm events and migrate into the utility trench, where the bedding material, made of gravel and other granular soils can allow water to move very quickly. Over time, water builds up in the utility trench from storm sewer leakage, as well as through other sources (other utilities, groundwater, etcetera),

and is unable to drain away quickly due to the relatively impermeable nature of the native soils surrounding the trench.

It is this situation, in combination with certain storm conditions and local lot drainage where issues may arise. For instance, where the ground and utility trench are already wet, possibly from an earlier storm event, and rainfall subsequently occurs, this may create a condition where there is enough leakage from the storm sewer system during the rainfall event to fill an already wet utility trench and push water up the bedding material around the FDC laterals servicing the homes and into the foundation weeping tiles. This water then drains directly into the FDC pipes through the weeping tiles, which may result in excess flow in the FDC system (surcharge). However, this condition by itself may not lead to basement water seepage. It is this condition, in combination with certain storm conditions (preceding rainfall followed by a sufficiently large storm event) and local lot drainage that may lead to water around the weeping tiles being unable to drain and potentially seeping into the basements of homes. This process is illustrated in Figures 2A to 2F.

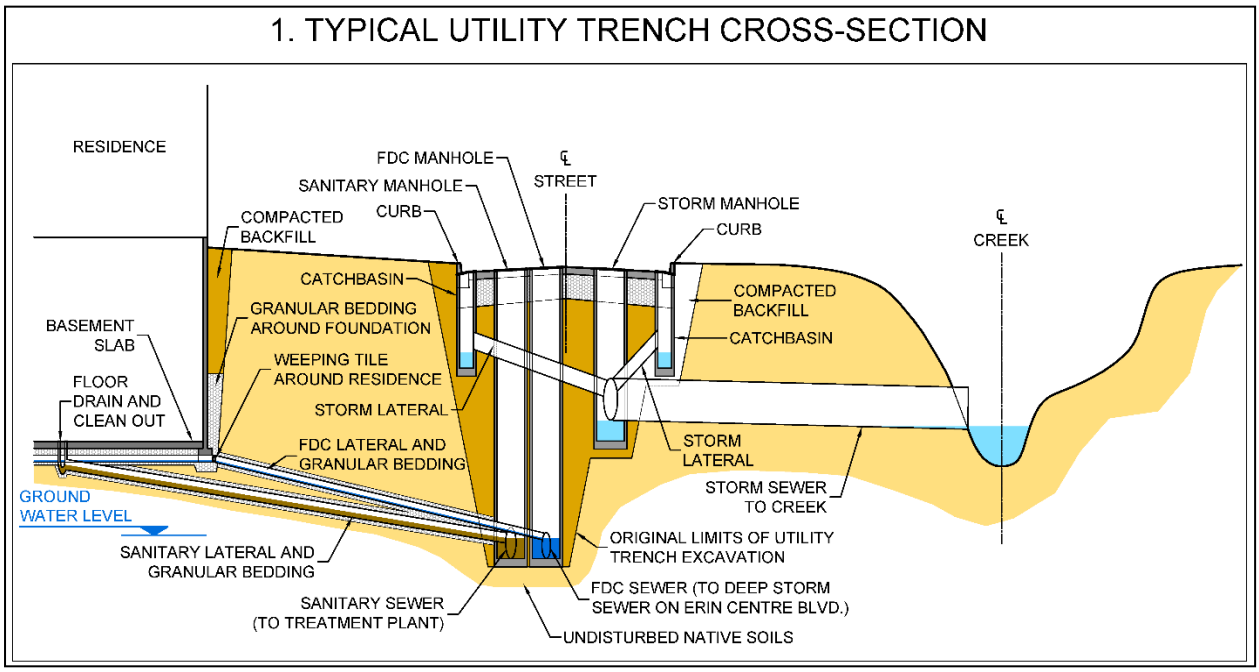

Figure 2A. Typical Residential Roadway Cross-Section showing Utility Trench

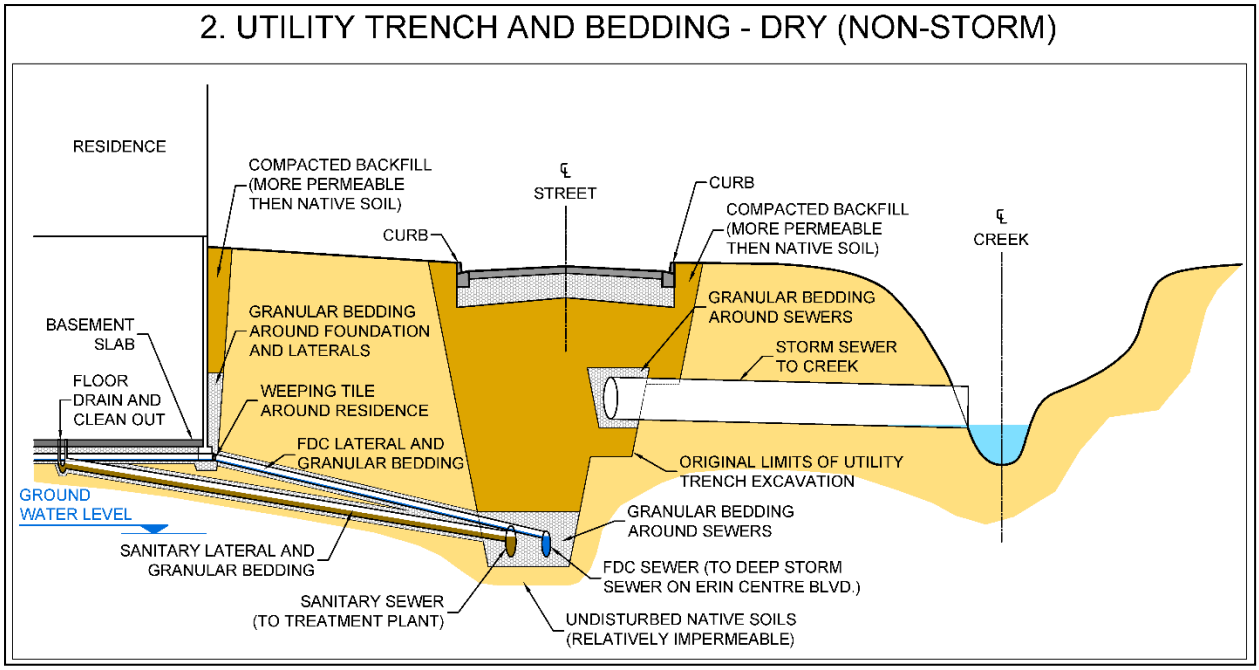

Figure 2B. Cross-Section showing Utility Trench and Granular Bedding during Dry Period

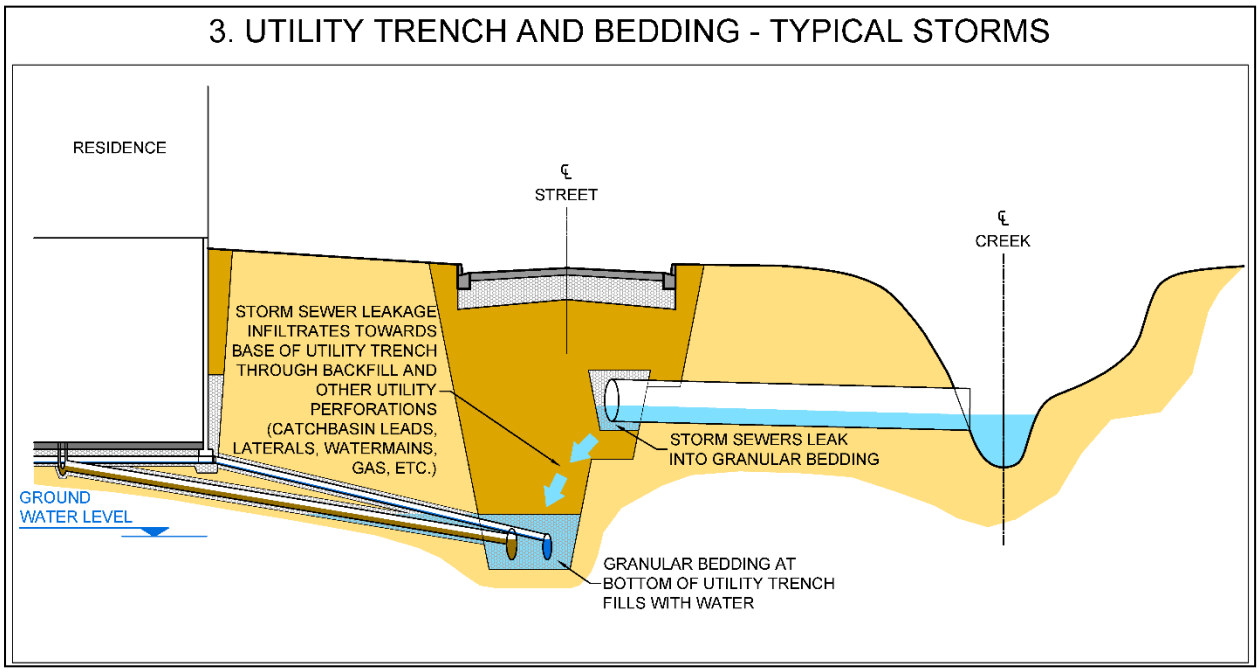

Figure 2C. Cross-Section showing Utility Trench and Granular Bedding During a Typical Storm

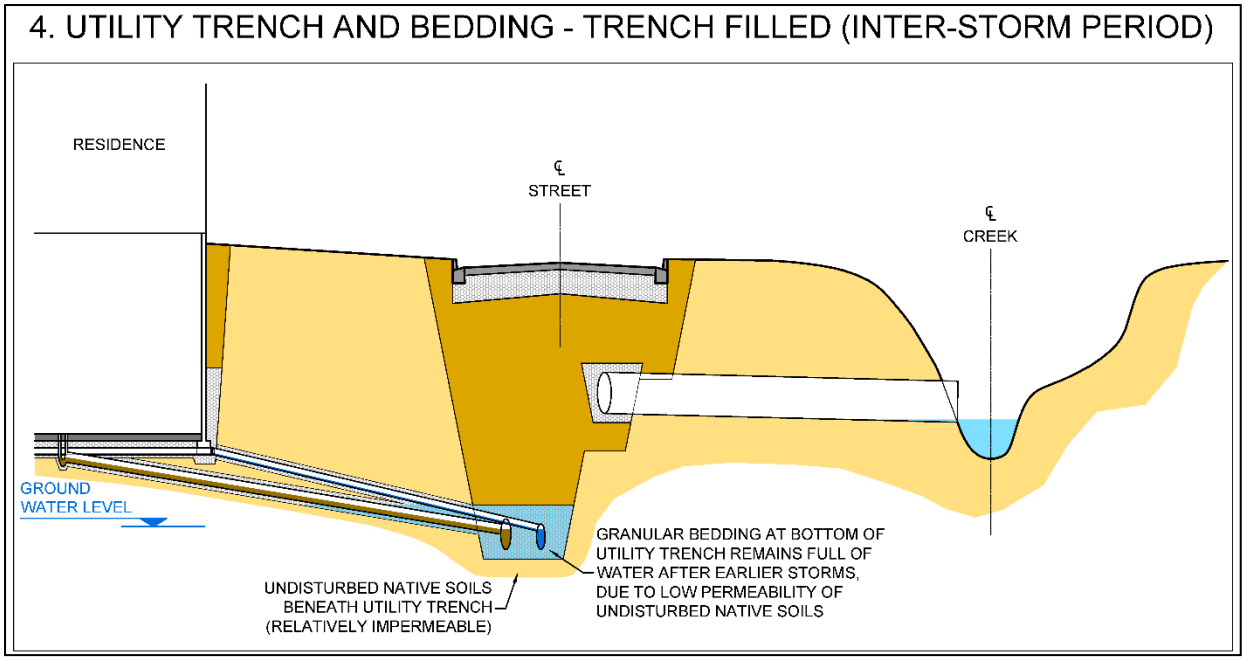

Figure 2D. Cross-Section showing Filling of Utility Trench from preceding Storm Event

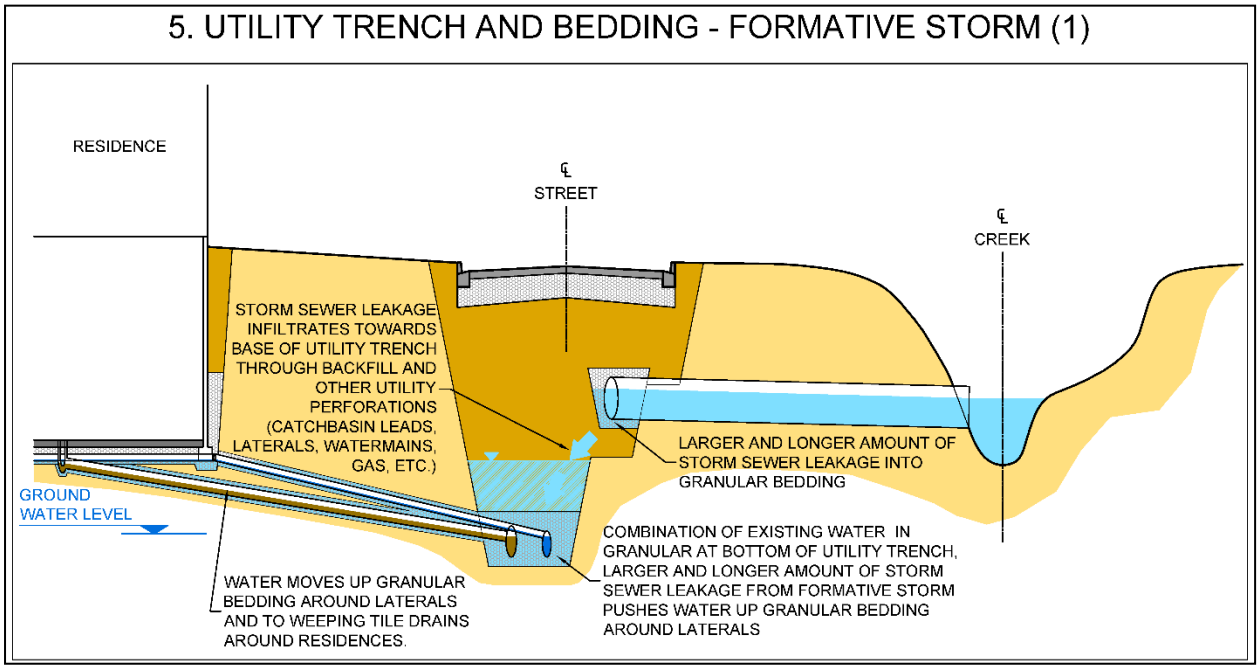

Figure 2E. Cross-Section showing Cumulative Impact during a Formative Storm

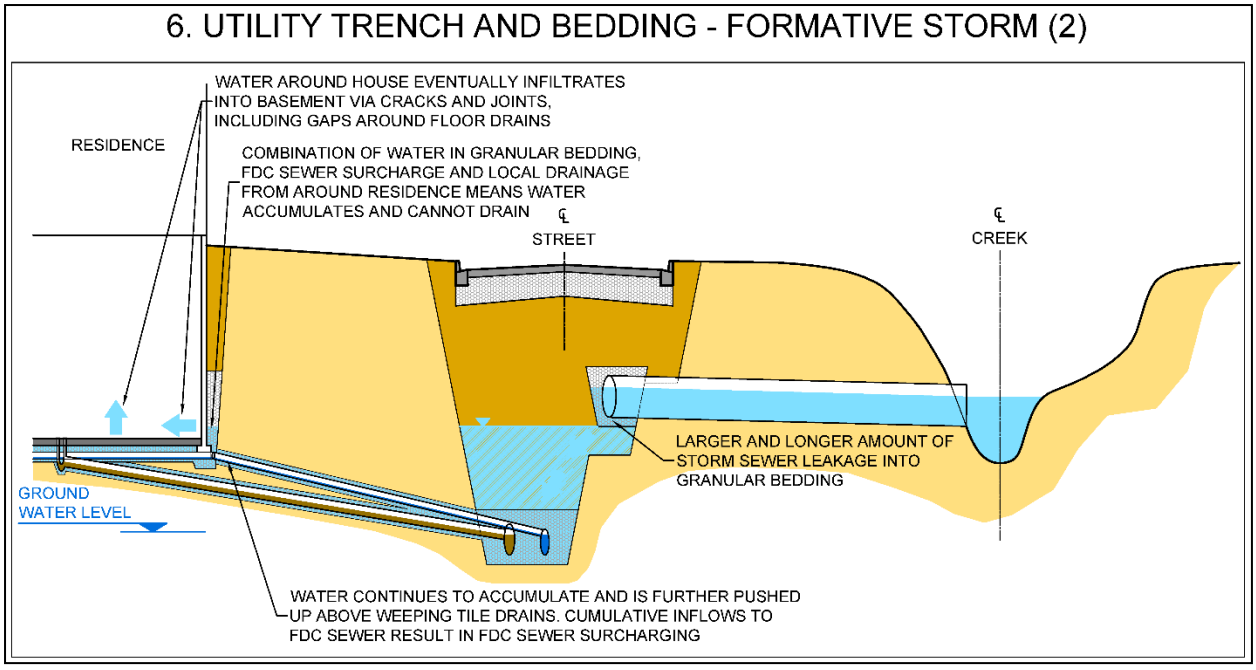

Figure 2F. Cross-Section showing Cumulative Impact during a formative Storm

The exact reasons why homes in the Lisgar District have not had basement water seepage before 2008 are not known. It is however considered that the increasing leakage of water from the storm system through normal aging has gradually increased the volume of water collected in the trenches over time, ultimately contributing to the problems first experienced in 2008.

The risk of basement water infiltration is also connected to the relative depths of the FDC system and basements of homes in the different areas of the Lisgar District. Under the condition where water has moved up the bedding material surrounding the FDC laterals to the homes, the homes placed at greatest risk of basement water infiltration would be those where the FDC system (and thus the utility trench) is the shallowest. In other words, the less vertical separation between the FDC pipe/utility trench and the basements, the more susceptible basements will be to water seepage.

A number of other factors have been identified which may be also impacting the overall operation of the FDC system, however, none of them, either alone or in combination, would cause water to seep in to basements to the extent reported. Table 2.6 provides a summary of Wood's conclusions with respect to the potential contributing factors in the basement water infiltration investigation.

Table 2.6. Summary of Assessment of Potential Factors in Basement Water Infiltration

Potential Factor	Level of Influence
Stormwater to Utility Trench	Primary Cause
FDC and Utility Trench Depths	May increase risk of basement water infiltration at specific locations
Groundwater	May contribute additional/excess flows to the FDC and utility trench (Not sufficient to cause problem)
Creek Backwater	
Osprey Marsh Pond (SWM) Backwater	
Basement Walkouts	
Inflow/Infiltration to FDC	
FDC Hydraulics	May impair conveyance capacity of FDC system (Not sufficient to cause problem)
FDC Design	
FDC Tailwater	
FDC Maintenance	
FDC Construction	
Cross-Connections	Not Applicable
Creek Maintenance	
GO Station	
Sanitary System	
Lot Grading	Insufficient information
Basement Construction / Changes	

3.0 Mitigation Plan for Reducing Basement Flooding

The basement water infiltration investigation and the foregoing conclusions led to a prioritized action plan in 2015, which identified potential mitigation measures intended to reduce the risk of future basement water infiltration. The action plan was subsequently updated in 2017 following further investigations. The plan has not been updated since 2017, although it is periodically revisited by City staff as remediation activities advance and based on supplemental annual monitoring findings.

3.1 Prioritized Action Plan 2015

To address the basement water infiltration issue, eleven (11) alternative actions were developed and evaluated for potential implementation and documented for Public Review in March of 2015. These eleven (11) actions were analyzed by the City and Wood for effectiveness (ability of proposed actions to reduce basement water infiltration) and feasibility (ease of implementation). Through this process, five (5) actions were carried forward to form a Prioritized Action Plan to reduce the risk of basement water infiltration while six (6) actions were screened out. A detailed matrix summarizing each of the eleven (11) alternative actions is provided in Appendix A. The following five actions (ref. Table 3.1) were recommended to be carried forward as mitigation actions to reduce extraneous sources of inflow to the FDC or remove them, based on their effectiveness and feasibility.

Table 3.1. Prioritized Action Plan 2015

Item #	Action	Description
1	Strategic Lining of Storm Sewers	Sealing the inside surface of storm sewers in strategic locations with an impermeable liner to reduce/eliminate leakage into bedding (and ultimately into FDC system).
2	Construction of a Utility Trench Dewatering System	Dewater bedding material around the FDC system to limit the accumulation of water in the utility trench and provide additional storage volume during storm events.
3	Construction of FDC Pumping Stations	Install pumping stations at key locations of the FDC system which will activate when the system either approaches or reaches surcharge conditions and pump water to the ground surface.
4	FDC Sewer Upgrades	Upsizing selected FDC sewers to increase their conveyance capacity and reduce surcharge.
5	Sump Pumps	Homeowner installs a new basement sump pump system to help to drain the weeping tile system around the home; sump pump would discharge to ground surface.

3.2 Updated Action Plan 2017

As discussed earlier, a storm event on July 13-14, 2017 resulted in reported instances of basement water infiltration in the Lisgar District. A total of thirty-five (35) residences within the Lisgar District reported basement water infiltration from the July 13-14, 2017 storm event. All of the affected properties were located along the west side of Black Walnut Trail (i.e. backing onto Lisgar Creek), with the exception of one property located along Golden Locust Trail. This is consistent with the location of previously reported instances of basement water infiltration in this area. The July 13-14, 2017 event is notable in that it was the first reported instance of basement water infiltration in this area (Black Walnut Trail) for which field monitoring data are available. Monitoring gauges were in place for the January 13, 2013 event (for which

seven (7) residences reported basement water infiltration), however all of these residences were in the vicinity of Osprey Boulevard.

Wood summarized and interpreted available monitoring data for the storm event, as well as suggested additional analyses and next steps. A public meeting was subsequently held on October 18, 2017 to provide an update on the ongoing works being completed for the Lisgar District Basement Water Infiltration Study. As part of the public meeting, an Updated Action Plan was presented to remove and respond to sources of excess water to the utility trench and FDC system (ref. Table 3.2).

Table 3.2. Updated Action Plan 2017

Item #	City Actions	Current Status (2022)
1	**Address Roadway Sub-Drain Leakage**	
	• Pursue prototype of roadway sub-drain plugs	Complete
	• Installation of plugs along Black Walnut Trail and other areas	Complete
	• Expansion to other areas within Lisgar District	Ongoing (part of this study)
2	**Construction of a Utility Trench Dewatering System**	
	• Carry Out Municipal Class EA Study	Complete
	• Complete detailed design work	Complete
	• Construction	Complete
3	**Construction of a FDC Pumping Station**	
	• Carry out Municipal Class EA Study	Complete
	• Conduct Hydraulic Modelling Analysis	Complete
	• Complete detailed design work	Complete
	• Construction	Complete
4	**Amend Sump Pump Subsidy Program**	
	• Increased Program Subsidy	Complete
5	**Continue with High Water Protocol**	
	• Continue to monitor and initiate pumping protocol as required	Ongoing
6	**Monitoring**	
	• Implement additional monitoring gauges in key study areas	Complete
	• Monitoring to verify effectiveness of implemented measures	Ongoing

A summary of the work completed since the 2015 Public Report, including many of the tasks noted in Table 3.2, was presented previously in Section 2.3. An FDC Pumping Station (both low and high flow components) was constructed at the Cactus Gate Parkette between 2020 and 2021, based on the recommendations of the 2018 Class EA report.

In addition, one of the actions recommended as part of the Updated Action Plan 2017 was the expansion of the resolution of sub-drain leakage to other areas in Lisgar. In addition, a recommendation was to continue monitoring of the Lisgar District Drainage systems to verify effectiveness of implemented measures. Continued instances of FDC system surcharge were observed after the 2017 Action Plan, including the January 11-12, 2020 event, which resulted in a number of reported incidents of basement water infiltration by area residents. The City of Mississauga therefore initiated the current study (Lisgar District Pumping Stations Class Environmental Assessment) in order to undertake an overall assessment of the Lisgar District drainage system, and to make recommendations for a longer-term plan for the number, preferred locations, and types of pumping stations with the Lisgar District necessary to reduce the potential for basement water infiltration. The review and screening of pumping station alternatives is discussed further in subsequent sections.

4.0 Pumping Stations Alternatives Assessment

4.1 Long-List of Alternative Locations

The Cactus Gate FDC Pumping Station was prioritized in 2018 for construction based on the reported instances of basement water infiltration on Black Walnut Trail based on the assessments completed as part of the 2018 Class EA. For the current Class EA, potential additional locations have been developed for the entirety of the Lisgar District. Fourteen (14) total Potential FDC Pumping Station Locations have been identified, as per Drawing 1 (attached). Long-listed locations have been identified based on:

- Public Land Ownership (park land generally)
- Proximity to the FDC trunk sewer (along Black Walnut Trail and then along Lisgar Creek)
- Proximity to the number of houses with reported incidents of basement water infiltration

The fourteen (14) locations are dispersed along the path of the trunk FDC sewer within the Lisgar District between the CPR (north) and Britannia Road (south) as follows:

- Three (3) north of Derry Road
- Three (3) near Trelawny Circle
- Five (5) between Doug Leavens Boulevard and Osprey Boulevard
- Three (3) near Osprey Marsh

The fourteen (14) long-listed potential alternative locations are as follows:

Location 1. Russian Olive Close at Buttonbush Park

Location 2. Black Walnut Trail at Smoke Tree Road Parkette

Location 3. Black Walnut Trail at Scotch Pine Gate Parkette

Location 4. Lisgar Creek at Forest Park

Location 5. Gracefield Drive at Lisgar Meadowbrook Trail

Location 6. Lisgar Creek at Lisgar Fields

Location 7. Lisgar Creek at Doug Leavens Boulevard

Location 8. Lisgar Creek at Pintail Circle

Location 9. Lisgar Creek at Nutcracker Drive (North)

Location 10. Lisgar Creek at Nutcracker Drive (South)

Location 11. Lisgar Creek at Lisgar Green Park

Location 12. Osprey Marsh at Prairie Circle

Location 13. Osprey Marsh at Lisgar Drive

Location 14. Osprey Marsh at Ninth Line

4.2 Supporting Existing Conditions Assessments

4.2.1 Stage 1 Archaeological Assessment

Wood completed a Stage 1 Archaeological Assessment (AA) in November 2021 to support of this Class EA. Copies of the report were shared with indigenous nations as documented in Section 4.6.3 and Appendix G. The complete report is included in Appendix B for reference. The Study Area for the Stage 1 AA was restricted to the 14 potential pumping station locations along the path of the trunk FDC sewer pipe, covering approximately 9.9 hectares of land (as per Section 4.1; refer to Drawing 1).

Previously, two (2) archaeological assessment reports were completed (by others) detailing archaeological work conducted within 50 metres (m) of the Study Area. Between 1966 and 1985, land use within the Study Area was agricultural, but subdivision development expanded both sides of Sixteen Mile Creek between 1985 and 2005.

Based on the property inspection carried out by Wood on August 13, 2021 the Study Area has general archaeological potential due to the location of natural water sources within 300 m, (including Sixteen Mile Creek), farmsteads and historic roads within 100 m (as per 1858 and 1877 historical atlas mapping), and 40 registered sites within 1 km, including eight (8) registered sites within 300 m of the Study Area. However, based on background research, the entire Study Area has been disturbed. The Stage 1 AA concluded that the Study Area has low archaeological potential due to extensive and intensive disturbance and does not require further archaeological assessment (i.e. does not require a Stage 2 AA). The project information was acknowledged by the Ministry of Heritage, Sport, Tourism and Cultural Industries on August 13, 2021 with the issuance of PIF number P362-0318-2021 (Stage 1).

4.2.2 Cultural Heritage Screening Checklist

Wood completed a Cultural Heritage Screening Checklist to assess the presence of potential Cultural Heritage Features within the study area; a copy is included in Appendix C. Based on the assessment, there are no identified or potential properties of Cultural Heritage Value within the Study Area. Due to this, a Cultural Heritage Evaluation Report (CHER) or Heritage Impact Assessment (HIA) is not required for the Lisgar District for the current Class EA.

4.2.3 Natural Environment Assessment

Existing ecological and aquatic conditions within the study area component of the Lisgar District were evaluated in the Natural Environment Report (NER) completed by Wood in August 2021. A copy of the report is included in Appendix D. The Study Area for the NER includes a 120 m buffer around the Project Location, as depicted in Figure 4.1.

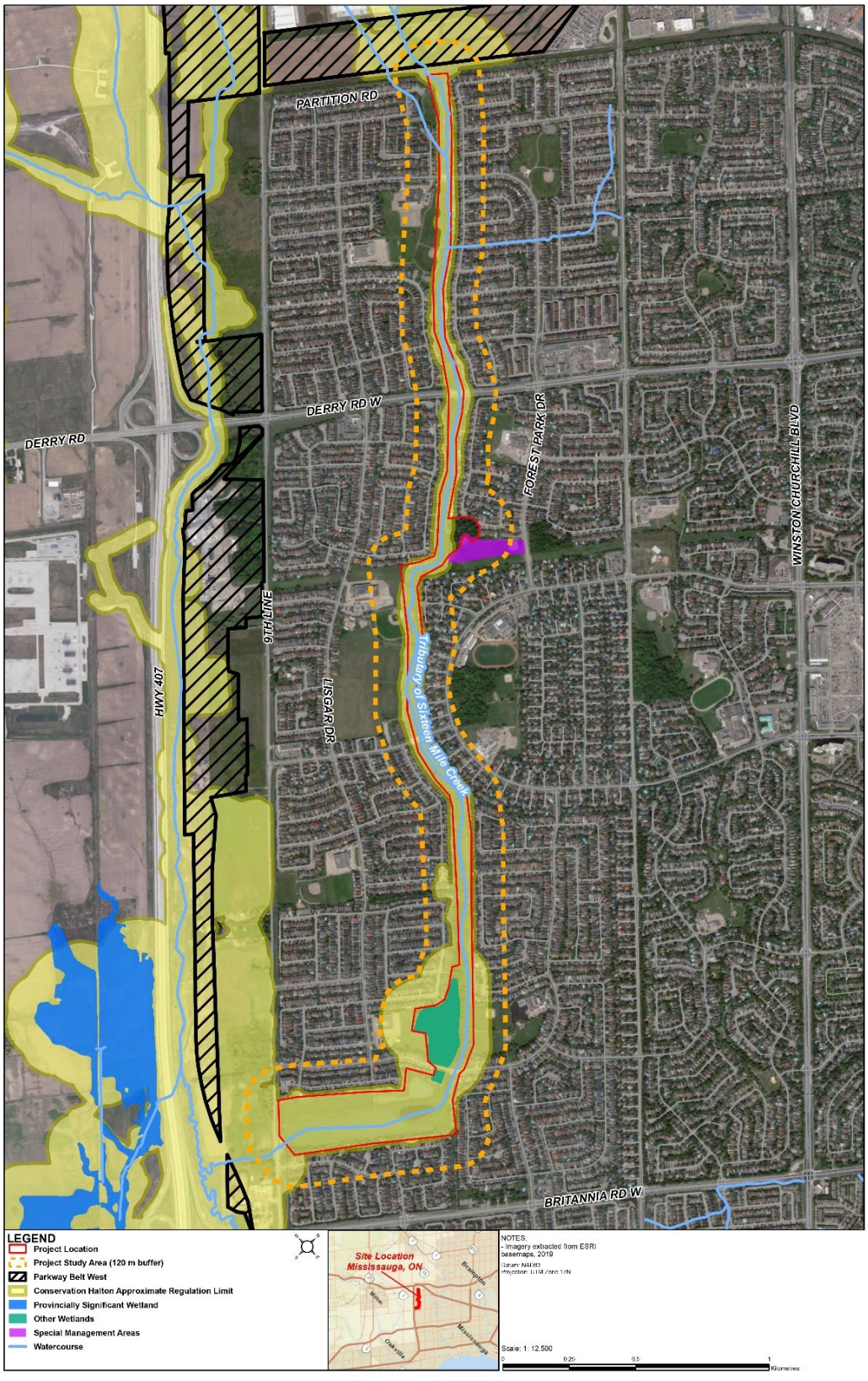

Figure 4.1. Natural Heritage Features within Lisgar District

Terrestrial field investigations were undertaken on May 13, 2021 to confirm vegetation communities, collect botanical information and denote presence of incidental wildlife to support secondary source data. An Ecological Land Classification (ELC) was completed for naturalized vegetation areas within and surrounding the Study Area and then cross referenced with provincially significant vegetation communities identified in the Significant Wildlife Habitat Technical Guide and in the Natural Heritage Information Centre. The remaining naturalized vegetation within the Study Area is along the banks of the tributary of Sixteen Mile Creek, stormwater management ponds, and few small forest patches, with the remaining Study Area used for residential properties, manicured parks, roads, and trails.

Based on background information, 199 species of birds, 56 species of butterflies, 42 species of mammals, 13 species of amphibians, and nine species of reptiles are reported to occur within the Study Area, however the exact locations of species occurrences and ranges were not available. Table 6-1 within the NER examines 24 Species at Risk (SAR) based on probabilities of occurrences and frequency within the Study Area. None of the SAR are defined as "High", meaning that none of those species have a high probability of occurrence within the habitats available within the Study Area. However, there is a "Moderate" potential for the following SAR to be within the Study Area: Canada Warbler, Eastern Wood-pewee, Red-headed Woodpecker, Snapping Turtle, Tricolored Bat, Little Brown Myotis, Northern Myotis, Eastern Small-footed Myotis, and Monarch.

An aquatic habitat assessment was completed on August 25, 2021 with a detailed assessment 50 m downstream to 20 m upstream of the Project Location. 18 species of fish are within vicinity of the Study Area, none of which are SAR.

There are two wetlands present within the Study Area (in the vicinity of Osprey Woods), designated as "Other Wetlands" in the City of Mississauga's Official Plan and "non-Provincially Significant Wetland" by the Ministry of Natural Resources and Forestry (MNRF). Under Section 6.3.12.g of the City's Official Plan, any wetland greater than 0.5 ha should be assessed for local significance, thus the larger wetland (north side of Osprey Boulevard) was classified as a Locally Significant Wetland as it is 3.11 ha. The other wetland (south side of Osprey Boulevard) is 0.16 ha and does not require assessment. The Study Area is located within a Significant Natural Area associated with a tributary of Sixteen Mile Creek, thus Significant Valley lands are present in the Study Area. Overall, the natural heritage features within the area include:

- Public and Private Open Spaces as illustrated in Schedule 4 of the City's Official Plan (2021);
- Green System as illustrated in Schedule A1 of the City's Official Plan (2021);
- Significant Natural Areas and Natural Green Spaces, Special Management Areas, other wetlands, Natural Hazards as illustrated in Schedule 3 of the City's Official Plan;
- One Locally Significant Wetland;
- Five Significant Woodlands; and
- Significant Valley Lands

The following candidate Significant Wildlife Habitat Types are also present within the Study Area:

- Bat Maternity Colonies: The FOD2-2, FOD9-4 and SWD3-1 within the Project Location are considered candidate bat maternity roost habitat
- Turtle Wintering Areas: The tributary of Sixteen Mile Creek and the OAO feature (i.e., natural pond), which are located within the Project Location is considered candidate Turtle Wintering Habitat.
- Reptile Hibernaculum: A total of four potentially suitable rockpiles were present within the Study Area that could indicate SWH
- Amphibian Breeding Habitat (Woodland and Wetland): Some features present within the Study Area may provide suitable habitat for amphibian breeding.
- Habitat for Special Concern Species.

Deadfall in Osprey Woods, providing potential wildlife habitat.

Muskrat in Creek at Osprey Woods.

Osprey Boulevard Bridge habitat facing upstream.

Regenerating habitat along pedestrian path on south end of Study Area.

4.3 Alternative Location Evaluation

4.3.1 Evaluation Criteria

The principal Evaluation Criteria have been identified as follows:

- ***Drainage Area Served****:* The amount of nearby land that will be serviced by the Pumping Stations. A larger drainage area would be considered more positively.
- ***Property Suitability***: The suitability of the property based on public land ownership and local property constraints, such as the amount of public space available (parkette versus City owned easement) and ease of access both for construction and longer-term operations and maintenance. Additional factors related to baseline studies for archaeology, cultural heritage, and ecology (as per Section 4.2) would also be considered under this criterion (i.e. any expected negative impacts related to the social or ecological environment from the proposed works).
- ***Number of Houses in Proximity that Reported Basement Water Infiltration****:* The Pumping Station should be located in proximity to the greatest number of houses that reported basement water infiltration in order to best address the issue. In addition, frequency and severity of observed FDC system surcharging is an additional consideration of risk. Locating a pumping station slightly upstream of directly affected areas generally has the potential for the greatest effectiveness.

As noted, public (City) land ownership contiguous with the creek is considered an important factor/requirement (which was considered as part of the long-listing described in Section 4.1), given the likely inability of the local storm sewer system to serve as the receiver of pumped FDC flows due to its limited capacity (i.e. storm sewers within the Lisgar District originally designed to a 2-year return period standard, given shallow grades and lack of ground cover), and therefore it is considered preferable that any FDC pumping station have a "free" outlet, likely to a surface drainage feature with a direct connection to Lisgar Creek. This would restrict potential FDC pumping stations to locations with immediate access to the creek, given that private property acquisition is considered cost-prohibitive and unlikely to be supported by area property owners.

4.3.2 Evaluation of Long-List of Alternatives

The fourteen (14) long-listed alternatives have been assessed relative to the three (3) principal evaluation criteria previously noted. The scoring has been assessed as either positive, neutral, or negative. The results are presented in Table 4.1.

Table 4.1. Long-List of Alternatives

Potential Pumping Station Locations	Evaluation Criteria			Evaluation
	Drainage Area Served	Property Suitability	# of Reported Cases	Screened/ Short-listed
1. Russian Olive Close at Buttonbush Park	🔴	🟢	🟡	Screened out
2. Black Walnut Trail at Smoke Tree Road Parkette	🟡	🟢	🟢	Short-listed
3. Black Walnut Trail at Scotch Pine Gate Parkette	🟡	🟢	🟢	Short-listed
4. Lisgar Creek at Forest Park	🟢	🟡	🔴	Screened out
5. Gracefield Drive at Lisgar Meadowbrook Trail	🟢	🔴	🔴	Screened out
6. Lisgar Creek at Lisgar Fields	🟢	🔴	🔴	Screened out
7. Lisgar Creek at Doug Leavens Boulevard	🟢	🟡	🟢	Short-listed
8. Lisgar Creek at Pintail Circle	🟢	🟡	🟡	Short-listed
9. Lisgar Creek at Nutcracker Drive (North)	🟢	🔴	🟡	Screened out
10. Lisgar Creek at Nutcracker Drive (South)	🟢	🔴	🟡	Screened out
11. Lisgar Creek at Lisgar Green Park	🟢	🟡	🟢	Short-listed
12. Osprey Marsh at Prairie Circle	🟢	🟡	🟢	Short-listed
13. Osprey Marsh at Lisgar Drive	🟢	🔴	🟡	Screened out
14. Osprey Marsh at Ninth Line	🟢	🟡	🔴	Screened out

🟢 Positive 🟡 Neutral 🔴 Negative

Based on the preceding screening and evaluation of alternatives, two (2) locations within three (3) separate areas of interest have been short-listed for an FDC pumping system.

- Black Walnut Trail Area
  - Location 2 – Black Walnut Trail at Smoke Tree Road Parkette
  - Location 3 – Black Walnut Trail at Scotch Pine Gate Parkette
- Doug Leavens Boulevard and Pintail Circle Area
  - Location 7 – Lisgar Creek south of Doug Leavens Boulevard
  - Location 8 – Lisgar Creek at Pintail Circle
- Osprey Boulevard Area
  - Location 11 – Lisgar Creek at Lisgar Green Park
  - Location 12 – Osprey Marsh at Prairie Circle

The six (6) short-listed locations have been further assessed through additional technical analyses (individually and in combination) using integrated hydrologic/hydraulic modelling; this is summarized in Section 4.5. All six locations are on public lands, in close proximity to FDC trunk sewer and near areas with greater instances of reported basement water infiltration or observed FDC surcharging. Further discussion of each of the short-listed locations is provided in Section 4.3.3.

4.3.3 Details of Short-Listed Locations

4.3.3.1 Location 2: Black Walnut Trail at Smoke Tree Road Parkette

This location refers to the parkette on the west side of Black Walnut Trail, directly adjacent to Smoke Tree Road. An FDC pumping system in this location would serve an area of approximately 38.6 ha. This includes overlap with the upstream area served by the existing Cactus Gate FDC pumping station (9.8 ha). Contributing drainage areas are presented in Drawing 2 (attached).

The parkette is publicly owned (City of Mississauga), which is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern. The parkette is wider than others in the area (27 m).

Local traffic would be impacted during the construction work, as it is expected that the intersection would need to be closed during construction, as was the case for the pumping station at Cactus Gate. There are no MiWay transit routes which use this section of Black Walnut Trail. Pedestrian access would be a concern, as the site includes a section of the Lisgar Meadowbrook Trail and a pedestrian bridge across Lisgar Creek to Stonewood Park. Impacts to this feature would need to be carefully considered, including potential to keep the bridge open during construction. The access to Black Walnut Trail via the parkette would have to be closed regardless, which would temporarily direct pedestrians 200 m +\- to the south to Scotch Pine Gate to access the trail at that point.

No constraints associated with archaeology, cultural heritage, or ecology were identified with the site. Although not considered directly in the ecological assessment, there are at least five (5) trees which would require removal; there are another three (3) trees which would require further assessment to determine the need for removal. A portion of the site would be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application and careful attention to grading disturbances within these areas.

Based on comments from the City's Parks group (as provided to Wood July 29, 2022), the Smoke Tree site (Location 2) is generally preferred over the Scotch Pine Gate site (Location 3) as it has less trees which require removal, although efforts to retain as many trees as possible should be made. The importance of retaining the pathway between Black Walnut Trail and the Lisgar Meadowbrook Trail post-construction was noted, as was maintaining access to the pedestrian bridge throughout construction.

A summary of affected properties upstream of the Smoke Tree Road location is presented in Table 4.2. For the purposes of quantifying the potential benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of the extent of direct potential benefit.

Table 4.2. Summary of Previously Affected Properties near Smoke Tree Road

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	17	26	43
January 13, 2013	7	0	0	0
July 14, 2017	36	15	21	36
January 11-12, 2020	41	0	8	8
August 28, 2021	5	0	4	4
TOTAL[1]	**230**	**32 (14%)**	**59 (26%)**	**91 (40%)**

1. Includes properties affected multiple times

Based on the data provided in Table 4.2, a large number of previously affected properties would be in proximity to the proposed pumping station and potentially benefit from the PS. Upstream of the potential location, between 15 and 17 properties would have benefitted for two (2) storm events. Downstream of the potential location, between 4 and 26 properties would have benefitted for four (4) storm events.

In addition to the material presented in Table 4.2, it is noted that frequent FDC surcharging has been observed at this location. Smoke Tree Road is just downstream of monitoring gauge F1 which based on previous annual monitoring reports has experienced FDC surcharging (of varying degrees) 28 times since monitoring began in 2012 to the end of 2021 (or an average of 2.8 times per year). This is the most frequently observed surcharging location of all available monitoring gauges within the Lisgar FDC system.

4.3.3.2 Location 3: Black Walnut Trail at Scotch Pine Gate Parkette

This location refers to the parkette on the west side of Black Walnut Trail, directly adjacent to Scotch Pine Gate. An FDC pumping system in this location would serve an area of approximately 86.1 ha (this again includes overlap with the Cactus Gate FDC pumping station serving 9.8 ha). Relative to Location 2, the total area served for Location 3 includes an additional 2.8 ha of drainage contributing to Black Walnut Trail and a portion of Snowball Road, and a much larger area served by the FDC system along Scotch Pine Gate (approximately 44.6 ha). Contributing drainage areas are presented in Drawing 2 (attached).

The parkette is publicly owned (City of Mississauga), which as noted is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern. The parkette is slightly narrower than Location 2 (24 m as compared to 27 m).

Local traffic would be impacted during the construction work, as it is expected that the intersection would need to be closed during construction, as was the case for the pumping station at Cactus Gate. There are no MiWay transit routes which use this section of Black Walnut Trail. There is an access to the Lisgar Meadowbrook Trail through the parkette which would need to be closed during construction. Access would be diverted to Smoke Tree Road. The potential to keep the main trail open during construction would need to be confirmed.

No constraints associated with archaeology, cultural heritage, or ecology were identified with the site. Although not assessed in the ecology report, there are approximately 10 +\- trees that may require removal; further assessment would be required. A portion of the site would be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application.

As noted in the discussion of Location 2, the City's Parks Department noted (comments received July 29, 2022) that the Scotch Pine Gate site was less preferred than the Smoke Tree Road site, given the larger number of tree removals required.

A summary of affected properties upstream of the Scotch Pine Gate location is presented in Table 4.3. For the purposes of quantifying the potential benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of direct potential benefit.

Table 4.3. Summary of Previously Affected Properties near Scotch Pine Gate

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	27	16	43
January 13, 2013	7	0	0	0
July 14, 2017	36	24	12	36
January 11-12, 2020	41	4	4	8
August 28, 2021	5	2	2	4
TOTAL[1]	**230**	**57 (25%)**	**34 (15%)**	**91 (40%)**

1. Includes properties affected multiple times

Based on the data provided in Table 4.3, the total number of properties within 1 km would be consistent with those for the Smoke Tree Road Location. In this case there would be a greater number of potentially benefitting properties upstream of the location, due to the shift downstream. Between 2 and 27 properties would have benefitted upstream (4 storm events), while between 2 and 16 properties would have benefitted downstream (4 storm events).

In addition to the information presented in Table 4.3, it is noted that frequent FDC surcharging has been observed in this area. Scotch Pine Gate is just upstream of monitoring gauge F6. Based on previous annual monitoring reports, this location has experienced FDC surcharging (of varying degrees) 16 times since monitoring began in 2012 to the end of 2021 (or an average of 1.6 times per year). Observed FDC surcharging upstream (at gauge F1) occurs even more frequently, as noted previously.

Monitoring has previously been undertaken for the large contributing area along Scotch Pine Gate (44.6 ha) to confirm the proportion of FDC flows from this area. Gauge F27 was located between Terragar Boulevard and Lowville Heights (sufficiently upstream to avoid backwater from the trunk FDC) and recorded data for the 2018, 2019 and early 2020 monitoring periods. For observed surcharge events along Black Walnut Trail (including July 5 and August 21, 2018, and January 11-12, 2020) a minimal response was indicated at this location; no surcharging was indicated for either of the 2018 storm events that resulted in notable surcharging along Black Walnut Trail. For the January 11-12, 2020 event (which resulted in observed basement water infiltration), the results do indicate a minor FDC surcharge at this location for the January 12, 2020 storm only (0.69 m relative to 0.375 m pipe diameter) which was far less than the observed surcharging along Black Walnut Trail relative to the contributing drainage area, suggesting that much greater inflows are occurring closer to this area, and not from the Scotch Pine Gate branch. Gauges along Black Walnut Trail also indicated a surcharge for the January 11, 2020 storm, while there was no observable response at gauge F27.

4.3.3.3 Location 7: Lisgar Creek south of Doug Leavens Boulevard

This location refers to the area of open space along the east side of Lisgar Creek, just south of Doug Leavens Boulevard. An FDC pumping system in this location would serve a total area of 211.9 ha. Contributing drainage areas are presented in Drawing 2 (attached).

The area within the creek block is publicly owned (City of Mississauga), which as noted is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern. Access would still be via a primary road.

Local traffic would be slightly impacted during the construction work, as it is expected that a construction access and staging area would likely be required along Doug Leavens Boulevard. The road is 3 lanes wide and thus could accommodate a temporary lane closure for construction. There are no MiWay transit routes which use this section of Doug Leavens Boulevard. The section of Lisgar Meadowbrook Trail in this area is currently temporarily closed by the City and therefore would not be expected to impact construction. Any future plans for the trail would however need to be considered as part of the design.

No constraints associated with archaeology, cultural heritage, or ecology were identified with the site. Some localized tree removals would likely be required in order to develop the access from Doug Leavens Boulevard. A portion of the site would be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application.

A summary of affected properties in the vicinity of the site is presented in Table 4.4. For the purposes of quantifying the potential benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of direct potential benefit.

Table 4.4. Summary of Previously Affected Properties near Doug Leavens Boulevard

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	9	48	57
January 13, 2013	7	0	1	1
July 14, 2017	36	0	0	0
January 11-12, 2020	41	0	11	11
August 28, 2021	5	0	0	0
TOTAL[1]	**230**	**9 (4%)**	**60 (26%)**	**69 (30%)**

1. Includes properties affected multiple times

Based on the data provided in Table 4.4, the majority of properties which would benefit from a PS in this location would be downstream of the potential location, most notably along the Alderwood Trail area. A number of properties are indicated in this location for the October 19/20, 2011 and January 11-12, 2020 events.

In addition to the material presented in Table 4.4, it is noted that frequent FDC surcharging has been observed in this area. Gauge F3 is located near the location of the potential pumping station location along the FDC trunk sewer. Based on previous annual monitoring reports, this location has experienced FDC surcharging (of varying degrees) 25 times since monitoring began in 2012 to the end of 2021 (or an average of 2.5 times per year). This is one of the most frequently observed surcharging location of all available monitoring gauges within the FDC system, second only to locations along Black Walnut Trail.

4.3.3.4 Location 8: Lisgar Creek at Pintail Circle

This location refers to the area of open space along the east side of Lisgar Creek, adjacent to a pedestrian walkway from Pintail Circle. An FDC pumping system in this location would serve a total area of 220.0 ha. Contributing drainage areas are presented in Drawing 2 (attached).

The area within the creek block is publicly owned (City of Mississauga), which is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern.

Construction access would be a challenge for this location. Although manual access is possible via the pedestrian pathway from Pintail Circle, the access is considered too narrow to permit construction vehicle access (as well as longer-term operations and maintenance access). The location is currently used as a High Water Protocol temporary pumping site; access is from Lisgar Green Park to the south along the Lisgar Meadowbrook Trail (nearly 1 km to the south). It is expected the entire section of the Lisgar Meadowbrook Trail would require temporary closure during construction.

No constraints associated with archaeology, cultural heritage, or ecology were identified with the site. Some localized tree removals would potentially be required in order to support construction. A portion of the site would be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application.

A summary of affected properties in the vicinity of the site is presented in Table 4.5. For the purposes of quantifying the potential benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of direct potential benefit.

Table 4.5. Summary of Previously Affected Properties near Pintail Circle

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	10	47	57
January 13, 2013	7	0	1	1
July 14, 2017	36	0	0	0
January 11-12, 2020	41	0	11	11
August 28, 2021	5	0	0	0
TOTAL[1]	**230**	**10 (4%)**	**59 (26%)**	**69 (30%)**

1. Includes properties affected multiple times

Based on the data provided in Table 4.5, the potentially benefitting properties would generally be common to those for Location 7, generally downstream of the proposed location. As noted for Location 7, FDC sewer surcharging is frequently noted at the upstream gauge F3 near Doug Leavens Boulevard, as well as a gauge on the local FDC sewer from Alderwood Trail which is generally affected by tailwater levels from the trunk sewer along Lisgar Creek.

4.3.3.5 Location 11: Lisgar Creek at Lisgar Green Park

This location refers to the area of open space along the east side of Lisgar Creek, adjacent to the Lisgar Meadow Brook Trail in Lisgar Green Park. An FDC pumping system in this location would serve a total area of 258.2 ha. Contributing drainage areas are presented in Drawing 2 (attached).

The area within the creek block is publicly owned (City of Mississauga), which is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern.

No direct traffic impacts would be expected given the location is not along a roadway. Construction access would likely be via the main entrance to Lisgar Green Park at Osprey Boulevard and Grossbeak Drive. This access would need to be carefully managed to ensure safe access for pedestrians and also vehicles. It is likely that a portion of the park would need to be closed during construction. The portion of Lisgar Meadowbrook Trial would also likely need to be closed during construction.

No constraints associated with archaeology, cultural heritage, were identified with the site.

Ecological constraints have been identified given that the existing FDC sewer is located along the edge of Osprey Woods and the associated wetland area. Any works in this area would likely require additional review with MECP for Species at Risk, and may require further study. It is expected that some localized tree removals would potentially be required, in order to allow for a diversion from the trunk FDC sewer, which is located in the wooded area on the west side of Lisgar Meadowbrook Trail.

A portion of the site would also be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application.

A summary of affected properties in the vicinity of the site is presented in Table 4.6. For the purposes of quantifying the potential benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of direct potential benefit.

Table 4.6. Summary of Previously Affected Properties near Lisgar Green Park

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	45	64	109
January 13, 2013	7	1	6	7
July 14, 2017	36	0	0	0
January 11-12, 2020	41	11	20	31
August 28, 2021	5	0	0	0
TOTAL[1]	**230**	**57 (25%)**	**90 (39%)**	**147 (64%)**

1. Includes properties affected multiple times

Based on the data provided in Table 4.6, there is a split of potentially benefitting properties upstream and downstream of the proposed location. Upstream areas generally include the Alderwood Trail area; downstream areas include Osprey Boulevard and Prairie Circle, and Pondview Way.

In addition to the information presented in Table 4.6, it is noted that frequent FDC surcharging has been observed in this area. Gauge F4 is located along the trunk FDC sewer along the Osprey Marsh berm. Based on previous annual monitoring reports, this location has experienced FDC surcharging (of varying degrees) 18 times since monitoring began in 2012 to the end of 2021 (or an average of 1.8 times per year).

4.3.3.6 Location 12: Osprey Marsh at Prairie Circle

This location refers to the area of open space along Lisgar Meadowbrook Trail on the east side of Osprey Marsh, south of Osprey Boulevard. An FDC pumping system in this location would serve a total area of 311.2 ha. Contributing drainage areas are presented in Drawing 2 (attached).

The Osprey Marsh area is publicly owned (City of Mississauga), which is clearly advantageous. This location would also avoid having operating components of the system within the roadway right-of-way, which would be a long-term operations and maintenance concern.

No direct traffic impacts would be expected given the location is not along a roadway. Construction access would likely be via the Lisgar Meadowbrook Trail at Osprey Boulevard. This portion of Lisgar Meadowbrook Trail would also likely need to be closed during construction.

Temporary High Water Protocol (HWP) pumping is currently undertaken at this location. This would need to be relocated during construction, potentially downstream to Lisgar Drive\Pondview Way or Ninth Line.

No constraints associated with archaeology, cultural heritage, were identified with the site.

It is noted that there is a small area of identified wetland in proximity to the site, however no direct impacts to this area are expected as it is located on the far side of the existing creek. Buffer requirements would still need to be considered. Some localized tree removals may be required. Grading requirements and potential impacts to the creek would require further assessment.

A portion of the site would be within the regulated area of Conservation Halton (floodplain and stable top of bank hazards for Lisgar Creek) and would necessitate a permit application.

A summary of affected potential benefitting properties in the vicinity of the site is presented in Table 4.7. For the purposes of quantifying the benefit, properties located within 1 km upstream and downstream of the site have been considered to provide a reasonable estimate of direct potential benefit.

Table 4.7. Summary of Previously Affected Properties near Osprey Marsh

Storm Event	Total # Affected	Total # Upstream within 1 km of Potential Location	Total # Downstream within 1 km of Potential Location	Total # Within 1 km of Potential Location
October 19/20, 2011	141	83	26	109
January 13, 2013	7	7	0	7
July 14, 2017	36	0	0	0
January 11-12, 2020	41	31	0	31
August 28, 2021	5	0	0	0
TOTAL[1]	**230**	**121 (53%)**	**26 (11%)**	**147 (64%)**

1. Includes properties affected multiple times

The data provided in Table 4.7 are generally similar to those for Site 11. The balance between locations upstream and downstream is shifted slightly, with a greater number upstream. Localized observed FDC surcharging in this area would be consistent with results noted previously for Site 11 for the gauge along the Osprey Marsh berm.

4.4 Types of Pumping Stations

4.4.1 Utility Trench Dewatering Pumping System (Low Flow)

A Utility Trench Dewatering Pumping Station is a system that operates to dewater the utility trench (granular stone bedding) by removing small amounts of water on a continuous basis, much like a residential sump pump. The intent of the utility trench dewatering system for the Lisgar District is to dewater bedding material within the sewer utility trench to limit the accumulation of water, and thus provide additional storage volume during storm events.

The previously constructed system at the Cactus Gate Parkette included a low flow (utility trench) dewatering pumping system; relevant drawings and excerpts are included in Appendix E. The constructed design included a granular area (filled with clearstone) around the utility trench (FDC and sanitary sewers), surrounded by a geomembrane to limit interaction with groundwater in the surrounding native soils (the geomembrane is open at the upstream limits to allow inflow however). At the downstream end, a concrete collar was constructed along the lowest portion of the utility trench system (FDC and sanitary sewers) to block the movement of infiltrated water from travelling further downstream. Backflow valves were included as overflows to the granular bedding downstream in the event of an excessive accumulation of utility trench water, while preventing backflow from the downstream area. The clearstone drainage collection area is

then drained by a series of perforated pipes which direct drainage to a new maintenance hole. The collected flow is then directed to the pumping station wet well.

It is expected that not all of the proposed locations will incorporate the utility trench dewatering pumping system. Locations near or along residential roads (where there would be numerous residential lateral connections and a connected utility trench) would be the focus for this form of pumping system. Short-listed locations 2 and 3 would therefore potentially include a low flow pumping system, consistent with that implemented at the Cactus Gate FDC pumping station. Locations which may be located along the FDC trunk sewer along Lisgar Creek (i.e. short-listed locations 7, 8, 11 and 12) would likely not warrant this component, given the longer distance from residential street utility trenches and the greater potential for a disconnection in the utility trench bedding to these areas.

4.4.2 FDC Pumping System (High Flow)

An FDC Pumping Station differs from a utility trench dewatering system in that it operates to remove water from the FDC pipe network directly during periods of high flow. This pump would be larger but operate less frequently and only during certain storm or snowmelt events.

In general, this system would require a new diversion sewer to be connected to the FDC pipe system. The diversion pipe would be set somewhat above the elevation of the existing pipe, such that it would not activate until FDC water levels exceed the capacity of the existing pipe. The diversion pipe would need to be sufficiently sized to ensure conveyance of FDC surcharge flows to a dedicated pumping system, notionally a large diameter maintenance hole or underground tank with a wet well to capture excess flow. Pumps within this system would then re-direct the diverted water to Lisgar Creek, similar to the low flow system described earlier. Unlike the low flow system however, much larger capacity pumps would be required to ensure that pumping rates are sufficient to re-direct FDC surcharge at approximately the rate of inflow.

The constructed system at the Cactus Gate Parkette included a high flow component (refer to drawings included in Appendix E). The diversion sewer was set at the springline (half-way elevation) of the existing FDC sewer to divert high flows towards a wet well, which in turn discharges flows to surface to Lisgar Creek. The pumps were sized based on the expected required capacity for the high flow system since as noted, this governs over the low flow pumping requirements.

It is expected that all of the proposed FDC pumping systems will include the high flow component, as this is fundamental to the intent of managing FDC surcharging and associated impacts to basement water infiltration.

4.5 Technical Evaluation of Short-Listed Alternatives

4.5.1 Overview and Methodology

In order to support an informed planning process for the locations and capacities of potential FDC pumping stations, an analytical (modelling) tool is required to assess expected rates of flow within the FDC system during storm events, and the associated effectiveness of potential pumping strategies (locations, numbers, and pump station sizing/capacities). The focus of this assessment has been upon the observed response and associated capacity during high flow events, as these events would govern the capacity of the required pumping systems and mitigation measures.

Note that due to the nature of the Low Flow System (utility trench dewatering), there is no valid technical analysis technique to evaluate the distinct performance of one site versus another site. As such, for the technical evaluation, only the high flow system has been assessed, with the inherent understanding that the

low flow system (utility trench dewatering) would share the same location where such a system is considered appropriate (i.e. namely locations 2 and 3). Notionally, by capturing infiltrated water from the utility trench system on an ongoing basis, it is expected to further improve the overall performance of the combined system. Low flow operations also have the benefit of exercising the pumps regularly, rather than being on standby until a sufficiently large storm event occurs.

A hydraulic model of the FDC sewer system was previously developed (PCSWMM modelling software) as part of the assessment work in support of the March 2015 Public Summary Report. This model was used for a number of different assessments, including forensic modelling of an actual storm event based on available FDC monitoring data.

This hydraulic modelling was then further refined as part of the previously completed Class EA (2018). A key refinement incorporated into that modelling was the application of a unit hydrograph type approach to "calibrate" the modelling to the observed water level responses in the FDC sewer system (as available from monitoring gauges) for several formative storm events. This pseudo-calibration approach identified areas of greater and lesser relative inflows to the FDC system using a linear scaling factor, along with the contributing drainage areas to each inflow point. Once calibrated, the modelling was then applied to assess mitigation measures, specifically flow diversions to potential FDC pumping stations. Based on this modelling approach, the Cactus Gate Parkette was identified as the preferred location.

As part of the current study, a similar approach has been applied. Further details are provided in the Hydraulic Assessment Report (refer to Appendix F). The scope of the modelling has been extended however to include the entirety of the FDC sewershed network, down to the FDC trunk sewer outlet to the deep storm sewer system along Churchill Meadows Boulevard just south of Erin Centre Boulevard. In addition, an updated review of potential storm events was completed, using the most currently available monitoring data. Events were selected based on the magnitude of observed FDC surcharging and reports of basement water infiltration, as well as geographic impact to ensure that all areas were considered. As noted previously, water levels in the north area (Black Walnut) tend to increase very quickly to thunderstorm type events whereas the water levels in the south area (Doug Leavens to Osprey) tend to increase more to long-lasting saturated ground type events. Based on the screening completed, simulation events included:

- January 13, 2013
- June 12, 2014
- April 16, 2018
- January 11-12, 2020
- August 3, 2020
- August 28, 2021

For several of the preceding events, the City's High Water Protocol (HWP) was in place. As such, representation of the performance benefits associated with the pumps was necessarily included in the forensic modelling to ensure an accurate representation of flows and water levels.

Once developed, the modelling has been applied to assess the short-listed FDC pumping stations noted previously (with the assumption of no HWP in place). Overall, it is considered appropriate to approach the modelling assessment from upstream to downstream, given that any mitigation measures constructed upstream would be expected to benefit areas downstream as well. As such, any pumping stations recommended for upstream areas are included in the assessment of downstream areas.

Furthermore, a preference is noted for minimizing the number of additional pumping stations, if possible. Even though two (2) locations have been short-listed for each area, if the modelling indicates that one (1) pumping station is sufficient to address the FDC surcharge or if upstream pumping stations can address the issues, this would be the preference due to the associated costs, construction timelines, and long-term

operations and maintenance. If two (2) pumping stations are within close proximity, the more upstream location would benefit the greater number of properties.

A detailed technical summary of the hydraulic modelling has been included in Appendix F; the following provides a summary of the work completed and the associated findings.

4.5.2 Results

4.5.2.1 Black Walnut Trail Area

The key storm events selected for simulation of this area were:

- January 11-12, 2020
- August 3, 2020
- August 28, 2021

Within this area, the Cactus Gate Pumping Station was previously constructed and began operating in March 2021. However, it is considered there is limited to no additional capacity within this pumping station, as such the focus is upon potential additional pumping stations at location 2 (Smoke Tree Road) and/or location 3 (Scotch Pine Gate).

An additional pumping station at Smoke Tree Road was found to be beneficial in reducing FDC system surcharging. A peak flow of up to 0.13 m^3/s (130 L/s) would be required to be pumped based on the modelling.

A second pumping station at Scotch Pine Gate is considered to be of limited value as it reduces the effectiveness of the upstream location, but this option can be reviewed in the future with supplemental monitoring data. A stand-alone pumping station at Scotch Pine Gate (i.e. instead of one at Smoke Tree Road) would provide a similar overall benefit.

Residual FDC sewer surcharging was noted in some upstream areas. Given that the Cactus Gate pumping station cannot reasonably address all FDC surcharging in that area, other mitigation measures, such as local conveyance (FDC sewer pipe) upgrades (exact extents to be determined as part of future study) and measures to reduce FDC system inflows (such as downspout disconnections), are recommended, as a high number of connections have been observed in this area specifically. This area may also benefit from additional flow diversions and pumping stations downstream.

4.5.2.2 Doug Leavens Boulevard and Pintail Circle Area

The key storm events selected for simulation of this area were:

- June 12, 2014
- April 16, 2018
- January 11-12, 2020
- August 28, 2021

Potential pumping stations at locations 7 (Doug Leavens Boulevard) and 8 (Pintail Circle) were assessed using the preceding events. It was determined that an additional pumping station at Doug Leavens Boulevard would be beneficial in reducing FDC system surcharging. A peak flow of up to 0.22 m^3/s (220 L/s), would be required to be pumped based on the modelling.

A second pumping station at Pintail Circle is considered to be of limited value as it reduces the effectiveness of the upstream location, but this option can be reviewed in the future with supplemental monitoring. Location 7 is considered preferred as a stand-alone location to Location 8 for non-technical reasons, in

particular its ease of access for construction and longer-term operations and maintenance (access to Pintail Circle would require access via Osprey Boulevard and Lisgar Green Park some 1 km to the south).

Residual FDC sewer surcharging was noted in some upstream areas along Lisgar Creek. Given the limited number of residences affected by surcharge in this area, additional measures may warrant further consideration, such as local conveyance (FDC sewer pipe) upgrades (exact extents to be confirmed as part of future study) and measures to reduce FDC system inflows (such as downspout disconnections). This area may also benefit from additional flow diversions and pumping stations downstream.

4.5.2.3 Osprey Boulevard Area

The key storm events selected for simulation of this area were:

- January 13, 2013
- April 16, 2018
- January 11-12, 2020
- August 28, 2021

Potential pumping stations at locations 11 (Lisgar Green Park) and 12 (Osprey Marsh) were assessed using the preceding events. Based on a further technical review, a pumping station at location 11 was determined to be infeasible due to a conflict with the existing trunk sanitary sewer. As such, only the technical benefit of location 12 (Osprey Marsh) was assessed further. A pumping station at Osprey Marsh would be beneficial in reducing FDC system surcharging. Modelling indicates a peak flow of up to 0.27 m^3/s (270 L/s). Given the large capacity required in this case, a greater amount of space may be required for a pumping station which may necessitate localized adjustments to grading, potentially requiring a scoped re-alignment of Lisgar Creek at Osprey Marsh. This would need to be considered further as part of preliminary and detailed design.

Downstream of Osprey Marsh along Ninth Line, there is a residual FDC surcharge indicated for the area and further considerations may be required, including a potential additional pumping station closer to Ninth Line and conveyance upgrades (FDC sewer upsizing or relief sewers; exact extents to be determined as part of future study). Optimization of the proposed Osprey Marsh pumping station, such as some type of restrictor to limit discharge to the FDC sewer, is considered to be the preferred approach, given the challenges associated with other potential measures.

Residual FDC surcharging also continues to be indicated in upstream areas along Lisgar Creek (Derry Road to Doug Leavens Boulevard). Further pump station optimization and localized conveyance upgrades should again be considered in this area. Overall, downspout disconnections and other additional measures to reduce FDC system inflows should also be pursued.

4.5.2.4 Summary of Recommendations and Additional Considerations

Based on the technical hydraulic modelling assessment, future FDC pumping stations are recommended at:

- **Location 2 - Smoke Tree Road Parkette**
- **Location 7 – Doug Leavens Boulevard**
- **Location 12 – Osprey Marsh**

It should be noted that the benefits of a pumping station at Location 3 – Scotch Pine Gate are however generally similar to Location 2 (Smoke Tree Road) and could be considered as an alternative location depending on other non-technical factors. Overall, Location 2 is a slightly wider parkette, on a slightly less busy road, and is nearer to the most frequent area of observed FDC surcharge as compared to Location 3 and has therefore been advanced as the preliminary preferred location.

Given the nature of the proposed locations, a combined low flow and high flow pumping system is recommended for Location 2 (Smoke Tree Road). Locations 7 and 12 are located along the trunk FDC sewer further downstream and away from urban road utility trenches; as such only high flow pumping systems are recommended at these locations.

In addition, several aspects should be considered with respect to the proposed mitigation measures, summarized below.

- Regardless of the recommendations for permanent pumping stations, reduction of inflow into the FDC sewer should be maintained as a primary focus for the City as this will reduce demands of any retrofit mitigation measures and result in both immediate and long-term benefit to reducing the potential for basement water infiltration. The primary focus would be expected to be disconnection of residential roof downspouts which discharge below surface and presumably into the weeping tile system (and thus into the FDC sewer system).
- Residual capacity and future retrofitting potential (wet well, pumps and forcemain sizing) should be incorporated as part of the overall pump station design effort to provide additional resiliency in the event of future inflows greater than those estimated by the modelling work.
- Refinements and adjustment to the preliminary pump station capacities and layouts will likely occur as part of the preliminary and detailed design, and considerations should be made for diversion pipe sizing, wet well dimensions, pump capacities, grading, and utilities. This would also be expected to include orifice plates or other restrictors to force a greater proportion of FDC sewer flow to pump stations and away from the FDC sewer system.
- A backup generator is recommended to be included for all pumping stations so that the system can continue to function in the event of a potential power failure.
- Other remedial measures, including localized FDC sewer upgrades (especially between Gracefield Drive and Doug Leavens Boulevard due to the general unobstructed nature of the area; exact extents to be confirmed as part of future study) may potentially be a more cost-effective solution than additional pumping stations (above and beyond the primary recommended locations). Localized upgrades in the upper area of the sewershed (Terragar Boulevard and Golden Locust Drive area) are also recommended.

- Annual monitoring of the FDC network and related drainage systems should be continued to evaluate system performance and incremental benefit of remedial measures. Pumping station control systems should also be designed to incorporate data loggers to record pumped flows and volumes at a sufficient time step to support integration with the overall monitoring program.

4.6 Consultation Program

Engagement has been undertaken with Indigenous Nations, government agencies, the public, and property owners, for comments and feedback on the expansion of pumping stations within the Lisgar District. Formal consultation was initiated with the Notice of Commencement publication on April 29, 2021. Various methods of informal and formal communication have been employed throughout Class EA process, which are documented in Appendix G.

A Public Information Centre (PIC) was held to present the preceding findings to the public on November 17, 2021. Notification was issued in advance to area residents, key stakeholders, and indigenous communities. Copies of relevant materials are included in Appendix G.

4.6.1 Communication and Engagement Activities

To ensure that Indigenous Nations and stakeholders had the opportunity to influence the Project design, opportunities for engagement and comment were provided in a diverse set of engagement methods, including:

- Online engagement at www.mississauga.ca, where participants could learn more about the project and provide feedback via email or comment form;
- Notifications and email updates;
- Correspondence with utilities, conservation authorities;
- Notifications to, and discussions with, Property Owners;
- Notifications to Indigenous Nations; and
- Virtual Public Meeting.

4.6.2 Key Project Contacts and Stakeholders

A project contact list was developed at the outset of the Project and maintained throughout the duration. The list consisted of the following groups: members of the public, property owners, Indigenous Nations, review agencies (federal, provincial, municipal and conservation authorities), elected representatives, utility companies, transit authorities, community/interest groups and others.

Agencies

Provincial and Municipal Government, Conservation Authorities and Related Municipal Bodies

- Ministry of the Environment, Conservation and Parks (MECP)
- Ministry of, Tourism, Culture and Sport (MTCS)
- Region of Peel
- Credit Valley Conservation
- Conservation Halton

Elected Officials

Members of Parliament (MPs)

- Mississauga-Streetsville – Rechie Valdez

Members of Ontario Provincial Parliament (MPPs)

- Mississauga-Streetsville – Nina Tangri

City/Town Councillors and Regional Councillors

- City of Mississauga – Sue McFadden (Ward 10)

Other Stakeholders

Rail

- Canadian National Rail

Utilities

- Alectra
- Hydro One Networks
- Enbridge Pipelines Inc.

- Bell Canada

Stakeholder Groups / Public

- Lisgar Residents' Association
- Directly impacted property owners
- General public

4.6.3 Indigenous Consultation

Indigenous Nation engagement is a key component of the Class EA process. As previously noted, the Ministry of the Environment, Conservation and Parks (MECP) delegated the procedural aspects of the duty to consult to the City of Mississauga in its response to the Notice of Commencement on May 21, 2021. On May 21, 2021, the MECP advised that engagement should occur with the following Indigenous Nations:

- Haudenosaunee Confederacy Council as represented by the Haudenosaunee Development Institute (HDI),
- Huron-Wendat Nation (HWN),
- Mississaugas of the Credit First Nation (MCFN), and
- Six Nations of the Grand River (SNGR).

The official delegation of the duty to consult from the MECP was received on June 16, 2021. Following understood consultation protocols with for these Indigenous Nations, Wood contacted the Nations at specific milestones throughout the Study. On July 19, 2021, Wood provided each Nation with a cover letter, a plain language project summary and Notice of Study Commencement. Wood followed up by phone and email with each Nation to determine interest in the Study on August 6, 2021.

On February 1, 2022, Wood provided the Nations with an update on the Study, the Notice of PIC, the PIC slides, draft Stage 1 Archaeological Assessment and draft Natural Heritage Existing Conditions Report. Due to the COVID-19 pandemic, many of the Nations preferred correspondence and information to be conveyed by email.

A summary of consultation with each Indigenous Nation is provided below, and records of Indigenous Consultation are provided in Appendix G.

4.6.3.1 Haudenosaunee Confederacy Council as represented by the Haudenosaunee Development Institute (HDI)

Following the initial outreach on July 19, 2021, and August 6, 2021, the following engagement occurred with HDI:

- July 27, 2021 (phone call and email) and August 6, 2021 (phone call and email), HDI identified interest to receive /review natural environment studies, and participation opportunities in fieldwork.
- September 9, 2021 (email), the Project Team responded explaining the aquatic and terrestrial fieldwork was completed on May 13, 2021 and apologized for the oversight in failing to inform HDI prior to the activity. There was no further response from HDI on this matter.
- February 1, 2022 (email), the Project Team provided an update on the Study, including links to the PIC slides and the draft Stage 1 Archaeological Assessment and Natural Heritage Existing Conditions Report. The Project Team followed-up via email and phone on February 23, 2022 to ensure HDI confirmed receipt of the reports and to seek any feedback from HDI regarding the reports provided.

- No comments were received.

4.6.3.2 Huron-Wendat Nation (HWN)

Following the initial outreach on July 19, 2021, and August 6, 2021, the following engagement occurred with HWN:

- August 11, 2021 (email), HWN identified interest to participate in all archaeological fieldwork for this Study, and to receive copies of the draft reports for review and comment.
- August 17, 2021 (email), the Project Team identified the Stage 1 Archaeological Assessment was ongoing and the draft report will be provided to HWN for review and comment.
- February 1, 2022 (email), the Project Team provided an update on the Study, including links to the PIC slides and the draft Stage 1 Archaeological Assessment and Natural Heritage Existing Conditions Report. The Project Team followed-up via email and phone on February 23, 2022 to ensure HWN confirmed receipt of the reports and to seek any feedback from HWN regarding the reports provided.
- February 10, 2022 (email), HWN responded asking if there are any archaeological studies or fieldwork necessary for this Study and if there was funding available to review the reports and provide recommendations.
- February 14, 2022 (email), the Project Team responded to HWN to state there was no fieldwork left to be conducted, and the City would provide funding for report review.
- February 16, 2022 (email), HWN asked if comments could be submitted by April 1, 2022.
- February 23, 2022 (email), the Project Team confirmed that April 1, 2022 was acceptable for the comment deadline for the Stage 1 Archaeological Assessment and Natural Heritage Existing Conditions Report. The Project Team followed up on April 28, 2022 to ask for a timeline to receive the comments.
- No comments were received.

4.6.3.3 Mississaugas of the Credit First Nation (MCFN)

Following the initial outreach on July 19, 2021, and August 6, 2021, the following engagement occurred with MCFN:

- August 6, 2021 (email), MCFN responded identifying interest in participating in the field work.
- September 9, 2021 (email), the Project Team responded explaining the aquatic and terrestrial fieldwork was completed on May 13, 2021 and apologized for the oversight in failing to inform MCFN prior to the activity. There was no further response from MCFN on this matter.
- February 1, 2022 (email), the Project Team provided an update on the Study, including links to the PIC slides and the draft Stage 1 Archaeological Assessment and Natural Heritage Existing Conditions Report. The Project Team followed-up via email and phone on February 23, 2022 to ensure MCFN confirmed receipt of the reports and to seek any feedback from MCFN regarding the reports provided.
- February 23, 2022 (email): MCFN stated file access issues with the links provided, which the Project Team rectified on the same day and MCFN confirmed access to the files..
- No comments were received.

4.6.3.4 Six Nations of the Grand River (SNGR)

Following the initial outreach on July 19, 2021, and August 6, 2021, the following engagement occurred with SNGR:

- February 1, 2022, the Project Team provided an update on the Study, including links to the PIC slides and the draft Stage 1 Archaeological Assessment and Natural Heritage Existing Conditions Report.
- February 1, 2022 (email), SNGR stated file access issues with the links provided, which the Project Team rectified on the same day and SNGR confirmed access to the files..
- March 16, 2022 (email), SNGR requested access to the draft Stage 1 Archaeological Assessment, which the Project Team provided on the same day.
- No comments were received.

4.6.4 Project Notices

The Notice of Commencement was published through the Mississauga News on April 21, 2021. A public notice was published through the Mississauga News prior to the Public Information Centre (PIC), as well as prior to the Notice of Commencement and Notice of Completion. Table 4.8 below summarizes all notices circulated as part of the Project. Copies of these notices can be found in Appendix G.

Table 4.8: Summary of Notices

Type	Medium	Language	Location	Date
Notice of Commencement	Newspaper	English	Mississauga News	April 21, 2021
Notice of Public Information Centre	Virtual	English	Email	November 5, 2021

4.6.5 Public Consultation

On November 17, 2021 from 7:00 to 8:30pm EST the City of Mississauga hosted the Public Information Centre (PIC) for the Lisgar District Pumping Station EA and Town Hall. Due to the ongoing COVID-19 pandemic and gathering restrictions the meeting was held virtually through www.mississauga.ca. Notification for the PIC was sent to residents and the Lisgar Residents' Association ahead of time via email. Consultation and feedback from the Lisgar Residents' Association is available in Appendix G.

The session was planned as a dual-purpose information event, with a presentation of both the findings of the current Class EA as well as an overall Town Hall Update Session to explain the City's High Water Protocol program (including recent improvements) as well as other ongoing initiatives (FDC smoke testing for cross-connections, ongoing sump pump subsidy program, etcetera). Councilor Sue McFadden provided an introduction to the PIC due to her involvement in the community and past projects within the Lisgar District. As well, the meeting provided the opportunity to understand any concerns surrounding the project so responses can be incorporated into the final reports.

The project website was: https://www.mississauga.ca/projects-and-strategies/environmental-assessments/lisgar-district-pumping-stations-study/ and participants could communicate by submitting a Comment Form via email to the City by December 1, 2021. The Public Information Centre Presentation can be found in Appendix G. Letters to property owners adjacent to the three proposed pumping station were provided after the PIC for further follow up and feedback from directly affected property owners.

Residents were provided the opportunity to submit written questions during the event. City and Wood staff provided answers live during the event as well. Questions received during the event as well as those sent thereafter were compiled into a summary Question and Answer summary (refer to Appendix G).

Questions relevant to the current Class EA included those regarding the existing Cactus Gate Pumping Station as well as Future Pumping Stations. There were questions regarding the capacity of the existing Cactus Gate Pumping Station and concern about the proximity of the proposed additional pumping station at Smoke Tree Road, including its potential impact to the pedestrian bridge and access to the adjacent park and schools. Pumping station capacity and size was an area of interest, as were aesthetics (potential to construct features below ground to the extent possible) and noise impacts and disruption to adjacent residents. A complete copy of questions and answers has been included along with copies of the PIC materials in Appendix G.

Table 4.9: Summary of Key Public Information Centre Details

Category	Details
Date	November 17, 2021 from 7:00pm to 8:30pm EST
Location	www.mississauga.ca.
Number of Attendees	Approximately 40
Number of Questions/Comments Received	47 (refer to Appendix G for questions and responses)
Project Information Presented	• Background Information and Update on Cactus Gate Pumping Station and Monitoring Program – provided a history of basement water infiltration issues in the area, previous public consultation, and the construction and implementation of the Cactus Gate Pumping Station • Lisgar District Pumping Station Class Environmental Assessment – description of Class EA, location assessment for potential pumping stations, and introduction of preliminary preferred solution

5.0 Preferred Solution and Implementation Plan

5.1 Pumping Stations and Implementation

The alternative assessment (ref. Section 4) has determined the Preferred Solution to involve the construction of three (3) separate FDC pumping systems. Overall, it is considered preferred to implement the pumping stations in sequence from upstream to downstream, as the flow reduction benefits of removing extraneous water upstream will also benefit downstream FDC trunk sewer capacity. In general, a greater number of affected properties are located upstream (i.e. along Black Walnut Trail). Based on the preceding, the proposed prioritization in order from highest to lowest is:

1) Location 2 - Black Walnut Trail and Smoke Tree Road
2) Location 7 – Lisgar Creek south of Doug Leavens Boulevard
3) Location 12 - Osprey Marsh

Preliminary concept plans for each of the preceding three (3) locations have been presented in Drawings 3a, 3b, and 3c respectively. These concept plans are necessarily generalized. It is expected that these plans will be further refined as part of the subsequent preliminary and detailed design process.

Location 2 is proposed as a combined low flow\high flow pumping system. Locations 7 and 12 are proposed as high flow only pumping stations.

As noted previously, and consistent with some comments received from area residents (refer to Section 4.6), the design effort should consider residual capacity and future retrofitting potential (wet well, pumps and forcemain sizing) to provide additional resiliency in the event of future inflows greater than those estimated by the modelling work. Additional considerations should also be made for diversion pipe sizing, and the need to consider orifice plates or other restrictors to force a greater proportion of FDC sewer flow to pump stations and away from the FDC sewer system for further optimize their function. Other typical detailed design factors would require consideration, including potential utility conflicts and also servicing requirements (electrical and natural gas supplies). Backup generators are recommended to be included for all FDC pumping stations, so that they can continue to operate in the event of a power failure (which could occur during a storm event, particular a thunderstorm).

Given that the works will be designed and implemented sequentially, opportunities for design improvements should be considered where feasible (i.e. "lessons learned" from previous projects).

It is expected that City staff will seek Council approval for the required capital funding to support the preliminary and detailed design and construction of the preferred solution (i.e. 3 FDC pumping stations). As per the November 17, 2021 PIC, the City has proposed to sequence the works on an annual basis (subject to council approval):

- Location 2 (Smoke Tree Road)
    - Design and tender preparation over the course of 2022
    - Construction over the course of 2023
- Location 7 (Doug Leavens Boulevard)
    - Design and tender preparation over the course of 2023
    - Construction over the course of 2024
- Location 12 (Osprey Marsh)
    - Design and tender preparation over the course of 2024
    - Construction over the course of 2025

5.2 Potential Impacts and Mitigation

Based on the preceding, further potential impacts and issues have been considered, along with a proposed mitigation strategy. These considerations are presented generally (for all three (3) sites) in Table 5.1. The preceding potential impacts and mitigation measures should be implemented into the subsequent detailed design phase for the FDC pumping systems. Specific considerations for each of the three (3) sites, building off the alternative evaluation considerations noted in Section 4.3.3, are presented thereafter in Tables 5.2 to 5.4.

Table 5.1. General Mitigation Considerations

Subject	Impact / Issue	Mitigation / Action
Construction	• Traffic • Noise • Dust • Vibration • Excess Soil	• Management plan (staging, traffic management, erosion and sediment control) required to meet City standards • Contractor will ensure City requirements are met • Pre-construction condition surveys of adjacent residences are proposed • Active vibration and settlement monitoring during construction • Ensure requirements of Excess Soil Regulations are followed including characterization and appropriate off-site re-use or disposal depending on results
Operation	• Noise • Odour • Maintenance	• Pumps will be deep below ground and operate infrequently; noise would be expected to be minimal • Backup generator would operate infrequently; an enclosed model should be considered, and a noise assessment undertaken if required as part of environmental approvals process • Discharges would be stormwater flows (not sanitary) filtered through aggregate material - no odour is anticipated • Purposeful maintenance access to be specifically designed from adjacent roadways • Provide consideration of interaction with pedestrian traffic and trails as required
Aesthetics	• Pumps • Other features • Parkette • Buildings	• Pumps would be well below ground and not visible from the parkette. • Wet well structure would need to extend slightly above the ground surface but generally minor; design can consider opportunities to place as much as possible below the surface • Electrical (control) panel and backup generator should be located along the edge of the parkette to the extent possible. Enclosure "wraps" can be considered which provide a more natural look, as was done for the Cactus Gate Pump Station. • Landscape plan will be created for restoration, and should review opportunities to camouflage features where possible

Subject	Impact / Issue	Mitigation / Action
		• Permanent structures (buildings) will be minimized to the extent possible; may be required for larger capacity pumping stations.
Creek Discharge	• Outlet	• All pumping stations are necessarily located adjacent to creek; Conservation Halton permit may be required if works within regulated area or if local channel requires widening/reinforcement to accept additional discharges from system or potentially relocation based on space constraints.
Climate Change	• Resiliency	• Pumping station and utility dewatering trench will add capacity to overall system, providing resiliency to changing climate. Consideration for "upsizing" during detailed design.

Table 5.2. Specific Mitigation Considerations for Location 2 (Smoke Tree Road)

Subject	Impact / Issue	Mitigation / Action
Social Environment	• Road and Trail Closures during construction • Road and Trail restoration	• Communicate intersection closure (Black Walnut Trail and Smoke Tree Road) well in advance to residents (prior to construction start) and provide workable detour routes. Communicate updates on schedule regularly. • Make efforts to keep the pedestrian bridge open throughout construction as well as the connection to the Lisgar Meadowbrook Trail (diversion to Scotch Pine Gate access). • Ensure road is properly restored and matches to existing roadway. • Ensure re-construction restores trail connection between Black Walnut Trail and Lisgar Meadowbrook Trail and the pedestrian bridge.
Natural Environment	• Tree impacts • Creek impacts • Soil impacts	• Confirm number of trees to be removed (5 to 8) through further study and minimize to the extent possible. Removal timing to comply with applicable timing requirements. Protect remaining trees throughout construction. Ensure replacements are consistent with requirements of City Parks group and utilize native species. • Minimize disturbance to the creek to the extent possible by re-using existing overland swale to the extent possible. • Consider characterization requirements of Excess Soil Regulations as part of field work in support of design. Ensure all excess soil is re-used or disposed in compliance with results and regulations. Ensure appropriate ESC controls throughout construction to avoid migration of soil.
Permits	• Environmental Compliance Approval (ECA)	• An ECA will be required from MECP for the works; to be submitted through the City's Transfer of Review (TOR) authority, and potentially through pending Consolidated Linear Infrastructure (CLI-ECA) program

Subject	Impact / Issue	Mitigation / Action
	• Permit to Take Water (PTTW) and/or Environmental Activity and Sector Registry (EASR) • Conservation Halton • Road Occupancy Permit • Park Access Permit	• Review findings of geotechnical\hydro-geological field investigation to determine whether a PTTW is required from MECP for the permanent operation of the low-flow dewatering system. It is expected that a short-term PTTW or EASR for dewatering during construction phase; to be determined based on expected flow rates. • A CH permit for works within a regulated area is expected to be required. Confirm works are adequately floodproofed and do not impact existing floodplain (cut/fill). • City permits (ROP and PAP) to be applied for prior to construction. Parks permit to consider tree management strategy as noted for natural environment.

Table 5.3. Specific Mitigation Considerations for Location 7 (Doug Leavens Boulevard)

Subject	Impact / Issue	Mitigation / Action
Social Environment	• Road and Trail Closures during construction • Road and Trail restoration	• Limit road closures to the extent possible given arterial nature of Doug Leavens Boulevard. Communicate any closures well in advance to residents (prior to construction start) and provide workable detour routes. Communicate updates on schedule regularly. • No trail impacts expected given that this section of trail is not currently open. However, ensure design does not limit any future opportunities to re-open or use the trail on this side of Lisgar Creek.
Natural Environment	• Tree impacts • Creek impacts • Soil impacts	• Confirm number of trees to be removed through further study and design and minimize to the extent possible. Removal timing to comply with applicable timing requirements. Protect remaining trees throughout construction. Ensure replacements are consistent with requirements of City Parks group and utilize native species. • Minimize disturbance to the creek to the extent possible by locating pumping station outfall further up and away from primary creek. • Consider characterization requirements of Excess Soil Regulations as part of field work in support of design. Ensure all excess soil is re-used or disposed in compliance with results and regulations. Ensure appropriate ESC controls throughout construction to avoid migration of soil.
Permits	• Environmental Compliance Approval (ECA)	• An ECA will be required from MECP for the works; to be submitted through the City's Transfer of Review (TOR) authority, and potentially through pending Consolidated Linear Infrastructure (CLI-ECA) program

Subject	Impact / Issue	Mitigation / Action
	• Permit to Take Water (PTTW) and/or Environmental Activity and Sector Registry (EASR) • Conservation Halton • Road Occupancy Permit • Park Access Permit	• It is expected that a short-term PTTW or EASR for dewatering during construction phase; to be determined based on expected flow rates from hydro-geological study in support of future design work. • A CH permit for works within a regulated area is expected to be required. Confirm works are adequately floodproofed and do not impact existing floodplain (cut/fill). • City permits (ROP and PAP) to be applied for prior to construction. Parks permit to consider tree management strategy as noted for natural environment.

Table 5.4. Specific Mitigation Considerations for Location 12 (Osprey Marsh)

Subject	Impact / Issue	Mitigation / Action
Social Environment	• Road and Trail Closures during construction • Road and Trail restoration	• Limit road closures to the extent possible given arterial nature of Osprey Boulevard. Communicate any closures well in advance to residents (prior to construction start) and provide workable detour routes. Communicate updates on schedule regularly. • It is expected that the section of Lisgar Meadowbrook Trail will require closure during construction. Provide alternative routes and detour mapping. • Re-locate high water protocol (HWP) temporary pumping to an alternative location as required, such as Lisgar Drive\Pondview Way or Ninth Line. • Ensure re-construction restores all trail connections and park and trail amenities (benches, etcetera).
Natural Environment	• Tree impacts • Wetland impacts • Creek impacts • Soil impacts	• Confirm number of trees to be removed through further study and design and minimize to the extent possible. Removal timing to comply with applicable timing requirements. Protect remaining trees throughout construction. Ensure replacements are consistent with requirements of City Parks group and utilize native species. • Ensure wetland limits and setbacks are accounted for as part of work and no disturbance to this area. • Minimize disturbance to the creek to the extent possible by locating pumping station outfall further up and away from primary creek. Depending on extents of pumping station scoped creek re-alignment may be required. Ensure supporting studies are completed to mitigate any potential impacts including a thorough staging plan for construction.

Subject	Impact / Issue	Mitigation / Action
		• Consider characterization requirements of Excess Soil Regulations as part of field work in support of design. Ensure all excess soil is re-used or disposed in compliance with results and regulations. Ensure appropriate ESC controls throughout construction to avoid migration of soil.
Permits	• Environmental Compliance Approval (ECA) • Permit to Take Water (PTTW) and/or Environmental Activity and Sector Registry (EASR) • Conservation Halton • Road Occupancy Permit • Park Access Permit	• An ECA will be required from MECP for the works; to be submitted through the City's Transfer of Review (TOR) authority, and potentially through pending Consolidated Linear Infrastructure (CLI-ECA) program • It is expected that a short-term PTTW or EASR for dewatering during construction phase; to be determined based on expected flow rates from hydro-geological study in support of future design work. • A CH permit for works within a regulated area is expected to be required. Confirm works are adequately floodproofed and do not impact existing floodplain (cut/fill). Additional studies and investigations may be necessary to support the permit application if a creek re-alignment is confirmed to be required. • City permits (ROP and PAP) to be applied for prior to construction. Parks permit to consider tree management strategy as noted for natural environment.

5.3 Other Measures

As noted in Section 4.5.2.4, several other measures should be considered in conjunction with the primary proposed FDC pumping stations:

- Regardless of the recommendations for permanent pumping stations, reduction of inflow into the FDC sewer should be maintained as a primary focus for the City as this will reduce demands of any retrofit mitigation measures and result in both immediate and long-term benefit to reducing the potential for basement water infiltration. The primary focus would be expected to be disconnection of residential roof downspouts which discharge below surface and presumably into the weeping tile system (and thus into the FDC sewer system). It is recommended that the City implement these measures as soon as possible. A field reconnaissance of properties would be required to identify properties (in addition to the results of previous investigations including smoke testing). It would need to be determined whether or not a City-led program would be the most efficient way to address identified issues (i.e. single contractor) or whether the onus would be placed upon residents to bring drainage issues into compliance within a specified time frame.

- Other remedial measures, including localized FDC sewer upgrades (especially between Gracefield Drive and Doug Leavens Boulevard due to the general unobstructed nature of the area) may potentially be a more cost-effective solution than additional pumping stations (above and beyond the currently recommended pumping stations). Localized upgrades in the upper area of the sewershed (Terragar Boulevard and Golden Locust Drive area) are also recommended. Where feasible, pipe upgrades should be combined with existing capital planning for road and

infrastructure reconstruction, however given the age of the area it is not expected that the area would be prioritized on the basis of age.

- Annual monitoring of the FDC network and related drainage systems should be continued to evaluate system performance and incremental benefit of remedial measures.

6.0 Summary

6.1 Study Background

Commencing in 2008, approximately 200 homes in the Lisgar District experienced water seeping into their basements following certain rainfall events. In response, the City undertook a number of actions, such as video inspection and cleaning of the foundation drain collector (FDC) system and putting in place a High Water Protocol (deploying pumps during major storms).

In October 2011, Wood was retained to undertake an engineering study to determine the cause(s) of basement water infiltration and recommend corrective measures. After comprehensive monitoring and analysis, the engineering study determined the problem to be primarily related to the build-up of water in the bedding material of the utility trenches that contain the storm, sanitary and FDC sewer systems.

In March 2015, the results of the study were presented to the Public which outlined a Mitigation Plan. The Plan recommended prioritized mitigation measures for the City to address the basement water infiltration issue, with the highest priority mitigation measure being the strategic lining of priority storm sewers to minimize leakage.

As part of the implementation of the Prioritized Action Plan, storm sewer lining works were completed for the highest priority area (Phase 1 - Black Walnut Trail) between December 2016 and March 2017. Following a large storm event in July 2017 that resulted in reported basement water infiltration, the Prioritized Action Plan was updated in 2017, which advanced an FDC Pumping Station as a higher priority mitigation measure to be assessed, planned, designed and constructed.

In September 2018, a Class EA was completed for the Black Walnut Trail area pumping station system and the preferred solution identified an FDC pumping system at Cactus Gate Parkette. The preferred approach was a combined high flow – low flow pumping system given the associated efficiencies around construction and design, and also long-term operation and maintenance. This FDC pumping station began construction in 2019 and was operational in 2021.

A large storm event on August 28, 2021 resulted in five incidents of reported basement water infiltration. The Cactus Gate Pumping station helped mitigate the impacts of the storm, along with the High Water Protocol temporary pumping. Continuing from the Class EA completed in 2018, this Class EA has specifically been undertaken to determine the preferred locations and form of Pumping Stations within the entirety of the Lisgar District to further reduce the potential for basement water infiltration.

A public meeting was held on November 17, 2021 to provide the Public with an update on the Cactus Gate Pumping Station and Monitoring Program, information regarding this Class EA, and an overview of the High Water Protocol.

6.2 Alternative Assessment

A number of Pumping Station alternatives were developed consisting of low flow and high flow systems. A Utility Trench Dewatering Pumping Station (low flow system) is a system that operates to dewater the utility trench (granular stone bedding) by removing small amounts of water on a continuous basis, much like a residential sump pump. The intent of the utility trench dewatering system for the Lisgar District is to dewater the bedding material within the sewer utility trench to limit the accumulation of water, and thus provide additional storage volume during storm events. A FDC Pumping Station differs from a utility trench dewatering system in that it operates to remove water from the FDC pipe network during periods of high flow. This pumping system would be larger but operate less frequently and only during certain storm or snowmelt events.

A long-list of potential alternative locations for the proposed FDC pumping systems was developed. Further, it was recommended that for synergy in construction activities, it would be preferred to construct both the low and high flow systems in the same location. Based on a review of the Lisgar District the following long-list of alternative locations was generated:

Location 1. Russian Olive Close at Buttonbush Park

Location 2. Black Walnut Trail at Smoke Tree Road Parkette

Location 3. Black Walnut Trail at Scotch Pine Gate Parkette

Location 4. Lisgar Creek at Forest Park

Location 5. Gracefield Drive at Lisgar Meadowbrook Trail

Location 6. Lisgar Creek at Lisgar Fields

Location 7. Lisgar Creek at Doug Leavens Boulevard

Location 8. Lisgar Creek at Pintail Circle

Location 9. Lisgar Creek at Nutcracker Drive (North)

Location 10. Lisgar Creek at Nutcracker Drive (South)

Location 11. Lisgar Creek at Lisgar Green Park

Location 12. Osprey Marsh at Prairie Circle

Location 13. Osprey Marsh at Lisgar Drive

Location 14. Osprey Marsh at Ninth Line

The principal Evaluation Criteria used in the assessment were:

- *Drainage Area Served:* The amount of nearby land that will be serviced by the Pumping Stations.
- *Property Suitability*: The suitability of the property based on public land ownership and local property constraints, such as the amount of public space available (parkette versus City owned easement) and factors related to the social and natural environments.
- *Number of Houses in Proximity that Reported Basement Water Infiltration:* The Pumping Station should be located in proximity to the greatest number of houses that reported basement water infiltration in order to best address the issue.

Long-list of Alternatives

Potential Pumping Station Locations	Evaluation Criteria			Evaluation
	Drainage Area Served	Property Suitability	# of Reported Cases	Screened/ Short-listed
1. Russian Olive Close at Buttonbush Park	🔴	🟢	🟡	Screened out
2. Black Walnut Trail at Smoke Tree Road Parkette	🟡	🟢	🟢	Short-listed
3. Black Walnut Trail at Scotch Pine Gate Parkette	🟡	🟢	🟢	Short-listed
4. Lisgar Creek at Forest Park	🟢	🟡	🔴	Screened out
5. Gracefield Drive at Lisgar Meadowbrook Trail	🟢	🔴	🔴	Screened out
6. Lisgar Creek at Lisgar Fields	🟢	🔴	🔴	Screened out
7. Lisgar Creek at Doug Leavens Boulevard	🟢	🟡	🟢	Short-listed

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8. Lisgar Creek at Pintail Circle	🟢	🟡	🟡	Short-listed
9. Lisgar Creek at Nutcracker Drive (North)	🟢	🔴	🟡	Screened out
10. Lisgar Creek at Nutcracker Drive (South)	🟢	🔴	🟡	Screened out
11. Lisgar Creek at Lisgar Green Park	🟢	🟡	🟢	Short-listed
12. Osprey Marsh at Prairie Circle	🟢	🟡	🟢	Short-listed
13. Osprey Marsh at Lisgar Drive	🟢	🔴	🟡	Screened out
14. Osprey Marsh at Ninth Line	🟢	🟡	🔴	Screened out

🟢 Positive 🟡 Neutral 🔴 Negative

Based on the preceding screening, the Lisgar District was divided into three areas and short-listed locations for an FDC pumping system were as follows:

- Black Walnut Trail Area
  - Location 2 – Black Walnut Trail at Smoke Tree Road Parkette
  - Location 3 – Black Walnut Trail at Scotch Pine Gate Parkette
- Doug Leavens Boulevard and Pintail Circle Area
  - Location 7 – Lisgar Creek south of Doug Leavens Boulevard
  - Location 8 – Lisgar Creek at Pintail Circle
- Osprey Boulevard Area
  - Location 11 – Lisgar Creek at Lisgar Green Park
  - Location 12 – Osprey Marsh at Prairie Circle

The six (6) short-listed locations were subsequently assessed further for their technical effectiveness (individually and in combination) using hydraulic modelling.

6.3 Technical Evaluation of Short-Listed Alternatives

In order to support an informed design process for an FDC pumping station under high flow conditions, a hydraulic model of the FDC sewer system (PCSWMM modelling software) was used for a number of different assessments, including forensic modelling of the observed FDC system response to actual storm events based on available FDC monitoring data. The hydraulic model was used to model six (6) major storm events from between 2013 and 2021. The modelling uses an approximate unitary flow response for each of the storm events, and then applies different weighting factors based on identified hydraulic zones, until a reasonable match to the observed water levels is obtained. The resulting flows are then applied to assess the relative benefits of FDC diversions and high flow pumping, including the number and capacity of required pumping systems.

Given the preceding, as well as social, ecological, cultural heritage, and archaeological assessments carried out in the Study Area, the prioritized sequence of FDC pumping stations are as follows:

1) Location 2 - Black Walnut Trail and Smoke Tree Road (combined low\high flow)
2) Location 7 – Lisgar Creek south of Doug Leavens Boulevard (high flow only)
3) Location 12 - Osprey Marsh (high flow only)

Additional refinements are expected during the subsequent preliminary and detailed design phase. A backup generator is recommended to be integrated into all pumping station systems.

In addition to the preceding, a number of additional considerations have been noted including reducing extraneous inflows to the FDC sewer system through residential downspout disconnections, and other localized works such as FDC sewer upgrades (replacement and relief sewers; exact extents to be confirmed as part of future study). Monitoring should continue in order to assess the effectiveness of mitigation measures as they are implemented and ensure that any "lessons learned" are applied to subsequent pumping stations and other mitigation measures.

6.4 Preferred Solution and Implementation Plan

Through the Class EA process documented herein, along with feedback from City staff and the Public, the preferred solution consists of the priority sequencing of three (3) separate FDC pumping stations noted previously. Additional measures related to the reduction of extraneous flows to the FDC system and conveyance (FDC sewer) upgrades have also been noted.

Mitigation measures have been considered to address potential impacts both during construction, and post-construction (long-term operations and maintenance). Measures to specifically address aesthetics, creek discharge and climate change have been proposed (ref. Section 5.2). These, along with other specific municipal and Provincial guidance directives, should be considered during final planning and design, construction and implementation, including operation and maintenance.