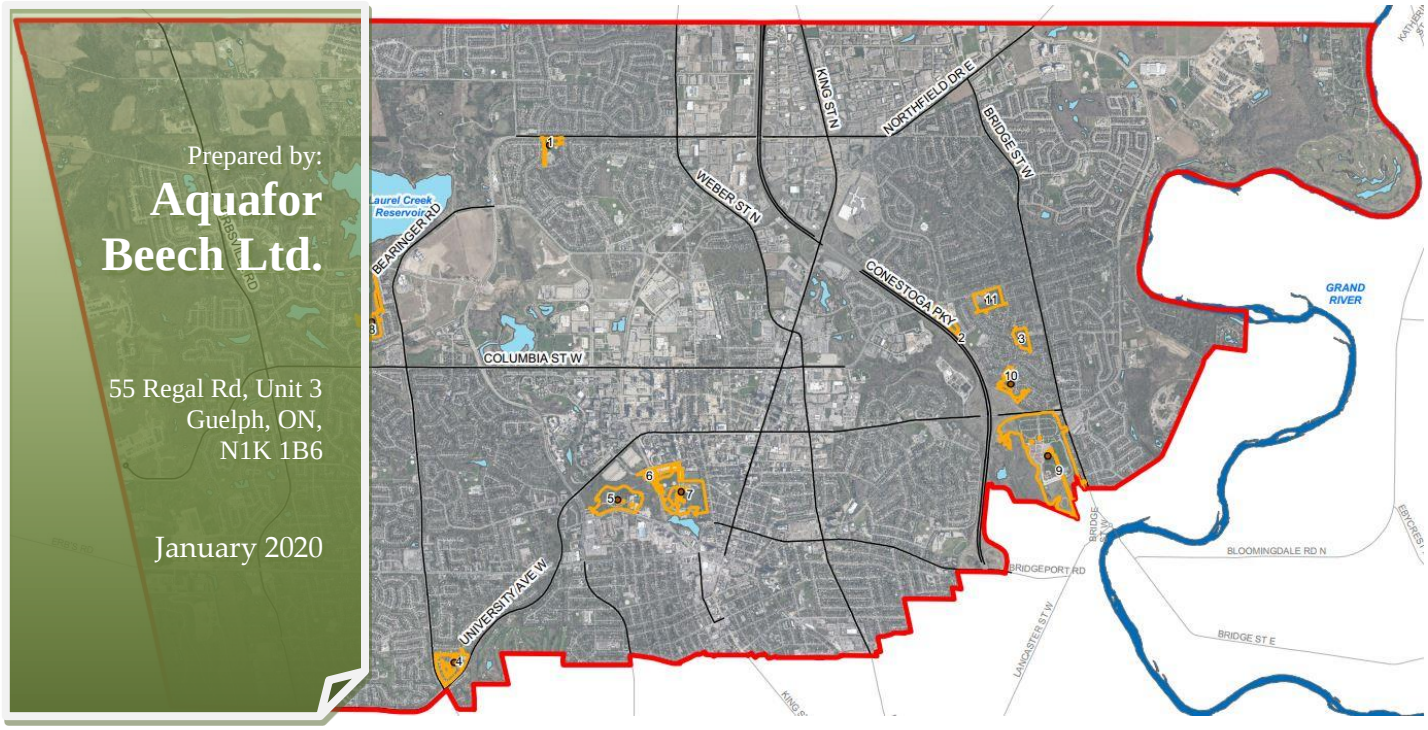
Prepared for:

**City of Waterloo**

# STORMWATER MANAGEMENT MASTER PLAN
# MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

## DRAFT END-OF-PIPE SWM FACILITY OPPORTUNITIES REPORT





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January 2020

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## 1.0 Introduction

A significant portion of the City of Waterloo was developed prior to the development of current stormwater management (SWM) criteria. As such, there are areas within the city where uncontrolled and untreated stormwater runoff is directly discharged to the receiving streams. Local monitoring data from the annual SWM Audit and general industry experience have shown that these uncontrolled discharges are responsible for a significant portion of the contaminant loadings to receiving streams as well as increasing the potential for downstream erosion and flooding.

The following end-of-pipe (EOP) facility opportunities study was initiated to provide a framework for a long-term strategy to implement stormwater quality and quantity control within the existing urbanized areas of the City of Waterloo as part of the Integrated Stormwater Management Master Plan (ISWM-MP).

### *1.1 Background*

According to the City's GIS database, a total of 81 active SWM facilities and 241 Oil and Grit Separator units (OGS) exist within the City of Waterloo. Of the 81 active SWM facilities, the City owns and is responsible for operations and maintenance at 59 of these. Of the 241 OGS units, 61 are owned and maintained by the City, 12 by the Region and 168 are privately owned OGS units.

In total, 2,063 ha (40.9%) out of the 5041.3 ha of urban area in the City of Waterloo has SWM control:

- 1,499.8 ha (29.8%) is controlled for water quality by surface SWM facilities (ponds, wetlands and hybrid facilities)
- 1,852.1 ha (36.8%) is controlled for water quantity by surface SWM facilities (ponds, wetlands, hybrid facilities and dry ponds)
- The 61 municipal OGS units provide additional water quality control for an additional 75ha (4.1%) within the City of Waterloo.

Accordingly, there is approximately 2,978.3 ha (59.1% of the urban area) that does not have either water quality or quantity control. **Figure 1.1** shows the percentage of existing urban area with SWM control in the City of Waterloo. **Figure 1.2** shows the location of the existing SWM facilities within the City of Waterloo.

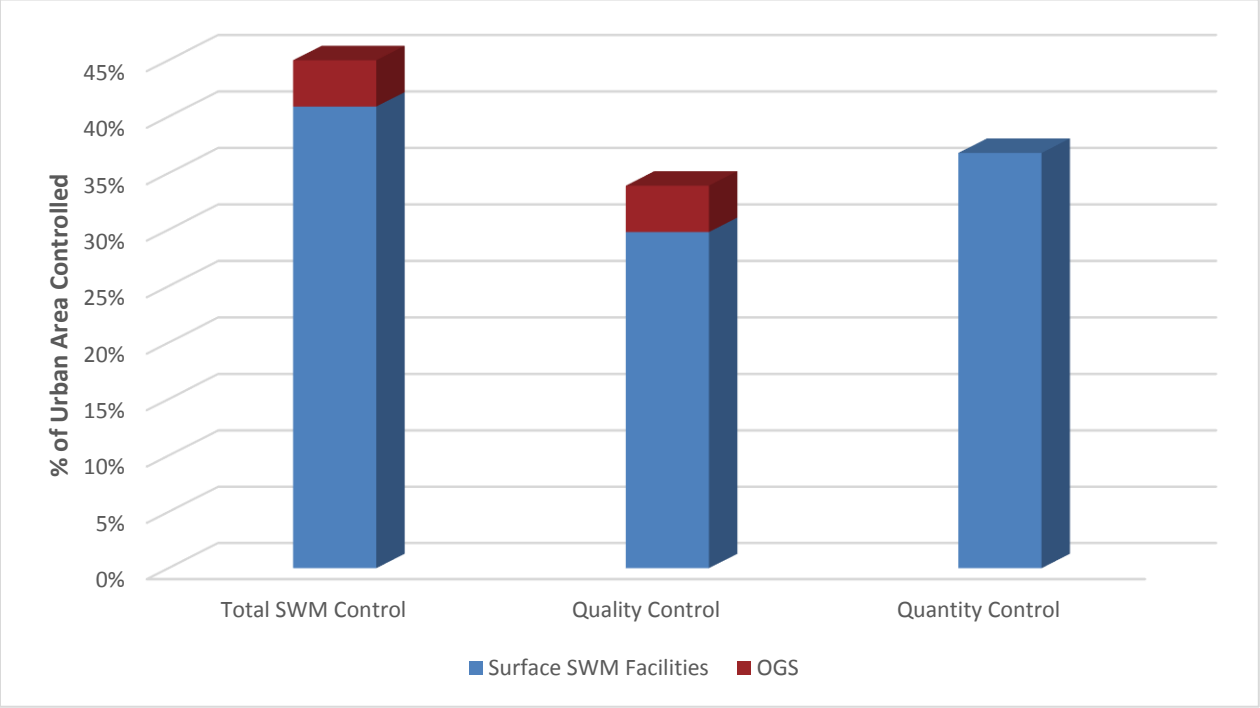



**Figure 1.1 – Percentage of City Controlled by SWM Assets**

THE CITY OF Waterloo

# MUNICIPAL CLASS EA INTEGRATED STORMWATER MANAGMENT MASTER PLAN

**FIGURE : 1.2**
**EXISTING SWM FACILITIES**

- Watercourse
- Roads
- Water Bodies
- Rivers
- Stormwater Management Ponds
- SWM Facility Drainage Area
- Study Area

**Existing OGS Structures**

- City of Waterloo
- Region of Waterloo
- Private
- University of Waterloo
- WCDSB
- WRDSB
- Null

0 0.5 1 Kilometers

N

Aquafor Beech Limited

Base data provided by The City of Waterloo, 2017.

Date: March 2019

### 1.1.1 Previous Studies

The 2005 City of Waterloo Master Drainage Study: Urbanized Subwatersheds document identified potential SWM facility locations within the City. Seven drainage areas were identified where new SWM facilities meeting Level 2 (per the MOECC, 2003) wet pond criteria could be implemented throughout the City of Waterloo (See **Appendix A**). Four locations were not recommended for implementation at the time of the report, as three would require demolition of existing buildings, and the construction of the fourth would negatively impact riparian zones most in need of protection. Therefore, only the three locations along Clair Creek between Columbia Street and Fischer-Hallman Road (205, 206, and 207) were recommended, but have not been constructed. These locations were not identified in the current study as feasible opportunities. The Master Drainage Study also identifies alternative SWM strategies that can be implemented though site redevelopment projects for areas that don't have downstream SWM facilities. These alternatives include SWM basins, infiltration facilities, green roofs, and/or oil/grit separators, depending on the site constraints.

## 1.2 Report Objective

The principle objective of this report is to identify locations where new end-of-pipe stormwater management facilities could be implemented within existing urban areas of the City without stormwater control to increase the proportion of SWM controlled drainage areas in the City to improve:

- Water quality control
- Water quantity control
- Erosion control

As such a list of potential sites which represent opportunities for new end-of-pipe stormwater management (SWM) facilities were identified as a component of the City of Waterloo's Integrated SWM Master Plan. Sites were assessed using a four (4) step process as input into the Municipal Class Environmental Assessment Master Planning process. The information included in this report will be used to identify the preferred alternative for each site.

The following objectives were addressed as part of this report:

1. Identification of locations within the City of Waterloo which represent potential opportunities for the construction of new surface or subsurface SWM facilities.

2. Review existing information and conduct field investigations and impact assessments at each identified location based on technical, environmental and social considerations.

3. Create summaries of all feasible SWM facility opportunities outlining:
    a. Contributing drainage area, Total Impervious Area (%) and existing sewer inverts
    b. Land ownership and existing easements
    c. Current use
    d. Available area including known constraints (vegetation, wetlands and regulatory floodplain constraints).
    e. Identified utilities and conflicts (sanitary, gas mains and watermain)
    f. Site Photos of key elements
    g. Observations from site investigations

4. Undertake a performance assessment to identify conceptual SWM facility alternatives for each of the feasible or possible SWM facility opportunities based on the aforementioned considerations. The performance assessment included the potential water quality benefits as well the development of cost estimates for implementing each potential new SWM opportunity.

### *1.3 Coordination with Other Plans and Policies*

The following report is not intended to be read or applied in isolation; in fact, the following report should be considered in the context of the Integrated Stormwater Management Master Plan within which it is developed and also have regard for other City Strategic Plans, Master Plans, Secondary Plans and Policies. More specifically, many of the proposed SWM opportunities represent potential synergies with other studies and plans and should be considered as such. Implementation of the preferred approaches for each SWM opportunity location should have regard for the following:

- **Waterloo Park Master Plan (October 2009)** which directs the City's investment and initiatives in the future planning, design, acquisition, improvement, management, programming and use of City parks.
- **City of Waterloo Asset Management Plan (November 2016)** inventories City assets, indicates their condition, and provides a plan and financing strategy to ensure adequate performance.
- **Silver Lake and Laurel Creek Rehabilitation in Waterloo Park – Environmental Assessment Addendum (June 2018)** evaluated alternatives for Silver Lake and Laurel Creek rehabilitation. Of relevance to this report is the recommendation to implement stormwater quality controls through Waterloo Park to reduce sediment loading to Silver Lake.
- **Grand River Water Management Plan (2014)** addresses the issues faced by the Grand River watershed. The goals of the plan are to: improve water quality to maintain river health and reduce the impact of the Grand River on Lake Erie; ensure water supplies for communities and ecosystems, reduce flood damage potential, and increase resiliency to deal with climate change. Many agencies share the responsibility for managing water resources. In 2009, they agreed to develop a new plan to address today's most important issues: population growth, climate change and the impacts of extensive agriculture. The plan was developed through a collaborative process. It is based on "best value solutions" - the most effective and efficient ways to meet the goals.

## 2.0 Evaluation Process

The project team identified potential SWM facility opportunity locations within the table lands and valley lands of the City of Waterloo. A screening assessment of the study area revealed 11 sites where potential stormwater management facilities may be feasibly implemented after excluding, for example: sites which already have a SWM facility, are within the City's Natural Heritage System (NHS), where connections to existing storm sewers could not be made etc. To manage the complexity and constraints inherent within the study area for each stormwater management (SWM) site, a four-phase evaluation approach was used. A total of 11 sites were evaluated using this approach; each phase was subject to a unique set of evaluation criteria and considerations. The following four (4) evaluation phases establish the framework of the evaluation process:

1) Phase 1 – Geographic Information Systems (GIS)/Land Assessment
2) Phase 2 – Field Reconnaissance and Impact Assessment

3) Phase 3 – Performance Assessment
4) Phase 4 – Consultation with City Staff

The methodology used to assess potential site locations is outlined in **Figure 2.1**. The following sections describe the process outlined in **Figure 2.1** and the methods by which the various criteria for evaluating potential facility locations were obtained.

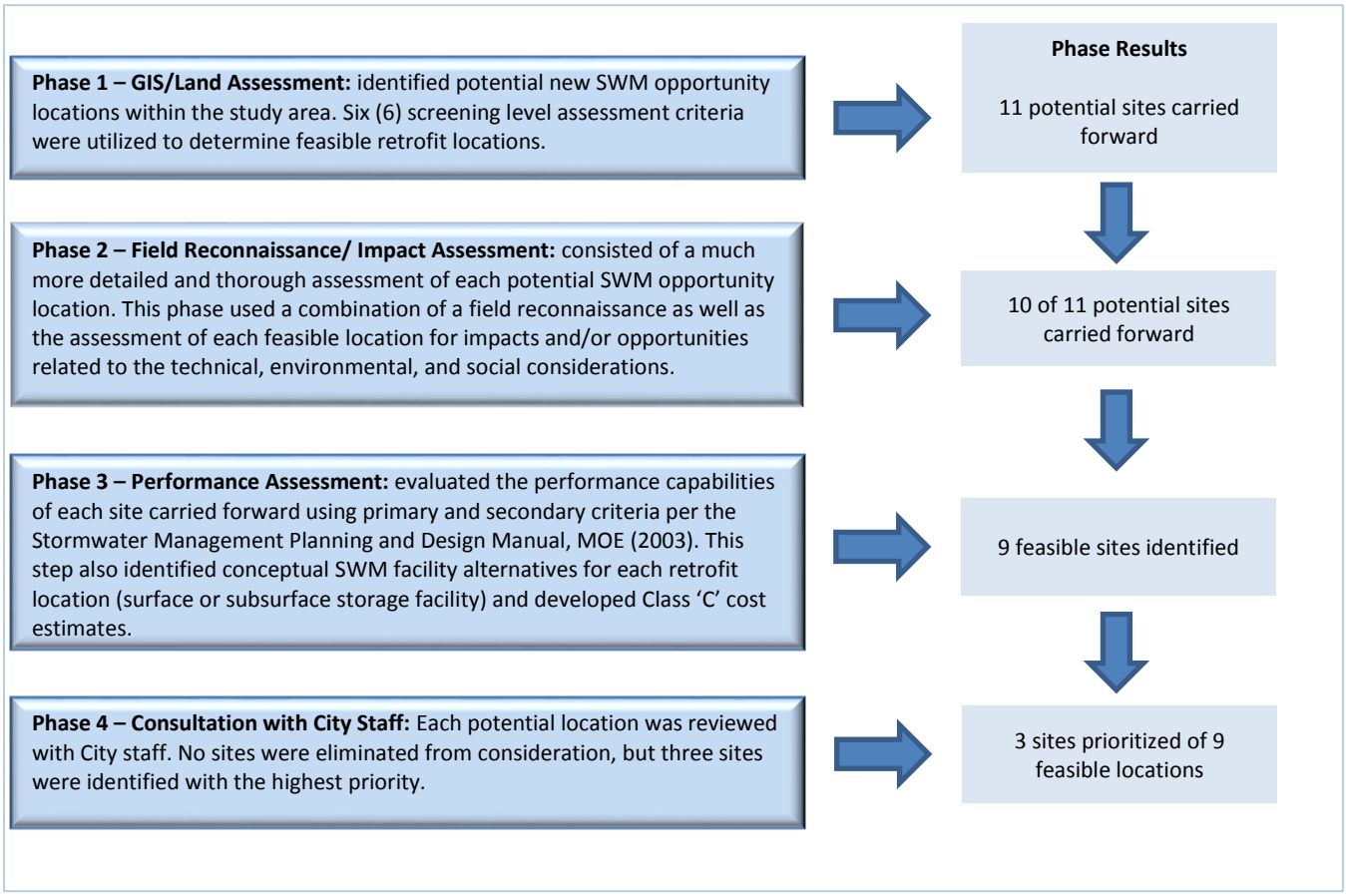



**Figure 2.1 – Process Summary**

## *2.1 Phase 1 Assessment – GIS/Land Assessment*

The Phase 1 assessment involved analyzing available GIS databases to locate potential table and valley land SWM opportunities throughout the City of Waterloo. Potential new SWM opportunity sites were evaluated using the following six (6) technical evaluation criteria:

1. Available area (area must be >1ha);
2. Land Ownership: Municipal (M), Conservation Area (C), Provincial (P) including transportation corridors, Hydro Corridor (HC), and Unknown land ownership (Unk), Vacant lands (V) and existing site use;
3. Stormwater Infrastructure
    - Pipe Size: >450mm, and >900mm in Valley Lands within 200m of the identified site boundary;
    - Pipe Depth;

- Drainage Area;
- Drainage area (sewershed);
- Total Impervious Area Percentage (TIMP);

4. Topographic Constraints;
5. Significant Vegetation & Wetlands;
6. Preliminary Water Quality Estimates;

***Available Area*** estimates were conducted for all potential SWM opportunity locations. Available area estimates considered topography, built-out environment (structures, buildings, roads etc.), and the natural environment (forested areas, etc.). Sites with less than 1 ha of available area were eliminated. It was determined that any identified sites with less than 1 ha of available area would provide minimal stormwater benefits and may be economically restrictive.

***Land Ownership and Site Usage*** of the proposed SWM opportunity locations was an important consideration for feasibility. All land parcels designated as conservation, municipal, provincial, hydro corridor, unknown, and vacant were identified and flagged. Publicly owned lands were considered to be most feasible from a land ownership perspective. Available areas identified on privately-owned lands were eliminated from the evaluation - it was anticipated that such sites would have significant social and economic impacts. Vacant lands adjacent to or in close proximity to identified sites were further considered based on field reconnaissance activities.

***Stormwater Infrastructure*** within the vicinity of the site area is critical for the conveyance of stormwater to potential SWM opportunity location. A desktop analysis of the available storm sewer infrastructure determined if storm sewers (greater than 450mm and greater than 900mm in Valley Lands) passed through or in close proximity to the sites (within 200m). Accessible storm sewer infrastructure was a minimum requirement for feasibility consideration. Infrastructure screening also considered:

- Pipe size
- Pipe depth
- Drainage area (sewershed)
- Total basin imperviousness (TIMP)

***Topographic Constraints*** which typically included significant grade changes or hummocky topography which would limit the ability to access and connect to the existing storm sewer were eliminated from further consideration. Where topographic constraints bordered otherwise suitable lands, regarding was considered for SWM opportunity evaluation.

***Significant Vegetation & Wetlands*** within available areas were identified during the desktop analysis. Sites with significant vegetation (wooded areas and identified wetlands per the City's Natural Heritage System, Schedule A4 of the City of Waterloo Official Plan) were noted. In several cases, the desktop analysis could not conclusively assess the vegetation conditions at various locations. Where the desktop analysis was not effective, or adjacent vacant lands were identified, the locations were carried forward. Site feasibility contingent on the influence of significant vegetation was confirmed following the Phase 2 assessment, where necessary.

***Preliminary Water Quality Performance*** **Assessment** for available areas greater than 1 ha was completed using **Table 3.2** of the 2003 MOE Stormwater Management Planning and Design Manual. Performance

targets for stormwater management practices (SWMP) have specific water quality sizing criteria based on the total imperviousness of the site and the level of protection required (Enhanced- Level 1). A preliminary water quality assessment was undertaken which utilized only volumetric water quality requirements based on drainage area (ha), impervious level (%) and the enhanced storage requirements for each SWM opportunity location, assuming a wet pond which is 1.5m in depth. Shallow wet ponds were assumed to ensure a conservative approach. Locations which did not achieve Level 1 water quality protection were eliminated. Those carried forward were re-evaluated for performance which was conducted subsequently in Phase 2 where physical design standards (e.g. side slopes, pond depth, freeboard etc.) were considered. During this second phase evaluation, actual storage potential was based on individual site characteristics.

Each potential SWM opportunity site was determined as feasible, possible or not feasible based on the land assessment outlined below in **Table 2.1**.

**Table 2.1 – Geographic Information Systems (GIS)/Land Assessment**

| Feasible | Possible | Not Feasible |
|---|---|---|
| • Available area greater than 1 ha<br>• Conservation (C), Municipal (M), Provincial (P), Hydro Corridor (HC), Unknown and Vacant land ownership<br>• No topographic constraints<br>• No planned use/ active park elements present<br>• No vegetation constraints or wetlands<br>• No infrastructure required<br>• Sufficient water quality provided | • Available area limited<br>• Unknown land ownership<br>• Planned use/ active park elements present<br>• Additional infrastructure required<br>• Moderate vegetation constraints and or partial wetlands present<br>• Some water quality provided | • Available area less than 1 ha<br>• Topographic limitations<br>• Pipe size <450mm<br>• Pipe size <900mm (Valley Lands)<br>• High vegetation constraints and or significant portion of the area is dominated by wetlands<br>• No water quality provided |
| *Note: Consideration was made for proposed facilities within park areas where existing planned uses could be identified (i.e. active park elements) such as sports fields, play structures etc. such that it did not directly interfere with the existing land usage or its intrinsic value.* | | |

Concluding the Phase 1 assessment, 11 sites were classified as feasible or possible and were carried forward to the Phase 2 assessment. The results of the Phase 1 assessment are presented in **Table 2.2. Appendix B: Preliminary Mapping** includes the preliminary mapping for the 11 sites.

### *2.1.1 Source Protection Plans (SPP) and Regional Policy*

The Grand River Source Protection Plan (LERSPC 2012, Approved 2015, effective July 1, 2016) drinking water source protection plans identify the risks to municipal water quality and water supplies, and the policies and programs that will reduce the risks. Volume II of the Grand River Source Protection Plan covers the Region of Waterloo including the City of Waterloo. Specific policies relating to Stormwater Management within Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZs) can be found from policy RW-MC-15 through RW-CW-20.1.

As it relates to new end-of-pipe SWM opportunities, or more specifically the planning, design and construction of new SWM Ponds, policies RW-MC-16 and RW-MC-17 should be followed.

**RW-MC-16:** To ensure the new discharge of stormwater from a stormwater management facility does not become a significant drinking water threat within vulnerable areas where this activity would be a significant drinking water threat:

a. The Ministry of the Environment shall prohibit the new discharge of stormwater from a stormwater management facility within the Environmental Compliance Approvals process in the following areas as appropriate.
    i. In Wellhead Protection Area A;
    ii. In Intake Protection Zone One (1).

b. The Ministry of the Environment shall ensure that the Environmental Compliance Approval that governs the new discharge of stormwater from a stormwater management facility includes appropriate terms and conditions to ensure the activity does not become a significant drinking water threat when permitted in the following areas as appropriate:
    i. In Wellhead Protection Area B where the vulnerability is equal to ten (10);
    ii. In Wellhead Protection Area E where the vulnerability is greater than or equal to eight (8);
    iii. In Intake Protection Zone Three (3) where the vulnerability is equal to eight (8);
    iv. Where a Nitrate and/or Chloride Issue has been identified, in all Issue Contributing Areas except Wellhead Protection Area A.

The Environmental Compliance Approval should include, as minimum, water quality monitoring measures and reporting annually to the Ministry of the Environment, as appropriate. Where there is a Nitrate, and/or Chloride Issue, groundwater and/or surface water quality shall be monitored for Nitrate and Chloride, respectively.

**RW-MC-17:** The Regional Municipality of Waterloo and the Area Municipalities shall review and, if necessary, amend their Official Plans and Zoning By-laws to reflect policy RW-MC-16 as it relates to stormwater management in the following areas to ensure these activities never become significant drinking water threats:

i. In Wellhead Protection Area A;
ii. In Intake Protection Zone One (1).

The above polices were reviewed with the appropriate mapping and the results are illustrated on Figure 2.2. The above policies do not preclude the implementation of the identified new SWM opportunities, although consideration of the policies will be required during the design of the new facilities. For example, to mitigate the risk associated with infiltration of chloride-laden stormwater design measures can include valves at the inlet of infiltration facilities that bypass stormwater during winter operations or impervious liners.

# MUNICIPAL CLASS EA INTEGRATED STORMWATER MANAGMENT MASTER PLAN

THE CITY OF Waterloo

## FIGURE : 2.2
## STORMWATER INFILTRATION CONSTRAINTS

- Watercourses
- Single Line Road Network
- Water Bodies
- Potential SWM Facility Locations
- Waterloo Boundary
- Issue Contributing Area - Chloride / Sodium / TCE
- WHPA Vulnerability Score 8 - 10
- WHPA Vulnerability Score 2 - 6.3
- Intake Protection Zone 3

0 0.5 1 Kilometers

N

Aquafor Beech Limited

Base data provided by The City of Waterloo, 2017.

Date: April 2019

Township of Wellesley
Township of Woolwich
Township of Wilmot
City of Waterloo
City of Kitchener
Creek D
Beaver Creek
Monastery Creek
Laurel Creek Reservoir
Cedar Creek
Forwell Creek
Clair Creek
Maple Hill Creek
Laurel Creek
Critter Creek
Willow Creek
Cuckoo Creek
Cooper's Creek
Colonial Creek
Minnow Creek
Horst Creek
Melitzer Creek
GRAND RIVER
ERBSVILLE RD
BEARINGER RD
WEBER ST N
KING ST N
NORTHFIELD DR E
BRIDGE ST W
CONESTOGA PKY
COLUMBIA ST W
UNIVERSITY AVE W
1
3
4
6
7
8
9
10
11

**Table 2.2 – Phase 1 Assessment Results**

| Site ID | Location Name | Pipe Size | Ownership | Current Site Use | Significant Vegetation | DA (ha) | TIMP (%) | Available Area (ha) | Sufficient Area for Level 1 Water Quality† | Notes | Result of Phase 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | Northfield Park | 1350mm | City | Sports Field/ Park | No | 49 | 57% | 0.8 | yes | n/a | Feasible |
| 02 | Cadbury Court | 600mm | City/ Unknown | Vacant | Wooded | 4 | 56% | 0.87 | yes | Investigate vacant parcel west of City property<br>Low drainage area<br>WHPA Vulnerability Score 2-6.3 | Possible |
| 03 | Dunvegan Park | 1200mm | City | Sports Field/ Park | Single Trees | 23 | 56% | 0.9 | yes | Located within drainage area of Site #10 | Feasible |
| 04 | Belgreen Park / Warrington Park | 1200mm | City | Park | Partially Wooded | 45 | 60% | 0.7 | yes | WHPA Vulnerability Score 8-10 | Possible |
| 05 | Waterloo Park (Father David Bauer Drive) | 900mm | City | Sports Field/ Park | Partially Wooded | 25 | 70% | 0.38 | yes | Issue Contributing Area – Chloride/Sodium/TCE | Possible |
| 06 | Waterloo Park (by LRT) | 1200mm | City | Sports Field/ Park | Single Trees | 33 | 63% | 0.88 | yes | Potential sanitary sewer conflict<br>Issue Contributing Area – Chloride/Sodium/TCE | Possible |
| 07 | Waterloo Park (Seagram Drive) | 600mm | City | Sports Field/ Park | Partially Wooded | 31 | 64% | 2.3 | yes | Southerly site area may not be feasible for implementation due to pipe location at north<br>Located within drainage area of Site #6<br>Issue Contributing Area – Chloride/Sodium/TCE | Possible |
| 08 | Laurelwood Park | 900mm | City | Sports Field/ Park | Partially Wooded | 9 | 56% | 2.6 | yes | Issue Contributing Area – Chloride/Sodium/TCE | Feasible |
| 09 | Bechtel Park | 1200mm | City of Kitchener | Sports Field/ Park/ Vacant | Partially Wooded | 35.6 | 56% | 3.1 | yes | Investigate nearby property owned by City of Kitchener where storm sewer passes beneath Conestoga Parkway;<br>WHPA Vulnerability Score 2-6.3 | Possible |
| 10 | Sandowne Park | 1200mm | City | Park | Partially Wooded | 54 | 55% | 0.6 | yes | Potential sanitary sewer conflict<br>WHPA Vulnerability Score 2-6.3 | Possible |
| 11 | Lexington Park | 675mm | City/ Unknown | Parking Lot/ Sports Field | Single Trees | 10 | 61% | 0.75 | yes | n/a | Feasible |

† *Preliminary Water Quality Performance Assessment* – assumes a wet-pond (highest volume requirement per Table 3.2 of the MOE SWMPD) and a nominal depth of 1.5m (50% of typical maximum depth).

### 2.2 Phase 2 – Field Reconnaissance/Impact Assessment

In April 2019, members of Aquafor Beech Limited conducted a field reconnaissance of the 11 potential SWM opportunity locations carried forward from Phase 1. The field assessment involved identifying site specific constraints and opportunities and potential impacts related to any future SWM opportunities proposed for each site location. The field assessment evaluated each feasible/ possible location for impacts and/or opportunities related to the technical, environmental, and social considerations. The field assessments were also used to verify site conditions and identify site features at greater detail.

Results of the Field Reconnaissance/Impact Assessment for each of the 11 potential site locations carried forward from Phase 2 are detailed below.

#### 2.2.1 General Site Characteristics

The field reconnaissance was used to confirm and or identify site characteristics which were not evident within the GIS mapping and aerial photography examined during the *Phase 1 – GIS/Land Assessment*. General site characteristics which were noted and or delineated in the field for the included:

- General site characteristics
- Topography
- Existing stormwater infrastructure and drainage issues
- Confirmation and/or observation of utilities
- Confirmation of current use, programming and condition
- Delineation of vegetation boundaries
- Identification of invasive species (where possible)
- Confirmation of wetland areas
- Observation of delineated floodplain limits
- Watercourse and outfall water quality conditions
- Confirmation of vacant lands (surface cover and evidence of activity)
- Related infrastructure issues
- Surrounding land-uses and encroachments onto non-private property

#### 2.2.2 Technical Considerations

The following technical considerations were noted as part of field reconnaissance activities:

- **Topography** – Unfavorable topography which prevented the acquisition of a suitable inlet or outlet to the proposed SWM opportunity site resulted in the elimination of the site from future consideration. Topography which would result in a significant increase in excavation to permit facility construction were determined to increase the difficulty of SWM opportunity installations and associated costs and consequently, such facilities were not carried forward.
- **Utilities** – mapped utilities were confirmed. Unmarked utilities were also noted.
- **Related infrastructure issues** – where existing stormwater infrastructure were present and could be accessed; a visual inspection was performed to note any deficiencies and/or issues. These were noted and used as a modifier to the prioritization in later phases. (i.e. repairs to infrastructure,

unrelated to the SWM opportunity, may be more cost effective if undertaken as part of the construction of the new SWM opportunity). Issues of note include:

  - **Site 7:** Erosion and sediment build-up at potential outlet location in creek channel before it enters the culvert near the LRT tracks. There is a good opportunity for concurrent stream restoration.

- **Pipe cover (depth) and outlet conditions** – Sites which outlet to a surface water feature were visually assessed for defect and condition. Pipe depth at the outlet was also confirmed.
- **Confirmation of vacant lands** – locations with bordering vacant land were investigated to confirm surface cover and evidence of development activity. Sites of note include:
  - **Site 2:** Significant construction is occurring on the vacant land. This site was not carried forward.

### *2.2.3 Environmental Considerations*

The field reconnaissance was also used to confirm the presence and/or potential impact to existing vegetation. Identification of the quantity, grouping, sizes of trees, and other significant vegetation as noted during investigations. Surrounding vegetation type (e.g. meadow, forest, manicured, etc.) was also recorded with photos, in addition to wetland boundaries which were confirmed for accuracy. Where additional features were identified they were recorded (e.g. Site 6-3: Sign indicating "Natural Regeneration Area"). The following environmental considerations were noted as part of field reconnaissance activities:

- **Vegetation boundaries** – Limits of significant on-site vegetation (as indicated on the aerial photography) were confirmed and delineated. Available area estimates were revised to exclude areas of significant vegetation. See the **Summary Figures** presented at the end of **Section 2.4** for vegetation boundary delineation. Sites of note include:
  - **Site 2:** Dense vegetation is present on the City-owned property. It is recommended that this site be eliminated from further phases of evaluation, especially since the adjacent land is no longer vacant.
  - **Site 7**: Proposed inlet and outlet are located in a Supporting Natural Feature, as identified in Schedule A4 of the City of Waterloo Official Plan.
  - **Site 8**: Proposed outlet is within a Core Natural Feature as identified in Schedule A4 of the City of Waterloo Official Plan.
- **Mature Trees** – were identified on each site based on the following criteria:
  - Mature vegetation: >10cm diameter above breast height (DBH)
  - Immature vegetation: <**10cm** DBH
- **Watercourse condition and Water quality** – Sites which outlet to a surface water feature were visually assessed for defect and condition and where possible water quality condition was noted. Issues of note include:
  - **Site 7:** Erosion and sediment build-up at proposed outlet in creek channel before it enters the culvert near the LRT tracks. Channel condition is poor.

- **Identification of invasive species** – where observed, the presence of invasive species were noted.
    - None observed during site investigation.
- **Wetland Boundaries** – mapped wetland boundaries were also noted and confirmed for accuracy for all sites where mapped wetlands were previously identified by the City. Sites of note include:
    - None observed during site investigation.
- **Floodplain limits** – for all sites within the regulatory floodplain, the limits of the floodplain were observed and conditions outside and within the floodplain were noted.

### *2.2.4 Social Considerations*

Potential social impacts were also identified as part of the field evaluations. As part of the evaluation process, the project team aimed to incorporate social considerations by identifying potential existing site uses and features which included but is not limited to:

- General site uses and aesthetics,
- Community gardens,
- Planned uses – Sports fields (soccer, baseball, ice-rinks, tennis courts, cricket pitch etc.) and play structure. Evidence of recent use and/or status was also noted as relevant. Issues of note include:
    - **Site 6**: The Waterloo Park Master Plan identifies Site 6 as the location of a proposed Ecological/Education Area with a building and parking lot in place of the existing sports field. The timetable of development and extent to which this development would be compatible with a subsurface SWM facility is unknown.
- Passive uses – Pedestrian walkways and trails,
- Surrounding land-uses and encroachments onto City property

Site reconnaissance was undertaken with the understanding that the potential SWM opportunity may present potential drawbacks or impacts, including but not limited to:

- Loss of existing park areas and sports fields,
- Loss or disruption of trails
- Requirement to relocate park features
- Temporary loss of park use during construction activities
- Impacts to neighboring properties (residential, commercial and industrial)

**Table 2.3** summarizes the current site conditions and uses and potential social impacts for each of the 10 sites carried forward from Phase 1.

**Table 2.3 – Summary of Current Site Conditions and Potential Social Impacts for Potential SWM Opportunity Sites**

| Map & Site ID | Location Name | Surrounding Land-use† (see Appendix B) | Current Site Use | | | Notes |
|---|---|---|---|---|---|---|
| | | | Pathway/Trails | Sports Fields | Playground | |
| 01 | Northfield Park | Residential/ Institutional | Yes | Soccer | - | Soccer nets are moveable. |
| 03 | Dunvegan Park | Residential | Yes | Tennis | Playground & Swings | Existing amenities in good condition. |
| 04 | Belgreen Park / Warrington Park | Residential | Yes | Tennis | - | Existing tennis court currently undergoing upgrades. |
| 05 | Waterloo Park (Father David Bauer Drive) | Residential/ Institutional | - | No | - | - |
| 06 | Waterloo Park (by LRT) | Institutional | - | Soccer | - | Used for other sports, including Ultimate Frisbee (observed). Waterloo Park Master Plan identifies Site 6 as the location of a proposed Ecological/Education Area with a building and parking lot in place of the existing sports field. |
| 07 | Waterloo Park (Seagram Drive) | Institutional | Yes | Baseball x2, Cricket, Tennis x6 | - | Eby Farmstead, Animal Farm, parking, washrooms at southern portion of site. |
| 08 | Laurelwood Park | Residential | Yes | Baseball | Playground & Swings | Existing amenities in good condition. |
| 09 | Bechtel Park | Residential/ Highway | Yes | Baseball, Soccer (multiple sizes) | - | Parkview Cemetery, dog park also located within site. |
| 10 | Sandowne Park | Residential/ Highway | Yes | - | - | Benches placed throughout. Horseshoe pits installed in narrow segment behind houses nearest Conestoga Parkway. |
| 11 | Lexington Park | Residential | - | Baseball, Soccer | - | Existing gravel parking lot used by WMB Church. Unknown land ownership. Opportunity for parking lot upgrades. |
| † Defined in field by field engineer. | | | | | | |

Following the completion of Phase 2, 10 of the 11 sites have been carried forward to Phase 3. It is important to note the following:

- **Site 2:** This site deemed not feasible following site assessment due to new construction on the vacant land, the heavy vegetation on the City-owned land, and the small drainage area.

### *2.3 Phase 3 – Performance Assessment*

The performance assessment is intended to develop conceptual SWM facility alternatives for each of the feasible or possible SWM opportunity locations carried forward from Phases 1 and 2 using a set of primary and secondary evaluation criteria. The conceptual alternatives identify details such as SWM facility type, size, configuration and function for each potential location.

The following sections describe the primary and secondary assessment criteria and outline their significance to the performance assessment and the development of the conceptual alternatives.

#### *2.3.1 Performance Criteria*

The following primary and secondary evaluation criteria were used to develop the conceptual alternatives for each potential SWM facility and determine the feasibility of each SWM facility:

*Primary Criteria*

The primary criteria used in the evaluation are as follows:

1) **Available areas with SWM pipe depths <5m were evaluated as Surface facilities (wet pond, wetland and hybrid facilities) with the following exemptions:**
   - Where surface constraints exist, due to impacts to active and passive use of parks and park features, sport fields and trails, subsurface storage facilities may be considered regardless of pipe depth criteria.
   - In addition, for site within the regulatory floodplain, subsurface storage facilities may also be considered regardless of pipe depth criteria.

2) **Available areas with SWM pipe depths >5m were evaluated as Subsurface Storage facilities (due to excess excavation requirements for surface facilities).**

3) **Per the Stormwater Management Planning and Design Manual, Ministry of the Environment (MOE) (2003)**
   - Provide a minimum 50% of Level 1 (80% long –term suspended solid removal) water quality control without exceeding available areas
   - Conceptual alternatives possess the ability adheres to design guidelines to insure proper function and safety requirements

*Secondary Criteria*

The secondary criteria used in the evaluation include:

4) **Ability to Provide Quality and Erosion Control (25mm Storm Event)**
   According to the Stormwater Management Planning and Design Manual (MOE,2003), the larger volume of the erosion control active storage or the water quality active storage should be provided by proposed SWM facilities. The volume of water from the 25mm rain event was used, as it was larger than the active storage volume criteria ($40m^3$/ha).

**5) Ability to Provide Quantity Control**

In addition to quality and erosion control, any remaining storage available for quantity control was identified as an overall net benefit and ensured increased consideration of the applicable SWM opportunity. Additional flood control was not allocated to subsurface storage facilities as this would increase facility size and costs. (Note that additional flood storage maybe accommodated based on available area and allocated budgets).

### *2.3.2 Performance Evaluation*

End-of-pipe (EOP) stormwater management facilities receive stormwater from a conveyance system, upstream facilities or surface water tributaries, and discharge the treated water to receiving waters. In essence, there are four (4) traditional types of end-of-pipe SWM facilities:

1. Wet ponds;
2. Wetlands; and
3. Hybrid - wet pond/ wetland
4. Subsurface stormwater facilities

*Facility Type Assessment*

For the purpose of the Phase 3 assessment, from the list above, the types of end-of-pipe controls have been grouped into:

- **Surface Facilities** (wet pond, wetland and hybrid facilities)
- **Subsurface Storage Facilities**

The use of surface facilities such as wet pond, wetland and hybrid facilities becomes impractical, from an economic and social perspective, as installation depths increase. Therefore, the use of subsurface storage facilities was introduced as an alternative for servicing storm sewers at depths greater than 5m. As a preliminary cut-off, a depth of 5m was used to select surface facilities versus subsurface storage facilities. **Table 2.4** demonstrates the criteria for each EOP control.

**Table 2.4: EOP Criteria**

| EOP Type | Criteria |
|---|---|
| Surface Facility | 1. Pipe depth <5m |
| Subsurface Storage Facility | 1. Pipe depth >5m,<br>2. Site has surface constraints which cannot be mitigated, or<br>3. Site is within the Regulatory Floodplain |

One location (site #5) was removed from consideration, as the drainage area for the proposed inlet was too small (2.5 ha). A total of 9 potential locations were therefore considered. Following the above criteria, **Table 2.5** lists the 9 locations identified as potential SWM facility opportunities:

1) One (1) locations were identified as where a **Surface Facility (bioswale)** was the primary alternative, and
2) Eight (8) locations were identified where a **Subsurface Storage Facility** was the primary alternative.

**Table 2.5: Surface versus Subsurface Storage SWM Opportunities**

| Map & Site ID | Location Name | Pipe Depth Below Ground Surface (BGS) (m) | Surface Constraints which cannot be mitigated | Within Regulatory Floodplain | Recommended Facility Type (1- Primary alternative; 2- Secondary alternative) |
|---|---|---|---|---|---|
| 01 | Northfield Park | 2.9 | Yes | No | Subsurface Storage Facility† |
| 03 | Dunvegan Park | 2.7 | Yes | No | Subsurface Storage Facility† |
| 04 | Belgreen Park / Warrington Park | 2.8 | Yes | No | Subsurface Storage Facility† |
| 06 | Waterloo Park (by LRT) | 2.3 | Yes | No | Subsurface Storage Facility† |
| 07 | Waterloo Park (Seagram Drive) | 2 | Yes | No | Subsurface Storage Facility† |
| 08 | Laurelwood Park | 1.7 | No | No | 1) Surface Facility◊<br>2) Subsurface Storage Facility† |
| 09 | Bechtel Park | 6.0 | No | No | Subsurface Storage Facility |
| 10 | Sandowne Park | 2.8 | Yes | No | Subsurface Storage Facility† |
| 11 | Lexington Park | 1.4 | Yes | No | Subsurface Storage Facility† |
| † Pipe depth criteria modified by Surface Constraints which cannot be mitigated<br>◊ Bioswale is proposed to fully treat the park runoff and a portion of the catchment runoff, however the majority of the catchment runoff would have to be managed by the subsurface facility. | | | | | |

*Level 1 Water Quality Control*

Surface and Subsurface Storage Facilities are recommended to follow the 2003 MOE Stormwater Management Planning and Design Manual (SWMPD) in regards to design and sizing criteria in order to provide adequate water quality, erosion, and quantity control. These guidelines are also used to accurately design and dimension facilities to ensure proper facility function, safety and performance is achieved.

For Surface and Subsurface Storage Facilities, the 2003 MOE Stormwater Management Planning and Design Manual (SWMPD) manual was followed to determine the general facility size, capacity, configuration, and dimensions. The SWMPD design guidelines and generic design specifications for subsurface plastic arch stormwater subsurface storage facilities (i.e. Cultech, Triton and others) as well as concrete subsurface storage facilities (i.e. CONSTORM®, Contech®, Stormtrap®, Rotondo®) were used to develop the conceptual alternatives for each SWMF, respectively. **Table 2.6** lists the design guidelines and assumptions for both surface and subsurface storage SWM opportunity.

**Table 2.6: General Design Standards/Specification - Surface & Subsurface Storage Facilities**

| Surface Facility | Subsurface Storage Facility |
|---|---|
| General Assumptions<br>○ Assumed freeboard is pipe depth from ground surface<br>○ Average 4:1 side slopes<br>○ Assumed facility buffer of 2m from top of bank<br>○ Available permanent pool storage:<br>• Base volume estimate (assumes 3.0m perm pool depth)<br>• Adjusted volume estimate (applies a 30% increase in required permanent pool volume base estimates to account for loss of storage due to submerged berms etc.<br>• Permanent pool storage active below the storm sewer invert | ○ Volume control per unit area = ranged from 1.0m3/m2 to 2.5m3/m2 (average 1.5$m^3/m^2$)<br>○ Plastic Arch Dimension<br>• Span Length = 1.495m<br>• Riser Height = 0.914m<br>• Unit Length = 0.845m<br>○ Concrete Arch Dimension<br>• Span Length = 6.0m<br>• Riser Height = 1.35m<br>• Unit Length = 2.5m<br>○ Storage volume is active below the storm sewer invert |

Initially conducted during the Phase 1 assessment, the Phase 3 assessment re-evaluated each potential SWM opportunity for performance using specific water quality sizing criteria outlined in Table 3.2 of the 2003 MOE SWMPD and corresponding design standards. The goal when evaluating each potential SWM opportunity was to obtain a minimum of 50% of the Level 1 (80% long-term total suspended solid removal) water quality storage requirements for each facility. However, actual storage potential was determined by adhering to physical design standards (e.g. side slopes, pond depth, freeboard, etc) and individual site characteristics. Water quality targets were maximized as permissible by design standards and available area. For subsurface storage facilities, water quality targets were limited to the maximum number of subsurface units which could be accommodated. **Table 2.7** summarizes the performance criteria used to determine each of the site's feasibility and determine if adequate area exists to permit the construction of the new SWM opportunity.

**Table 2.7 – Summary of Available Area to Provide Level 1 Water Quality Control**

| Map & Site ID | Location Name | Pipe Depth Below Ground Surface (BGS) (m) | Recommended Facility Type Primary alternative; 2- Secondary alternative) | DA (ha) | TIMP (%) | Required Perm Pool volume ($m^3$)◊ | Required Ex. Detention Vol ($m^3$)† | Depth of Perm Pool or Subsurface Storage Facility WL (m) | Estimate of Available Flood Storage ($m^3$) | Total Area (ha) | Available Retrofit Area (non-constrained) (ha) | Required Facility Area (ha) | Percentage of Required Facility Area |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Northfield Park | 2.9 | Subsurface Storage Facility | 49 | 57 | 9398 | 6983 | 2.9 | n/a | 1.3 | 0.8 | 0.81 | 102% |
| 3 | Dunvegan Park | 2.7 | Subsurface Storage Facility | 25.3 | 56 | 4796 | 3542 | 2.7 | n/a | 2.2 | 0.9 | 0.73 | 61% |
| 4 | Belgreen Park / Warrington Park | 2.8 | Subsurface Storage Facility | 45.3 | 60 | 8991 | 6795 | 2.8 | n/a | 0.85 | 0.7 | 0.78 | 111%* |
| 6 | Waterloo Park (by LRT) | 2.3 | Subsurface Storage Facility | 32.7 | 63 | 6708 | 5150 | 2.3 | n/a | 1.1 | 0.88 | 0.58 | 66% |
| 7 | Waterloo Park (Seagram Drive) | 2 | Subsurface Storage Facility | 31 | 64 | 6428 | 4960 | 2 | n/a | 13.5 | 2.3 | 0.56 | 24% |
| 8 | Laurelwood Park | 1.7 | 1) Surface Facility 2) Subsurface Storage Facility | 9 | 57 | 1726 | 1283 | 1.7 | n/a | 13.5 | 2.6 | 0.2 | 8% |
| 9 | Bechtel Park | 6.0 | Subsurface Storage Facility | 35.6 | 56 | 6749 | 4984 | 6 | n/a | 8.6 | 3.1 | 1.26 | 41% |
| 10 | Sandowne Park | 2.8 | Subsurface Storage Facility | 54.5 | 55 | 10211 | 7494 | 2.8 | n/a | 1.8 | 0.6 | 0.88 | 126%* |
| 11 | Lexington Park | 1.4 | Subsurface Storage Facility | 10.2 | 62 | 2070 | 1581 | 1.4 | n/a | 2.3 | 0.75 | 0.18 | 24% |

†Extended detention calculated for the 25mm rain event;
◊ Assumes largest storage volume requirement per the MOECC 2003 (wet pond)
* Total area is sufficient for facility, but vegetated areas would have to be removed as current available area is too small

## 2.4 Phase 4 – Consultation with City Staff

The consultation with City staff was intended to identify constraints, opportunities and synergies with other City of Waterloo projects and or plans in regards to the identified SWM Pond Opportunities carried forward from Phase 1, 2 and 3.

As such, on April 30, 2019, all SWM opportunity locations carried forward from Phases 1, 2 and 3 were presented to City staff from various departments to illicit feedback and provide an opportunity for City staff to review and discuss each location in detail.

### 2.4.1 Non-feasible SWM Opportunities

Following the discussion with City staff, no sites were deemed not feasible.

### 2.4.2 Feasible SWM Opportunities

Three sites were identified as being priority locations, including:

- Northfield Park (Site 1)
- Laurelwood Park (Site 8)
- Sandowne Park (Site 10)

The remaining sites include:

- Dunvegan Park (Site 3)
- Belgreen Park / Warrington Park (Site 4)
- Waterloo Park by LRT (Site 6)
- Waterloo Park near Seagram Drive (Site 7)
- Bechtel Park (Site 9)
- Lexington Park (Site 11)

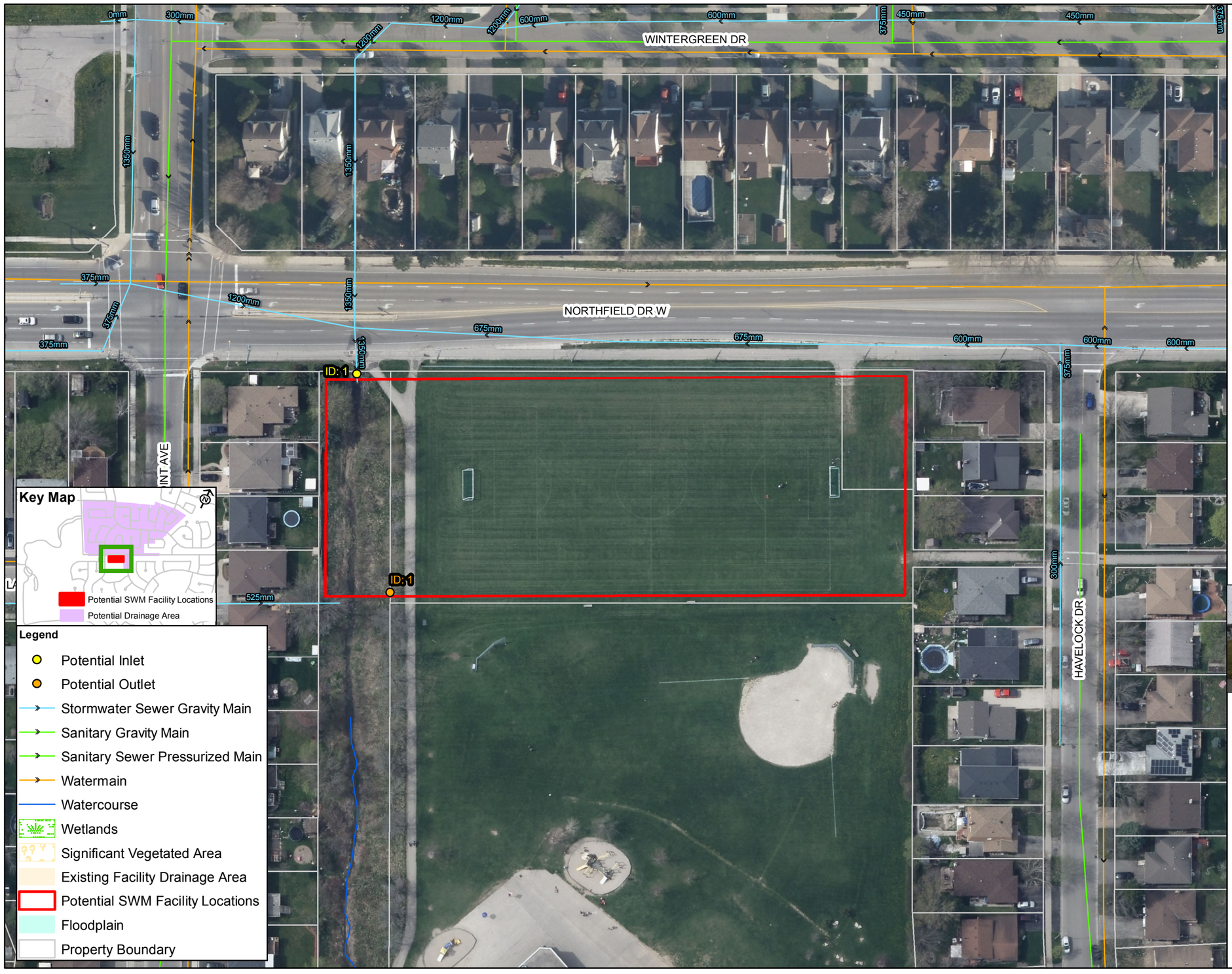
**Table 2.8** highlights relevant discussion points in regards to each of the nine locations. **Summary Figures** for each of the nine (9) SWM opportunities are presented following **Table 2.8.**

**Table 2.8 – Summary of Discussion Points with City Staff**

| Map & Site ID | Location Name | Notes |
|---|---|---|
| 1 | Northfield Park | • The field is always wet, so this is a good opportunity to improve drainage<br>• High priority site |
| 3 | Dunvegan Park | • Neighbourhood would be concerned about a surface pond in the bowl area<br>• No known plans for reconstructing the tennis courts<br>• Preference is to use the green space at the north side of the park |
| 4 | Belgreen Park / Warrington Park | • Currently resurfacing tennis courts<br>• The neighbourhood is protective of the berm for noise protection<br>• Partial capture is possible, as City-owned property is smaller than required area<br>• This might be a good long-term project, to be completed once the tennis courts need refurbishing |
| 6 | Waterloo Park (by LRT) | • Lower priority site |
| 7 | Waterloo Park (Seagram Drive) | • Not enhancing the baseball diamonds at this point, but good opportunity to implement subsurface storage if enhancements do go ahead in the future |
| 8 | Laurelwood Park | • Bioswale is an enhancement to the park, making it a feature the community might support<br>• The proposed area is already a wet area<br>• Existing ash trees will likely be coming down in the near future as part of the ash borer program<br>• High priority site |
| 9 | Bechtel Park | • City of Kitchener property, but still a possibility to explore |
| 10 | Sandowne Park | • Playground was installed last November |

| Map & Site ID | Location Name | Notes |
|---|---|---|
| | | • Reduced treatment level would be feasible if insufficient land area for full Level 1 treatment<br>• To avoid dismantling the playground, may be possible to encroach into the woodlot (but need to determine status of forest)<br>• Erosion has been an issue in the creek downstream, so managing high flows would be beneficial<br>• Other than the playground, the park doesn't have high use due to the steep slopes<br>• High priority site |
| 11 | Lexington Park | • Parking lot and field (on west side) owned by WMB Church<br>• Baseball diamond used frequently by Waterloo Minor Ball<br>• Recently did upgrades to ball diamond<br>• This park is a potential location for a future splash pad |

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 1: Northfield Park




**Ownership:** City of Waterloo
**Current Use:** Sports Field (Soccer Field)
**Total Area:** 1.3ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.8ha
**Drainage Area:** 49ha
**TIMP %:** 57%
**Inlets at:** 1350mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 2.9m
**Outlets to:** Existing Stream
**Depth to Pipe Invert at Outlet:** N/A
**Floodplain Present:** No
**Mature Trees:** No
**Identified Conflicts:**
•None Identified

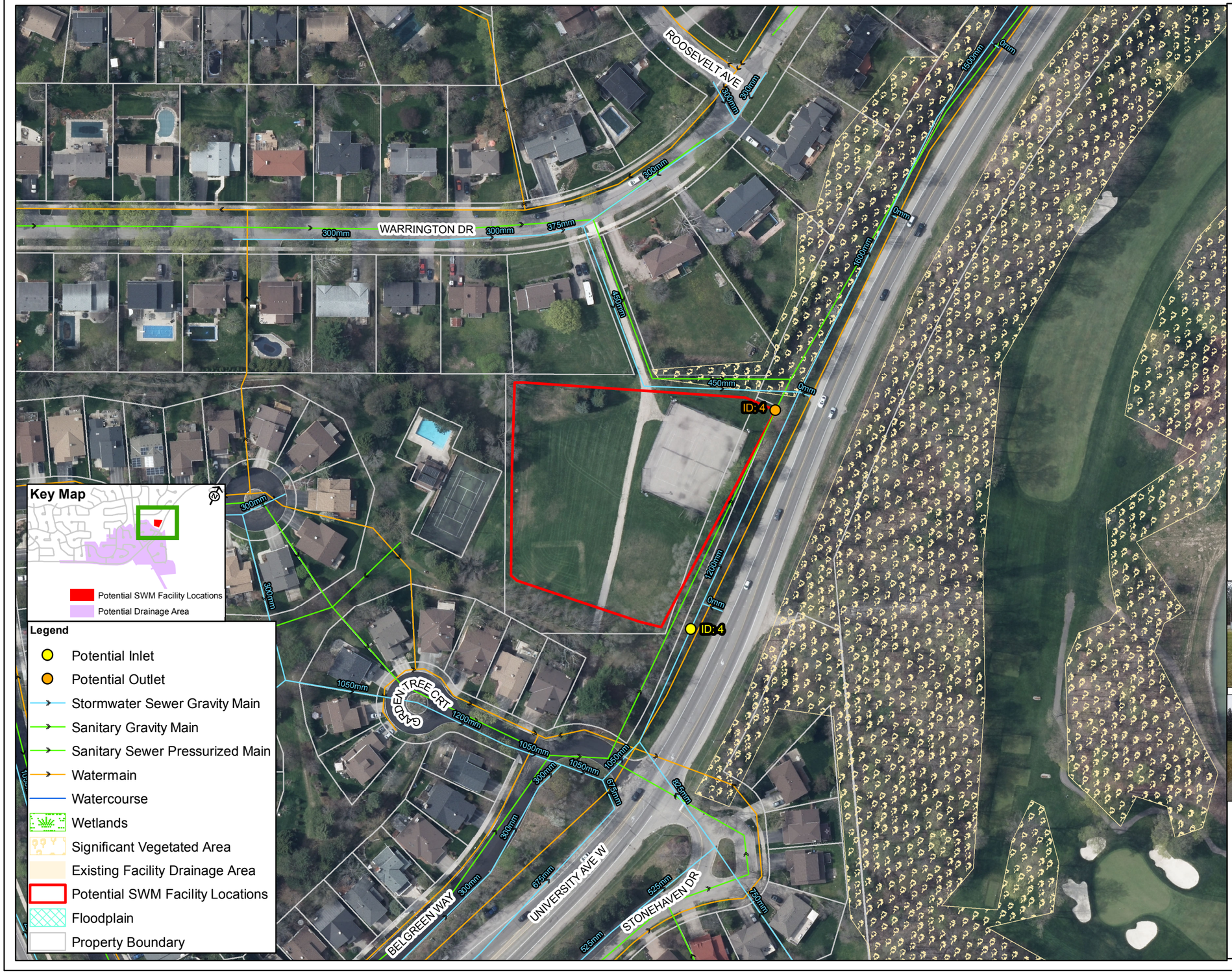
**Notes:**
•Asphalt pedestrian walkway along western side of park; outlet would have to pass beneath.
•School grounds immediately adjacent to the south.
•Priority Location.

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 3: Dunvegan Park


**Ownership:** City of Waterloo
**Current Use:** Park
**Total Area:** 2.2ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.9ha
**Drainage Area:** 23ha
**TIMP %:** 56%
**Inlets at:** 1050mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 2.7m
**Outlets to:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** 4m
**Floodplain Present:** No
**Mature Trees:** Yes
**Identified Conflicts:**
•None Identified

**Notes:**
•Tennis courts have lighting, likely with buried electrical conduits that may intersect the site.
•Catchbasin and stormsewer identified in south parcel but not on mapping, appearing to discharge to Dunvegan Drive.
•Located within the drainage area of Location 10.

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 4: Belgreen Park / Warrington Park




**Ownership:** City of Waterloo
**Current Use:** Park
**Total Area:** 0.85ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.7ha
**Drainage Area:** 45ha
**TIMP %:** 60%
**Inlets at:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 2.8m
**Outlets to:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** 2.5m
**Floodplain Present:** No
**Mature Trees:** Yes
**Identified Conflicts:**
•None Identified

**Notes:**
•Tennis courts currently undergoing upgrade. Lights are present likely with buried electrical conduits that may intersect the site.
•Vegetated berm present between site and University Ave, but existing catch basin and stormsewer connection present.
•Stormsewer along University Ave located in the boulevard, reducing traffic disruptions during construction.

Meters
0 15 30 60

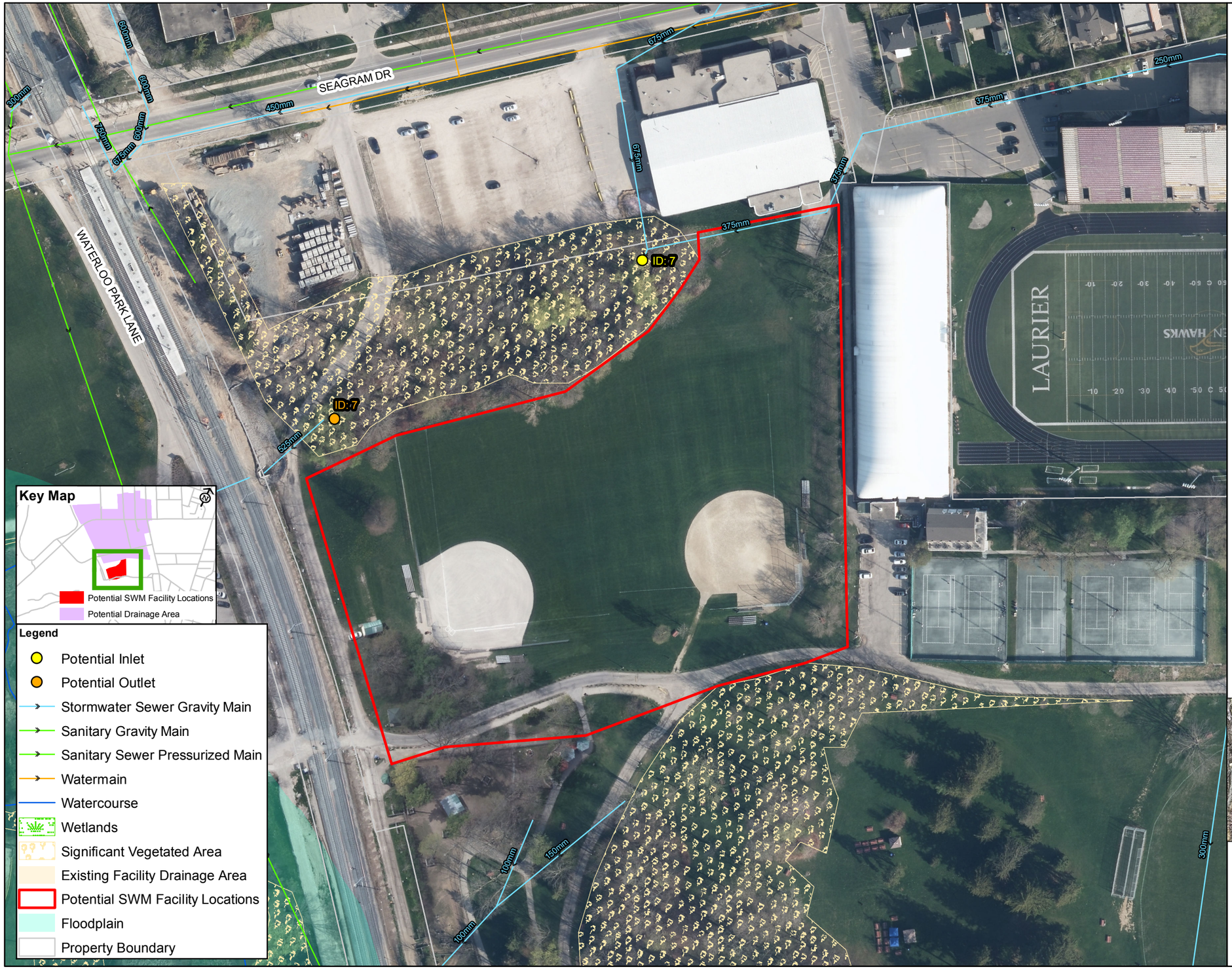
# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 6: Waterloo Park (by LRT)


**Ownership:** City of Waterloo
**Current Use:** Sports Field (Soccer)
**Total Area:** 1.1ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.88ha
**Drainage Area:** 33ha
**TIMP %:** 63%
**Inlets at:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 2.3m
**Outlets to:** Daylights to creek
**Depth to Pipe Invert at Outlet:** N/A
**Floodplain Present:** Yes
**Mature Trees:** No
**Identified Conflicts:**
•Sanitary sewer crosses field along northern edge

**Notes:**
•Low elevation of soccer field surface compared to outlet may be a constraint.
•Inlet from stormsewer will be within 40m of active LRT track.
•Stormsewer daylights to creek near the soccer field; proposed outlet to the creek.
•Captures drainage area of Location 7.

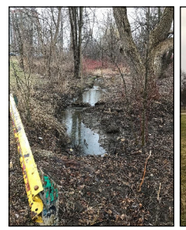
0 10 20 40 Meters

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 7: Waterloo Park (Seagram Drive)




**Ownership:** City of Waterloo
**Current Use:** Park, Sports Field (Baseball)
**Total Area:** 13.5ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 2.3ha
**Drainage Area:** 31ha
**TIMP %:** 64%
**Inlets at:** 600mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 1.7m
**Outlets to:** Daylights to creek
**Depth to Pipe Invert at Outlet:** N/A
**Floodplain Present:** Yes
**Mature Trees:** Yes
**Identified Conflicts:**
•None identified

**Notes:**
•Erosion and sediment build-up noted at proposed outlet in creek channel before it enters the culvert beneath the LRT tracks. Opportunity for concurrent stream restoration.
•Proposed inlet and outlet located in Supporting Natural Feature as identified in Schedule A4 of the City of Waterloo Official Plan.
•Located in drainage area of Location 6.



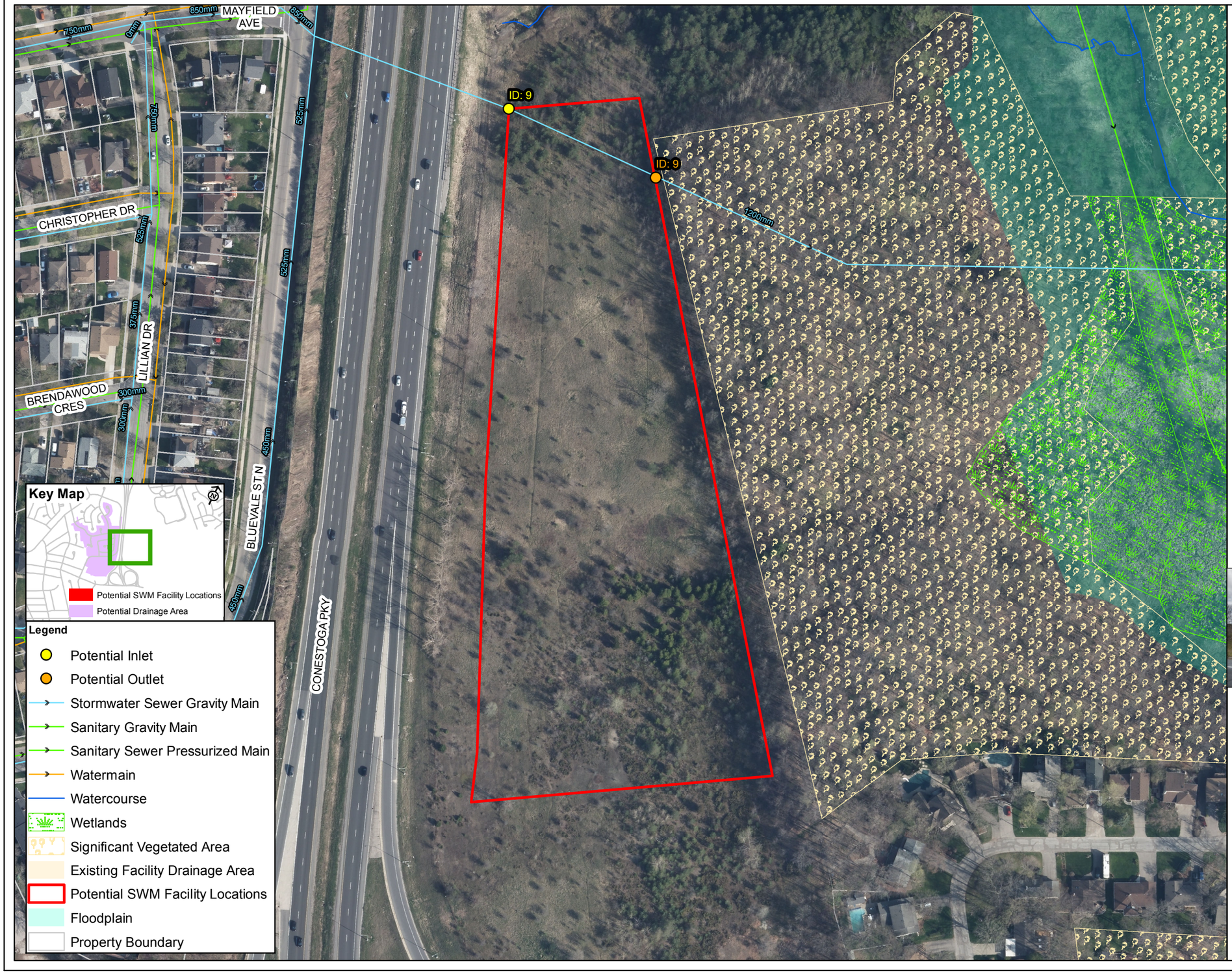
# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 8: Laurelwood Park


**Ownership:** City of Waterloo
**Current Use:** Park, Sports Field (Baseball)
**Total Area:** 13.5ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 2.4ha
**Drainage Area:** 9ha
**TIMP %:** 56%
**Inlets at:** 900mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 1.8m
**Outlets to:** 900mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** 1.7m
**Floodplain Present:** Yes
**Mature Trees:** Yes
**Identified Conflicts:**
•None identified

**Notes:**
•Many Ash trees along path painted with red spray paint and display signs of insect damage.
•Existing swale drains park to the north.

0 15 30 60 Meters

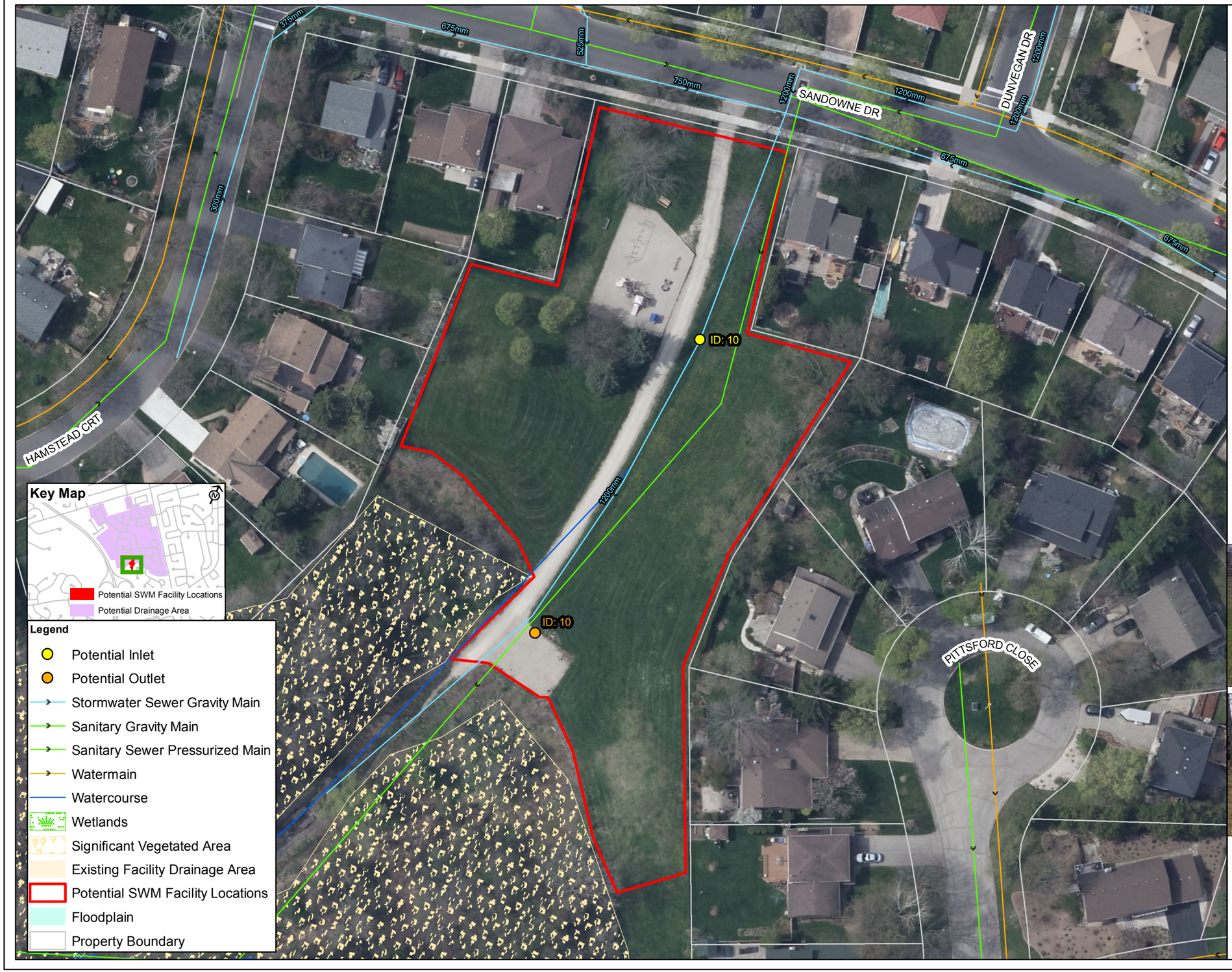
# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 9: Bechtel Park




**Ownership:** City of Kitchener
**Current Use:** Park, Trails
**Total Area:** 8.6ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 3.1ha
**Drainage Area:** 36ha
**TIMP %:** 56%
**Inlets at:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 6m
**Outlets to:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** Unknown
**Floodplain Present:** Yes
**Mature Trees:** Yes
**Identified Conflicts:**
•None identified

**Notes:**
•Property is owned by City of Kitchener and is adjacent to City of Kitchener Core Natural Heritage Feature and Region Core Environmental Feature.
•Vehicular access to site is limited.
•Photo below obtained from Google Street View (October 2018).

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 10: Sandowne Park




**Ownership:** City of Waterloo
**Current Use:** Park, Trails
**Total Area:** 1.8ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.6ha
**Drainage Area:** 54ha
**TIMP %:** 55%
**Inlets at:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 2.8m
**Outlets to:** 1200mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** Unknown
**Floodplain Present:** No
**Mature Trees:** Yes
**Identified Conflicts:**
•Sanitary sewer runs parallel to storm sewer

**Notes:**
•Ground surface slopes away from residential backyards.
•Catchbasin and manhole identified east of inlet, but not shown on mapping.
•1200mm stormsewer daylights to creek through gabion basket headwall just downstream of the proposed outlet.
•Captures drainage area of Location 3.
•Priority Location.

Meters
0 5 10 20

# City of Waterloo Integrated SWM MP - Possible SWM Facility Location 11: Lexington Park


**Ownership:** City of Waterloo/ Unknown
**Current Use:** Gravel Parking Lot, Sports Field (Baseball)
**Total Area:** 2.3ha
**Forested Area:** 0ha
**Wetland Area:** 0ha
**Available Area:** 0.75ha
**Drainage Area:** 10ha
**TIMP %:** 61%
**Inlets at:** 675mm Ø stormsewer
**Depth to Pipe Invert at Inlet:** 1.4m
**Outlets to:** 750mm Ø stormsewer
**Depth to Pipe Invert at Outlet:** 1.5m
**Floodplain Present:** No
**Mature Trees:** No
**Identified Conflicts:**
Washrooms located between parking lot and baseball diamond, but no servicing marked on maps.

**Notes:**
•Three monitoring wells located adjacent to washrooms.

### 2.4.3 Assessment of Potential SWM Opportunities Based on Economic Impacts

The construction cost estimates for the surface and subsurface storage facilities were based on the following:

**Surface Facilities**

1. Previous surface facility construction within the region had unit costs ranging from $150 to 215/$m^3$ (avg. of $190/$m^3$) of permanent pool volume created. Previous studies in the GTHA have utilized a rate of $100/$m^3$ for excavation required to excavate down to the proposed facility inlet (i.e. pipe depth) and a rate of $140.00/$m^3$ of permanent pool volume created thereafter. Analysis of this approach revealed an average total unit cost of $175/$m^3$ of permanent pool volume created. As such a range of $175/$m^3$ to $190/$m^3$ has been applied to account for unit cost variability and project uncertainty.
2. A minimum construction cost of $250,000 per facility was also used for smaller facilities to account for costs associated with mobilization, demobilization, bonding, erosion and sediment control and dewatering etc.
3. Bioswale construction cost is typically based on the linear distance of treated area. Previous projects have used $350/m for bioswales with a subdrain and $250/m for bioswales without a subdrain.

**Sub-Surface Facilities**

1. Costing for each subsurface storage unit has been based on unit costs of previously constructed facilities in the GTHA, through discussions with several municipalities and product distributors. The unit costs for subsurface facilities ranged from $350/$m^3$ to $450/$m^3$ per unit of water quality storage volume provided.
4. A minimum construction cost of $350,000 per facility was also used for smaller facilities to account for costs associated with mobilization, demobilization, bonding, erosion and sediment control and dewatering etc.

Implementation costs for each feasible SWM facility opportunity are summarized in **Table 2.9** below.

**Table 2.9: Estimated Cost ($) of the 10 Feasible SWM Facility Opportunities**

| Map & Site ID | Location Name | Recommended Facility Type (1 - Primary alternative; 2- Secondary alternative) | Drainage Area (ha) | Estimated Construction Cost ($) (millions)† |
|---|---|---|---|---|
| 01 | Northfield Park | Subsurface Storage Facility | 49 | $3.29 – 4.23 |
| 03 | Dunvegan Park | Subsurface Storage Facility | 23 | $1.53 – 1.96 |
| 04 | Belgreen Park / Warrington Park | Subsurface Storage Facility | 45.3 | $3.15 – 4.05 |
| 06 | Waterloo Park (by LRT) | Subsurface Storage Facility | 32.7 | $2.35 – 3.02 |
| 07 | Waterloo Park (Seagram Drive) | Subsurface Storage Facility | 31 | $2.25 – 2.89 |
| 08 | Laurelwood Park | 1) Surface Facility (bioswale)<br>2) Subsurface Storage Facility | 9 | 1) $0.02 – 0.03<br>2) $0.60 – 0.77 |
| 09 | Bechtel Park | Subsurface Storage Facility | 35.6 | $2.36 – 3.04 |
| 10 | Sandowne Park | Subsurface Storage Facility | 54.5 | $3.57 – 4.59 |
| 11 | Lexington Park | Subsurface Storage Facility | 10.2 | $0.72 – 0.92 |
| | | **TOTALS** | 236.3◊ | $19.84 – 25.50* |

† Class 'C' cost estimate
◊ Total area does not include Sites 3 and 7 separately, as they are included in the drainage areas of Sites 10 and 6, respectively
* total cost includes both options 1 and 2 for Site 8

## *2.5 Implementation Considerations*

All the proposed SWM facilities will require additional investigation or monitoring prior to implementation. Table 2.10 outlines which of the following will be required for each facility, and ranks the projects based on City staff comments, drainage area, and ease of implementation.

**Environmental Impact Statement (EIS)** – would be needed for projects that have the potential to impact the Natural System. It would provide recommendations for preventing, minimizing, or mitigating impacts to the Natural System, and opportunities to enhance or restore its quality and connectivity. The EIS may include a geotechnical assessment and /or a feature-specific water budget assessment (as required).

**Geotechnical Investigation** – would be focused on the local soil information gathered through subsurface geotechnical investigations and undertaken for the purposes of structural design of centralized stormwater management facilities.

**Hydrogeological Investigation** – would deal with the movement and distribution of groundwater as controlled by local geological materials that make up the solid medium that controls the storage, movement and chemical evolution of groundwater.

**Hydraulic and Hydrologic Modelling** – Surface runoff peak flow estimates would be generated for the 2yr, 5yr, 25yr, 50yr, and 100yr design rainfall events for the existing and pre-development land use conditions. The proposed SWM facilities would be modelled using approved hydraulic and hydrologic models to evaluate their efficacy.

**ICA, WHPA, IPZ Considerations** – new SWM facilities must be managed to ensure the facility does not become a significant drinking water threat if they are within WHPA (8-10), IPZ 3, or ICA (nitrate and/or chloride). Water quality monitoring is a minimum requirement for these facilities.

**Utility Locates** – several unmarked utilities were identified during site visits, so utility locates would be necessary to determine constraints to the design of the proposed SWM facilities.

**Table 2.10: Implementation Considerations**

| Priority Rank | Site Name & ID | EIS | Geotechnical Investigation | Hydrogeological Investigation | Hydrologic Model | ICA, WHPA, IPZ Consideration | Utility Locates |
|---|---|---|---|---|---|---|---|
| 1 | Northfield Park (Site 1) | y | y | y | y | y | y |
| 2 | Sandowne Park (Site 10) | y | y | y | y | y | y |
| 3 | Laurelwood Park (Site 8) | y | y | y | y | y | y |
| 4 | Belgreen Park / Warrington Park (Site 4) | - | y | y | y | y | y |
| 5 | Lexington Park (Site 11) | - | y | y | y | - | y |
| 6 | Bechtel Park (Site 9) | y | y | y | y | y | y |
| 7 | Waterloo Park (by LRT) (Site 6) | y | y | y | y | y | y |
| 8† | Dunvegan Park (Site 3) | - | y | y | y | - | y |
| 9† | Waterloo Park (Seagram Drive) (Site 7) | y | y | y | y | y | y |

† Sites 3 and 7 are within the drainage area of sites 10 and 6 and would therefore provide additional flood control but minimal water quality benefits.

## 3.0 Summary

A four (4) phase feasibility assessment was conducted to identify available areas throughout the City of Waterloo which have the potential to accommodate new stormwater management facilities. Of the potential sites which were screened, nine (9) of the initial eleven (11) were ultimately deemed feasible upon completion of the four (4) phase evaluation process. In total, one (1) site were identified where a surface facility (bioswale) was the primary alternative and eight (8) sites were identified where a subsurface storage facility was the primary alternative. **Figure 3.1** demonstrates the locations of the 9 feasible SWM opportunity locations.

The implementation of the proposed SWM facility opportunities would increase the City's SWM Assets to 63 facilities at a cost of $19.84 – 25.50 million. The implementation of the nine opportunities would increase the SWM control in the urban area in the City of Waterloo by an additional 236 ha (4.7%) to a total of 2,299 ha (45.6%). **Figure 3.2** summarizes the percentage of existing urban area with SWM control in the City of Waterloo. A breakdown is as follows:

- 1,736 ha (34%) would be controlled for water quality control by surface SWM facilities (ponds, wetlands, hybrid facilities and sub-surface storage facilities)
- 1,852 ha (36.7%) would remain controlled for water quantity by surface SWM facilities (ponds, wetlands, hybrid facilities and dry ponds). However additional flood storage may be incorporated into the SWM opportunity sites where additional land is available.
- The 61 OGS units would continue to provide additional water quality control for areas outside the respective drainage areas for the 61 SWM facilities, providing an additional 75 ha (4.1%) of water quality control.

Accordingly, at full implementation, approximately 2,978 ha (59.1% of urban area) would remain uncontrolled. It is therefore recommended that the proposed SWM facilities opportunities be combined with other urban retrofit initiatives such as roadway LID retrofits, residential LID retrofits, as well as retrofits of public spaces and municipal properties to more fully control the City's existing urban areas.

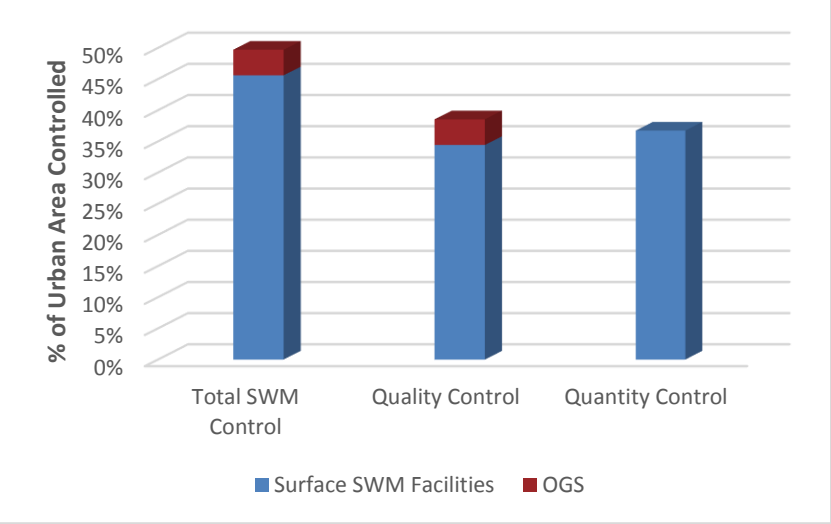



**Figure 3.2 – Percentage of City Controlled by SWM Assets**

THE CITY OF Waterloo

# MUNICIPAL CLASS EA INTEGRATED STORMWATER MANAGMENT MASTER PLAN

**FIGURE : 3.1**
**POTENTIAL SWM FACILITY LOCATIONS**

- Roads
- Water Bodies
- Rivers
- Potential SWM Facility Locations
- Stormwater Management Ponds
- Municipal Boundary

0 0.5 1 Kilometers

N

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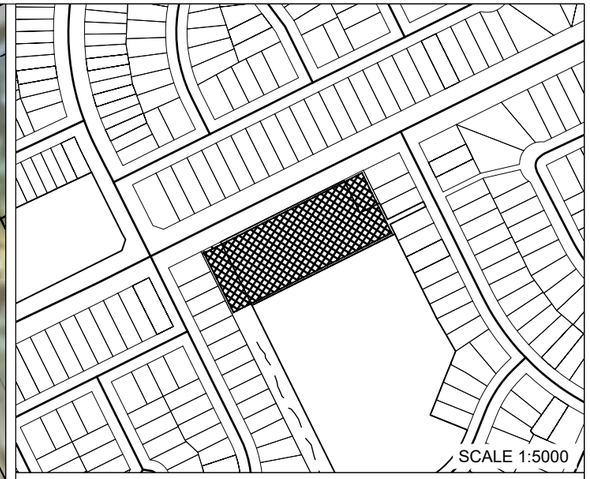
Base data provided by The City of Waterloo, 2017.

Date: March 2019

## 4.0 Conceptual Design of SWM Facilities

For each of the identified sites, a conceptual plan was developed for the end-of-pipe facility. These concepts are presented in **Figures 4.1** through **4.9**. Each figure identifies the proposed storage facility within the identified site area, inlets and outlets, as well as the downstream receiver (either storm sewer or watercourse). Where the information is available, inverts at the proposed inlets and outlets are identified. For Laurelwood Park (**Figure 4.7**), a bioswale is also proposed to capture and filter local drainage before discharging to existing receiver and provide park enhancement features along the existing trail.

# Figure 4.1: Northfield Park Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: SPORTS FIELD (SOCCER)
TOTAL SITE AREA: 1.3ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 0.8ha
DRAINAGE AREA: 49ha
TIMP % : 57%
FLOODPLAIN PRESENT : NO
MATURE TREES: NO
INLETS AT: 1350mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 2.9m
OUTLETS TO: EXISTING STREAM
DEPTH TO PIPE INVERT AT OUTLET: N/A
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 7,840$m^2$
TOTAL FACILITY STORAGE: 7,170$m^3$
TARGET WATER QUALITY STORAGE:9,400$m^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 76%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 4,000

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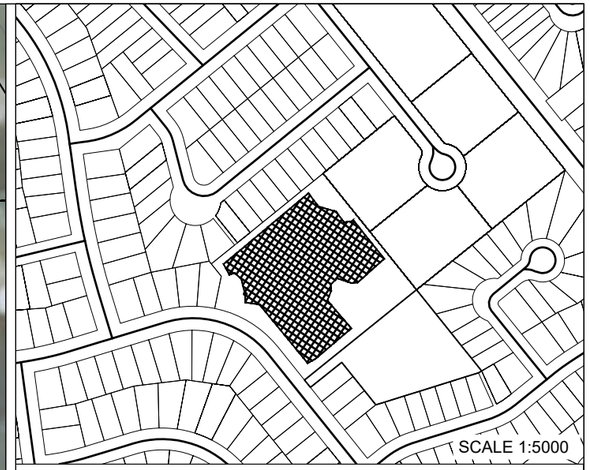
# Figure 4.2: Dunvegan Park Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: PARK
TOTAL SITE AREA: 2.2ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 0.9ha
DRAINAGE AREA: 23ha
TIMP % : 56%
FLOODPLAIN PRESENT : NO
MATURE TREES: YES
INLETS AT: 1050mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 3.9m
OUTLETS TO: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT OUTLET: 3.6m
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 4,770$m^2$
TOTAL FACILITY STORAGE: 4,390$m^3$
TARGET WATER QUALITY STORAGE: 4,360$m^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 100%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 2,432

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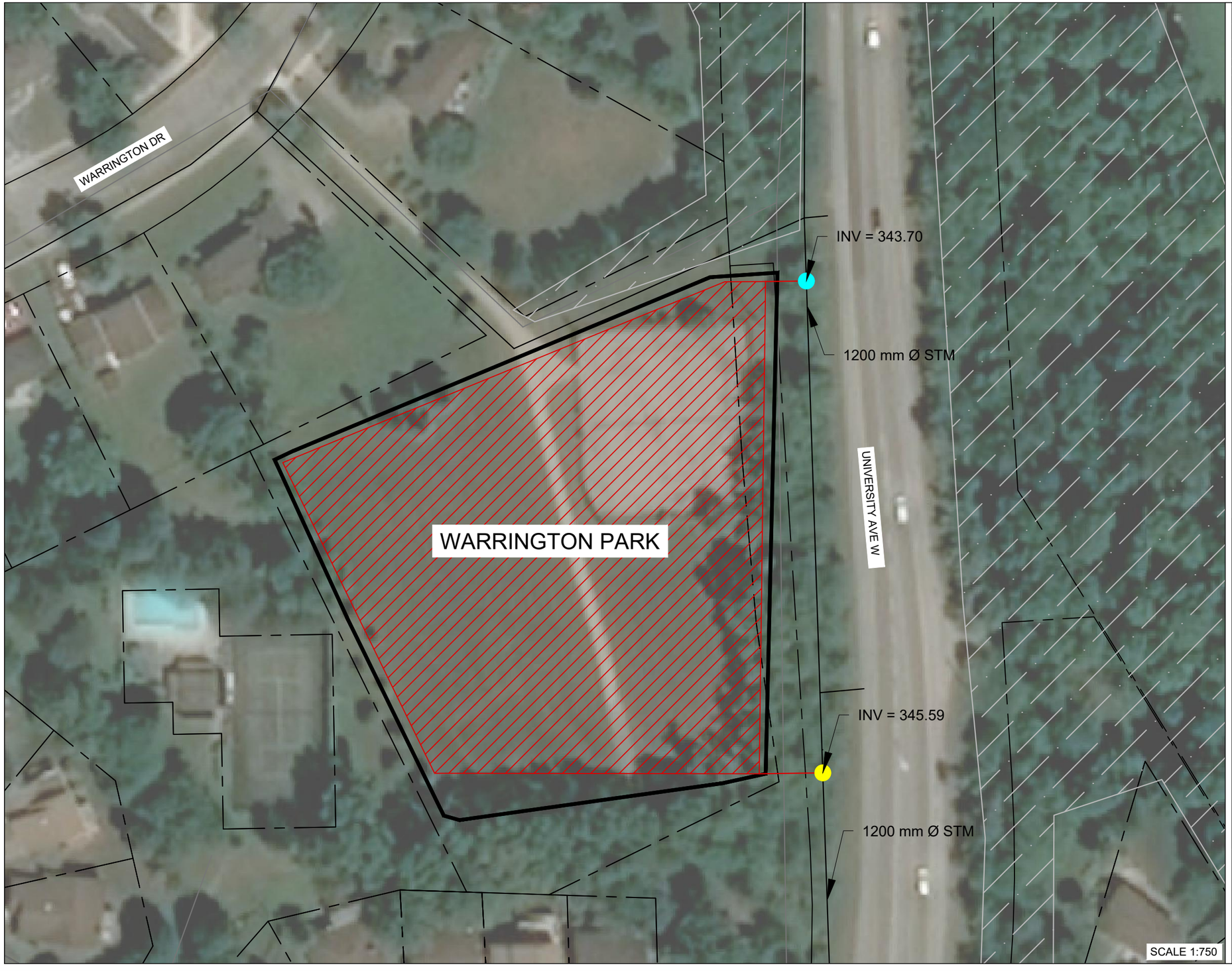
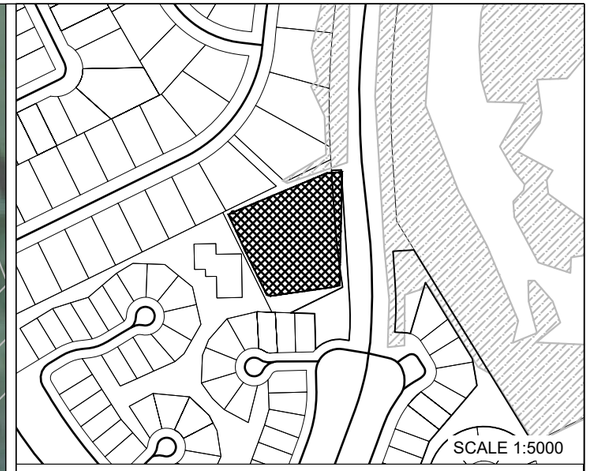
# Figure 4.3: Belgreen Park/Warrington Park Conceptual Design




## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: PARK
TOTAL SITE AREA: 0.85ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 0.7ha
DRAINAGE AREA: 45ha
TIMP % : 60%
FLOODPLAIN PRESENT : NO
MATURE TREES: YES
INLETS AT: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 2.8m
OUTLETS TO: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT OUTLET: 2.5m
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 6,110m$^2$
TOTAL FACILITY STORAGE: 5,620m$^3$
TARGET WATER QUALITY STORAGE: 8,990m$^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 63%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 3,116

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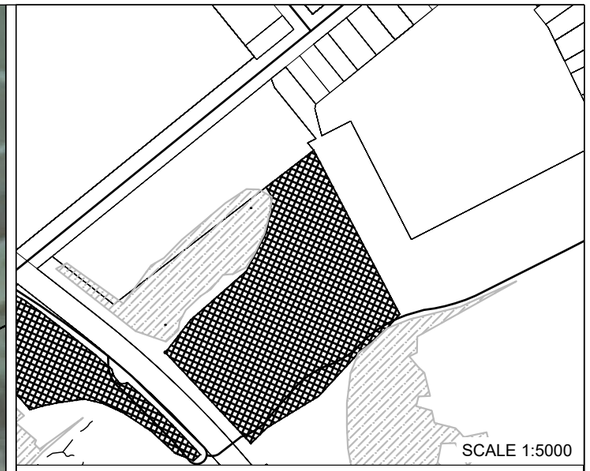
# Figure 4.4: Waterloo Park (Seagram Drive) Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: PARK, SPORTS FIELD (BASEBALL)
TOTAL SITE AREA: 13.5ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 2.3ha
DRAINAGE AREA: 31ha
TIMP % : 64%
FLOODPLAIN PRESENT : YES
MATURE TREES: YES
INLETS AT: 600mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 1.7m
OUTLETS TO: DAYLIGHTS TO CREEK
DEPTH TO PIPE INVERT AT OUTLET: N/A
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 7,250$m^2$
TOTAL FACILITY STORAGE: 6,720$m^3$
TARGET WATER QUALITY STORAGE: 6,710$m^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 100%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 3,696

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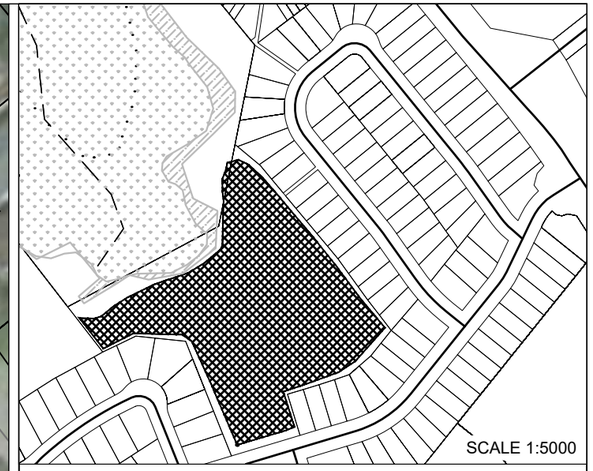
# Figure 4.5 Laurelwood Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: PARK, SPORTS FIELD (BASEBALL)
TOTAL SITE AREA: 13.5ha
FORESTED AREA: 0ha
WETLAND AREA: 0ha
AVAILABLE AREA: 2.6ha
DRAINAGE AREA: 9ha
TIMP % : 56%
FLOODPLAIN PRESENT : YES
MATURE TREES: YES
INLETS AT: 900mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 1.8m
OUTLETS TO: 900mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT OUTLET: 1.5m
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 1,835m$^2$
TOTAL FACILITY STORAGE: 1,720m$^3$
TARGET WATER QUALITY STORAGE: 1,710m$^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 100%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 936

## TYPICAL BIOSWALE CROSS SECTION




NOT TO SCALE

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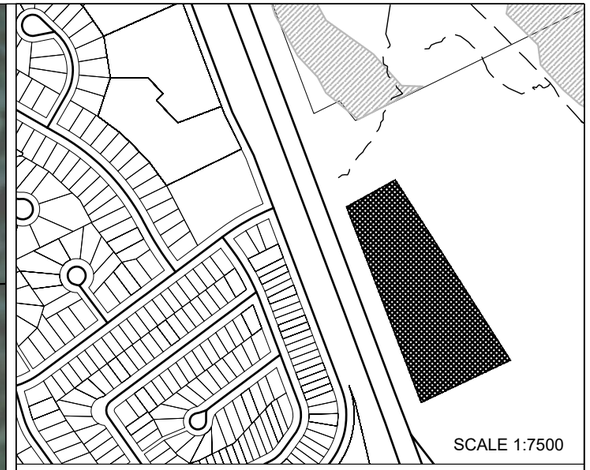
# Figure 4.6: Bechtel Park Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF KITCHENER
CURRENT USE: PARK, TRAILS
TOTAL SITE AREA: 8.6ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 3.1ha
DRAINAGE AREA: 36ha
TIMP % : 56%
FLOODPLAIN PRESENT : YES
MATURE TREES: YES
INLETS AT: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 6.0m
OUTLETS TO: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT OUTLET: 5.9m
IDENTIFIED CONFLICTS: NONE IDENTIFIED

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 7,420$m^2$
TOTAL FACILITY STORAGE: 6,815$m^3$
TARGET WATER QUALITY STORAGE: 6,750$m^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 100%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 3,784

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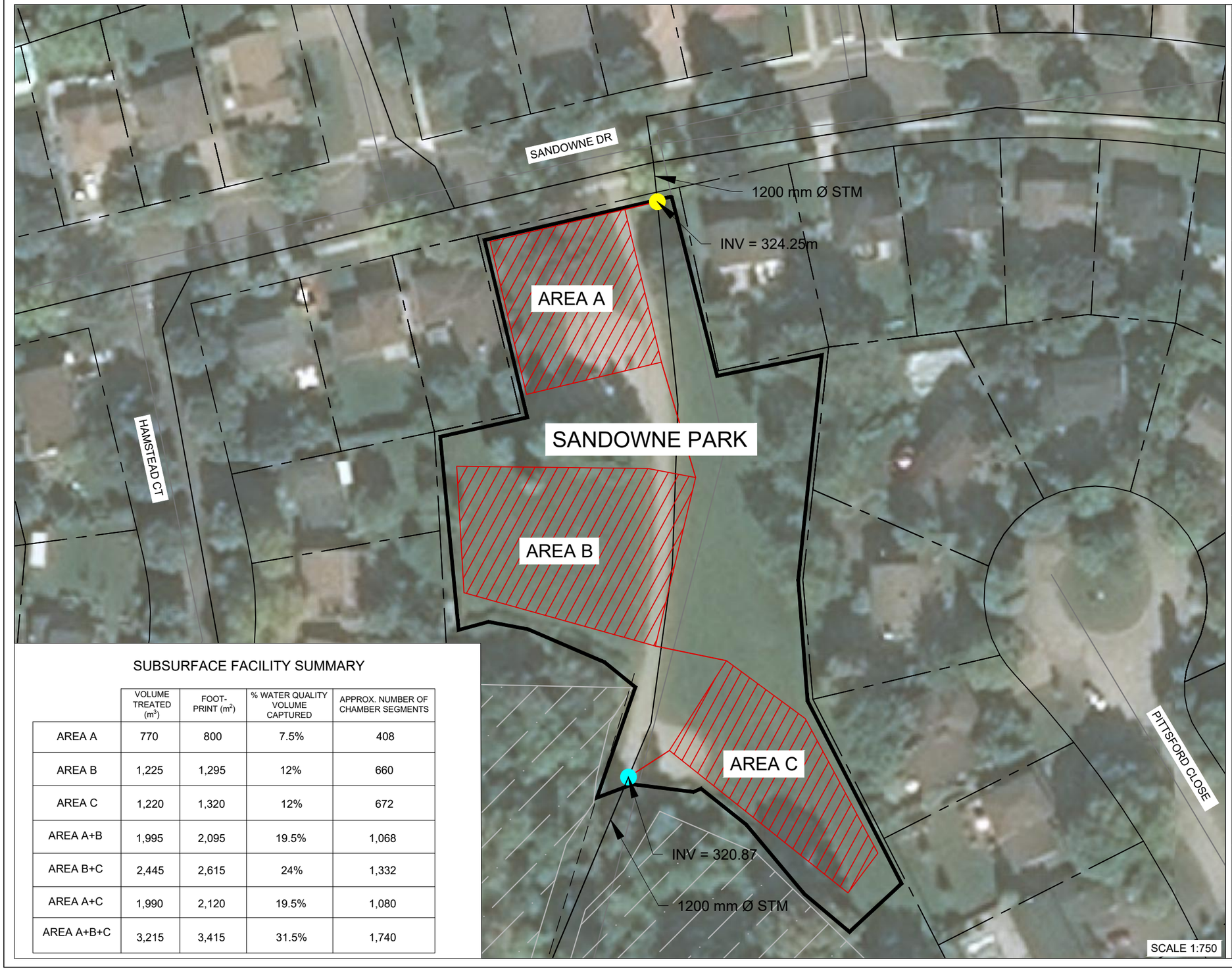
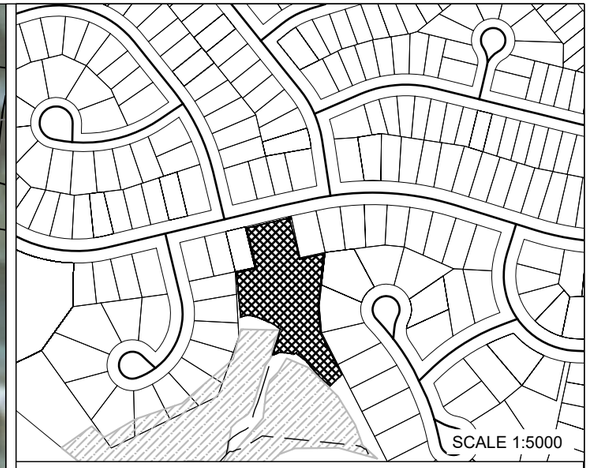
# Figure 4.7: Sandowne Park Conceptual Design




## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

## CURRENT CONDITIONS:

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: PARK, TRAILS
TOTAL SITE AREA: 1.8ha
FORESTED AREA: 0ha
WETLAND AREA: 0ha
AVAILABLE AREA: 0.6ha
DRAINAGE AREA: 54ha
TIMP %: 55%
FLOODPLAIN PRESENT: NO
MATURE TREES: YES
INLETS AT: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 3.2m
OUTLETS TO: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT OUTLET: 3.1m
IDENTIFIED CONFLICTS: SANITARY SEWER RUNS PARALLEL TO STORM SEWER

## PROPOSED FACILITY DESIGN:

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TARGET WATER QUALITY STORAGE: 10,211$m^3$
SEE TABLE FOR PERFORMANCE BREAKDOWN OF IDENTIFIED SUBSURFACE LOCATION OPTIONS

## SUBSURFACE FACILITY SUMMARY

| | VOLUME TREATED ($m^3$) | FOOT-PRINT ($m^2$) | % WATER QUALITY VOLUME CAPTURED | APPROX. NUMBER OF CHAMBER SEGMENTS |
|---|---|---|---|---|
| AREA A | 770 | 800 | 7.5% | 408 |
| AREA B | 1,225 | 1,295 | 12% | 660 |
| AREA C | 1,220 | 1,320 | 12% | 672 |
| AREA A+B | 1,995 | 2,095 | 19.5% | 1,068 |
| AREA B+C | 2,445 | 2,615 | 24% | 1,332 |
| AREA A+C | 1,990 | 2,120 | 19.5% | 1,080 |
| AREA A+B+C | 3,215 | 3,415 | 31.5% | 1,740 |

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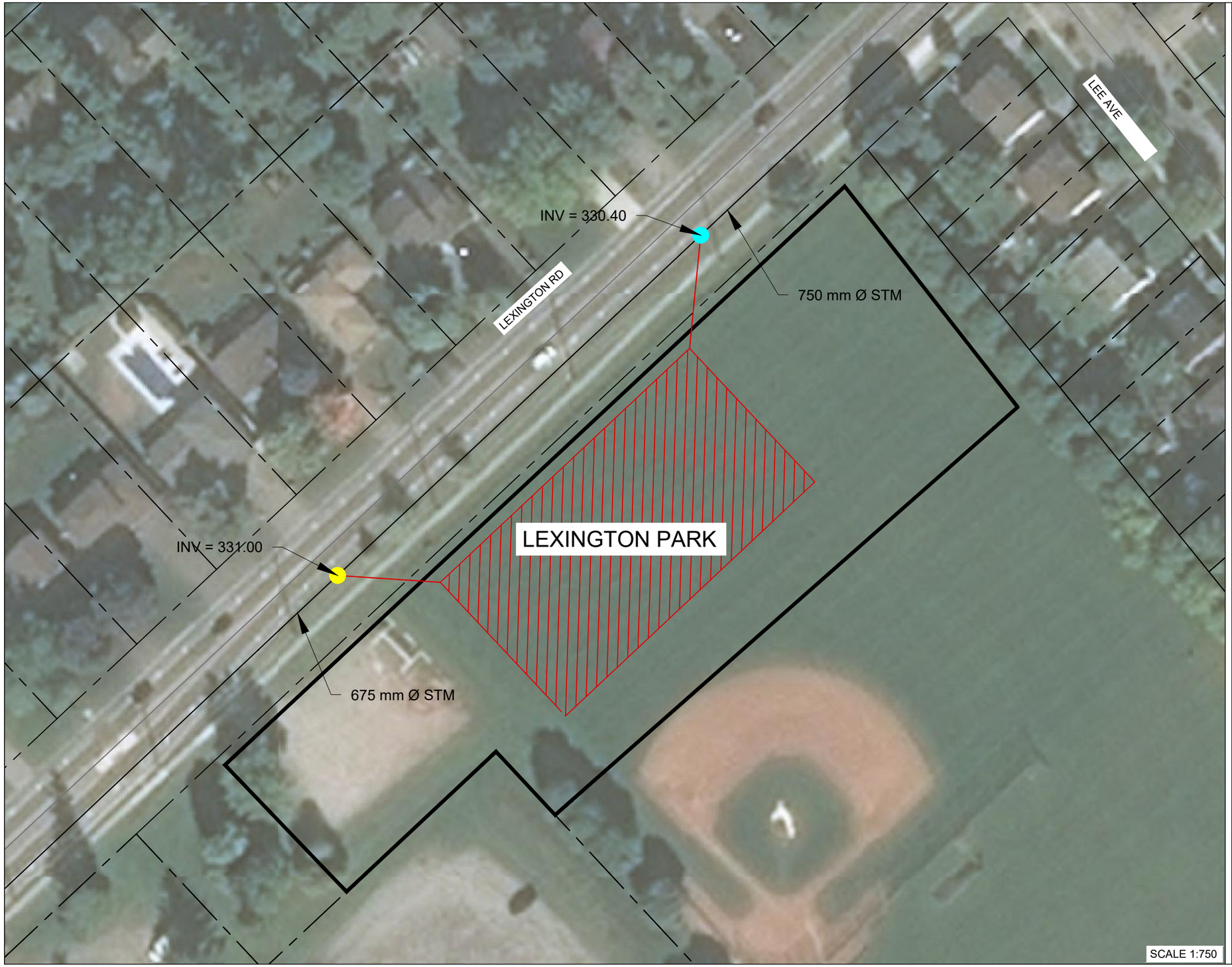
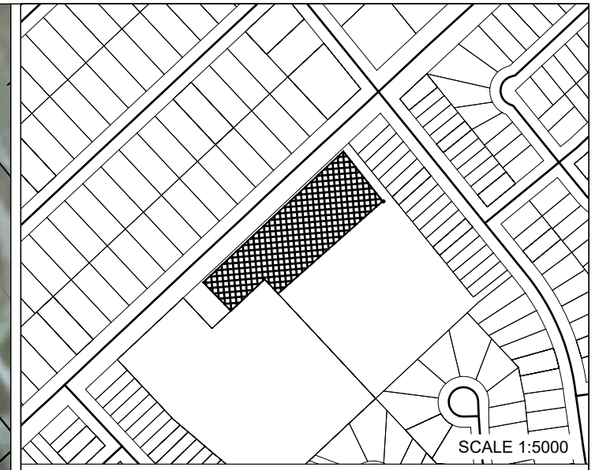
# Figure 4.8: Lexington Park Conceptual Design




## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

CURRENT CONDITIONS:

- OWNERSHIP: CITY OF WATERLOO
- CURRENT USE: SPORTS FIELD (BASEBALL), GRAVEL PARKING LOT
- TOTAL SITE AREA: 2.3ha
- FORESTED AREA: 0ha
- WETLAND AREA: 0 ha
- AVAILABLE AREA: 0.75ha
- DRAINAGE AREA: 10ha
- TIMP %: 61%
- FLOODPLAIN PRESENT: NO
- MATURE TREES: NO
- INLETS AT: 675mm Ø STORMSEWER
- DEPTH TO PIPE INVERT AT INLET: 1.4m
- OUTLETS TO: 750mm Ø STORMSEWER
- DEPTH TO PIPE INVERT AT OUTLET: 1.5m
- IDENTIFIED CONFLICTS: WASHROOMS LOCATED BETWEEN PARKING LOT AND BASEBALL DIAMOND, BUT NO SERVICING MARKED ON MAPS

PROPOSED FACILITY DESIGN:

- SYSTEM: SUB-SURFACE INFILTRATION GALLERY
- TOTAL FACILITY AREA: 2,120$m^2$
- TOTAL FACILITY STORAGE: 2,070$m^3$
- TARGET WATER QUALITY STORAGE: 2,050$m^3$
- PROPORTION OF WATER QUALITY VOLUME CAPTURED: 100%
- APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 1,116

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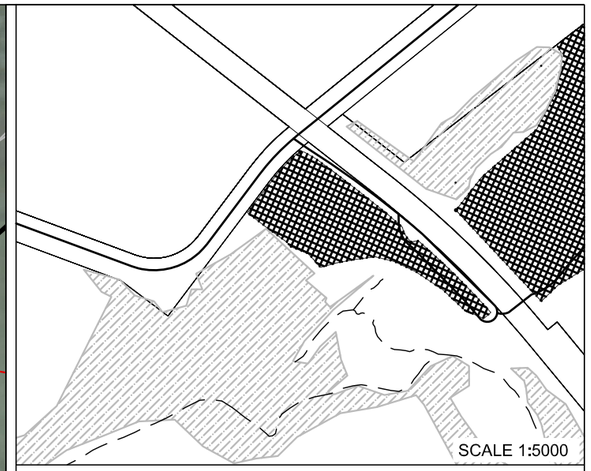
# Figure 4.9: Waterloo Park (LRT) Conceptual Design


## LEGEND

- PROPOSED SUBSURFACE STORAGE FACILITY
- PROPOSED SITE LOCATION
- PROPOSED SITE BOUNDARY
- SIGNIFICANT VEGETATED AREA
- WETLANDS
- EXISTING WATERCOURSE
- EXISTING PROPERTY LINE
- PROPOSED STORM PIPE EXTENTION
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING FLOODPLAIN BOUNDARY
- PROPOSED INLET LOCATION
- PROPOSED OUTLET LOCATION

**CURRENT CONDITIONS:**

OWNERSHIP: CITY OF WATERLOO
CURRENT USE: SPORTS FIELD (SOCCER)
TOTAL SITE AREA: 1.1ha
FORESTED AREA: 0ha
WETLAND AREA: 0 ha
AVAILABLE AREA: 0.88ha
DRAINAGE AREA: 33ha
TIMP % : 63%
FLOODPLAIN PRESENT : YES
MATURE TREES: NO
INLETS AT: 1200mm Ø STORMSEWER
DEPTH TO PIPE INVERT AT INLET: 2.3m
OUTLETS TO: DAYLIGHTS TO CREEK
DEPTH TO PIPE INVERT AT OUTLET: N/A
IDENTIFIED CONFLICTS: SANITARY SEWER CROSSES FIELD ALONG NORTHERN EDGE

**PROPOSED FACILITY DESIGN:**

SYSTEM: SUB-SURFACE INFILTRATION GALLERY
TOTAL FACILITY AREA: 3,340$m^2$
TOTAL FACILITY STORAGE: 3,080$m^3$
TARGET WATER QUALITY STORAGE: 6,710$m^3$
PROPORTION OF WATER QUALITY VOLUME CAPTURED: 46%
APPROXIMATE NUMBER OF MODULAR CHAMBER SEGMENTS: 1,704

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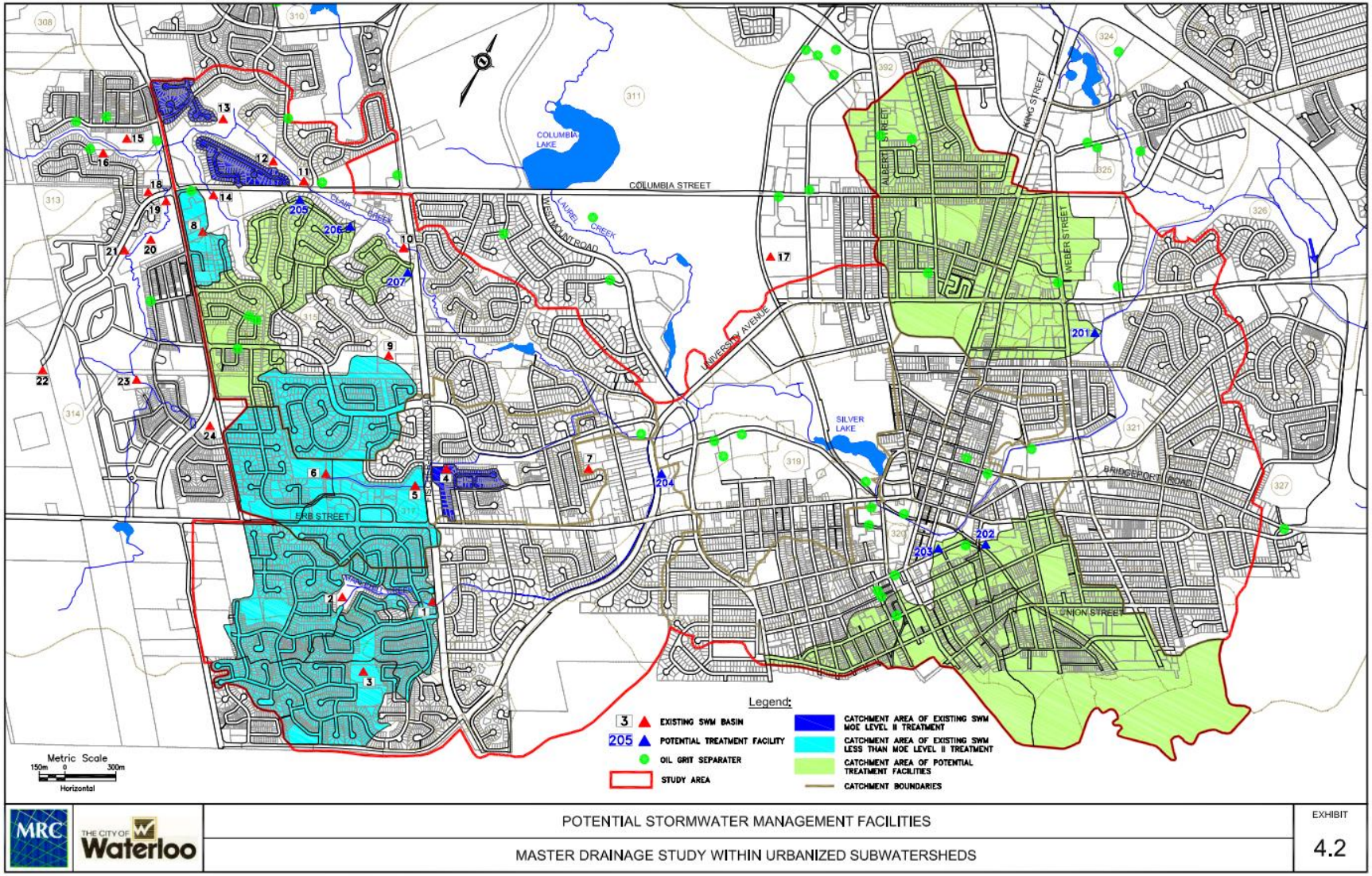
**Appendix A**

**Previous Studies**


COLUMBIA LAKE
COLUMBIA STREET
LAUREL CREEK
WESTMOUNT ROAD
UNIVERSITY AVENUE
ALBERT STREET
KING STREET
WEBER STREET
SILVER LAKE
ERB STREET
BRIDGEPORT ROAD
UNION STREET
Legend:
EXISTING SWM BASIN
POTENTIAL TREATMENT FACILITY
OIL GRIT SEPARATER
STUDY AREA
CATCHMENT AREA OF EXISTING SWM MOE LEVEL II TREATMENT
CATCHMENT AREA OF EXISTING SWM LESS THAN MOE LEVEL II TREATMENT
CATCHMENT AREA OF POTENTIAL TREATMENT FACILITIES
CATCHMENT BOUNDARIES
Metric Scale
150m 0 300m
Horizontal
MRC
THE CITY OF Waterloo
POTENTIAL STORMWATER MANAGEMENT FACILITIES
MASTER DRAINAGE STUDY WITHIN URBANIZED SUBWATERSHEDS
EXHIBIT
4.2

**Appendix B**

**Preliminary Mapping**

# MUNICIPAL CLASS EA INTEGRATED STORMWATER MANAGMENT MASTER PLAN

**FIGURE :**
**PRELIMINARY SCREENING FOR POTENTIAL SWM FACILITIES LOCATIONS**

- Potential_SWM_Facility_Locations_point
- Potential_SWM_Facility_Locations (Phase 2)
- Roads
- Water Bodies
- Rivers

0 0.5 1 Kilometers

N

Aquafor Beech Limited

Base data provided by The City of Waterloo, 2017.

Date: March 2019

THE CITY OF Waterloo

# MUNICIPAL CLASS EA INTEGRATED STORMWATER MANAGMENT MASTER PLAN

**FIGURE :**
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- **Potential_SWM_Facility_Locations (Phase 1)**
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**Appendix C**

**Land Use with New Opportunity Locations**


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**FIGURE :**
**LANDUSE SURROUNDING POSSIBLE SWM FACILITY LOCATIONS**

- Potential Drainage Area
- Potential SWM Facility Locations

**Landuse**

- Agricultural
- Commercial
- Green
- Industrial
- Institutional
- Mixed-Use Commercial
- Mixed-Use Employment
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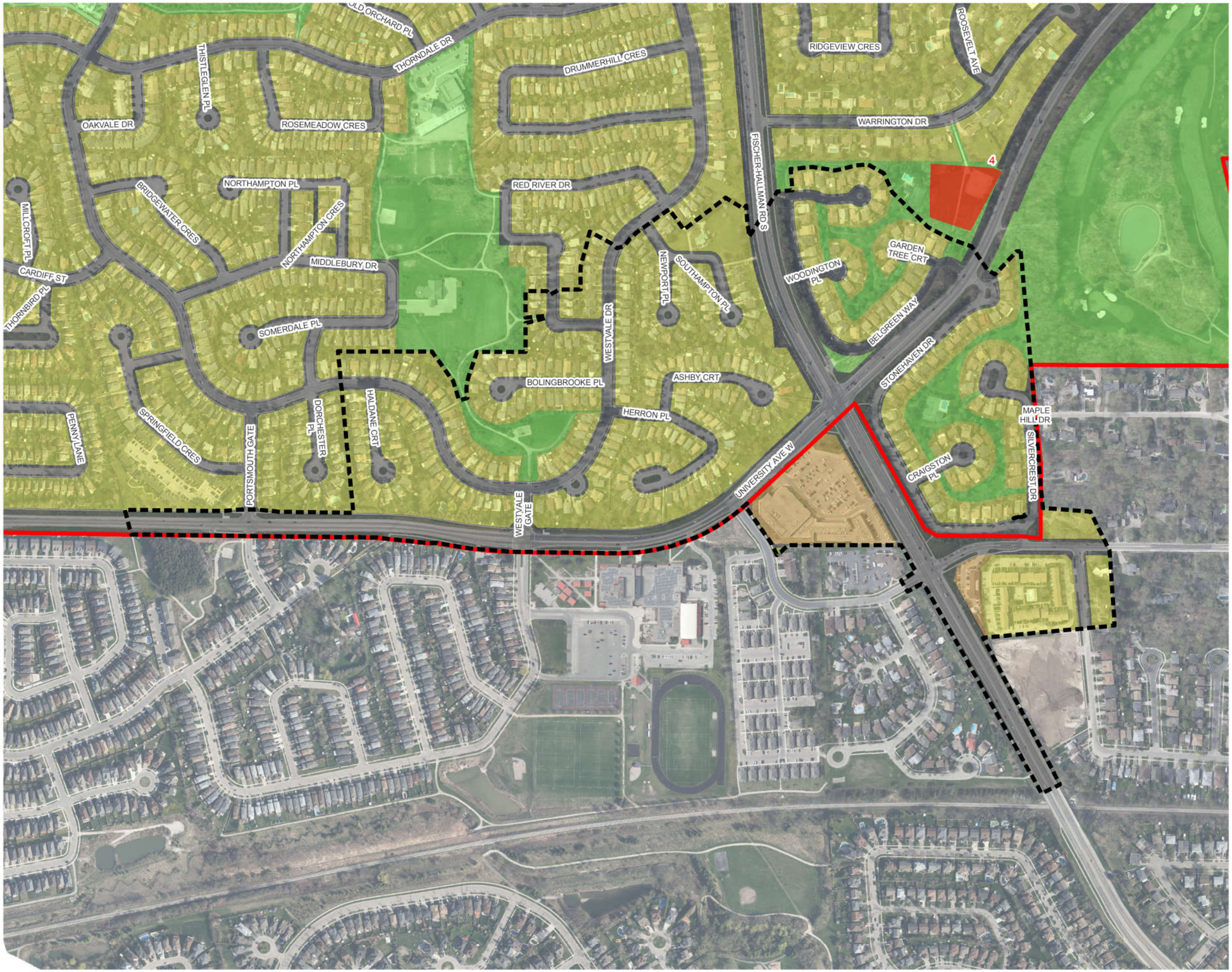


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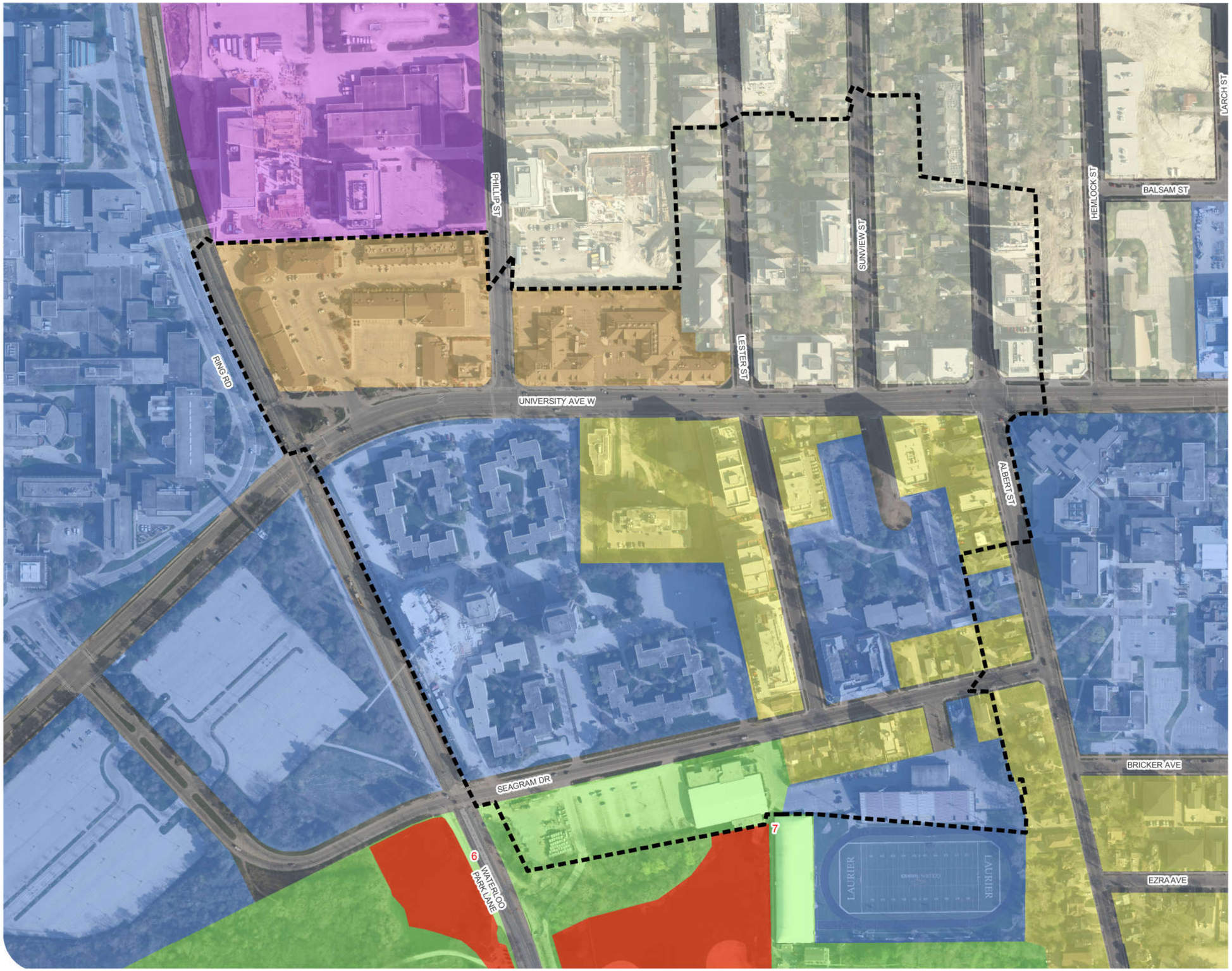


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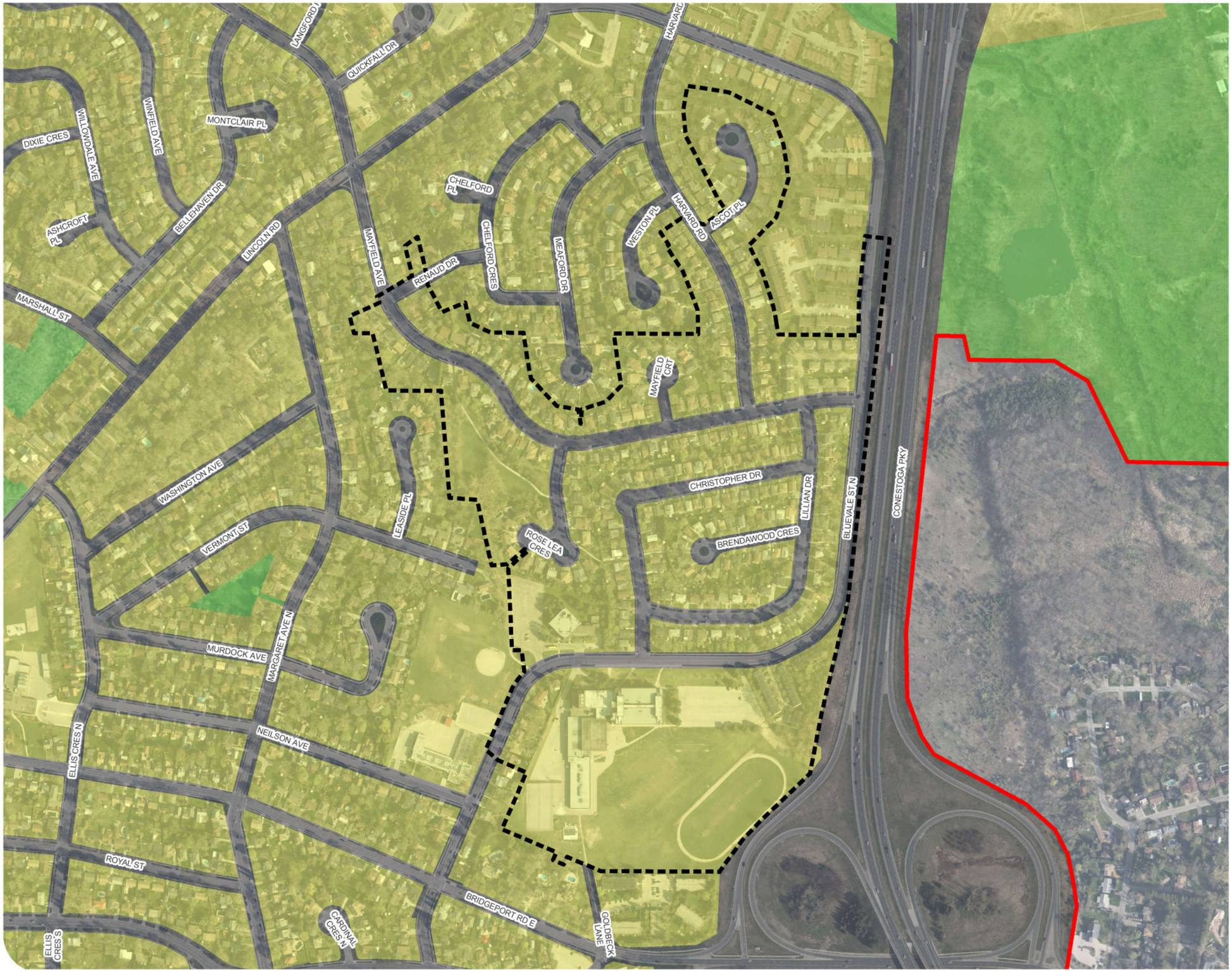


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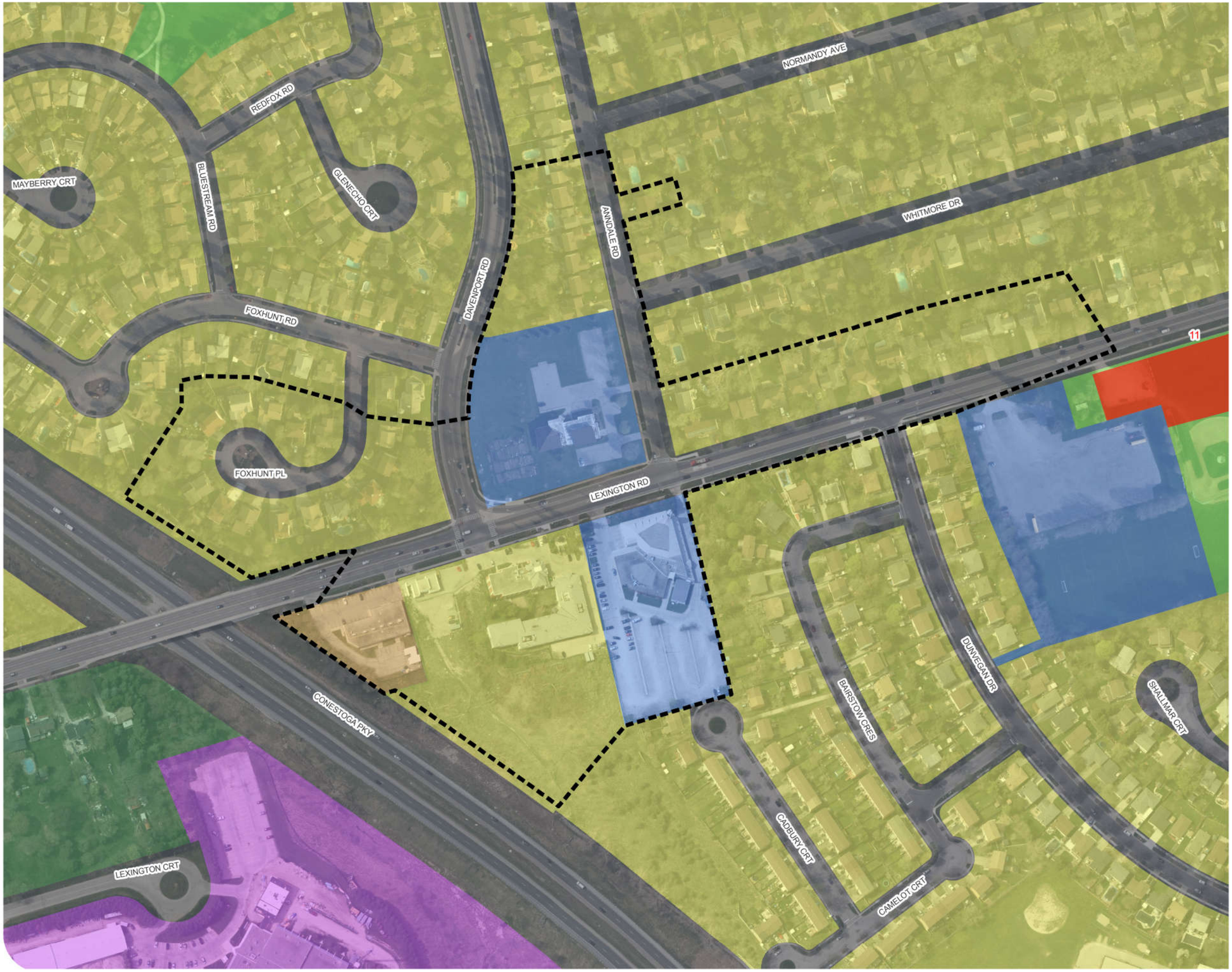


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