



**Silver Lake and Laurel Creek
Rehabilitation in Waterloo Park –
Environmental Assessment
Addendum**

June 4, 2018

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Sign-off Sheet

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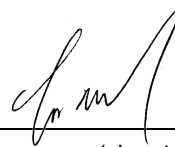
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Executive Summary

The City of Waterloo (the City) is conducting a study to identify and evaluate alternatives to rehabilitate Silver Lake and Laurel Creek in Waterloo Park (the Project). Waterloo Park (the Park) has been described as the ‘Jewel of the City’, and Silver Lake is a unique element that has provided recreational amenity and picturesque aesthetic for the Park since 1890, making it a central feature of the City of Waterloo. As the community around the Park has grown, so have the services of Waterloo Park and the impacts on its features.

Currently, surface water discharge creates poor water quality and sediment conditions in Silver Lake, and contributes to the instability of Laurel Creek. Stream restoration is required to improve water conveyance in the Park, while maintaining attention to the flooding limits, natural aesthetics of the Park, cultural landscape elements, and the short and long-term implementation concepts.

The rehabilitation of Silver Lake and Laurel Creek are two large components of the updated 2009 Waterloo Park Master Plan (WPMP). The Project will lead specifically to the preferred alternative for enhancing and protecting the ecological function for these natural features within the Park. This will then lead to the identification and classification of other integrated and complementary natural areas throughout the park to develop an overall management strategy for park natural heritage aspects in an urban setting.

Currently, the Park is a mixed-use area that accommodates several users and will continue to develop based on the Park Master Plan (2009). The Park was once primarily devoted to pedestrians and cyclists, and is now a transportation hub with the Region of Waterloo’s Light Rail Transit (LRT) system introducing a major mode of transport linking the Park to the larger community.

In 1995, the City and the Grand River Conservation Authority (GRCA) carried out the Class Environmental Assessment (EA) “A Rehabilitation Plan for Silver Lake and Laurel Creek in Waterloo Park”. This addressed the cultural heritage of Laurel Creek and Silver Lake, and included technical approaches to improve water quality through measures such as sediment management, improved lake circulation, and naturalization of many riparian areas.

Remedial work in 1997 included the construction of two low flow pipes that were installed to convey sediment downstream of Silver Lake; however, these low flow outlets have not been performing adequately and, as a result, excessive sediment deposition in Silver Lake has filled in the deep pools.

To date, several recommendations outlined in that plan have not been implemented for a variety of reasons. Specifically, the poor water quality and sediment conditions in Silver Lake and the instability of Laurel Creek upstream of Silver Lake continue to be a long-term issue after the implementation of many of the recommended measures.

SILVER LAKE AND LAUREL CREEK REHABILITATION IN WATERLOO PARK – ENVIRONMENTAL ASSESSMENT ADDENDUM

Study Purpose

The purpose of the study is to determine the preferred rehabilitation option for Silver Lake and Laurel Creek within the defined Study Area located in the Park (Figure ES-1), and to carry out the associated Class EA Addendum. The study will identify and evaluate alternatives for enhancing and protecting the ecological function and natural features within the Park, ensuring that Silver Lake and Laurel Creek continue to be key attractions in the City.

Study Area Description

Located within the City of Waterloo, Ontario, Waterloo Park is bordered by urban development including education and research facilities (for example, the University of Waterloo and Perimeter Institute), recreational facilities (for example, the Waterloo Memorial Recreation Complex), parking lots, retail shops and restaurants, and a variety of residential developments including high and low-density housing.

The Project-specific Study Area includes Silver Lake and the segment of Laurel Creek located within the defined boundaries of Waterloo Park (Figure ES-1). The Study Area is defined by a West and East side, separated by the LRT route; the Study Area does not include the LRT right-of-way or easement.

Silver Lake Alternatives

Based on the opportunities and constraints analysis, the following alternative solutions were identified:

1. Do Nothing
2. Dredge and Reconstruct
3. Dredge and Reconfigure
4. Create a Channel for Laurel Creek Around Silver Lake
5. Remove Silver Lake

Laurel Creek Alternatives

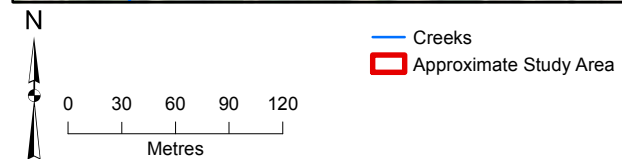
Based on the opportunities and constraints analysis, the following alternative solutions were identified:

1. Do Nothing
2. Spot Repairs and Debris Removal
3. Full Channel Reconstruction

Preferred Solution

A rigorous evaluation process was conducted to determine the preferred solution for Silver Lake and Laurel Creek. The preferred solution is Alternative 3 – Dredge and Reconfigure Silver Lake, including spot repairs using natural channel design principles along Laurel Creek in the West Study Area.

The development of the conceptual design for Silver Lake and Laurel Creek construction elements allows a preliminary opinion of the cost of these elements to be determined (see Table ES-1).



Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure ES-1
Study Area
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park
City of Waterloo, Ontario

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Table ES-1: Opinion of Probable Cost for Construction of Project Elements

Item	Description	Cost	Notes
1.	Startup/mobilization	\$250,000	
2.	Water management	\$250,000	
3.	Sediment removal	\$3,900,000	30,000 m ³ at an assumed cost of \$130/m ³
4.	Grading/excavation	\$300,000	30,000 m ³ of material moved @ \$10/m ³
5.	Shoreline improvements	\$650,000	500 m of armour stone @ \$1,300/m
6.	Outlet repairs	\$100,000	Repair leaks in weir, improve maintenance access to culvert grate, repair culvert entrance
7.	Stormwater management (within Waterloo Park)	\$100,000	Assume 2 locations for stormwater control facilities and 2 locations for drainage/conveyance improvements
8.	Restoration/landscaping	\$150,000	Assume some wetland replacement (for forebay)
9.	Creek rehabilitation – site 1	\$40,000	Remove and repair eroded storm sewer and restore 25 m of channel @ \$1500/linear m
10.	Creek rehabilitation – site 3	\$250,000	Remove existing weir and failing gabions and restore 150 m of channel @ \$1500/linear m
11.	Creek rehabilitation – site 5	\$80,000	Weir remnant removal and restoration of 50 m of channel @ \$1500/linear m
12.	Provisional/Contingency items	\$300,000	
	Subtotal	\$6,370,000	
	10% Contingency	637,000	
	TOTAL	7,007,000	

Project Implementation Schedule

Following the 30-day review period of the Class EA report and with no outstanding concerns or Part II Order requests, the City intends to proceed with the implementation of this project. The subsequent steps include:

- Completion of the EIS – Fall 2018
- Detailed Design – Fall 2018-Spring 2019
- Permitting – Spring 2019
- Tendering – Fall 2019
- Construction – Fall 2019-Winter 2020

SILVER LAKE AND LAUREL CREEK REHABILITATION IN WATERLOO PARK – ENVIRONMENTAL ASSESSMENT ADDENDUM

Abbreviations

CH2M	CH2M HILL Canada Limited (CH2M)
City of Waterloo	Waterloo
EA	Environmental Assessment
EAA	Environmental Assessment Act
ECA	Environmental Compliance Approval
ESR	Environmental Study Report
GRCA	Grand River Conservation Authority
LIDS	low impact development
LRT	Light Rail Transit
MEA	Municipal Engineers Association
MOECC	Ontario Ministry of Environment and Climate Change
MTCS	Ontario Ministry of Tourism, Culture and Sport
MTE	a
OGS	oil grit separator
Stantec	Stantec Consulting Ltd.
SWM	storm water management
the Park	Waterloo Park
the Project	Silver Lake and Laurel Creek Rehabilitation in Waterloo Park Environmental Assessment Addendum
TOP	Terms of Reference
WPAC	Waterloo Park Advisory Committee
WPMP	Waterloo Park Master Plan

SILVER LAKE AND LAUREL CREEK REHABILITATION IN WATERLOO PARK – ENVIRONMENTAL ASSESSMENT ADDENDUM

Introduction and Purpose
June 4, 2018

1.0 INTRODUCTION AND PURPOSE

The City of Waterloo (the City) is conducting a study to identify and evaluate alternatives to rehabilitate Silver Lake and Laurel Creek in Waterloo Park (the Project). Waterloo Park (the Park) has been described as the ‘Jewel of the City’, and Silver Lake is a unique element that has provided recreational amenity and picturesque aesthetic for the Park since 1890, making it a central feature of the City of Waterloo. As the community around the Park has grown, so have the services of Waterloo Park and the impacts on its features.

Currently, surface water discharge creates poor water quality and sediment conditions in Silver Lake, and contributes to the instability of Laurel Creek. Stream restoration is required to improve water conveyance in the Park, while maintaining attention to the flooding limits, natural aesthetics of the Park, cultural landscape elements, and the short and long-term implementation concepts.

The rehabilitation of Silver Lake and Laurel Creek are two large components of the updated 2009 Waterloo Park Master Plan (WPMP). The Project will lead specifically to the preferred alternative for enhancing and protecting the ecological function for these natural features within the Park. This will then lead to the identification and classification of other integrated and complementary natural areas throughout the park to develop an overall management strategy for park natural heritage aspects in an urban setting.

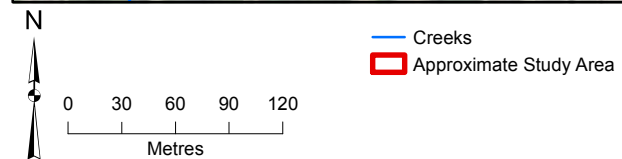
1.1 BACKGROUND

Currently, the Park is a mixed-use area that accommodates several users and will continue to develop based on the Park Master Plan (2009). The Park was once primarily devoted to pedestrians and cyclists, and is now a transportation hub with the Region of Waterloo’s Light Rail Transit (LRT) system introducing a major mode of transport linking the Park to the larger community.

Within the Park, historic uses of Silver Lake include swimming, picnicking, boating and leisure. The broadening of the community has introduced new park uses (for example, the skate park). Construction of the Central Promenade is currently underway, and construction of the Central Street Entrance has begun. The Central Promenade work includes a second pedestrian bridge across the mouth of Silver Lake. The East and West sections of the Park (see Figure 1) will be connected over the LRT lines with additional connections made in the future.

In 1995, the City and the Grand River Conservation Authority (GRCA) carried out the Class Environmental Assessment (EA) “A Rehabilitation Plan for Silver Lake and Laurel Creek in Waterloo Park”. This addressed the cultural heritage of Laurel Creek and Silver Lake, and included technical approaches to improve water quality through measures such as sediment management, improved lake circulation, and naturalization of many riparian areas.

Remedial work in 1997 included the construction of two low flow pipes that were installed to convey sediment downstream of Silver Lake; however, these low flow outlets have not been performing adequately and, as a result, excessive sediment deposition in Silver Lake has filled in the deep pools.



Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure 1
Study Area
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park
City of Waterloo, Ontario

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To date, several recommendations outlined in that plan have not been implemented for a variety of reasons. Specifically, the poor water quality and sediment conditions in Silver Lake and the instability of Laurel Creek upstream of Silver Lake continue to be a long-term issue after the implementation of many of the recommended measures.

1.2 STUDY PURPOSE

The purpose of the study is to determine the preferred rehabilitation option for Silver Lake and Laurel Creek within the defined Study Area located in the Park (Figure 1), and to carry out the associated Class EA Addendum. The study will identify and evaluate alternatives for enhancing and protecting the ecological function and natural features within the Park, ensuring that Silver Lake and Laurel Creek continue to be key attractions in the City.

The focus of Silver Lake is to investigate and outline a strategy for addressing siltation issues, and the objective for Laurel Creek is to establish the existing conditions of the stream channel and outline potential corrective measures.

The Project will document past and current conditions, evaluate a range of alternatives, and finally, select the preferred approach and/or establish priorities for the various Park elements within the Study Area.

1.3 PROJECT TEAM ORGANIZATION

In consideration of the complex history of the Study Area, a Project team was established to provide relevant input on key decisions, and to complete all technical and regulatory aspects of the Project. The team outlined below is uniquely qualified to complete the Study, and was chosen to facilitate thorough and accurate Project execution. The principle parties involved on the Project team include:

- City of Waterloo – Project Management (Engineering Services, Design and Construction, Environment and Parks, Growth Management, Water Services)
- Stantec Consulting Ltd. (Stantec) – Project Management (General); natural and cultural heritage baseline information including field surveys
- CH2M HILL Canada Limited (CH2M) – Public Consultation and Environmental Assessment Lead, Lake Sediment Quality baseline information

Additional subject matter experts were invited to participate in the planning process undertaken for the Project (Section 6.0).

1.4 GENERAL STUDY AREA DESCRIPTION

Located within the City of Waterloo, Ontario, Waterloo Park is bordered by urban development including education and research facilities (for example, the University of Waterloo and Perimeter Institute), recreational facilities (for example, the Waterloo Memorial Recreation Complex), parking lots, retail shops and restaurants, and a variety of residential developments including high and low-density housing.

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The Project-specific Study Area includes Silver Lake and the segment of Laurel Creek located within the defined boundaries of Waterloo Park (Figure 1). The Study Area is defined by a West and East side, separated by the LRT route; the Study Area does not include the LRT right-of-way or easement.

The Park currently offers a variety of active and passive recreational uses, presenting unique challenges and opportunities within the Study Area. Therefore, the Study has considered the following points.

- The Park has a long and rich heritage, and is developing based on the WPMP (2009) outlining elements that the EA must consider including key view sheds, interpretive opportunities, and historic elements.
- The existing Boardwalk connects to a long network of trails that will be maintained throughout construction activities, and for long-term use
- Natural heritage features including wetland and woodland communities, wildlife species at risk, and natural vegetation will be protected throughout construction and supported as a result of the Study (for example, potential habitat creation or restoration).
- Silver Lake is an online pond that continues to accumulate sediment from the upstream drainage area despite dredging activities in 1997, and requires the removal of approximately 30,000 m³ of sediment to restore lake storage capacity and improve water quality.
- The instability of Laurel Creek remains an issue after the implementation of many recommended measures, and upstream development has and will continue to modify the flow characteristics of the watercourse.
- Stream restoration must work to improve water conveyance in the park while paying attention to flooding limits, natural aesthetics, and cultural landscape elements.
- The original EA outlined several recommendations that are currently past the threshold for implementation (as defined in the Municipal Engineers Association [MEA] Class EA process).

1.5 ENVIRONMENTAL ASSESSMENT PROCESS

1.5.1 Ontario's Environmental Assessment Act

Ontario's *Environmental Assessment Act* (EAA) was passed in 1975 and was first applied to municipalities in 1981. The EAA requires the study, documentation, and examination of the environmental effects that could result from projects or activities.

The objective of the EAA is to consider the possible effects of these projects early in the planning process, when concerns may be most easily resolved, and to select a preferred alternative with the fewest identified impacts.

The EAA defines “environment” very broadly as follows:

- *air, land, or water;*
- *plant and animal life, including human life;*

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- *the social, economic, and cultural conditions that influence the life of humans or a community;*
- *any building, structure machine, or other device or thing made by humans;*
- *any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or*
- *any part or combination of the foregoing, and the interrelationships between any two or more of them, in or of Ontario.*

In applying the requirements of the EAA to projects, two types of EA planning and approval processes are identified:

1. Individual EAs (Part II of the EAA): Projects for which Terms of Reference (TOR) and individual EA are carried out and submitted to the Minister of the Environment and Climate Change for review and approval.
2. Class EAs: Projects are approved subject to compliance with an approved Class EA process; provided that the appropriate Class EA approval process is followed, a proponent will comply with the requirements of the EAA.

1.5.2 Class Environmental Assessment Process

This study is being undertaken according to the five phases of assessment defined in the MEA's Municipal Class EA document (MEA, 2000 amended in 2007, 2011, and 2015):

- Phase One: Identify the problem or opportunity
- Phase Two: Identify alternative solutions, and establish a preferred solution
- Phase Three: Examine alternative methods of implementing the preferred solution that will minimize negative effect and maximize positive effects
- Phase Four: Preparation of an Environmental Study Report (ESR)
- Phase Five: Implementation

The Municipal Class EA classifies projects in terms of the following schedules.

1. Schedule A projects are minor operational and upgrade activities and may go ahead without further assessment once Phase One of the Class EA process is complete (that is, the problem is reviewed, and a solution is confirmed).
2. Schedule "A+" projects are pre-approved but still require public notification prior to implementation of the project. Projects categorized as Schedule A+ include activities such as municipal infrastructure plans previously approved by a council member (Phase 1).
3. Schedule B projects must proceed through the first two phases of the process. Proponents must identify and assess alternative solutions to the problem, inventory impacts, and select a preferred solution. They must also contact relevant agencies and affected members of the public. Provided that no significant impacts are found and

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no requests are received to elevate the project to Schedule C or undertake the project as an Individual EA (Part II Order), the project may proceed to the next phase.

4. Schedule C projects require more detailed study, public consultation, and documentation, as they may have more significant impacts. Projects categorized as Schedule C must proceed through all five phases of an assessment. An ESR must be completed and available for a 30-day public review period, prior to proceeding to implementation.

If there are major issues that cannot be resolved upon completion of the final ESR, individuals may request the Minister of Environment and Climate Change to require the regions to comply with Part II of the EAA. Upon receiving a Part II Order Request, the Minister reviews the request and study information, and makes one of the following decisions: deny the request, refer the matter to mediation, or require completion of an Individual EA. Many factors are considered by the Minister in making decisions, including the adequacy of the planning process, the potential for significant adverse environmental effects after mitigation measures are considered, the participation of the requester in the planning process, and the nature of the request (MEA, 2000, as amended in 2007, 2011, and 2015).

The Study is being carried out as a Schedule B project and will follow the Municipal Class EA process (as amended in 2007, 2011, and 2015) to meet, at a minimum, Phases 1 and 2 requirements.

1.6 PROJECT DEVELOPMENT

1.6.1 Historical Studies

The technical background information reviewed for the Project included reports produced for the City specifically for Silver Lake as well as additional reports on the Laurel Creek watershed. The specific technical information reviewed and used in the various technical reports prepared for the Study (Appendix A) are included directly within those reports and not duplicated here.

1.6.1.1 Laurel Creek Watershed Study

The Laurel Creek Watershed Study was completed for the GRCA in 1992 (GRCA, 1992). It incorporated updated hydrology and hydraulic modeling for the entire 75 km² watershed and made recommendations for policies that would maintain and improve conditions within the watershed. The report did not make specific recommendations about Silver Lake or Laurel Creek within Waterloo Park.

1.6.1.2 A Rehabilitation Plan for Silver Lake and Laurel Creek in Waterloo Park Class Environmental Assessment

The purpose of this report was to review and identify recommended rehabilitation options for Silver Lake and Laurel Creek within the Park (Totten Sims Hubicki Associates Ltd., et al., 1995). The study was conducted as a Class EA to ensure that an appropriate suite of interests was considered and documented to arrive at a recommended rehabilitation plan.

The preferred option included a new cascading outlet to convey flow into the culverts below Caroline Street and Waterloo Town Square, new trails including a History Walk and a path/boardwalk along the north shore, naturalized

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shoreline around Silver Lake, wetlands and a water garden, deepening Silver Lake, installation of a sediment bypass pipe, treatment of animal display area runoff, development of Trumpeter Swan habitat and naturalization of Laurel Creek. Most of these features were constructed shortly after the completion of the report.

1.6.1.3 Geomorphic Inventory of Waterloo Creeks

Parish Geomorphic and Planning & Engineering Initiatives Ltd. (2002) assessed the status of approximately 60 km of watercourse reaches throughout the City. Specific objectives included:

- Establishing a database of geomorphological and hydraulic characteristics of watercourses across the City
- Assessing the geomorphological state of each reach and rank rehabilitation priorities
- Assisting the City in developing costs and a 10-year budget for creek rehabilitation

Laurel Creek was assessed, including the reach within Waterloo Park, but no specific recommendations were made for Silver Lake.

1.6.1.4 Master Drainage Study – Urbanized Subwatersheds

McCormick Rankin Corporation completed (2005) a report that provided the City with an updated understanding of existing drainage deficiencies and recommendations for future mitigation strategies within the urban areas of the Laurel Creek watershed.

This study included the Silver Lake and Waterloo Park areas; however, the scope did not include recommendations for Silver Lake and Laurel Creek within Waterloo Park. The modeling developed as part of this study was used as the basis of later modeling of the entire Laurel Creek watershed.

1.6.1.5 Baseline Inventory Summary Report

The purpose of MTE (2013) was to develop a baseline understanding of conditions in Silver Lake and Waterloo Park, and included the following activities.

- Collection and analysis of hydrologic, hydraulic and geomorphic information
- Collection of environmental information, including wetland delineation
- Development of remedial strategies and options for Silver Lake and Laurel Creek within Waterloo Park
- Provide budgetary input into future Class EA activities

This report was used as the basis for existing conditions within the current Class EA study.

1.6.1.6 Floodplain Mapping for the Laurel/Clair Special Policy Area

Stantec is currently conducting an update to the hydrology and hydraulic modeling for the Laurel Creek watershed, building on previous modeling (for example, Laurel Creek Watershed Study, Master Drainage Study) to update the

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floodplain mapping within the current Special Policy Area (Uptown Waterloo). While this study is not yet complete, the model work already finished provides up-to-date information on the watershed area including Silver Lake and Laurel Creek within the Park.

1.6.2 Current Environmental Assessment Objectives and Tasks

The current EA Study will:

- Document past conditions using the historical studies listed above (Section 1.6.1.6)
- Investigate current site conditions (Section 2.0)
- Identify potential alternative solutions for the defined problem (Section 3.0)
- Evaluate a range of alternative solutions (Section 4.0)
- Identify a preferred approach and/or establish priorities for the various Park elements (Section 4.4 and Section 5.0)

The EA Addendum will serve to combine the analysis to date, identify any gaps, and develop and evaluate alternatives using the information gathered. To achieve this, the Project objectives consist of the following.

1. Background Review
2. Supplemental Site Inventory/Investigation
3. Hydrogeology Investigation
4. Hydraulics and Hydrology Investigation
5. Definition of Opportunities and Constraints
6. Impact Assessment
7. Identification of Alternatives
8. Selection of Preferred Alternatives and Detailed Analysis of Preferred Alternatives
9. Agency Liaison and EA Documentation
10. ESR
11. Environmental Impact Study

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The following supplemental site investigations were conducted to inventory the existing natural environment conditions prior to the identification and assessment of alternative improvements for Silver Lake and Laurel Creek.

- Geomorphic assessment
- Aquatic habitat field reconnaissance
- Three-season botanical survey and vegetation classification
- Habitat assessment for wildlife Species at Risk
- Turtle basking surveys
- Migratory bird surveys
- Heritage feature assessment
- Stage I archaeological assessment
- Surface water investigation

Following completion of the Study, an Environmental Impact Study report will be completed to address potential impacts related to design features and activities. The report will include a description and assessment of the existing natural environment features and functions within the Park Master Plan Area that will or may reasonably be expected to be impacted, including confirmation of natural heritage features, habitats and boundaries. The identification and assessment of the magnitude and significance of potential short-term and long-term impacts, both direct and indirect, to the natural environment will be conducted using an established assessment methodology. Recommendations regarding the appropriate mitigation measures to avoid and minimize potential negative impacts, as well as restoration, enhancement or compensation measures (as appropriate) including the identification of ecological enhancement, restoration and long-term stewardship opportunities will be included.

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2.0 EXISTING STUDY AREA CONDITIONS

2.1 LAND USE PLANNING

2.1.1 Existing Land Use

Waterloo Park, locally known as the historic jewel of the City, is approximately 64 ha of land providing a variety of active, passive, natural and historic features across a wide range of activities, including sports fields, facilities, trails, and Silver Lake. The Park is a Green Zone with surrounding land zoned for Residential (general and multi), Industrial, Commercial and University use (City of Waterloo, 2015). The Study Area is generally bounded by Seagram Drive/University Avenue to the north, Father David Bauer Drive to the south, Albert Street/Caroline Street to the east, and to the west by University Avenue/Westmount Road.

The City Official Plan documents “Council’s vision for growth and change within the community, guided by the public interest” and as such provides direction for land use decisions within the City.

According to the November 2016 Official Plan, Waterloo Park (including Silver Lake) is designated as Open Space, and includes both Core and Supporting Natural Areas. It is located adjacent to the uptown Waterloo Growth Centre and any development along the Silver Lake shoreline must maintain floodplain storage and will be subject to review and approval by the GRCA.

2.1.2 Provincial Policy Statement

Under the Ontario Planning Act, the Provincial Policy Statement established the policy foundation for appropriate development to protect resources including public health and safety, and the quality of the natural and built environment. A review of the Provincial Policy Statement in the context of the Study purpose identified the relevant planning framework applicable to the Project’s planning process.

1.1 Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns

1.1.1 Healthy, liveable and safe communities are sustained by:

- a) *promoting efficient development and land use patterns which sustain the financial well-being of the Province and municipalities over the long term;*
- b) *accommodating an appropriate range and mix of residential (including second units, affordable housing and housing for older persons), employment (including industrial and commercial), institutional (including places of worship, cemeteries and long-term care homes), recreation, park and open space, and other uses to meet long-term needs;*
- c) *avoiding development and land use patterns which may cause environmental or public health and safety concerns;*
- d) *avoiding development and land use patterns that would prevent the efficient expansion of settlement areas in those areas which are adjacent or close to settlement areas;*

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- e) *promoting cost-effective development patterns and standards to minimize land consumption and servicing costs;*
- f) *improving accessibility for persons with disabilities and older persons by identifying, preventing and removing land use barriers which restrict their full participation in society;*
- g) *ensuring that necessary infrastructure, electricity generation facilities and transmission and distribution systems, and public service facilities are or will be available to meet current and projected needs; and*
- h) *promoting development and land use patterns that conserve biodiversity and consider the impacts of a changing climate.*

1.5 **Public Spaces, Recreation, Parks, Trails and Open Space**

1.5.1 *Healthy, active communities should be promoted by:*

- a) *planning public streets, spaces and facilities to be safe, meet the needs of pedestrians, foster social interaction and facilitate active transportation and community connectivity;*
- b) *planning and providing for a full range and equitable distribution of publicly-accessible built and natural settings for recreation, including facilities, parklands, public spaces, open space areas, trails and linkages, and, where practical, water-based resources;*
- c) *providing opportunities for public access to shorelines; and*
- d) *recognizing provincial parks, conservation reserves, and other protected areas, and minimizing negative impacts on these areas*

2.2 **NATURAL ENVIRONMENT**

This section provides a description of the existing natural heritage environment within the Study Area.

2.2.1 **Existing Natural Heritage**

The following significant natural heritage features were identified during site investigations completed in the Park throughout 2017, and illustrated on Figure 2:

- Locally significant wetlands
- Core and supporting natural heritage features
- Bat maternity colonies
- Turtle wintering and nesting areas
- Snapping Turtle habitat
- Eastern Wood-Pewee habitat
- Fish habitat in Silver Lake and Laurel Creek

For complete information and findings, the full report is included as Appendix A3.

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2.2.2 Hydrology, Hydraulics and Fluvial Geomorphology

A review of the surface water resources within the Study Area was completed, including hydrologic, hydraulic and fluvial geomorphologic conditions of the system. A summary of the identified areas of concern are documented in Appendix A4, and illustrated in Figure 3.

A review of previous recommendations for the Study Area was undertaken to inform future rehabilitation recommendations.



Figure 3: Areas of Concern Identified During the Field Work

2.2.3 Hydrogeological Review

A hydrogeological review was completed to provide a general characterization of hydrogeological conditions within the Study Area based on a desktop review of available public documents and field investigation. The review included a summary of groundwater level and surface water level measurements, and vertical hydraulic gradients along Laurel Creek and within Silver Lake.

The surface water levels within Silver Lake remained relatively stable over the monitoring period with increases corresponding to precipitation events. No clear indications of groundwater discharge or groundwater recharge were noted in Laurel Creek within the Study Area.

For complete information and findings, the full report is included as Appendix A5.

2.2.4 Lake Sediment Quality

Approximately 30,000 m³ of sediment will be excavated from the Silver Lake basin within the next two years. In 2016, CH2M conducted the City of Waterloo SWMF Sediment Plant Growth Study to evaluate beneficial reuse options compared to sediment disposal. The report also evaluated sediment from SWM Pond #53, a smaller scale pilot study requiring the removal of 360 m³ of sediment, to be completed in summer 2018. The SWM Pond #53 sediment beneficial reuse Environmental Compliance Approval (ECA) application is in the final stage of Ontario Ministry of Environment and Climate Change (MOECC) approval, with the pilot study scheduled to begin in June 2018. This is

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the first SWM pond sediment beneficial reuse approval in Ontario, which sets an important precedent for potential alternatives in Silver Lake.

Sediment samples from Silver Lake were evaluated for exceedances of the Ontario Regulation (O.Reg.) 153/04 Table 1 and 2 soil standards:

- Trace Metals
- Polychlorinated Biphenyl
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Total petroleum hydrocarbons (PHCs)
- Sodium Adsorption Ratio (SAR)
- Electrical Conductivity

Sediment samples were also evaluated for the following topsoil quality/fertility parameters:

- Organic matter
- pH
- Total salts, chloride, SAR, Cation Exchange Capacity
- Available nutrients (including phosphorus, potassium, magnesium, calcium)
- Particle Size Distributions (clay, silt, sand, gravel)

The O.Reg. 153/04 evaluation determined that the Silver Lake sediments require non-hazardous waste management, primarily due to exceedances of the Table 1 soil standards for PHCs and PAHs. The landfill tipping fee for Silver Lake sediment would be \$3.6 million. However, the Region of Waterloo cannot accept the sediment due to storage capacity concerns, presenting uncertainties regarding the costs of transporting the sediment to a more distant landfill facility.

The 2016 report incorporated all of the Silver Lake and SWM Pond #53 sediment quality data into a comprehensive beneficial reuse evaluation. The primary objective of this experiment was to determine if the Silver Lake sediment and the SWM Wetland #53 sediment would support the growth of tall fescue (*Festuca arundinacea*) and perennial ryegrass (*Lolium perenne*), which are currently used in the City's municipal landscaping programs. Positive plant growth results indicate that the sediment could be diverted from landfill disposal to alternative topsoil amendment uses with added benefits, including reduced topsoil costs for the City's landscaping programs and use in yard waste compost. The MOECC is supportive of this triple bottom line approach to SWM pond sediment management.

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2.3 SOCIO-ECONOMIC ENVIRONMENT

The socio-economic setting for Waterloo Park is extremely diverse with a wide variety of neighbours and Park users and would be expected for a park embedded within an urban area. The Park itself offers a wide range of activities from passive recreation with trails and picnic areas and the Eby Farmstead to active recreation opportunities with the baseball and soccer fields, skate park and playground areas.

The diverse nature of Park users includes families, students, tourists, and retirees drawn to the area from or for the land uses immediately surrounding the Park, including:

- Educational amenities including the University of Waterloo and Perimeter Institute ((and Wilfrid Laurier University not too far away)
- Many forms of residential neighbourhood from single family housing to apartment buildings
- Recreational facilities (Granite Club Rink in the Park, Waterloo Tennis Club, Waterloo Library and Waterloo Memorial Recreation Complex)
- Commercial services (Waterloo Town Square, Uptown Waterloo, Barrel Yards and Westmount Place)
- Retirement facility (Lutherwood Village on the Park)

Parking and transit services allow users from further away to easily access Waterloo Park, and the new LRT stop is expected to further increase traffic through the Park, thereby expanding an already diverse group of users.

2.4 CULTURAL ENVIRONMENT

2.4.1 Cultural Heritage

A Cultural Heritage Overview was completed for Silver Lake and Waterloo Park to identify potential cultural heritage resources for consideration and protection during the future rehabilitation efforts. The overview included the Ministry of Tourism, Culture and Sport's (MTCS) Criteria for Evaluating Potential for Built Heritage and Cultural Heritage Landscapes ("the Checklist"), background research and site reconnaissance.

A total of 30 individual sites were identified as containing potential heritage and cultural resources as shown on Figure 4. During the future detailed design and construction stages of the Project, efforts will be required to protect these existing features.

For complete information and findings, the full report is included as Appendix A2.

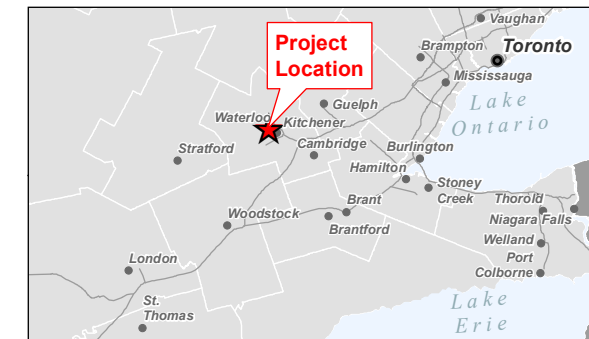


Legend
Study Area

Refer to Cultural Heritage Overview for
Feature Descriptions



- Notes**
- 1. Coordinate System: NAD 1983 UTM Zone 17N
 - 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
 - 3. Orthoimagery © First Base Solutions, 2014. Image Date 2014.



Project Location
Waterloo,
Ontario

161413464 REVA
Prepared by MDW on 2017-11-22
Technical Review by ABC on yyyy-mm-dd
Independent Review by SB on 2017-11-22

Client/Project
CITY OF WATERLOO
SILVER LAKE EA ADDENDUM
CULTURAL HERITAGE ASSESSMENT

Figure No.
4

Title

Cultural Heritage Features

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2.4.2 Archaeological Resources

A Stage 1 archaeological assessment was conducted for the Project. The Stage 1 consisted of background research and a property inspection, resulting in the determination that a portion of the Study Area exhibits high potential for the identification and recovery of archaeological resources. As such, in accordance with Section 1.3.1 and Section 7.7.4 Standard 1a of the MTCS 2011 Standards and Guidelines for Consultant Archaeologists (Government of Ontario, 2011), a Stage 2 archaeological assessment is recommended for part of the Study Area as shown in Figure 5.

For complete information and findings, the full report is included as Appendix A1.

2.5 FUTURE LAND USE PLANNING AND DEVELOPMENT

2.5.1 Community, Culture and Recreation Services Master Plan

The City's Community, Culture and Recreation Services Master Plan (City of Waterloo, 2008) provides overall direction to establish facilities and services for the enjoyment of Waterloo residents including access to recreation, sports, parks and heritage services. Development within the City parks is a collaborative process with a variety of City departments including Environment and Parks, Developmental, and Recreation and Leisure, to ensure sustainable, long-term planning goals are met. This plan outlines development principles for the Uptown Waterloo area, specifically, the importance of retaining both passive and active recreational opportunities within Waterloo Park to ensure:

- the Park retains its original multi-use functions
- there are always activities in the Park
- there is an improvement in participant safety and enjoyment
- that the active use of the Park will provide greater assurance that investment and maintenance will continue into the future

The Community, Culture and Recreation Services Master Plan recommended that the Park be assessed to achieve a balance of active and passive recreational use, and to preserve the natural heritage and environmental quality of the area. This recommendation is detailed in the WPMP (City of Waterloo, 2009).

2.5.2 Waterloo Park Master Plan

The City recognizes the importance of Waterloo Park and Silver Lake and has developed the WPMP (City of Waterloo, 2009) that reflects the growth of the City around the park and the changing dynamics of the population that enjoy the many opportunities for recreation and enjoyment.

The guiding principles from the WPMP identify the following priorities for the Park:

- Respect and honour the natural environment and enhance the significant landscape features of Waterloo Park
- Incorporate sound and sustainable environmental practices

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- Promote various uses/activities to promote healthy living. Generate safe, flexible and dynamic spaces that offer a variety of spatial experiences from small intimate to large interactive spaces
- Facilitate safe movement of park users and give priority to the pedestrian experience
- Profile water as a common design element,
- Seek to commemorate the rich cultural and historical heritage associated with the Park
- Establish guidelines for evaluating public-private partnerships in the Park

The EA will provide an opportunity to ensure that the Park, including Silver Lake and segments of Laurel Creek, will continue to be a key attraction within the City and ultimately support the WPMP. The guidelines from the WPMP have helped establish priorities and planning guidelines for the Study, specifically regarding the evaluation of alternatives.

Elements that have been considered through the EA process include:

- Establish visual connections within and throughout the Park, specifically by including vegetation around the Lake
- Manage environmental resources and natural features throughout the Park
- The potential for habitat creation around the Lake and green spaces
- Improvements to the trail systems through signage, improved connections, and surfacing
- Integration of educational opportunity (for example, Observation Platforms) to provide views across the Lake
- Expand programmable uses and create iconic spaces for generations to come

The rehabilitation of Silver Lake and Laurel Creek are two main components of the WPMP. Stream restoration must work to improve water conveyance in the park while paying attention to the flooding limits, natural aesthetics of the park, cultural landscape elements and the short and long-term implementation concepts as per the WPMP. The EA will lead specifically to the preferred alternative to enhance and protect the ecological function for these natural features within the Park. This will lead to the identification and classification of other integrated and complementary natural areas in areas of the Park to develop an overall management strategy for park natural heritage aspects in an urban setting.

The Park, including Silver Lake, has long been recognized as a premier amenity within the City and provides a community gathering place where people come to enjoy the park's many features actively and passively. The WPMP includes a vision statement that reflects the growth of the City around the Park and the changing dynamics of the population that enjoy the parks many opportunities for recreation and more passive enjoyment. One of the primary objectives of public participation is the engagement of people from many walks of life that have a vested interest in Project outcomes.

The various planning objectives from the WPMP have been integrated into the EA, specifically in the context of potential opportunities and constraints within the Park.

Development of Alternatives
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3.0 DEVELOPMENT OF ALTERNATIVES

3.1 OBJECTIVES AND TARGETS

The development of alternatives includes a synthesis of the identified Study components to best achieve the goals of the overall EA Addendum objectives (listed in Section 1.6.2). Study components included in the development of alternatives were identified through stakeholder and through public consultation throughout the planning process (Section 6.0). Specifically, the objectives and targets included in the selection of preferred alternatives, and the subsequent detailed analysis include the following:

- Select the most effective combination of alternatives based on environmental considerations (a blend of technical, environmental, aesthetic, economic, public and institutional feasibility in consideration of the applicable Class EA requirements)
- Quantify all benefits, capital, monitoring and operations/maintenance costs and liabilities that can be quantified in present day dollar terms
- Qualitatively describe all other benefits, costs and liabilities (such as, water quality, channel constraints, etc.)
- Combine these factors in a benefit cost matrix to compare and justify alternative components that comprise the Plan

3.2 OPPORTUNITIES AND CONSTRAINTS

A list of potential opportunities and constraints was generated by the Project team to facilitate an integrated approach to the identification of potential alternative solutions within the Study Area. Sources used to identify potential opportunities and constraints included in Table 3 are listed based on past Projects, the experience of the Project team, and feedback from the public consultation program (for example, the degree of community value). The identified opportunities and constraints are later used to identify the criterion used in the detailed evaluation of alternative solutions (Section 4.3).

Table 1. List of Potential Opportunities and Constraints

Source	Opportunity	Constraint	Considerations
Physical			
Land Ownership	Municipally owned open space	Not municipally owned space	- Opportunities for enhancement: in-stream, riparian, stormwater management, education of public (signage) - Cost of land purchase, access, permission, education of land owners
Land Use	Little additional construction / development	Majority of drainage area is developed, proximity to channels	- Stable watershed area - Limited opportunity for implementing best management practices, reduced working area - Lion’s Lagoon may be removed prior to construction - Future of boardwalk along lake edge to be considered - Goose management
Existing Dam and Downstream Culvert Structure	Control water levels and flow	- Current physical form - Flooding	- Can better manage lake - Cost of removal or modification, fish barrier - Property damage - Make it more visible? (aesthetically appealing) - Downstream culvert limits opportunities
Weir and Bypass Culvert	- Bypass sediment-laden flows - Construction management	Current physical form	- Improved sediment management/transport - Water circulation and sediment transport
Engineered Channels	Restoration opportunity	Current physical form	- Cost, land requirements, better water quality, and aquatic habitat - Cost of removal or modification, impacts on water quality, aesthetics, natural environment
Lake Configuration	Modification opportunity	- Current physical form - Physical location	- Better Lake circulation and water quality, natural environment conditions - Heritage value, landscaping and aesthetics, water quality degradation, habitat value - Consider examples of other off-line facilities as option
Park Amenities	WPMP established goals	- Multi-use park - Changing dynamic population	- Limits naturalization opportunities and modification opportunities - Conform to WPMP - Consider revenue opportunities for lost booking areas
Stormwater Infrastructure	Improved stormwater management	Land availability	- Water quality improvement - Cost and land requirements - Drainage – trail from University of Waterloo parking lot, cricket pitch (highest area is wettest)
Natural Environment			
Geology and Hydrogeology	Infiltration of stormwater, groundwater discharge	- High flows - Low flows	Water quality modification/improvement
Water Quantity	Dilution	- High flows - Low flows	- Improved water quality, better Lake circulation - Improved water quality - Flooding, erosion - Limit water quality improvement, habitat impairment
Water Quality	- Improved quality - Sediment management (ongoing)	Existing water quality/source	Continued water and Lake habitat impairment (including temperature), aesthetic impact
Aquatic Habitat (fish and benthics)	Restoration/enhancement	Impaired and degraded fish habitat	- Restored habitat structure within stream/lake, enhanced riparian vegetation for shade/cover to improve water quality - Poor fisheries values (tolerant fish species and benthics)

Table 1. List of Potential Opportunities and Constraints

Source	Opportunity	Constraint	Considerations
Terrestrial Habitat	Improved habitat for desirable species	- Locally rare plant species - Park values/aesthetics	- Reduced attractiveness to geese - Improved conditions around the lake and throughout the Park - Limits modification opportunities - Identify forest/woodland and wetland constraints for trails, creek relocation, etc.
Wildlife species	Restoration/enhancement	Urban park setting	- Few species-related constraints for modification - Consideration for Species at Risk (for example, bat surveys)
<i>Institutional</i>			
Policies and Guidelines	Application of Policies and Guidelines	Application of Policies and Guidelines	Applicable Policies and Guidelines
Permits/Approvals	Application of by-laws, permits, and approvals	Permit/approval requirements	- Applicable regulatory permit and timing (such as, MOECC, GRCA, MNRF) - Region (access, staging, woodland conservation area), heritage (schoolhouse only), accessibility (washrooms, etc.)
Programs and Educational Campaigns	Public education and involvement	- Implementation - Cost	Booking picnic areas, etc., activity nodes on Promenade (link with SWM)
Operation and Maintenance	Modify existing practices, creation of new programs	- Available resources - Cost	Debris removal, lake operation, sediment removal, gabion and weir condition in west area, drainage on west side (near ball diamonds) flows down existing stairs (remove stairs)
<i>Social</i>			
Heritage	Maintain or enhance heritage value	Maintaining heritage value	- Schoolhouse is heritage building. Abraham Erb homestead; grist mill popular; bandshell/weir - Configuration of the lake will be critical – look at options - Waterloo Park (as an entire unit) a candidate for cultural heritage landscape
Existing Use Features	Maintain or enhance	Maintaining existing park and recreational uses	- Alignment with WPMP - Study-specific components may provide opportunities for additional uses
Community Value	Modify community value	Lack of ability to modify community value	Balancing community values; individuals may value different aspects
Noise	Maintain or enhance existing infrastructure (for example, bandshell) for park use	Proximity to sensitive human receptors (for example, retirement community)	- Construction noise consideration - Study-specific components (for example, the Study is not assessing the use, construction or relocation of facilities such as the bandshell)
LRT	Major mode of transportation to facilitate connectivity	- Limits accessibility - Limits configurations for potential Lake design changes - Potential safety concerns	- LRT construction is finished; operations to commence late 2018 which may introduce safety issues - LRT operations may increase number of Park users
<i>Safety</i>			
Public Health and Safety	Maintain or enhance public health and safety	Existing and planned Park use including construction activities	Improved safety
Employee Health and Safety	Maintain or enhance public health and safety	Existing and planned Park use	Improved safety

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Development of Alternatives
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3.3 IDENTIFICATION OF ALTERNATIVES

An important step in the Class EA process is the identification of Alternatives that will address the identified problems or opportunities. According to the MEA's Municipal Class EA document (as amended in 2007, 2011 and 2015), an Alternative Solutions means:

“feasible alternative ways of solving an identified problem (deficiency) or addressing an opportunity, from which a preferred solution is selected”.

A baseline condition against which alternative solutions are evaluated must be considered in the Class EA process, referred to as the Do Nothing alternative. Alternatives have been developed for the Silver Lake and Laurel Creek Rehabilitation in Waterloo Park EA Addendum Project (the Project), that may provide sediment management and water quality improvement, and that have the potential to improve or enhance the conditions within Waterloo Park.

All of the alternatives described are inclusive of repairs, shoreline and drainage improvements, and water quality controls related to direct discharge locations (for example, parking lots). Water quality controls may include:

- Source Control Options – A variety of source control options (for example, low impact development [LID], oil/grit separators [OGS]) are available to improve stormwater quality.
- Implement End-of-Pipe Control Options – A variety of end-of-pipe control options within the park (for example, SWM basin) are available to improve levels of stormwater quality management.

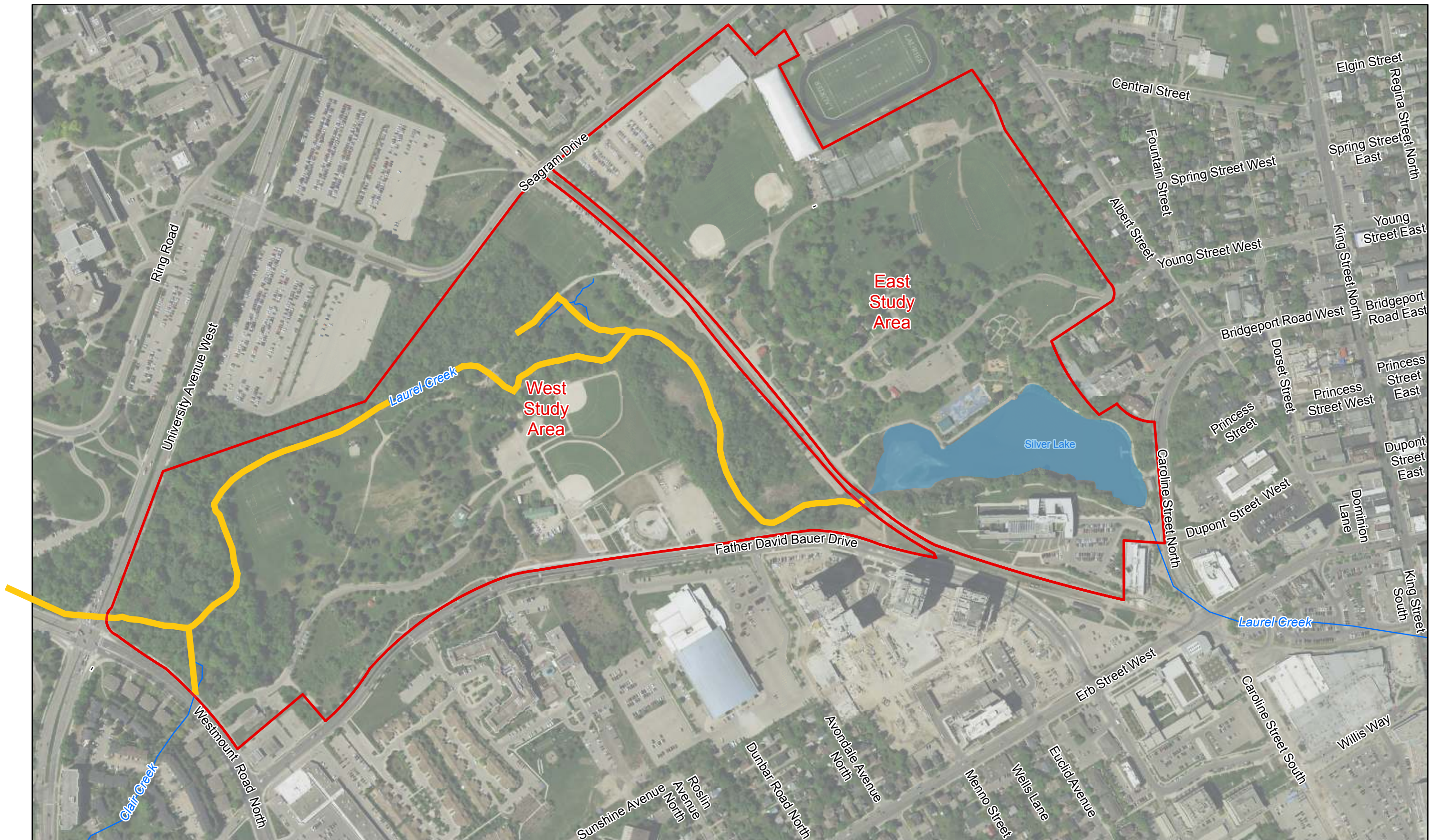
The following Alternatives have been identified as a feasible way of solving the identified problem while presenting various opportunities within the Park.

3.3.1 Alternative 1: Do Nothing

This alternative would see Silver Lake and Laurel Creek remain in their current condition and no extraordinary measures implemented to improve existing conditions.

3.3.2 Alternative 2: Dredge and Reconstruct

In this alternative, the sediments in the lake would be dredged (and properly managed) to improve current lake conditions, as shown in Figure 6. The lake would remain in its current configuration. Laurel Creek throughout the Park will be reconstructed to improve water quality and quantity.



Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure 6
Alternative 2 - Dredge and Reconstruct
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park

SILVER LAKE AND LAUREL CREEK REHABILITATION IN WATERLOO PARK – ENVIRONMENTAL ASSESSMENT ADDENDUM

Development of Alternatives
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3.3.3 Alternative 3: Dredge and Reconfigure

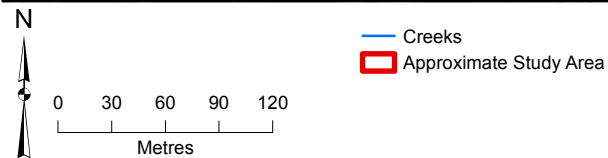
This alternative would see the sediments in lake dredged (and properly managed) with additional measures taken to improve the circulation of water in the lake to improve the water quality, as illustrated in Figure 7. Measures may include reconfiguring the footprint/shoreline of the lake and/or changing the depth of the lake and/or implementing sediment management and water quality improvement components associated with the lake such as a forebay up or downstream of the LRT. Additional measures would include spot repairs along Laurel Creek in the west study area such as debris removal, pedestrian bridge improvements, weir removal, gabion replacement, or bank stabilization, all using natural channel design principles.

3.3.4 Alternative 4: Create a Channel for Laurel Creek Around Silver Lake

In this alternative, a bypass creek channel would be constructed around the existing lake, as shown in Figure 8. The remaining water feature could take the form of a smaller lake or one or more wetland/pond features. Sediments in the lake would be dredged (and properly managed). Additional measures would include spot repairs along Laurel Creek in the west study area such as debris removal, pedestrian bridge improvements, weir removal, gabion replacement, or bank stabilization, all using natural channel design principles.

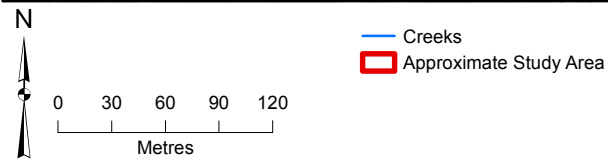
3.3.5 Alternative 5: Remove Silver Lake

In this alternative, the lake would be removed from the system by removing the lake outlet structure and Laurel Creek would be reconfigured to maintain flow, illustrated in Figure 9. Additional measures would include spot repairs along Laurel Creek in the West Study Area such as debris removal, pedestrian bridge improvements, weir removal, gabion replacement, or bank stabilization, all using natural channel design principles.



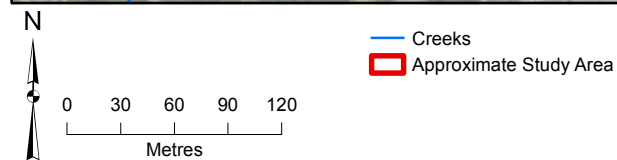
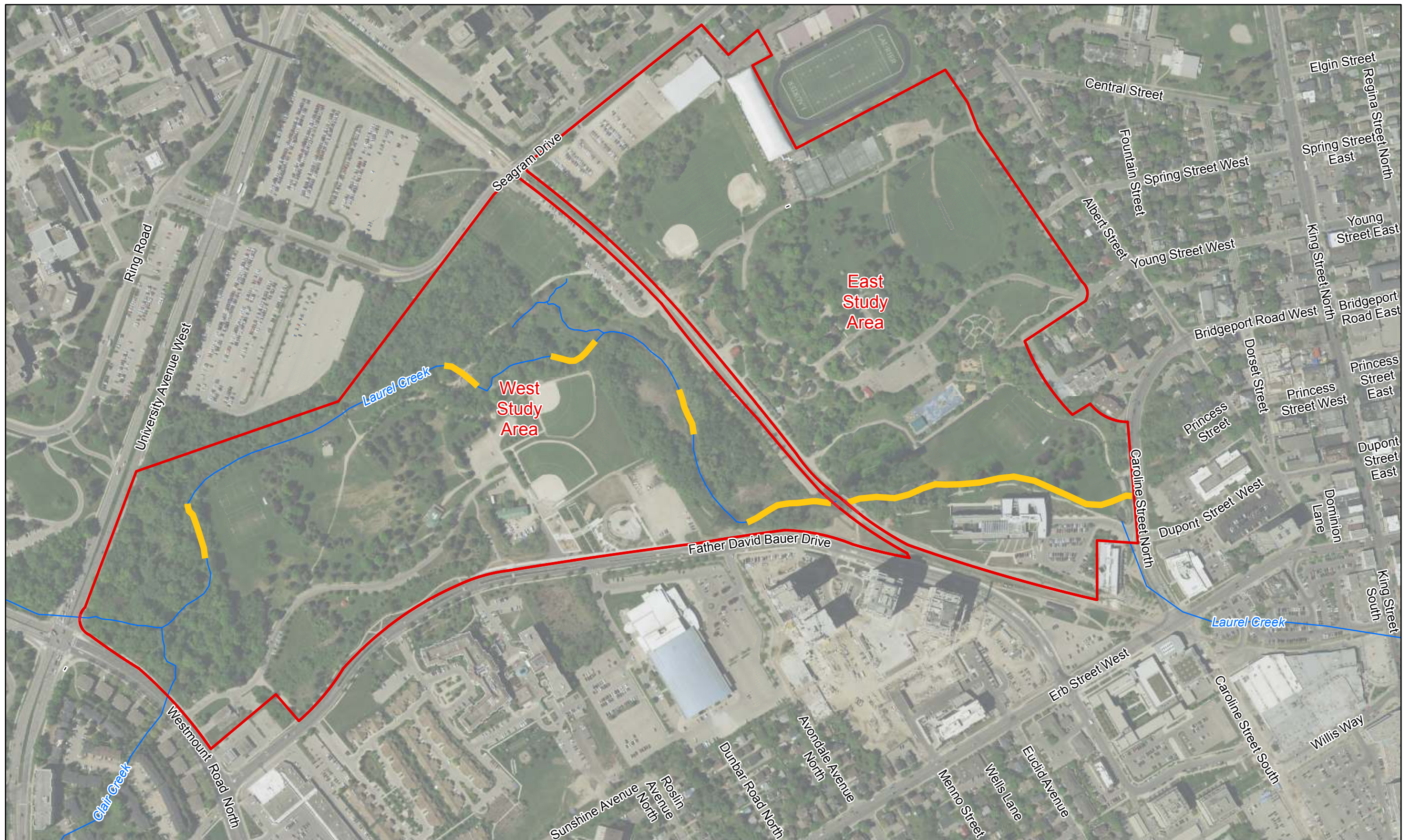
Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure 7
Alternative 3 - Dredge and Reconfigure
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park



Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure 8
Alternative 4 - Channel Around Silver Lake
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park



Notes:
1. Aerial Photograph - Web Map Service (2015)

Figure 9
Alternative 5 - Remove Silver Lake
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park

SILVER LAKE AND LAUREL CREEK REHABILITATION IN WATERLOO PARK – ENVIRONMENTAL ASSESSMENT ADDENDUM

Evaluation of Alternative Solutions
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4.0 EVALUATION OF ALTERNATIVE SOLUTIONS

4.1 EVALUATION APPROACH

The evaluation of the four integrated alternative solutions follows the standard EA approach through the development of a comprehensive set of evaluation criteria. Evaluation criteria are grouped in four main objective categories:

- Technical Environment Criteria
- Natural Environment Criteria
- Social Environment Criteria
- Economic Environment Criteria

The purposes of this evaluation are to eliminate alternatives that do not meet the objectives put forward in the problem statement, and to identify a preferred alternative that best satisfies the objectives of the EA. The preferred alternative then undergoes further detailed analysis and development to confirm it can meet the objectives of the EA and to identify, at a concept level, the requirements for implementation.

4.2 CRITERIA DEVELOPMENT

Category-specific criteria were developed to reflect project-specific components. A description of each criterion is presented along with the predicted measure (high, moderate and low) that will be used to evaluate the alternatives relative to each criterion in Table 4-1.

Input gathered from various City departments (for example, Environment and Parks, Engineering Services), agency consultation, and feedback from the public helped refine the criterion and the respective measures throughout the Study process.

Table 2: Criteria Development Measures

Criteria	Measure (High/ Moderate/Low)
Natural Environment	
Water Quality: The potential of the alternative to improve water quality over the long term.	This alternative will improve water quality: • substantially, • moderately, or • minimally, if at all.
Sediment Management: The potential for the alternative to manage sediment loads.	This alternative will provide: • a substantial degree of sediment stabilization/capture for stable natural sediment load,

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Table 2: Criteria Development Measures

Criteria	Measure (High/ Moderate/Low)
	- a moderate degree of sediment stabilization/capture for stable natural sediment load, or - very little sediment stabilization/capture for stable natural sediment load, and mitigation will be required to minimize risk.
Sediment Quality: The potential for the alternative to maintain or improve sediment quality.	This alternative will improve sediment quality: - substantially, - moderately, or - minimally.
Geomorphology: The potential for the alternative to result in a stable geomorphic condition.	This alternative will result in geomorphic conditions that are: - highly stable requiring very little maintenance to prevent erosion, - moderately stable requiring a minor degree of maintenance to prevent erosion, or - not stable and will require substantial maintenance to prevent erosion.
Wildlife Habitat: The potential for the alternative to remove, maintain or enhance wildlife habitat.	This alternative will: - enhance the quality of habitat, - maintain the quality of habitat, or - reduce the quality of habitat.
Fisheries: The potential for the alternative to sustain a warmwater fishery.	This alternative will: - result in an enhanced warmwater fishery with target management objectives exceeded, - maintain the current extent of warmwater fish distribution and life cycle requirements, meeting target objectives, or - not meet all fisheries management objectives.
Terrestrial Resources: The potential for the alternative to maintain or enhance existing terrestrial resources such as wetlands.	This alternative will result in existing terrestrial resources being: - substantially enhanced, - maintained, or - reduced, with substantial mitigation required to prevent loss.
Wildlife: The ability of the alternative to protect sensitive wildlife species (including the number of regional significant species and habitat specific species).	This alternative will: - substantially enhance potential for habitat-specific wildlife species, - maintain the existing suite of habitat-specific species, or - result in a loss of habitat-specific species and a potential influx of habitat-generalists where substantial mitigation may be required to prevent loss.
Reduce Goose Waste: The ability of the alternative to reasonably reduce goose waste in Waterloo Park while protecting wildlife and balancing the disruption to park users	This alternative will: - minimize disruption to park users without impacting habitat, - maintain the level of disruption to park users with no change to habitat or - increase the disruption to park users by increasing suitable habitat and subsequent use by geese.

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Table 2: Criteria Development Measures

Criteria	Measure (High/ Moderate/Low)
Vegetation: The ability of the alternative to protect regionally-significant species and native species and species with a high coefficient of conservatism (conservative species).	This alternative will see the native proportion and floristic quality of vegetation within Waterloo Park: • substantially increase, • be maintained at the existing level, or • be reduced.
Groundwater Resources: The ability of the alternative to protect groundwater resources.	Regarding groundwater resources, this alternative will provide: • a substantial level of protection, • a moderate level of protection, or • minimal protection.
<i>Social and Cultural Environment</i>	
Cultural/Heritage Resources: The potential of the alternative to protect and promote the cultural heritage landscape significance of Waterloo Park.	This alternative will see the level of protection and/or promotion of the cultural heritage landscape be: • substantially enhanced, • maintained at the current level, or • reduced.
Visual Aesthetics: The ability of the alternative to enhance the existing landscape while respecting the historic and cultural elements in Waterloo Park.	This alternative will see the existing landscape: • enhanced to promote key views of the lake and shoreline, • change slightly with a minor impact on the visual character of the area, or • be reduced.
Recreational Opportunities: The ability of the alternative to provide for enhanced recreational opportunities.	Regarding recreational opportunities, this alternative: • will provide potential, • may provide potential, or • does not provide potential.
Educational Opportunities: The potential for the alternative to provide education opportunities for users.	Regarding educational opportunities, this alternative: • will provide potential, • may provide potential, or • does not provide potential.
Community Health and Safety: The potential for the alternative to minimize risk or liability to community health and safety resulting from flood events, crime/vandalism, and/or nuisance noise/light.	Regarding community health and safety, this alternative will result in: • a high potential to minimize risk, • moderate potential to minimize risk/ the level of risk will remain the same, or • very little potential to minimize risk.

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Table 2: Criteria Development Measures

Criteria	Measure (High/ Moderate/Low)
Occupational Health and Safety: The potential for the alternative to minimize risk or liability to occupational health and safety resulting from flood events, O/M activities, and/or crime/vandalism.	Regarding occupational health and safety, this alternative will result in: • a high potential to minimize risk, • moderate potential to minimize risk/the level of risk will remain the same, or • very little potential to minimize risk.
Technical Environment	
Flood Protection: the ability of the alternative to maintain the existing level of flood protection.	This alternative will: • maintain or improve the existing level of flood protection, • maintain the existing level of flood protection throughout Waterloo Park, or • not contribute to flood protection.
Ease of Implementation: The ability of the alternative to be easily implemented on a technical, regulatory and/or practical basis.	With respect to obtaining regulatory approvals and construction techniques, this alternative is: • very easy to implement, • somewhat easy to implement, or • has many obstacles if it is to be implemented.
Erosion Control: the ability of the alternative to minimize streambank/shoreline erosion.	This alternative will provide: • a substantial level of erosion control, • an adequate level of erosion control, or • a minimal level of erosion control.
Maintenance of Stream Flow Regime: the ability of the alternative to maintain or improve the baseflow conditions in the stream.	This alternative will improve stream flow: • substantially, • somewhat, or • minimally, if at all.
Operation/Maintenance (O/M): The ability of the alternative to be operated and maintained with ease, and to be accessed with ease.	Relative to current O/M practices, this alternative will: • be very easy to implement or will ease the burden of current O/M activities, • moderately increase O/M requirements, or • substantially increase O/M requirements/activities for current staff.
Economic Environment	
Capital Costs: Estimated Capital Costs, including restoration/enhancement costs.	Relative to other alternatives, the cost is considered to be: • low, moderate, or high.
O/M Costs: Estimated annual operating costs for staff resources, ongoing O/M activities.	Relative to other alternatives, the cost is considered to be: • low, moderate, or high.

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Table 2: Criteria Development Measures

Criteria	Measure (High/ Moderate/Low)
Lifecycle Costs: Total annual capital, and O/M costs amortized over 20 years.	Relative to other alternatives, the cost is considered to be: • low, moderate, or high.

4.3 DETAILED EVALUATION

As per the MEA guidance (MEA, 2000 amended in 2007, 2011, and 2015), the systematic evaluation of alternatives is based on consultation with review agencies and the public to ensure relevant Project-specific or technical information gained during the planning process will assist the proponent in arriving at the best decision. Therefore, the initial list of criteria developed for the Project (Table 2) was refined to focus the evaluation of alternatives, based largely on feedback from subject matter experts, members of the Project team, and public consultation.

A detailed evaluation of alternatives was conducted as a collective exercise with the Project team by assigning a measure (*high*, *moderate* or *low*) and associated score (*10*, *5* or *0*, respectively) to the anticipated impact of the alternative solution on each criterion. These measures were converted to an assigned numerical score. The scores were then totaled and normalized by category to provide an overall score for each alternative (Table 3).

The evaluation of alternatives was based on an equal weighting of the four categories:

Technical Environment	25%
Natural Environment	25%
Social/Cultural Environment	25%
Economic Environment	25%
Total	100%

Table 3. Detailed Evaluation of Alternatives Identified for the Project

				Option 1 Do Nothing		Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake	
Category & Criterion	Description	Measure/Indicator	Rating Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score
Natural Environment				Subtotal	0	Subtotal	30	Subtotal	40	Subtotal	55	Subtotal	65
				Normalized to out of 10	0.0	Normalized to out of 10	4.29	Normalized to out of 10	5.7	Normalized to out of 10	7.9	Normalized to out of 10	9.3
Water Quality	The potential for the alternative to improve water quality within the study area over the long term.	The potential change in water quality compared to the existing conditions for selected measures: total suspended solids (TSS) and total phosphorus (TP).	10 The alternative may substantially improve water quality. 5 The alternative may moderately improve water quality. 0 The alternative will not improve water quality or may result in some deterioration.	It is anticipated that water quality will further deteriorate over time.	0	Moderate improvements in water quality are anticipated (such as, TSS and TP reductions) after Silver Lake is dredged and Laurel Creek is re-constructed.	5	Substantial improvements in water quality are anticipated (such as, TSS and TP reductions) after Silver Lake is dredged. It is anticipated that additional improvements in water quality will occur following the restoration of Silver Lake given the additional measures that may allow for improved circulation.	10	Substantial improvements in water quality are anticipated (such as, TSS and TP reductions) after Silver Lake is dredged. It is anticipated that additional improvements in water quality will occur for Laurel Creek once Silver Lake is taken off-line.	10	Substantial improvements in water quality are anticipated (such as, TSS and TP reductions) in Laurel Creek from implementation of creek restoration measures. With Silver Lake removed, there will no longer be a depositional environment.	10
Sediment Management	The potential for the alternative to manage sediment loads within the study area.	The potential change in sediment management, including quality, quantity and transport, from existing conditions.	10 The alternative may provide a substantial degree of sediment stabilization/capture for stable natural sediment loads. 5 The alternative may provide a moderate degree of sediment stabilization/capture for stable natural sediment loads. 0 The alternative will provide very little sediment stabilization/capture for stable natural sediment loads. Mitigation will be required to minimize risk.	No change is anticipated to the degree of sediment stabilization/capture. There is potential for further deterioration over time.	0	Moderate degree of sediment stabilization; however, Silver Lake will continue to be a depositional environment.	5	Substantial degree of sediment stabilization/capture due to creek restoration measures, and construction of water quality improvement components (for example, forebay).	10	Moderate degree of sediment stabilization; however, Silver Lake will continue to be a depositional environment from event runoff or flooding.	5	Substantial degree of sediment stabilization/capture due to creek restoration measures. Silver Lake will no longer be a depositional environment for sediment.	10
Geomorphology	The potential for the alternative to result in a stable geomorphic condition within the study area.	The potential change in the extent and risk of streambank erosion, stream bottom scour and sediment deposition compared to existing conditions.	10 The alternative may result in a highly stable geomorphic condition requiring very little maintenance to prevent erosion. 5 The alternative may result in a moderately stable geomorphic condition requiring a minor degree of maintenance to prevent erosion. 0 The alternative will not improve existing conditions requiring considerable maintenance to prevent erosion.	The alternative will not improve geomorphic conditions and may require substantial maintenance to prevent erosion.	0	The alternative may result in a highly stable geomorphic condition requiring very little maintenance to prevent erosion in consideration of the re-construction of Laurel Creek and dredging of Silver Lake	10	The alternative may result in moderately stable geomorphic condition requiring a minor degree of maintenance to prevent continued erosion in Laurel Creek, and in consideration of the dredging of Silver Lake	5	The alternative may result in moderately stable geomorphic condition requiring a minor degree of maintenance to prevent continued erosion in Laurel Creek, and in consideration of the dredging of Silver Lake.	10	The alternative may result in moderately stable geomorphic condition requiring a minor degree of maintenance to prevent continued erosion in Laurel Creek, and in consideration of the dredging of Silver Lake. Instability in Silver Lake will no longer be an issue as the latter will be removed.	10

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				Option 1 Do Nothing		Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake		
Category & Criterion	Description	Measure/Indicator	Rating Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	
Terrestrial Species and Related Habitat	The potential for the alternative to remove, maintain or enhance terrestrial habitat potential (for example, the change in desired vegetation/wetlands).	The potential change in terrestrial habitat function and/or availability.	10	The alternative may substantially enhance the functionality or availability of habitat for a variety of species, including species at risk.	This alternative may not substantially change terrestrial habitat function and/or availability.	0	The alternative may improve the quality of existing available terrestrial habitat for the benefit of urban wildlife species; however, this alternative will not create additional habitat.	5	The alternative may moderately enhance habitat function and availability from upgrades to Laurel Creek; any terrestrial habitat impacts from changes to the Silver lake footprint will be mitigated with replacement planting.	5	The alternative may substantially enhance terrestrial habitat function and availability for a variety of species, including potential species at risk by reducing the lake footprint and creating terrestrial/riparian habitat around the new channel. Silver Lake will be dredged, resulting in subsequent habitat improvement for existing urban species.	10	This alternative may substantially enhance terrestrial habitat availability and function, and may also reduce wildlife mortality risk for terrestrial species by removing Silver Lake and ultimately increasing the land area available for desirable terrestrial habitat.	10
			5	The alternative may moderately enhance the functionality or availability of habitat for urban wildlife and few, if any, species at risk.										
			0	The alternative may maintain or may result in a reduction of functionality or availability of overall habitat.										
Wetland Species and Related Habitat	The potential for the alternative to remove, maintain or enhance wetland habitat potential (for example, the change in desired vegetation/wetlands).	The potential change in wetland habitat function and/or availability.	10	The alternative may substantially enhance the functionality or availability of habitat for a variety of species, including species at risk.	This alternative will eventually result in a moderate increase in wetland habitat as Silver Lake continue to accumulate sediment.	0	This alternative may remove the existing wetland habitat at the head of the lake (formed by sediment deposition).	0	This alternative may remove the existing wetland habitat at the head of the lake (formed by sediment deposition) and if a forebay is located upstream of the LRT. Opportunities for enhancement or expansion of existing wetland habitat within Silver Lake will be considered as part of the design.	0	This alternative may remove the existing wetland habitat at the head of the lake (formed by sediment deposition). There is an opportunity to create wetland within the former lake footprint.	5	This alternative may substantially enhance wetland habitat availability and function, and ultimately increase the land area available for desirable wetland.	10
			5	The alternative may moderately enhance the functionality or availability of habitat for urban wildlife and few, if any, species at risk.										
			0	The alternative may maintain or may result in a reduction of functionality or availability of overall habitat.										
Aquatic Species and Related Habitat	The potential for the alternative to improve the productivity of local warmwater fisheries due to increased habitat diversity (such as through the creation of new habitat elements, enhanced shoreline structure, increased depth and added structure).	The potential change in aquatic habitat function and and/or availability.	10	The alternative may substantially improve the aquatic habitat function or availability.	The alternative may reduce aquatic habitat function and/or availability if Silver Lake continues to fill with sediment and Laurel Creek is not stabilized. A sustainable aquatic habitat would be unlikely.	0	The alternative may enhance the quality of habitat considering Silver Lake will be dredged and Laurel Creek banks will be stabilized; however, improvements to habitat availability or variety will be moderate as there is no potential to extend the creek length.	5	Overall, the alternative may moderately enhance the functionality, quantity, and variety of available aquatic habitat within the study area. Silver Lake may see substantial improvements from dredging and reconfiguring the footprint/shoreline, and with the addition of water quality features that may improve circulation. The banks of Laurel Creek will be stabilized; however, there is no extension of the stream channel.	5	The alternative will substantially enhance the functionality, quantity, and variety of available aquatic habitat (lake and riverine) within the study area by dredging and reconfiguring the footprint/shoreline of Silver Lake, and with the addition of water quality features that may improve circulation. Additionally, the banks of Laurel Creek will be stabilized with the potential to extend stream channel length.	10	The alternative may substantially enhance the extent of aquatic habitat specific to Laurel Creek considering the potential to extend stream channel length; however, improvements to habitat variety will be minimal. There may be reduced species diversity in consideration of Silver Lake being removed.	5
			5	The alternative may moderately improve the aquatic habitat function or availability.										
			0	The alternative will maintain or reduce the aquatic habitat function or availability.										

Table 3. Detailed Evaluation of Alternatives Identified for the Project

				Option 1 Do Nothing		Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake		
Category & Criterion	Description	Measure/Indicator	Rating	Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score
Goose Management	The potential to incorporate reasonable goose management practices to minimize the physical disruption to park users while protecting wildlife.	An observed reduction in the local goose population from existing conditions.	10	The alternative may result in a substantial decrease in the presence of geese within the park.	No change is anticipated as there are minimal deterrents for the geese.	0	No change is anticipated as there are minimal deterrents for the geese.	0	Modifications to the shoreline design may result in reducing the goose population while minimizing physical disruption to park users.	5	Modifications to the shoreline design may result in reducing the goose population while minimizing physical disruption to park users.	5	Removing Silver Lake will physically reduce preferred goose habitat.	10
			5	The alternative may result in a moderate decrease in the presence of geese within the park.										
			0	The alternative result in no change from existing conditions or results in an increase in local goose population.										
Social/Cultural Environment					Subtotal	0	Subtotal	40	Subtotal	50	Subtotal	25	Subtotal	20
					Normalized to out of 10	0.0	Normalized to out of 10	6.7	Normalized to out of 10	8.3	Normalized to out of 10	4.2	Normalized to out of 10	3.3
Cultural/Heritage Resources	The potential for the alternative to promote the cultural heritage landscape including the protection and conservation of existing heritage values within the study area.	Following construction, the potential for the alternative to enhance the promotion of cultural values by protecting heritage resources (for example, physical evidence or place of past human activity - the Mill Pond).	10	The alternative may provide an opportunity to potentially enhance the promotion and protection of the cultural/heritage resources and landscape significance.	This alternative will result in the degradation of cultural heritage resources due to continued degradation of Silver Lake.	0	It is anticipated that this alternative will maintain the current level of protection for the existing cultural heritage landscape significance, and may provide an opportunity to promote cultural/heritage values when Silver Lake is dredged. Existing values may be maintained (for example, association to the Mill Pond history).	5	It is likely that this alternative can provide an opportunity to enhance the protection and promotion of the existing cultural heritage landscape through long term improvements of Silver Lake and Laurel Creek. Existing values may be maintained or enhanced (for example, through increased heritage-based educational opportunities within the park that may provide a cultural/heritage connection).	10	It is anticipated that this alternative will reduce the current level of protection and promotion of historical and cultural heritage landscape significance through alteration of the lake to a reduced open water feature.	0	Removing Silver Lake will reduce the ability to protect existing cultural heritage landscape significance, or remove opportunities to promote cultural/heritage values.	0
			5	The alternative may provide an opportunity to maintain the current level of the promotion and protection of the cultural/heritage resources and landscape significance.										
			0	The alternative may reduce the ability to protect the existing cultural heritage landscape significance, or remove opportunities to promote cultural/heritage values.										
Community Health and Safety	The potential to minimize risk or liability to community health and safety resulting from: - Flood events - Crime/vandalism - Nuisance noise for surrounding residents	The potential change in risk or liability to community health and safety from existing conditions.	10	The alternative may result in very little risk/reduce existing level of risk.	Without management of the existing conditions and no strategy for repairs, risks to human health and safety likely increase.	0	Under this option Silver Lake and Laurel Creek will continue to maintain the current level of potential risk to human health and safety.	5	Under this option Silver Lake and Laurel Creek will continue to maintain the current level of potential risk to human health and safety.	5	Under this option Silver Lake and Laurel Creek will continue to maintain the current level of potential risk to human health and safety.	5	Under this option, Laurel Creek will continue to be managed to protect human health and safety. Removing Silver Lake will result in a reduction to the existing level of risk to community health and safety.	10
			5	The alternative may maintain the current level of potential risk.										
			0	The alternative may result in high potential risk/increase existing level of risk.										

Table 3. Detailed Evaluation of Alternatives Identified for the Project

			Option 1 Do Nothing			Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake		
Category & Criterion	Description	Measure/Indicator	Rating	Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score
Recreational Opportunities	The potential to provide for enhanced water-based recreational opportunities.	The potential change in existing water-based recreational opportunities within Waterloo Park as a result of the Project.	10	The alternative may provide substantial potential for enhanced opportunities.	Without management of existing conditions (for example, erosion) this alternative will reduce any potential for water-based recreational activities.	0	This alternative may provide the opportunity to enhance recreational activities on Silver Lake (for example, canoeing).	5	Reconfiguring the shoreline/footprint or increasing the depth of water in Silver Lake may provide substantial potential for water-based recreational activities. Additionally, increased water quality within Silver Lake may enhance the level of opportunity and subsequent use within the park.	10	This alternative may provide the opportunity to enhance recreational activities on Silver Lake (for example, canoeing).	5	This alternative will reduce the potential for water-based recreational activities.	0
			5	The alternative may provide moderate potential to enhance opportunities.										
			0	The alternative reduces the potential for enhanced opportunities.										
Educational Opportunities	The potential to provide education opportunities for users.	The potential for the alternative to improve educational opportunities including scientific (for example, research opportunities), cultural/heritage (for example, landscape significance within the park), and general (for example, educational plaques around the park for the general public).	10	The alternative may provide the potential for enhanced or new positive educational opportunities.	This alternative does not provide the potential for enhanced educational activities.	0	It is expected that this alternative will enhance and/or provide new positive educational opportunities for a variety of park users.	10	It is expected that this alternative will enhance and/or provide new positive educational opportunities for a variety of park users.	10	Dredging Silver Lake and creating a channel for Laurel Creek will provide the potential for enhanced educational opportunities including scientific (for example, why this is a good alternative to address our study purpose), and general educational opportunities. However, this alternative may reduce the cultural/heritage educational potential considering landscape significance may be reduced through the alteration of the lake to a reduced open water feature.	5	Removing Silver Lake and re-configuring Laurel Creek may provide potential for enhanced scientific educational opportunities (for example, why the lake is not the correct environmental condition in this location); however, it may reduce or remove the cultural/heritage or general educational opportunities specific to Silver Lake.	0
			5	The alternative will maintain the potential for educational opportunities but not provide an opportunity for enhanced or new opportunities.										
			0	The alternative does not provide the potential to enhanced opportunities, and may reduce or remove existing educational opportunities.										
Occupational Health and Safety	Potential to minimize risk or liability to occupational health and safety resulting from: - Flood events - O/M activities - Crime/vandalism	The potential to reduce risk or liability for employees from existing conditions.	10	The alternative may result in very little risk/reduce existing level of risk.	If no management strategies are implemented, Silver Lake will continue to fill with sediment and Laurel Creek will still require repairs; therefore, the existing level of risk may be increased.	0	Dredging Silver Lake and fully re-constructing Laurel Creek will not result in a change to occupational health and safety risk.	5	Dredging and re-configuring Silver Lake and repairing Laurel Creek will not result in a change to occupational health and safety.	5	Dredging the lake and creating a channel will not result in a change to occupational health and safety risk.	5	Under this option, Laurel Creek will continue to be managed to protect human health and safety. Removing Silver Lake will result in a reduction to the existing level of risk for employees.	10
			5	The alternative may maintain the current level of potential risk.										
			0	The alternative may result in high potential risk/increase existing level of risk.										

Table 3. Detailed Evaluation of Alternatives Identified for the Project

				Option 1 Do Nothing		Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake	
Category & Criterion	Description	Measure/Indicator	Rating Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score
Visual Aesthetics	The potential to aesthetically enhance the existing landscape while respecting the historic cultural elements in the park	The potential to enhance the visual character of Waterloo Park from existing conditions.	10	The existing landscape will be enhanced to promote key views of the lake and shoreline in strategic locations.	The visual character of the area will be continued to degrade as a result of this alternative.	0	Dredging Silver Lake and fully re-constructing Laurel Creek will promote key views throughout the Park without altering the landscape beyond recognition.	10	Dredging Silver Lake and fully re-constructing Laurel Creek will promote key views throughout the Park without altering the landscape beyond recognition.	10	Dredging Silver Lake and creating a channel for Laurel Creek may produce a moderate impact on the visual character of the area.	5	Removing Silver Lake will result in a landscape that may be difficult for frequent users to recognize; however, the existing landscape (for example, sediment build-up) will also be reduced. This alternative will not promote key views of Silver Lake; however, reconfiguring Laurel Creek may promote views of the shoreline in strategic locations throughout the study area.
			5	Components of the alternative may have a moderate impact on the visual character of the area; visual character may be modified only somewhat.									
			0	The alternative will reduce the visual character of the area; the landscape may be difficult for frequent users to recognize.									
Technical				Subtotal	10	Subtotal	10	Subtotal	15	Subtotal	10	Subtotal	10
				Normalized to out of 10	5.0	Normalized to out of 10	5.0	Normalized to out of 10	7.5	Normalized to out of 10	5.0	Normalized to out of 10	5.0
Flood Protection	The potential to maintain the existing level of flood protection within the study area.	The alternative will improve the level of local flood protection from existing conditions.	10	The alternative will improve or provide increased flood protection from existing levels	This alternative decreases the level of flood protection as sediment will continue to accumulate.	0	Dredging of Silver Lake maintains the existing level of flood protection. This alternative assumes no benefit from dredging.	5	Re-configuration of Silver Lake provides the opportunity to increase the level of flood protection for local features within Waterloo Park.	10	This alternative is expected to maintain the existing level of flood protection.	10	This alternative is expected to maintain the existing level of flood protection.
			5	The alternative will maintain the existing level of flood protection.									
			0	The alternative will decrease the level flood protection.									
Ease of Implementation	The potential to be easily implemented on a technical, regulatory, and/or practical basis.	The alternative will be easier to implement compared to other alternatives, in consideration of construct effort (for example, duration of schedule, availability of workforce), and permitting and/or regulatory approval requirements/timelines.	10	The alternative requires the least amount of construction effort (short duration, basic construction crew, minimal equipment), and few permits and/or regulatory approvals within a short period of time.	No construction effort, or permits and/or regulatory approvals are required.	10	A moderate amount of construction effort, and/or regulatory approvals will be required.	5	A moderate amount of construction effort, permitting and/or regulatory approvals will be required.	5	Substantial amounts of construction effort, permitting and/or regulatory approvals will be required.	0	Substantial amount of construction effort, permitting and/or regulatory approvals will be required.
			5	The alternative requires a moderate amount of construction effort (multi-season schedule, typical urban setting construction equipment), and several permits and/or regulatory approvals that may be subject to wait times.									
			0	The alternative requires a substantial amount of construction effort (long-term duration, skilled/specialized crew), and a substantial amount of permits and/or regulatory approvals that may include long wait times, or considered difficult to get.									

Table 3. Detailed Evaluation of Alternatives Identified for the Project

				Option 1 Do Nothing	Option 2 Dredge and Reconstruct		Option 3 Dredge and Reconfigure		Option 4 Channel Around Silver Lake		Option 5 Remove Silver Lake		
Category & Criterion	Description	Measure/Indicator	Rating Scale for Measuring Impacts	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score	Comparative Evaluation	Score
Economic Environment				Subtotal	30	Subtotal	15	Subtotal	20	Subtotal	10	Subtotal	20
				Normalized to out of 10	10.0	Normalized to out of 10	5.0	Normalized to out of 10	6.7	Normalized to out of 10	3.3	Normalized to out of 10	6.7
Operations & Maintenance	Estimated annual operating costs for staff resources and ongoing O/M activities.	Estimated O/M costs of the alternative relative to other alternatives.	10	Low cost.	This alternative assumes nothing is done (that is, no sediment management will occur); therefore, no costs are incurred.	10	Operational and maintenance will not change from existing conditions.	5	Operational and maintenance costs are likely to be reduced given the modifications to the footprint of Silver Lake and the implementation of design features which reduce sediment loading or facilitate sediment management.	10	Operational and maintenance will not change from existing conditions.	5	Operational and maintenance costs are likely to be reduced given the removal of Silver Lake, which will reduce sediment management related costs in the future.
			5	Moderate cost introduction, or maintain existing costs.									
			0	High cost.									
Lifecycle costs	Total annual capital, and O/M costs amortized over 20 years.	Estimated Lifecycle costs of alternative relative to other alternatives.	10	Low cost.	Lifecycle costs will not change. This alternative assumes nothing is done (that is, no sediment management will occur); therefore, no costs are incurred.	10	Initial capital costs will be incurred but savings should be achieved due to reduced maintenance.	5	Initial capital costs will be incurred but savings should be achieved due to reduced maintenance.	5	Initial capital costs will be incurred but savings should be achieved due to reduced maintenance.	5	It is anticipated that this alternative can substantially reduce costs given the removal of Silver Lake, which will ultimately reduce sediment management related costs in the future.
			5	Moderate cost introduction, or maintain existing costs.									
			0	High cost.									
Capital Cost	Estimated Capital Costs, including restoration/enhancement costs.	Estimated Capital Cost of alternative relative to existing costs.	10	Low capital costs; does not introduce new costs.	This alternative assumes nothing is done, and therefore, will not introduce new costs.	10	Dredging Silver Lake and re-constructing Laurel Creek will present new costs for restoration and enhancement measures.	5	It is anticipated that dredging and re-configuring Silver Lake will have moderate capital costs.	5	It is anticipated that re-configuring portions of Silver Lake and creating a new channel for Laurel Creek will have high capital cost initially.	0	It is anticipated that removing Silver Lake and re- configuring Laurel Creek may have high capital costs.
			5	Moderate capital cost introduction, or maintain existing costs.									
			0	High capital costs.									
All Categories				Subtotal	40	Subtotal	95	Subtotal	125	Subtotal	100	Subtotal	115
				Normalized Total	15.0	Normalized Total	21.0	Normalized Total	28.2	Normalized Total	20.4	Normalized Total	24.3

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4.4 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

4.4.1 Alternative 3: Dredge and Reconfigure Silver Lake

The detailed evaluation process identified *Alternative 3: Dredge and Reconfigure Silver Lake* as the preferred solution.

This alternative would see the sediments in lake dredged (and properly managed) with additional measures taken to improve the circulation of water in the lake to improve the water quality. Measures may include:

- reconfiguring the footprint/shoreline of the lake; and/or,
- changing the depth of the lake; and/or,
- implementing sediment management and water quality improvement components such as a forebay up or downstream of the Light Rail Trail.

Additional measures include spot repairs along Laurel Creek in the west study area such as debris removal, pedestrian bridge improvements, weir removal, gabion replacement, or bank stabilization, all using natural channel design principles.

4.5 SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to determine if the overall scoring of alternatives changes if criteria categories are assigned a different weighting scheme. Four scenarios were evaluated, with each category given a preferable weighting of 40% with the remaining three categories given a weighting of 20%. For example:

Natural Environment	40%
Technical Environment	20%
Social/Cultural Environment	20%
Economic Environment	20%
Total	100%

In every scenario, the sensitivity analysis indicates Alternative 3: Dredge and Reconfigure Silver Lake is preferred (Figure 10).

Sensitivity Analysis

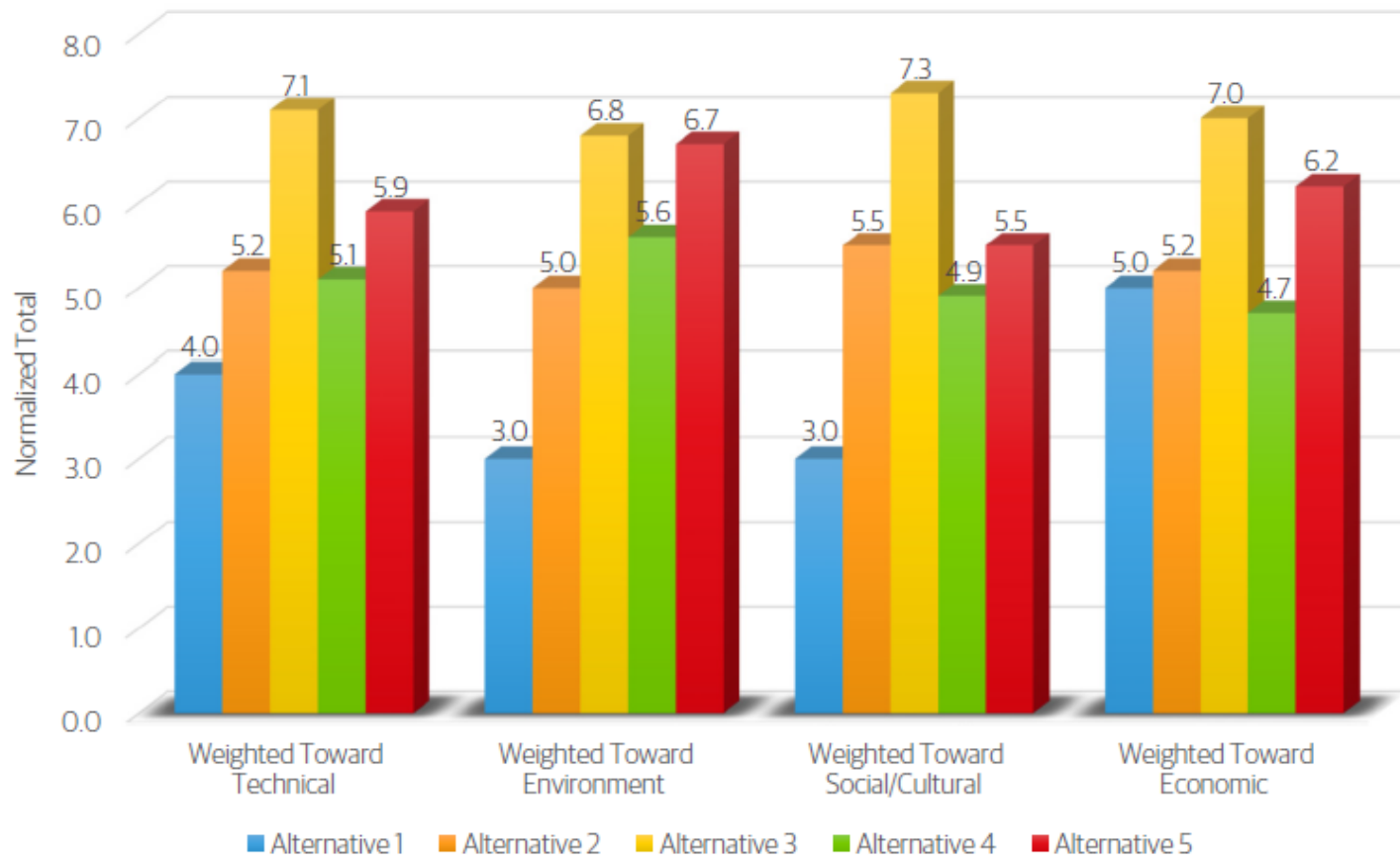


Figure 10
Normalized Evaluation Scores
Class Environmental Assessment Addendum for
Silver Lake and Laurel Creek in Waterloo Park
City of Waterloo, Ontario

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5.0 PREFERRED ALTERNATIVE COMPONENTS AND RECOMMENDATIONS

This section describes the preferred solutions for Silver Lake and Laurel Creek upstream, as identified through the evaluation outlined in Section 4.

5.1 SILVER LAKE COMPONENTS

The preferred solution for Silver Lake is Alternative 3 – Dredge and Reconfigure Silver Lake. This section describes the preferred solution's functions, acknowledging that the design of specific elements will be further developed at the detailed design stage. The goal of this project is to address ongoing siltation issues in Silver Lake. The philosophy to achieve this goal includes recognition that the Lake is not a natural feature and will have to be managed over the long term to maintain its function and appearance, and that improvements must address both the origin of the problem (sediment source) and the symptoms (lake appearance/function).

When analyzing the various possible design elements for improvements, it is important to recognize that the following constraints are associated with the Lake:

- The presence and basic footprint of the Lake is important to the Park's character; therefore, major changes will be avoided to maintain the existing heritage values/characteristics.
- Surrounding infrastructure includes existing and proposed crossings (railway and pedestrian) at the upper end of the Lake, sanitary sewer adjacent to the Lake and various storm system outlets which must be retained. The outlet enters a large storm sewer immediately downstream of the Lake, which will not be altered during this project, limiting the potential for alterations of the shoreline near Erb Street.
- Upstream flow regime (rates and volumes) will remain unchanged, which will limit the potential to improve flushing rates or in-Lake flow velocity. In addition, it is anticipated that the sediment load will be, at minimum, the existing condition moving forward should upstream controls not be constructed.

To improve Lake function, a multi-faceted approach is recommended, incorporating the following key concepts:

- Minimize the existing sediment load to the Lake by implementing upstream water quality controls. Reducing the upstream sediment load addresses the primary cause of the Lake's sedimentation issues.
- Minimize the distribution of sediment accumulation within the Lake by constructing a containment area or sediment forebay at its upper end to facilitate future cleanout operations. Sediment will continue to accumulate in the Lake and ongoing maintenance will be required; however, a forebay would contain the majority of the settled material in the upstream portion of the Lake, which would limit the frequency of disturbance within the main Lake and Park areas.
- Improve general conditions within the Lake by implementing various measures such as appropriate shoreline modifications, and lake bathymetry to improve in-Lake conditions such as waterfowl controls, operations and maintenance, and aesthetics.

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- Enhance the environmental system associated with the Lake (including aquatic and terrestrial components) to assist in achieving a more natural balance within the Lake and maximize the potential for stabilizing the Lake environment. This concept addresses the concern for a more sustainable and resilient system, which is can better withstand and/or mitigate occasional human or natural perturbations.

The elements proposed as part of this preferred alternative yield the following benefits:

- Lake water quality. The following elements will improve the Lake's water quality:
 - Removal of accumulated sediments.
 - Construction of a forebay to limit distribution of future sediment around the Lake.
 - Addition of aquatic plantings to stabilize Lake bottom material and limit re-suspension
 - Repair of the Lake outlet including the outlet weir itself and maintenance access to the grates at the entrance of the large downstream culvert. This will address the deteriorating conditions that currently exist and facilitate maintenance activities.
 - Increased water depth to improve lake aesthetics ("cloudy" appearance), minimize sediment re-suspension by waterfowl, and minimize water temperature increases
 - Implementation sediment removal measures upstream of the Lake to improve water quality by reducing the incoming sediment load within Waterloo Park. These include providing stormwater quality controls for Park areas (parking lots, animal areas, etc.) and encouraging neighboring stakeholders to do the same. Spot repairs to Laurel Creek upstream of Silver Lake will also help minimize ongoing erosion and sediment delivery to the Lake.
- Waterfowl management. Opportunities to limit the appeal of the Lake to waterfowl include shoreline undulations to limit sightlines, Lake deepening to reduce feeding opportunities, and appropriate shoreline plantings and near shore landscape elements to limit movement opportunities.
- Terrestrial habitat. Terrestrial habitats are maximized by retaining existing vegetation, and additional plantings of native species with measures to reduce the establishment of invasive exotic species.
- Aquatic habitat. Improvements to the aquatic habitat within the Lake will be created by establishing other (native) species by introducing deeper areas and undulating bathymetry, creating an increased variety of habitats, aquatic plantings, habitat structures, riparian cover improvements and edge treatments to provide edge shade, reduce localized solar warming and improve bank stabilization to minimize erosion.
- Aesthetics/Heritage Values. Lake aesthetics and heritage values are maintained and improved by maintaining the current Lake footprint in the main Park area, deepening the Lake to improve appearance, improving water quality by removing existing sediment and minimizing future deposition.

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- Operations and maintenance. Operations and maintenance improvements include constructing a forebay designed for regular cleanout with better access and flow by-pass opportunities as well as repairs/improvements to the outfall to rectify current deficiencies, improve safety and address the failing access at that location.
- Maintain the current flood conveyance capacity of the outflow.

Table 4 provides a summary of the proposed lake features and the opportunities addressed by each.

Table 4: Proposed Silver Lake Features

Lake Element	Function
Deepen Lake	• Remove accumulated sediment • Improve appearance • Minimize re-suspension • Decrease water temperatures • Improve habitat variety • Decrease attractiveness to waterfowl
Sediment Forebay	• Maximize sediment removal upstream of Lake • Improve accessibility for maintenance • Facilitate redirecting flows around the work area during forebay maintenance/cleaning operations
Shoreline modifications	• Minimize shoreline erosion • Discourage geese • Minimize potential for floating debris accumulation • Create habitat and biodiversity
Plantings/Landscaping	• Shoreline plantings to discourage geese • Minimize shoreline erosion • Maintain/improve terrestrial habitat with native species • Aquatic plantings to stabilize lake bottom • Improve aesthetics
Habitat Structures	• Improve aquatic habitat (surface and deep-water structures) • Discourage geese (surface/shoreline structures) • Create biodiversity and buffering through shoreline plantings/modifications
Outlet Conditions	• Maintain flood conveyance capacity • Improve maintenance safety/accessibility • Address existing deteriorated/failing conditions
Stormwater Controls (upstream of the Lake)	• Minimize sediment delivery to the Lake
Existing Infrastructure	• Maintain existing infrastructure around Lake (e.g., pedestrian crossings/LRT crossing) • Accommodate existing underground infrastructure (e.g., storm outlets, sanitary sewer alignments)

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5.2 LAUREL CREEK IMPROVEMENTS

The preferred solution for Laurel Creek in Alternative 3 includes completing spot repairs on Laurel and Clair Creeks through Waterloo Park to address key areas of concern.

To improve Creek function, a multi-faceted approach is recommended, incorporating the following key concepts:

- Minimize the existing sediment delivery to the Creek by implementing upstream water quality controls.
- Stabilize and/or repair areas of the Creek that were identified during field reconnaissance. This will improve habitat conditions within Waterloo Park as well as reduce the sediment load to downstream reaches and to Silver Lake.
- Increase environmental system health associated with the Creek by using natural channel design principles in any stream-related repair work.
- Identify areas for Operations and Maintenance staff to focus on for ongoing debris removal, etc.

The elements proposed as part of this preferred alternative are summarized in Table 5 and illustrated in Figure 3.

Table 5: Creek Areas of Concern

Site	Creek Disturbance	Recommendation
1	Debris accumulation	Remove and continue monitoring
2	Eroded Outfall on Clair Creek	Spot repairs to bank and infrastructure
2a	Debris accumulation	Remove and continue monitoring
3	Historic dam and gabion walls	Remove dam and gabions, reshape banks
4	Mid-channel bar	Monitor
5	Weir remnant	Remove weir remnant, reshape banks
9	Debris in trash racks	Remove and continue monitoring
Other	Bank erosion/incision observed. Tree roots provide moderate protection	Spot repairs to strengthen bank and to reduce force of flows on bank

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The various works identified can be grouped into three categories: maintenance, restoration and monitoring. Each are described as follows:

- Maintenance activities like debris removal do not require additional study, design or permitting. It is recommended that debris removal at sites 1, 2a and 9 be completed immediately.
- Restoration actions require some further assessment, design and permitting. The three sites in this category should be completed in the following order:
 - Site 2: Work at this site consists of the removal/repair of an eroded outfall. This site is a relatively high priority because of the potential for future damage of existing infrastructure if repairs are not completed. Some additional study is required to assess the cause of the erosion and the design should address the cause to minimize potential for recurrence. Because in-water work is required, permitting will be necessary
 - Site 3: Work at Site 3 consists of the removal of the existing dam structure and failing downstream gabions, and restoration of Laurel Creek using natural channel design principles to stabilize the channel and restore floodplain access. The existing dam structure is currently used as a pedestrian walkway, so further planning and design work is necessary to determine how and where the pedestrian crossing will be replaced. This location also requires extensive channel restoration work (gabion removal), so permitting will be a key consideration
 - Site 5: The remnant weir at this location should be removed, however, there is little current impact at this location, so this site is the lowest priority. Some natural channel design and permitting work is necessary to address this concern
- Monitoring for potential problems at site 4, and for general erosion issues (site “other”) should be an ongoing activity and if problems are identified, they should be addressed on an as-needed basis.

5.3 DESIGN CONSIDERATIONS AND CONSTRAINTS

The Silver Lake and Laurel Creek Rehabilitation in Waterloo Park Environmental Assessment Addendum provides direction for the future design and implementation phases of the project. It has been intentionally kept at a relatively conceptual level with the expectation that the final design process will develop the necessary details.

This section documents the design considerations that should be incorporated into the final design for both the Silver Lake and Laurel Creek components.

5.3.1 Silver Lake

During the course of the final Silver Lake design, the following must be prepared/completed:

- Geotechnical assessment and recommendations
- Quantification of sediment for removal and soils management plan

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- Finalized forebay design, including integration into the Park landscape, maintenance access and trail connections. This includes addressing any impacts to existing environmental features such as wetlands or habitat that may be impacted as a result of the forebay location or construction.
- Infrastructure design details both interior to the Lake (outlet repairs, weirs, etc.) and surrounding the Lake (storm outlets into the Lake, sanitary alignment adjacent to the Lake, etc.)
- Grading design (in-Lake and outside Lake) including cross section details and habitat enhancement features
- Landscaping plans
- Erosion and sediment controls
- Stormwater management controls for tributary areas within Waterloo Park
- Future trail alignments including incorporation of key Park features such existing trails, Park buildings (e.g. snack bar, etc.). These should incorporate AODA and CPETD elements.
- Construction access plans
- Water management plan (during construction)
- Finalize monitoring program
- Permitting

5.3.2 Laurel Creek

During the course of the final Laurel Creek design, the following must be prepared:

- Detailed plan and profile drawings of stream alignment using natural channel design principles (i.e., don't simply repair failing gabions)
- Geomorphic assessment to determine appropriate bankfull dimensions, substrate material, etc.
- Restore stream floodplain connectivity
- Maintain or enhance fish habitat and fish passage
- Planting/landscaping plan using native species
- Geotechnical assessment and recommendations to provide design support for bridge and trail alignments
- Future trail alignments
- Construction access plans
- Water management plan (during construction)

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- Finalize monitoring program
- Permitting

5.4 CONSTRUCTION CONSIDERATIONS

This section of the report identifies the potential construction impacts and recommends mitigation measures. Mitigation measures address water quality, aquatic habitat, terrestrial ecological features, and potential short- and long-term impacts associated with this undertaking.

5.4.1 Aquatic Habitat Impacts and Mitigation

There is potential for impacts to the fish and benthic communities in Silver Lake and Laurel Creek during dredging operations, channel reconfiguration, and Lake alterations. Practicing the following “good housekeeping” procedures during construction will reduce these impacts:

- Schedule a pre-construction briefing onsite with City and GRCA staff to discuss environmental sensitivities/constraints, erosion and sediment controls, required mitigation measures, emergency protocols, construction shutdown protocols, wildlife encounter and agency contact protocols, and other environmental inspection procedures that will be in place prior to and throughout construction
- The Contractor shall monitor the 5-day weather forecast and be prepared to shut down operations and temporarily secure/stabilize working areas under wet weather conditions
- In-water construction timing restrictions will be adhered to so that spawning fish, incubating eggs and fry emergence are protected, based on the fish community present. That being the case, no in-water work will be undertaken between March 15 and June 30, in accordance with the MNR Fisheries Timing Windows.
- All work will be performed in the dry. Dewatering of the work area will be discharged to settling areas or through filter media before discharge to receiving watercourse.
- Staging the dredging activities should minimize the extent of the area that requires dewatering at any given time. Work areas will be delineated with construction fencing to minimize the area of disturbance.
- Remove all dredged material to a location outside of the ordinary high-water mark and stabilize any waste materials removed from the work site to prevent them from entering the water body (that is, covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs).
- To avoid downstream impacts on fish and benthic communities, it will be necessary to maintain baseflow during construction and excavation activities.
- Any fish isolated by construction activities will be captured and released to the watercourse beyond the work zone.
- Good housekeeping practices related to materials storage, equipment fueling, equipment cleaning, and maintenance will be implemented during construction.

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- Proper Storage and Use of Excavated Materials – The following is a list of measures for controlling the release of sediments during removal near water bodies:
 - Heavy-duty Sedimentation Fence – a sedimentation fence will be placed between the work area and the water feature. Siltation fencing will be secured along the base by backfilling with earth to prevent runoff from flowing underneath the bottom edge.
 - Sedimentation fencing will be placed along the base of all spoil piles to prevent sediment-laden runoff from entering the watercourses.
- Worksite isolation and dewatering plans should be prepared as part of the final detailed design phase to identify appropriate worksite isolation methods, siltation controls, and dewatering measures to be implemented.

5.4.2 Natural Heritage Impacts and Mitigation

There is potential for impacts to the various natural heritage resources within the study area. Locally significant wetlands, unevaluated wetlands, and significant wildlife habitat (bat maternity colonies, turtle habitat including wintering and nesting areas, and Eastern Wood-Pewee habitat) were identified during the natural heritage fieldwork for the project. In addition to the “good housekeeping” practices mentioned to protect the aquatic habitat features, the following additional measures will reduce impacts to the natural heritage features:

- Avoid or minimize intrusion into key habitat areas
- If avoidance is not possible, the final design should incorporate habitat structures to improve conditions in the newly constructed areas. For example, if the Lake footprint changes impact wetland areas, compensation measures should be included to offset lost wetland area. The compensation should be coordinated with agency staff to ensure appropriate replacement features are designed.
- The final design should include habitat enhancement features. Again, in consultation with review agencies, the project should incorporate elements that improve habitat conditions and/or increase area of previously limited resources
- All restoration work should incorporate native species suitable for the area and minimize opportunities for invasive species to migrate into the study area

5.4.3 Cultural Heritage Impacts and Mitigation

A significant number of cultural resources were identified within the Study Area during this EA Addendum. During the final design process these features should be identified, retained enhanced wherever possible to maintain the current cultural heritage of the site. The following measures will reduce impacts to the cultural heritage features:

- Once the final footprint of the work is known, a Stage 2 archaeological assessment should be undertaken on those areas identified as having archaeological resource potential to protect any artifacts that might be found

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- Impacts to the identified cultural heritage resources in the Study Area should be avoided, if possible, or documented and incorporated into the final design if necessary. Any impacts to cultural heritage resources should be coordinated with City staff.
- If avoidance is not possible, the final design should incorporate habitat structures to improve conditions in the newly constructed areas. For example, if the Lake footprint changes impact wetland areas, compensation measures should be included to offset lost wetland area. The compensation should be coordinated with agency staff to ensure appropriate replacement features are designed.

5.4.4 Short-Term Construction Impacts

There are several potential short-term impacts associated with this project, which may include the following:

- Increased Truck Traffic: During construction, the truck traffic to and from the study area will increase as equipment is needed to remove the excavated materials. To mitigate these impacts, the hours of work will be specified in the contract and will adhere to the City's by-laws. It is anticipated that the majority of the work will be carried out from Monday to Friday between 7 a.m. and 6 p.m.
 - Noise: Excavation traffic and equipment could generate noise as part of normal operations. The proposed measures to mitigate noise impacts include the following:
 - All construction vehicles and equipment are to be equipped with muffling devices and operated in a fashion to minimize noise in the project area
 - The City's noise by-law will be enforced for all construction activities
- Dust and Mud: Excavation traffic could create dust and mud problems, pending weather conditions. The proposed mitigation methods include the following:
 - Dust control measures such as the application of water or calcium chloride will be undertaken as necessary to minimize dust migration
 - Public roadways will be kept clean and free of mud by regular street cleaning and/or by tire-washing facilities for vehicles exiting the construction site
- Erosion and Sedimentation: There is the potential for erosion and sedimentation during construction. The proposed mitigation measures include the following:
 - An erosion and sedimentation control plan will be prepared and implemented during construction
 - The use of hay bales, silt fences, trenches or other measures will be implemented (as necessary) to minimize erosion and sediment transport
 - Any areas disturbed during construction will be stabilized as soon as possible
 - Operations will be completed in the dry through work site isolation and dewatering

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- **Water Management:** If pumping is required for dewatering or stream diversion approach is required during construction the following measures are recommended:
 - Ensure pump intakes are operated in a manner that prevents streambed disturbance and fish mortality
 - Ensure the pumping system is sized to accommodate possible high flows that might occur during construction. Pumps should be monitored at all times, and backup pumps should be readily available on site in case of pump failure
 - Protect pump discharge areas to prevent erosion and release of suspended sediments downstream, and remove any accumulated material when works are completed (ref OPSS 517 and 518)
- **Soil management:** When excavating the accumulated sediment in Silver Lake, the latest MOECC guidelines for soil management should be followed, including testing and disposal requirements.
- **Fuel Spills:** In re-fueling construction equipment, spills could occur and contaminate surface and groundwater. Proposed mitigation measures include the following:
 - The requirement of health and safety plans for construction activities
 - Preparation of a contingency plan for cleaning up fuel spills, ready for implementation
 - Establishing designated areas for re-fueling construction equipment with a minimum separation distance of not less than 30 metres from any watercourse
- **Wildlife Disturbance:** Physical intrusion and noise generated by construction activities represents a short-term disturbance to wildlife within the study area. It is expected that once construction is complete, wildlife will quickly return to their normal use patterns within the Park and associated natural areas. To minimize impacts, the following mitigation measures are proposed:
 - To minimize impacts on nesting birds, and to correspondingly avoid contravention of the Migratory Birds Convention Act, construction activities should be restricted within the potential nesting period. If this is unavoidable, a nest search of the area will be scheduled a minimum of three days before site work and will be undertaken by qualified individuals so that no active nests covered by the Migratory Birds Convention Act are destroyed or damaged
- **Vegetation Removal:** Removal of vegetation is possible during construction and grading operations. Proposed mitigation measures include:
 - Where grading and construction permits, any trees adjacent to the channel should be retained to maintain cover
 - Provide tree protection fencing where needed to protect vegetation adjacent to construction areas from inadvertent disturbance
 - Following grading activities, any disturbed areas should be stabilized and vegetated through a combination of seeding, planting, and naturalization with native species

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Because of the sensitive nature of the work around water bodies, and the high-traffic nature of the location (both during and after construction), the City should consider a pre-qualification process to ensure that the contractor that is ultimately selected to perform the rehabilitation works is qualified to undertake the project and has experience with similar work. This project has a very high profile and poor-quality work, either in terms of construction quality and/or in terms of schedule could jeopardize the success of the final product.

5.5 IMPLEMENTATION PLAN

5.5.1 Net Environmental Impacts

Opportunities to improve the Lake's overall water quality will help to restore and enhance the natural environment conditions within the study area. Restoring the natural systems and enhancing existing natural features will help to improve water quality.

The cumulative impact of implementing the upstream control measures and reconfiguring the Lake will be an overall net benefit to the environment within the study area. Potential impacts are considered minor and will be mitigated during construction.

The preferred alternative seeks to implement measures that restore and enhance features while minimizing the need for future maintenance, and corresponding disturbance, within the watercourse.

5.5.1.1 Laurel Creek Improvements

Implementing the proposed upstream measures will improve aquatic habitat conditions in Laurel Creek and also improve the overall quality of water that enters Silver Lake. While some loss of existing habitat is a by-product of this work, there will be an overall net improvement through replacement with enhanced habitat features.

5.5.1.2 Sediment Removal

This project's primary objective is to improve conditions in the Lake by removing the already accumulated sediment, and by taking multiple actions to remove sediment closer to where it is generated and before it reaches the Lake. Stormwater management measures will reduce in-stream sediment loading, and improved channel conditions will minimize erosion (sediment generation) within the channel itself.

Creating a sediment forebay at the upper end of the Lake would capture much of the remaining sediment load, minimizing the deposition and cleanout frequency in the main Lake area. A sediment forebay is designed and intended to be cleaned out on a regular (relatively frequent) basis to maintain overall lake and system conditions.

Any reduction in sediment transport to the Lake, whether through measures within Waterloo Park or in other upstream areas will reduce how often dredging will be required to remove accumulated sediments in the Lake. However, sediment deposition in the Lake will continue as the upstream drainage area delivers a healthy sediment load for these stream systems. As an online impoundment, the Lake will continue to be an area of sediment deposition but successfully implementing measures to control and manage sediment in upstream areas will significantly improve the Lake's long-term water quality and minimize ongoing maintenance requirements.

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5.5.1.3 Lake Reconfiguration

Reconfiguring the Lake by increasing depth, while encouraging sediment deposition within the proposed sediment forebay, will help maintain water quality. By concentrating deposition within the forebay and by reducing sediment load entering the Lake, the frequency and extent of future dredging operations will be reduced, thereby minimizing future environmental impacts and costs.

Changes in the Lake footprint can also improve conditions by minimizing stagnant areas and offering opportunities for aesthetic (viewsheds) and recreational (trail) improvements. Any changes in footprint will be reviewed to ensure that critical habitat features are retained or enhanced for a net environmental benefit.

Lake reconfiguration in conjunction with restoring the shoreline through plantings, trail adjustments, and management of waterfowl will also provide water quality enhancements.

5.5.1.4 Vegetation Enhancements

Improving riparian cover and edge treatments within the Lake will enhance aquatic habitat, reduce bank erosion, and provide cover, resulting in net improvements to water quality and improved fish habitat opportunities. Any proposed plantings will feature native species which help improve existing habitat conditions.

5.5.1.5 Aquatic Habitat

As a result of improved water quality conditions and the incorporation of aquatic habitat enhancement measures such as cover, structure, substrate, and riparian vegetation, net improvements in the overall productivity of the fish community within Silver Lake and contributing watershed are possible.

5.5.2 Permitting

The implementation of the preferred alternative will require a number of permits and approvals that will need to be secured prior to the construction of any works proposed for this undertaking. The following are considerations and/or requirements that may be part of the final implementation:

- MOECC: An Environmental Compliance Authorization will be required from the MOECC to manage and remove the accumulated sediment in Silver Lake.
- GRCA: A Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Permit (pursuant to Ontario Regulation 150/06) will be required for work within the GRCA regulated area, which includes lands within or adjacent to the Lake, Laurel Creek, or their associated floodplains.
- Fisheries and Oceans Canada (DFO): If any of the proposed works are expected to cause harm to fish, and authorization from the DFO under the Federal Fisheries Act would be required. It is expected the City will have to conduct a self-assessment to document existing and proposed impacts to fish and fish habitat. Depending on the final design, a request for review may be submitted to determine if further DFO review is necessary.
- Ministry of Natural Resources and Forestry (MNRF): Work carried out within the waterway, or which may occupy public land, may require approvals under the Lakes and Rivers Improvement Act and/or the Public Lands Act

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from the MNRF, however, these are typically addressed through the GRCA permit. Removal of existing dam and dam remnants within Laurel Creek may require further approval from MNRF and early pre-consultation is recommended to confirm the necessary protocols.

- **Heritage Resources:** A cultural heritage overview was completed as part of this EA Addendum to identify cultural resources within the study area. Any planned intervention should consider the heritage values that would be disturbed and incorporate appropriate mitigation measures into the final design.
- **Archaeological Resources:** The Stage 1 Archaeological Assessment conducted for this EA Addendum confirmed that portions of the study area retain archaeological potential. Should the final design include disturbance to these areas, a Stage 2 Archaeological Assessment must be completed prior to construction in accordance with the Ministry of Tourism, Culture and Sport guidelines.
- **Railway:** The presence of the railway crossing will necessitate approval of the proposed plans through the railway authority.

Specific permit requirements will be based on the ultimate design, construction and operation of the preferred alternative and should be confirmed through agency consultation as part of the final detailed design process.

5.5.3 Preliminary Opinion of Probable Cost

The development of the conceptual design for Silver Lake and Laurel Creek construction elements allows a preliminary opinion of the cost of these elements to be determined.

Table 6: Opinion of Probable Cost for Construction of Project Elements

Item	Description	Cost	Notes
1.	Startup/mobilization	\$250,000	
2.	Water management	\$250,000	
3.	Sediment removal	\$3,900,000	30,000 m ³ at an assumed cost of \$130/m ³
4.	Grading/excavation	\$300,000	30,000 m ³ of material moved @ \$10/m ³
5.	Shoreline improvements	\$650,000	500 m of armour stone @ \$1,300/m
6.	Outlet repairs	\$100,000	Repair leaks in weir, improve maintenance access to culvert grate, repair culvert entrance
7.	Stormwater management (within Waterloo Park)	\$100,000	Assume 2 locations for stormwater control facilities and 2 locations for drainage/conveyance improvements
8.	Restoration/landscaping	\$150,000	Assume some wetland replacement (for forebay)
9.	Creek rehabilitation – site 1	\$40,000	Remove and repair eroded storm sewer and restore 25 m of channel @\$1500/linear m

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Table 6: Opinion of Probable Cost for Construction of Project Elements

Item	Description	Cost	Notes
10.	Creek rehabilitation – site 3	\$250,000	Remove existing weir and failing gabions and restore 150 m of channel @ \$1500/linear m
11.	Creek rehabilitation – site 5	\$80,000	Weir remnant removal and restoration of 50 m of channel @ \$1500/linear m
12.	Provisional/Contingency items	\$300,000	
	Subtotal	\$6,370,000	
	10% Contingency	637,000	
	TOTAL	7,007,000	

5.5.4 Post-Construction Monitoring

One of the principle recommendations is that a comprehensive monitoring program be developed and implemented to provide baseline data to gauge the success of the various rehabilitation project elements. The monitoring program should be developed in conjunction with the final design, and may be combined with ongoing City monitoring programs (no need to duplicate efforts. Monitoring should generally include the following:

- **Water Quality:** Measure water quality upstream and downstream of Laurel Creek works, and within Silver Lake to measure changes in water quality
- **Sediment Accumulation:** Measure sediment depth in the new forebay annually to develop a forecast for future cleanouts
- **Silver Lake Conditions:** Visual inspection of Silver Lake to confirm shoreline erosion is controlled, the outlet functions in a satisfactory manner, overland drainage is appropriately managed
- **Natural Heritage:** Field reconnaissance to document changes to natural heritage communities in the Study Area (terrestrial, wetland and aquatic)
- **Creek Morphology:** Measure the extent of erosion and changes in creek morphology annually
- **Trail Conditions:** Inspect trail conditions on a regular basis to identify maintenance measures

Data should be compiled and reviewed annually for the first few years to confirm the rehabilitation is achieving the desired goals and to modify monitoring as appropriate.

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6.0 PUBLIC AND REVIEW AGENCY CONSULTATION

As outlined in the Municipal Class EA document (MEA, 2000 amended in 2007, 2011, and 2015, consultation early in the planning process that continues throughout the duration of the Study is a key feature of a successful EA. The Study is being carried out as a Schedule B project, and has exceeded the mandatory requirements in order to address the needs of the project and associated local stakeholders. This section summarizes the consultation process conducted for the Study including a summary of the formal Study notices, PICs, agency consultation, Project Team meetings, Focus Group meetings, and First Nation notification.

Documentation supporting the consultation process, including the Study stakeholder list, a record of communication and mail/outs and comment/response tracking form, is organized chronologically in Appendix B.

Project information was routinely posted on the City's website: <https://www.waterloo.ca/>

6.1 NOTICE OF COMMENCEMENT

A formal Notice of Commencement was advertised in the Waterloo Chronicle on June 15, 2017, posted to the City's website on June 13, 2017 and sent to identified agencies and public stakeholders. A copy of the notice is included in Appendix B2.

6.2 PUBLIC INFORMATION CENTERS

To meet the consultation objectives of the Study, there were three Project-specific PICs held. All of the PICs were located at the Waterloo Memorial Recreation Complex at 101 Father David Bauer Drive in Waterloo, Ontario which is across the street from the West Study Area.

6.2.1 Public Information Centre Number 1

A formal PIC notice with the study purpose, PIC location details and request for attendance was included in the Notice of Commencement.

On Thursday, June 22, 2017 the Project team hosted PIC No. 1 to outline the goals and objectives of the Project and to solicit feedback from the public on the study.

Thirty-six (36) members of the public attended the PIC. The attendees' interests in the Project varied with attendees including local residents, members of the general public, and representatives of local interest groups. The top three conditions identified as having limited the attendees' enjoyment of Waterloo Park are: sediment build up in the lake; poor water quality; and, park connectivity. When asked what the most important criteria to consider when choosing the best option for Waterloo Park, the respondents noted that Recreational Use and Safety was the primary consideration, followed closely by Protecting the Environment.

Feedback from PIC. No. 1 was used to support, refine or identify opportunities and/or constraints as a result of public feedback. The PIC No. 1 Summary Memorandum is provided in Appendix B3.

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6.2.2 Public Information Centre Number 2

A formal notice with PIC details was advertised in the Waterloo Chronicle on November 30, 2017 and December 7, 2017, and posted to the City's website on November 27, 2017.

On Tuesday, December 12, 2017 the Project team hosted PIC No. 2 to present information regarding the existing conditions of Silver Lake and Laurel Creek, provide a list of alternative solutions, and identify the process that will be used to evaluate the alternatives in order to determine the preferred solution(s).

Thirty (30) people signed the Attendance Register. Attendees identified as local residents, students, members of the general public, and representatives of local interest groups. Some attendees talked with the Project team, and/or sat to fill in the comment sheet. The comment sheet results indicate that a number of the respondents were not in favour of the 'Do-Nothing' and 'Remove Silver Lake' options. There were also a number of respondents that were in favour of the 'Dredge and Reconfigure Silver Lake' option. The comment sheets captured several questions regarding the alternative options showing interest for further information. Thirteen respondents found the proposed weighting criteria generally acceptable by agreeing with or not having an issue with the proposed weighting. Six respondents offered a suggested weighting structure; however, there was no clear consensus among the suggestions with different respondents favouring any of the four evaluation categories.

PIC No. 2 feedback supported the refinement of the detailed evaluation criteria and the use of equal weighting criteria. The PIC No. 2 Summary Memorandum is provided in Appendix B4.

6.2.3 Public Information Centre Number 3

A formal notice with PIC details was advertised in the Waterloo Chronicle on March 1, 2018 and March 8, 2018 and posted to the City's website. Additionally, PIC details (for example, date, location and time) were posted on mobile signs around the Project study area in early March 2018.

On Tuesday, March 20, 2018 the Project team hosted PIC No. 3 for the Project. The purpose of the PIC was to provide a summary of public consultation efforts, outline the evaluation of the five potential alternative solutions presented at PIC No 2, and to present the identified preferred alternative.

There were fifty-five (55) people that signed the Attendance Register. Attendees identified as members of the general public, local residents or students, and representatives of local interest groups (Waterloo Park Advisory Committee, and Watershed Discipleship – Mennonite Church of Eastern Canada). Some attendees talked with the Project team, and/or sat to fill in the Comment Sheet. A total of twenty-six (26) Comment Sheets were received including twenty-five (25) submitted at the PIC and one (1) received via mail approximately two weeks following the PIC. The Comment Sheet results indicate there are no issues or concerns with the Municipal Class Environmental Assessment process. Most respondents (twenty-one [21]) agree that the evaluation of the five alternatives was fair and transparent while one (1) notes that the evaluation process was fair but not transparent. Members of the public expressed interest in receiving details regarding some of the mitigation options, and would like to know more about *Alternative No. 3 Dredge and Reconfigure Silver Lake* including the design and activities required to complete the Project. There is some remaining preference for *Alternative No. 5 Remove Silver Lake* in the spirit of improving water quality.

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PIC No. 3 feedback was used to identify any relevant issues or concerns with the identified preferred alternative and/or the evaluation process used to reach that solution. The PIC No. 3 Summary Memorandum is provided in Appendix B5.

6.3 AGENCY CONSULTATION

According to the EA requirements, numerous regulatory agencies were included on the Project distribution list (Appendix B1) and received a Notice of Commencement and the PIC notices. Communications received through agency consultation are included in Appendix B.

6.3.1 GRCA

In consideration of the complex history of the Study Area and expertise required to identify a preferred solution, the GRCA was included as a subject matter expert in the overall Project Team (see Section 6.4).

6.3.2 MTCS

6.3.2.1 PIC No. 1

A comment sheet was received via email from MTCS noting the requirement to determine the impact on cultural heritage resources. The document highlighted the importance of engaging relevant resources (for example, Indigenous communities, historical societies, etc.) and provided links to screening guidance tools for archaeological and heritage landscape resources (Appendix B3).

6.3.2.2 PIC No. 2

An email was received from MTCS acknowledging the receipt of PIC No. 2 materials, and reiterating the recommendations previously received. As requested, the Stage 1 archaeological assessment that has been initiated for the Project will be submitted directly to MTCS (Appendix B4).

6.3.2.3 PIC No. 3

An email was received from MTCS acknowledging the receipt of PIC No. 3 materials and noting that *Alternative No. 3 Dredge and Reconfigure Silver Lake* was identified as the preferred solution. MTCS recommends that screening for built and cultural landscapes be conducted, and requested a status update on the Stage 1 archaeological assessment. The Stage 1 assessment has been submitted directly to MTCS (Appendix B5).

6.4 PROJECT TEAM MEETINGS

The Project team consists of the City of Waterloo Project Manager, City Staff from key departments (including Parks, Design and Construction, Communications), regulatory agencies (for example, GRCA) and subject matter experts from Stantec and CH2M.

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Key City departments that attended the Project Team Meetings include:

- Environment and Park
- Engineering Services
- Engineering Services: Design and Construction
- Engineering Service: Development Engineering
- Water Services
- Growth Management: Environmental and Heritage Planning

A summary of the Project team meetings is provided below.

- On May 12, 2017, City of Waterloo staff (5), Stantec and CH2M met to introduce team members, and provide a history of the project area.
- On May 16, 2017, City of Waterloo staff (4), GRCA, Stantec and CH2M conducted a site visit to review the current conditions in Silver Lake and Laurel Creek, look at potential maintenance improvements, and highlights from the 2018 study.
- On July 12, 2017, City of Waterloo Staff (5), Stantec and CH2M met to review PIC No. 1 results and to discuss ongoing work (for example, natural heritage, hydrogeology), and opportunities and constraints associated with the Project.
- On October 23, 2017, City of Waterloo staff (9), GRCA, Stantec and CH2M met to discuss Project progress as well as the five-identified potential alternative solutions.
- On November 6, 2017, City of Waterloo staff (8), GRCA, Stantec and CH2M conducted a site visit to discuss the five potential alternatives from a general planning perspective (for example, alignment with the Master Plan).
- February 5, 2018, City of Waterloo staff (9), GRCA, Stantec and CH2M met to review the results of PIC No. 2 as well as review the detailed criteria and weighting structure.

6.5 FOCUS GROUP MEETINGS

The Project Team met with the following stakeholders associated with Waterloo Park.

- Waterloo Park Advisory Committee (WPAC), June 14, 2017 with City staff (4), Stantec, CH2M, and the Municipal Heritage Committee. WPAC was provided with a Project overview, and the team discussed topics including Project importance, historical use, and potential alternatives.
- Perimeter Institute, September 13, 2017 with City staff (2), Stantec, and CH2M to discuss the importance of the park, including a few suggestions for improvement. For example, education nodes and benches around water

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feature(s). The Project Team provided a brief questionnaire that was circulated to and filled out by Perimeter Institute staff.

- University of Waterloo, January 25, 2018 with City staff (2), Stantec, and CH2M to discuss potential research opportunities within Waterloo Park as well as solutions to help support the outcome of the Project. Specifically, drainage from the University (for example, parking lots) to help manage the conditions within Silver Lake.

6.6 FIRST NATION CONSULTATION

A formal Notice of Commencement and PIC notices (as described above) were mailed to Indigenous and Northern Affairs Canada and the Ontario Ministry of Aboriginal Affairs in addition to the following communities:

- Six Nations of the Grand River
- Mississaugas of the New Credit First Nation
- Haudenosaunee Development Institute
- Oneida Nation of the Thames
- Metis Nation of Ontario

To date, a response has not been received.

6.7 NOTICE OF COMPLETION

A formal Notice of Completion will be advertised pending council approval on June 25, 2018 of the final EA report. An example of the notice is included in Appendix B6

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References

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