City of Hamilton

Green Standards and Guidelines for Low Impact Development

December 20, 2023 Final

Green Standards and Guidelines for Low Impact Development

City of Hamilton

Final

Project No.: WW22011024
Date: December 20, 2023

WSP
3050 Harvester Road
Burlington, ON
Canada, L7N 3J1

wsp.com

Revision History

FIRST ISSUE

24 Jul 2023	Working Draft Copy	
Prepared by	Reviewed by	Approved by
Emma Haug-Kindellan, Water Resources Engineer Samantha Stokke, Environmental Planner	Ron Scheckenberger, S&A Senior Advisor	Emma Haug-Kindellan, Water Resources Engineer

REVISION 1

October 19 2023	Final Draft Copy	
Prepared by	Reviewed by	Approved by
Emma Haug-Kindellan, Water Resources Engineer Samantha Stokke, Environmental Planner	Ron Scheckenberger, S&A Senior Advisor	Emma Haug-Kindellan, Water Resources Engineer

FINAL

December 20, 2023	Final Copy	
Prepared by	Reviewed by	Approved by
Emma Haug-Kindellan, Water Resources Engineer Samantha Stokke, Environmental Planner	Ron Scheckenberger, S&A Senior Advisor	Emma Haug-Kindellan, Water Resources Engineer

Signatures

Prepared by

December 20, 2023

Samantha Stokke, RPP, MCIP
Senior Environmental Planner

Date

Reviewed by

December 20, 2023

Ron Scheckenberger, M.Eng., P.Eng.
Senior Advisor & Senior Water Resources Engineer, Scheckenberger & Associates Ltd.

Date

Approved[1] by (must be reviewed for technical accuracy prior to approval)

December 20, 2023

Emma Haug-Kindellan, M.Eng., P.Eng.
Water Resources Engineer

Date

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

WSP Canada Inc. (WSP) prepared this report solely for the use of the intended recipient, City of Hamilton, in accordance with the professional services agreement. The intended recipient is solely responsible for the disclosure of any information contained in this report. The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report. This limitations statement is considered an integral part of this report.

The original of this digital file will be conserved by WSP for a period of not less than 10 years. As the digital file transmitted to the intended recipient is no longer under the control of WSP, its integrity cannot be assured. As such, WSP does not guarantee any modifications made to this digital file subsequent to its transmission to the intended recipient.

PRODUCTION TEAM

WSP

Project Manager & Water Resources Engineer	Emma Haug-Kindellan, M.Eng., P.Eng.
Senior Environmental Planner	Samantha Stokke, RPP, MCIP

SCHECKENBERGER & ASSOCIATES LTD.

Senior Advisor & Senior Water Resources Engineer	Ron Scheckenberger, M.Eng., P.Eng.

TABLE OF CONTENTS

Tables

Figures

Appendices

1 INTRODUCTION

1.1 Study Purpose

The City of Hamilton (the City) has under the guidance of Council, prepared City-wide Green Standards and Guidelines (GSG) to largely guide ***private development*** applications. The GSG creates a guideline and approach that tailors to the specific needs and conditions within the City, the applicable watershed and sub watersheds, and area specific stormwater management (SWM) criteria. These guidelines are intended to work in unison with other City initiatives such as the Climate Action Strategy, to mitigate and adapt the City to the effects of climate change. The GSG provides developers with a decision methodology and implementation considerations to inform private development applications. This decision methodology/matrix allows development proponents to systematically evaluate their development applications to identify best management practice options and onsite control requirements. It is important to understand that the City is separately reviewing the stormwater management requirements for ***public works / lands***, and this is expected to be a future complement to these GSG.

In order to support the development of the GSG, various levels of legislative guidance have been reviewed including federal, provincial, regional, municipal and conservation authority guidance, in order to establish the legislative framework under which the GSG will operate. The development of the GSG has also included various case study examples within the City to provide insights into current planning of Low Impact Development (LID) practices in comparison to future requirements under the guidance within the GSG.

1.2 Green Infrastructure and Low Impact Development

In order to assist in the utility of these guidelines, it is considered important to clearly articulate the understanding around the fundamental terms used to describe various forms of similar but distinct concepts when describing low impact development, green infrastructure and natural infrastructure / assets. The definitions which follow outline the differences in these terms and should be considered by the users of these guidelines when interpreting the direction accordingly:

Green Infrastructure (GI):

— Both natural and human-made elements that provide ecological and hydrological functions and processes. GI can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.

Natural Infrastructure / Assets:

— The term “natural infrastructure” refers to naturally occurring landscape features and/or nature-based solutions that promote, use, restore or emulate natural ecological processes (i.e., wetlands, forests, parks, etc.).

Low Impact Development (LID):

— Stormwater management approach that seeks to manage precipitation at source through better site design and use of built LID practices.

— Typically includes a suite of site design strategies to mimic the area’s natural hydrology through stormwater infiltration, evapotranspiration, rainwater harvesting, filtration, and detention.

— LID practices can include those which are “enhanced assets” such as bio-swales, rain gardens, green roofs, etc., as well as “engineered assets” such as permeable pavement, exfiltration systems, etc. LID practices often employ vegetation and soil in their design, however not always, and the specific form may vary considering local conditions and community character.

In summary, LID practices are man-made measures to off-set the impacts of development, while Natural infrastructure considers the water management services provided by natural features or nature-based solutions. Green Infrastructure considers both concepts and embodies these into a more holistic term.

1.3 Purpose and Use of Document

The City of Hamilton continues to develop at a rapid pace, with projections to 2051 exceeding 700,000 people. This amount of development (new greenfield and re-development) requires careful management of the impacts of urbanization (impervious / hard surfaces) on the natural environment and public safety. Furthermore, climate change is also predicted to exacerbate these impacts. In light of the foregoing, the City has defined a need to manage stormwater more comprehensively and systematically, with an emphasis on those measures / practices which manage runoff at its source (i.e., source controls), while also acknowledging the need for more traditional end-of-

pipe solutions. Due to the lack of contemporary and comprehensive guidance, the City has been operating under a process whereby City staff has been directing developers to Provincial or industry-based guidance which does not acknowledge the unique needs or requirements of Hamilton. While this approach has resulted in several positive outcomes, the lack of consistency and formal procedures has at times resulted in uneven and less fulsome stormwater solutions.

On the basis of the foregoing, the City has developed these guidelines (GSG) to support private development applications. The current GSG report includes the following content:

- **Review of Legislation & Industry Best Practices:** This provides the legislative framework for SWM Guidelines preparation and outlines the Best Practices being implemented across various municipalities (i.e., Ontario, Canada, Global).
- **Hamilton Today:** This provides an overview of the watershed systems across the City of Hamilton and outlines the Stormwater Management criteria currently being applied based upon existing guidelines / study findings.
- **Goals & Objectives:** This demonstrates the process followed for envisioning the GSG, and the associated Goals and Objectives being achieved through this process.
- **Hamilton Retention Criteria Framework:** This establishes the framework for following a hierarchical approach and outlines the specific targets developed for the City of Hamilton. This section also outlines case studies which demonstrate the application of this criteria.
- **Review of LID BMP Practices:** This outlines a long-list of LID BMPs and describes functional / land use considerations, and outlines preliminary design guidance for each practice.
- **Implementation Requirements and Next Steps:** This section describes the implementation requirements and future actions required by the City for advancing the next steps of the GSG process.

Development proponents are to use the direction herein to establish green solutions to address the impacts of their developments in a consistent and contemporary manner. Furthermore, the City will be separately preparing guidance for public works projects which will need to follow similar procedures for managing the impacts due to public works projects such as new or re-constructed roads.

As a first step, the criteria and standards as presented can also be applied to the public ROW, however as noted, it is City staff's intent to prepare more fulsome guidance and standards specific to the Public ROW in the near future.

2 REVIEW OF LEGISLATION & INDUSTRY PRACTICES

2.1 Legislative Review

Numerous policies and legislative requirements for stormwater management, particularly related to private onsite controls and green infrastructure, are embedded in legislation and policies at the federal, provincial, conservation authority and municipal levels. This legislative review has documented the relevant legislation, policies, guidelines, reports, and other information to identify the requirements and best practices for private onsite stormwater management, as well as green infrastructure to inform green standards and guidelines specific to Hamilton. The legislative review has been structured as follows:

2.1.1 Federal Guidance

2.1.2 Provincial Guidance

2.1.3 Conservation Authority Guidance

2.1.4 Municipal Policies, Plans and Strategies

A detailed summary of the information reviewed is provided in **Appendix A**. This (Section 2.1) provides a high-level summary of the documents which most directly inform the GSG.

2.1.1 Federal Guidance

Federal guidance provides goals and general guidelines for development and watershed management and provides an avenue for establishing specific policies at the provincial and municipal level. Documents such as the Canadian Environmental Protection Act (1999) and the Achieving a Sustainable Future Strategy (2019) provide a vision for sustainable development for provincial and municipal documents to build upon.

2.1.2 Provincial Guidance

The Provincial government provides guidance on stormwater management planning through policies, legislation, guidelines and regulatory information, which provide clear support for onsite LID practices. The Provincial Policy Statement (PPS) (2020) provides policy direction and sets the framework for regulating land use planning and development, in order to protect resources of provincial interest, public health and

safety, and the quality of the natural and built environment. Relative to stormwater management, the PPS supports the use of LID measures through specific policies that require stormwater management measures for new development to prepare for the impacts of a changing climate through the effective management of stormwater, such as the use of green infrastructure, as well as promoting stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and LID. Similarly, A Place to Grow Growth Plan for the Greater Golden Horseshoe (Growth Plan) (2019) provides direction on growth and development within the Greater Golden Horseshoe and recommends that municipalities develop stormwater master plans that consider LID, green infrastructure and stormwater retrofits. Furthermore, the Municipal Act authorizes municipalities to pass by-laws, implement programs, provide services and actions pertaining to stormwater, for the purposes of preventing damage to property resulting from flooding, and protection and conservation of the environment.

Other Provincial documents such as the Niagara Escarpment Plan (2017), MECP Stormwater Management Planning and Design Manual (2003), MECP Subwatershed Planning Guide (Draft) (2022), and the MECP Interpretation Bulletin: Expectations Regarding Stormwater Management (2015), further encourage the use of LID techniques to manage stormwater, providing guidance on procedural and technical aspects of stormwater management practices. Recently, the Province enacted Bill 109: More Homes for Everyone Act (2022) and Bill 23: More Homes Built Faster Act (2022), both of which made modifications to Provincial Acts such as the Planning Act, Municipal Act, and Conservation Authorities Act, among others, with the objective of increasing housing affordability in Ontario. In relation to stormwater management, these modifications have impacted the planning and development review process, such as limitations on the matters municipalities can require as part of development applications for developments of 10 units or less, limitations on matters which Conservation Authorities can require as part of development applications, as well as reduced review time by municipalities for Site Plan Control and Zoning By-Law Amendments, which if not met result in financial penalties. These modifications overall limit the power for municipalities to require onsite controls related LID.

2.1.3 Conservation Authority Guidance

Conservation Authorities administer polices and plans to regulate development within their respective jurisdiction. The City of Hamilton falls within the jurisdiction of four conservation authorities: Hamilton Conservation Authority (HCA), Conservation Halton (CH), Niagara Peninsula Conservation Authority (NPCA), and Grand River Conservation Authority (GRCA); each conservation authority provides policy guidance, specific stormwater management criteria and Best Management Practices within their

respective jurisdiction, to be implemented through development applications. Some of these plans include HCA Planning and Regulation Policies and Guidelines (2011), CH Guidelines for Stormwater Management Engineering Submissions (2021), NPCA Policy document: Land Use Planning and Review Policy (2020), NPCA Stormwater Management Guidelines (2010), and GRCA Consolidated Policies for Implementing O.Reg 150/06 (2015).

2.1.4 Municipal Policies, Plans and Strategies

Municipal guidance directs stormwater management through strategic policies found in Plans, Strategies, and Guidelines, and provides specific policies on the implementation of green infrastructure and LID within a local context. Both the Rural Hamilton Official Plan (2013) and Urban Hamilton Official Plan (2013) include policies that encourage the use of green infrastructure by integrating, protecting, and enhancing environmental features and landscapes. The Official Plans encourage on-site stormwater management and infiltration techniques such as stormwater management ponds, green roofs, vegetated swales, permeable pavement systems or other LID practices to be incorporated into building and site designs when technically possible. In addition, the Urban Official Plan includes prescriptive policies that require the City to implement actions and strategies to address climate change adaptation goals, such as stormwater management monitoring, analysis and planning that assess the impacts of a changing climate and incorporates actions such as the implementation of LID and green infrastructure. It also requires the City to maintain and update a Stormwater Master Plan that would provide direction for incorporating LID and green infrastructure within the city, and identify the need for stormwater retrofits, where appropriate. Additional plans and guidelines which support the use of green infrastructure and LID in Hamilton include the Hamilton Climate Change Impact Adaptation Plan (2022), Taking Action on Climate Change – A Community Plan (2015), and Complete Streets Design Guidelines (2022).

Other plans such as the Stormwater Management Master Plan (2007), Storm Drainage Policy and Guidelines for Stormwater Infrastructure Design (2004), Development Charges Background Study (2019), and the Comprehensive Development Guidelines and Financial Policies Manual (2019) further support and guide the implementation of LID and green infrastructure within the City of Hamilton, through information and recommendations related to operations and maintenance costs, incentives for implementation, and technical requirements. These documents provide relevant information such as strategies and clear steps for implementation of a source control or BMP program, storm drainage requirements and applicable LID measures, as well as information on managing costs associated with implementing LID measures within Hamilton.

The legislative review identifies LID and green infrastructure guidance at the federal, provincial, conservation authority, and municipal level, through plans, legislation, and guidelines, to support sustainable development where possible. The City-wide GSG supports the goals and requirements outlined at the various levels of government, and provides developers the tools to successfully carry out the intentions of these goals and requirements, to support Hamilton's growth and address impacts of development.

2.2 Industry Best Practices

A comprehensive analysis of industry-wide best practices has been conducted to determine the available guidance across other jurisdictions related to the design and implementation of LID practices, in order to provide specific guidance on Low Impact Development (LID) practices tailored to the City of Hamilton. The evaluation of LID guidelines has encompassed the following aspects of LID design:

- Analytical Techniques/Methods
- Design Practices/Guidance
- Implementation Requirements
- Lifecycle Costs, including Maintenance
- Barriers to Implementation
- Monitoring Requirements

The best practices review has been organized into four (4) distinct scales to better understand the available guidance for LID practices. This includes reviewing local guidelines applicable to the City of Hamilton, followed by a provincial review across the province of Ontario, then nationally in Canada, and lastly completing a review of available guidance at the global scale. A summary of this review has been provided in the subsequent sections, with additional information located within **Appendix B**.

2.2.1 City of Hamilton

The key City of Hamilton documentation available for existing LID guidance includes the following:

- Comprehensive Development Guidelines (City of Hamilton, 2019)
- Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses (AMEC Environment & Infrastructure a division of AMEC Americas Limited, April 2013)

These two (2) documents have been reviewed to assess the existing guidance requirements established for the City of Hamilton, to identify the current applicable

guidance that private development applications must follow. The summary of this review is shown in **Table 2-1**, which identifies whether the documents provide any guidance with respect to analytical techniques, design practices, implementation requirements, life cycle costs (including maintenance considerations), barriers encountered, and monitoring recommendations.

Table 2-1: Available LID Guidance for Engineering Design in the City of Hamilton

Source	Analytical Techniques	Design Practices	Implementation Requirements	Lifecycle Costs including Maintenance	Barriers	Monitoring
Comprehensive Development Guidelines (City of Hamilton, 2019)	-	✓	✓	-	✓	-
Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses (AMEC Environment & Infrastructure a division of AMEC Americas Limited, April 2013)	✓	✓	✓	-	✓	-

The existing documentation available from the City's existing guidelines generally provide a long-list of LID BMP practices which may be suitable for implementation depending upon the land use (largely ICI focused discussions), and generally identify some potential considerations as to special requirements for certain LID BMPs to be implemented. However, the current guidance appears to lack details related detailed design requirements and often references external guidance from the 2003 MOE manual. This suggests the need for further details related to LID BMPs as part of a separate or enhanced guidance manual, such as the current initiative for the GSG.

2.2.2 Ontario

The available LID guidance across Ontario has been reviewed through a selection of Provincial and Municipal guidance documents. The municipalities selected for review include Toronto, Kitchener, Burlington, Ottawa, and Barrie, which represent a diverse range of urban centers in the province. Other guidance is available through the local Conservation Authorities including Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC), as well as through their joint organization Sustainable Technologies Evaluation Program (STEP). The Ministry of Environment,

Conservation and Parks (MECP) also has detailed guidance available at the provincial scale, available through both the 2003 guide, as well as the recent Draft Guidance published in January 2022.

Each of these documents have been reviewed and summarized as part of **Table 2-2**.

Table 2-2: Available LID Guidance for Engineering Design in Ontario

Author	Source	Analytical Techniques	Design Practices	Implementation Requirements	Lifecycle Costs including Maintenance	Barriers	Monitoring
STEP	Low Impact Development Stormwater Management Planning and Design Guide (May 2022)	✓	✓	✓	✓	✓	✓
TRCA / CVC	Low Impact Development Stormwater Management Planning and Design Guide (2010)	✓	✓	✓	✓	✓	✓
MECP	Stormwater Management Design Guide (2003)	✓	✓	✓	✓	✓	✓
	DRAFT Low Impact Development Stormwater Management Guidance Manual (January 2022)	✓	✓	✓	-	✓	✓
Toronto	Toronto Green Streets Technical Guidelines (November 2017)	-	✓	✓	-	✓	-
Kitchener	Integrated Stormwater Management Master Plan (ISWM-MP) (Aquafor Beech Limited, October 2016)	-	-	✓	-	-	-
Burlington	Sustainable Building and Development Guidelines (December 2021)	-	✓	✓	-	-	-
	Stormwater Management Design Guidelines (Wood Environment & Infrastructure Solutions, May 2020)	-	✓	✓	-	-	-
Ottawa	Low Impact Development Technical Guidance Report (Aquafor Beech Limited & Dillon Consulting, February 2021)	-	-	✓	-	✓	✓
Barrie	Infiltration Low Impact Development Screening Process (May 2017)	-	-	✓	-	✓	-

Through review of the available guidance across the province, there are several key resources which can be used to inform the design and implementation of LID BMPs.

Generally, it can be seen that the guidance produced by the MECP and the local Conservation Authorities (TRCA/CVC, STEP) provide the most robust inventory of design guidance for LID BMPs. These include specific design requirements for each individual LID BMP, as well as analytical techniques identifying the necessary design calculations (i.e., spreadsheet assessments), as well as the most recent hydrologic modelling guidance produced by the MECP in the 2022 Draft Manual. Implementation requirements and barriers / constraints for certain LID BMPs are well documented as part of these guidelines, and there are various resources available with focus on operations and maintenance, monitoring and life cycle costs for LID BMPs. These represent the main information resources across the province and provide the foundation for LID BMP design and implementation.

In terms of the guidance available from the local municipalities, it was found that they often back reference the key resources produced by the province / local CAs as the main source for details associated with the design requirements for each LID BMP, but they also offer unique perspectives for allowances and requirements specific to their municipality. These include identifying minimum capture requirements (ref. Section 3.5.1), zoning limitations for certain LID BMPs, infiltration restrictions, approved short-lists of LID BMPs, selection / screening processes and submission requirements for review and approval by the municipality. These demonstrate how the resources developed at the provincial / regional scale can be further tailored to the conditions and sensitivities within the specific municipalities, allowing a locally focused guide for designers to make informed decisions with respect to SWM and LID BMP design.

2.2.3 Canada

From a national perspective, several municipalities across the country have been selected for review including Calgary, Vancouver, Halifax, and Edmonton, representing the variability in LID design and implementation guidance available throughout the neighboring provinces. The findings from the national review of LID guidance is summarized in **Table 2-3**.

Table 2-3: Available LID Guidance for Engineering Design in Canada

City	Source	Analytical Techniques	Design Practices	Implementation Requirements	Lifecycle Costs including Maintenance	Barriers	Monitoring
Calgary	Stormwater Management & Design Manual (City of Calgary, 2011)	✓	✓	✓	-	✓	-
	Stormwater Source Control Practices Handbook (City of Calgary, 2007)	-	✓	✓	✓	✓	-
Vancouver	The Citywide Integrated Stormwater Management Plan – Volume 2, Best Practice Toolkit (City of Vancouver, 2016)	-	✓	✓	✓	-	-
	Stormwater Source Control Design Guidelines (2012)	✓	✓	✓	✓	✓	✓
Halifax	Stormwater Management Standards for Development Activities (July 2020)	-	✓	✓	-	-	-
Edmonton	Low Impact Development Best Management Practices Design Guide (City of Edmonton, December 2014)	✓	✓	✓	✓	✓	✓

Through review of LID BMP guidelines available across other provinces, it can be seen that some municipal guidance documents provide more details with respect to the allowable LID BMP practices, their design considerations and analytical techniques, and ultimate maintenance / monitoring requirements. Some of the guidelines reviewed had detailed fact sheets and step by step guides for design for each individual LID BMP practice as well as the minimum retention criteria that they should be designed to. It should be noted that not all provinces in Canada have an equivalent to the Conservation Authorities as we have in Ontario. Therefore, some of these major municipalities in other provinces have become the primary resource for LID BMP design

within their respective province and must therefore have sufficient levels of detail. These resources can be used in conjunction with the resources available in Ontario to strengthen the guidance available for LID BMP design across Canada.

2.2.4 Global

The integration of LID practices is rapidly growing in Canada, but other jurisdictions abroad have a variety of established guidance material related to the design, implementation and ongoing maintenance and monitoring requirements of LID practices. A range of guidance material has been reviewed from government agencies across the United States of America, as well as select locations internationally, to provide additional perspectives to guiding innovation SWM opportunities and integration of LID practices. The findings of the documentation reviewed as part of this international best practices exercise is summarized in **Table 2-4**.

Table 2-4: Available LID Guidance for Engineering Design Globally

City	Source	Analytical Techniques	Design Practices	Implementation Requirements	Lifecycle Costs including Maintenance	Barriers	Monitoring
New York, New York	New York City Stormwater Design Manual (2022)	-	✓	✓	✓	-	-
Portland, Oregon	Stormwater Management Manual (2020)	✓	✓	✓	-	✓	-
Los Angeles, California	LID BMP Design Guide (2014)	✓	✓	✓	-	✓	-
Minnesota, USA	Minnesota Stormwater Manual Wiki (2023)	✓	✓	✓	-	-	-
Nashville, Tennessee	Stormwater Management Manual – LID (2021)	✓	✓	✓	✓	✓	-
Topeka, Kansas	Stormwater Design Handbook (2023)	-	✓	✓	-	✓	✓
Boulder, Colorado	Owners LID Post Construction Maintenance Guide (2020)	-	-	✓	✓	-	✓
Mobile, Alabama	LID Handbook for the State of Alabama (2007)	-	✓	✓	-	✓	-

City	Source	Analytical Techniques	Design Practices	Implementation Requirements	Lifecycle Costs including Maintenance	Barriers	Monitoring
Augusta, Georgia	Stormwater Design Manual (2020)	✓	✓	✓	✓	✓	✓
Singapore	Managing Urban Runoff Drainage Handbook (2013)	-	✓	✓		✓	✓
Queensland, Australia	Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands (2010)	-	✓	-	-	✓	-

Through this review of international resources, it has been found that several government agencies have robust LID Guidance material, including but not limited to:

- Details regarding permitting / City review processes
- Flow charts / guidance related to applicable SWM criteria and how proponents can determine their respective site requirements
- Description and check-list of hierarchical approach required for SWM
- Long-list of SWM practices and LID BMPs for review and screening
- Detailed screening processes for the selection and implementation of LID BMPs
- Fact sheets, design templates, CAD standards, etc. for each respective LID BMP
- Operations, Maintenance and Monitoring guidebooks for each respective LID BMP, and information related to compliance reporting
- Life cycle costing and activity details to be implemented under private ownership
- Live websites (i.e., Wiki) to provides updates to latest information

These can be referenced as key resources and best practices as part of future LID guidance material within Canada to generate more robust guidance material for future design, implementation and life cycle planning for LID BMPs as part of the treatment train process.

2.2.5 On-Site Retention Criteria

A wide variety of existing guidance documentation has been reviewed as part of this jurisdictional scan of best practices across the SWM industry. This has included a range in perspectives and requirements depending upon the scale of guidance, being either local / provincial, as well as where the guiding authority is located (across Canada or internationally). In addition to the elements of LID BMP design highlighted in the previous sections, a summary has been prepared identifying any jurisdictions which have minimum on-site retention criteria requirements, and any other important considerations as part of their guidance material. This has been summarized in the following **Table 2-5**.

Table 2-5: Minimum On-Site Retention Criteria Summary

Municipality	Minimum Retention Criteria	Other Details
Burlington, ON	5 mm	— Gives precedence to Subwaterhsed Studies (SWS), Master Drainage Plans (MDP), or other local study. — Encourages full retention of the 90th Percentile.
Mississauga, ON	5 mm	— States this as the minimum, and identifies that SWS, MDP or other local studies may have a higher minimum requirement. — Recommendations provided for single-family dwellings which are exempt from the minimum requirement by listing on-lot BMPs to achieve improvements.
Kitchener, ON	12.5 mm	— IDF (Intensity-Duration-Frequency) parameters published for the 12.5- and 25-mm storms for modelling. — Has a Cash-in-Lieu program for any remaining control requirements remaining after the maximum extent possible.
Toronto, ON	5 – 25 mm	— Three (3) tiered stormwater retention and reuse requirement ranging in the minimum capture and green infrastructure / LID BMP implementation. — Hierarchical approach of source control, conveyance control and end-of-pipe control.

Municipality	Minimum Retention Criteria	Other Details
		— Cash-in-lieu / exemption memorandum is required if the minimum cannot be met.
Niagara Region, ON	5 mm	— Gives precedence to SWS, MDP, or other local study. — Encourages full retention of the 90th Percentile.
Barrie, ON	5 mm	— Tiered retention / water balance requirement based upon site size. Sites > 5 ha, post-to-pre infiltration on-site where soils permit, whereas sites < 5 ha should minimize impacts and provide minimum 5 mm.
Halifax, NS	10 mm	— Coupled with a runoff volume control target of matching post to pre for the 5-year storm runoff volumes. — Hierarchical approach of source control, conveyance control and end of pipe control promoted.
Vancouver, BC	48 mm	— Managing 90% of Vancouver's average annual rainfall volume through this minimum design standard. Goal of application across 40% of Vancouver's Impervious areas by 2050.
Calgary, AB	40 – 90 mm	— Net-zero increases in runoff volume, with a tiered City-Wide minimum runoff volume control target applied, depending upon subwatershed system and type of development.
Montreal, QB	10 – 50 mm	— Varying scale of retention volume dependent upon site location (ultimate drainage system – release rates) and the site imperviousness. — Online mapping / submission requirements clearly identified.
Nashville, TN	1 inch (25.4 mm)	— Where full retention cannot be provided, water quality filtration of the equivalent storm / 80% TSS removal is required. — Also applies to residential infill developments based upon a threshold increase in impervious area.

Municipality	Minimum Retention Criteria	Other Details
Atlanta, GA	1 inch (25.4 mm)	— Water quality requirements include treating the first 1.0” of runoff with green infrastructure, and holding the first 1.0” of rainfall runoff volume on-site
Portland, OR	10-year storm	— Hierarchical approach with the most preferred option being total on-site infiltration of the 10-year storm using vegetated infiltration facilities; alternative criteria presented depending upon constraints.

As demonstrated through this review, there are several municipalities which implement minimum retention criteria, with the lowest capture depth being 5 mm, and the highest being upwards 90 mm / design storm retention. In Ontario, the minimum retention criteria range between 5 mm to 25 mm, and often references are made to prioritizing the 90th percentile rainfall depths consistent with MECP’s latest guidance. Across Canada the retention criteria are found to be higher, ranging from 10 mm up to 90 mm, which is largely dependent upon the climate conditions within the region. In the US, the guidance is found to be capture and retain the first 1 inch of rainfall, which would be equivalent to approx. 25 mm, similar to the latest guidance in Ontario, as well as some locations requiring higher levels of on-site control up to a 10-year storm.

In addition to the minimum retention criteria, it was found that several of the guidance documents also encourage a hierarchical approach to SWM design, where the first priority is on-site control via LID BMPs, followed by conveyance controls, and lastly conventional end of pipe controls. Some guidelines even identified that priority should be given to vegetated LID BMPs, emphasizing the preference for surface-based on-site controls. This demonstrates the shift across the industry to prioritizing on-site controls as part of the treatment train process for SWM.

3 HAMILTON TODAY

3.1 State of Hamilton Watersheds

3.1.1 General Overview

The City of Hamilton is home to a unique set of environmental features, including fifteen (15) systems and several receiving water bodies. The watershed systems are a mixture of urban and rural land uses with many containing provincially significant wetlands, environmentally significant areas, and areas of natural and scientific interest.

The City of Hamilton completed its Stormwater Master Plan (SWMP) in 2007 (City of Hamilton Stormwater Master Plan – Class Environmental Assessment Report (City-Wide), Aquafor Beech Limited, May 2007), and is currently working on an updated study which will help to refine the infrastructure recommendations within the urban boundary limits of the City of Hamilton. As part of the 2007 SWMP, an assessment of watersheds, creeks and receiving bodies of water was completed which included consideration of existing environmental conditions or environmental impacts. The general outcomes of this study are noted below:

- Characterization and assessment of the existing conditions across the various watershed systems using both hydrologic / hydraulic modelling, as well as a City-wide water balance / water quality mass balance model.
- Assessment of five (5) different SWM scenarios to identify a preferred City-wide SWM strategy to mitigate growth impacts across the City.
- The ultimate preferred SWM strategy included implementing source controls, conveyance controls, existing SWMF retrofits, stream restoration projects, storm sewer infrastructure upgrades and a rural stewardship program.

An overview of the watershed systems across the City is provided in Table 3-1 below, and are shown visually on Figure 3-1 as available from the City of Hamilton Stormwater Master Plan (ref. Aquafor Beech, 2007).

Table 3-1: Hamilton Watersheds (adapted from 2007 SWMP)

Watershed	Receiving Waterbody	Watershed Area (ha)	Total Coverage (%)
Big Creek	Grand River	12 473	10%
Borer's Creek	Hamilton Harbour	2 092	2%
Bronte Creek	Lake Ontario	8 901	7%

Watershed	Receiving Waterbody	Watershed Area (ha)	Total Coverage (%)
Central Business	Hamilton Harbour	3 132	3%
Chedoke Creek	Hamilton Harbour	2 658	2%
Community of Stoney Creek Watercourses	Lake Ontario	3 491	3%
Fairchild Creek	Grand River	17 421	14%
Forty Mile Creek	Lake Ontario	1 986	2%
Grindstone Creek	Hamilton Harbour	1 088	1%
Red Hill Creek	Hamilton Harbour	6 912	6%
Spencer Creek	Hamilton Harbour	36 249	29%
Stoney Creek	Lake Ontario	3 079	2%
Sulphur Creek	Hamilton Harbour	4 128	3%
Twenty Mile Creek	Lake Ontario	10 985	9%
Welland River	Niagara River	10 534	8%
TOTAL	-	125 129	-

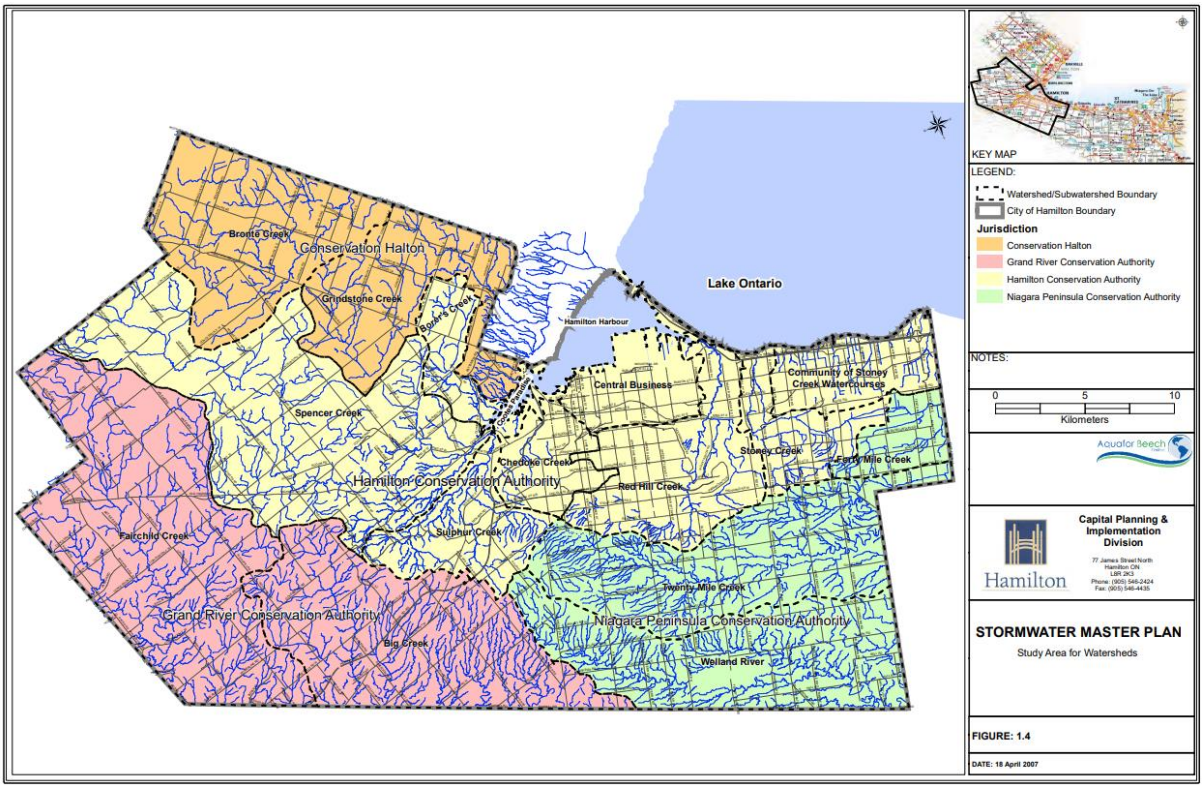


Figure 3-1: Watersheds within the City of Hamilton (ref. Aquafor Beech, 2007)

Watershed systems are often unique in their land cover, hydrologic and ecologic functions, and environmental sensitivity. This is often why SWM criteria may range depending upon which watershed system or ultimate receiver may be impacted. As such, it's important to acknowledge the localized needs for each watershed system, which are often identified as part of preceding studies such as a SWMP or local Subwatershed Studies (SWS). As part of these studies, further details are often provided in terms of potential impacts / risks to the local environmental systems, and localized management strategies are often identified which are required to be implemented at further study stages. A review of applicable SWM criteria from existing studies across the watershed systems within the City has been completed to provide a high-level overview of the trends and requirements for SWM as established through these preceding studies. Further detail is provided in Section 4.2.

3.1.2 Combined and Separate Sewer Systems

Sewer systems are comprised of two separate sewer pipes, with sewage traveling via a sanitary sewer to a wastewater treatment plant, and stormwater traveling via a storm sewer outletting directly into the environment. In Hamilton's historical downtown area and on the north of Mohawk Road, wastewater and stormwater are collected by a combined sewer system flowing to a wastewater treatment plant as separate sewer systems were not yet developed at the time (ref. Figure 3-2).

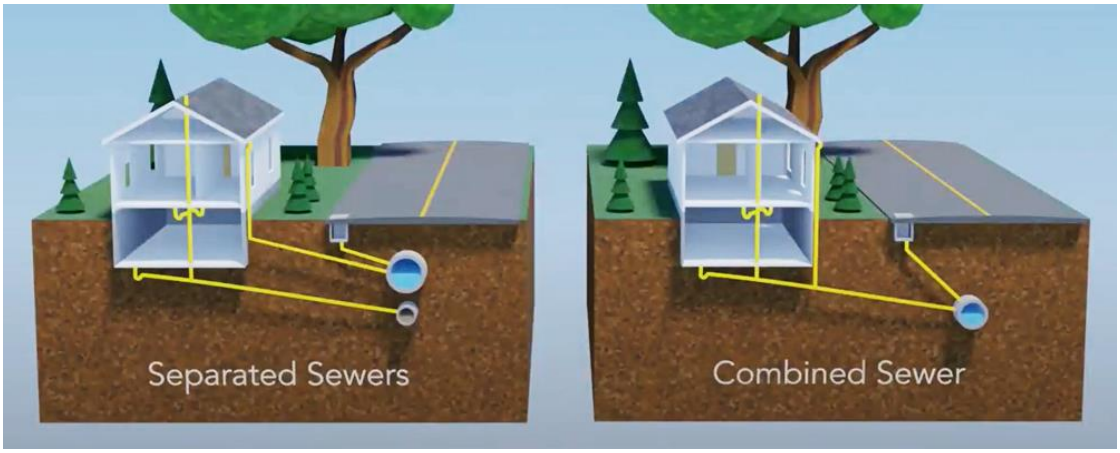


Figure 3-2: Separated and Combined Sewers (ref. Hamilton, 2023)

During precipitation events, the high volume of stormwater runoff contributing to a combined sewer system may exceed the combined sewer system's capacity and overflow into the environment. To mitigate these occurrences, a total of nine (9) combined sewer overflow tanks have been implemented by the City which hold more then 314,000 cubic meters of diluted wastewater provide additional capacity to the

combined sewer system and prevents overflow into Hamilton harbor and flooding (ref. Hamilton, 2023).

A map demonstrating the combined sewer overflow wastewater catchment areas is shown in Figure 3-3. Generally, these areas are concentrated within the downtown core of the Hamilton area, north of Lincoln M Alexander, and west of the Red Hill Valley Parkway.

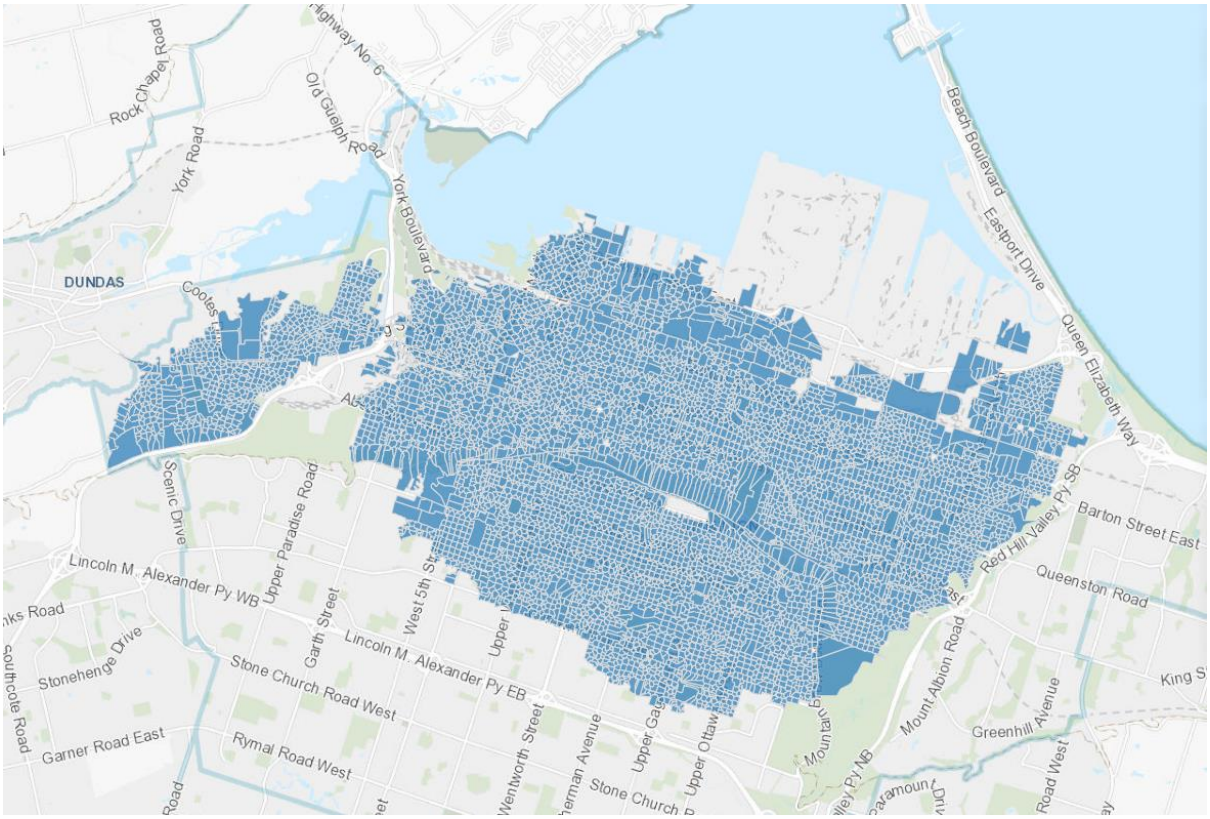


Figure 3-3: Combined Sewer Overflow Wastewater Catchment Areas (ref. Open Hamilton, 2022)

Areas contributing to a combined sewer system would have different sensitivities and risks associated with changes in land cover as a result of development. As such, the City requires that any new / retrofit development contributing to a combined sewer system consult with City staff to confirm any constraints or additional on-site control requirements.

3.2 Applicable Stormwater Management Criteria

3.2.1 Current Watershed-Based Criteria

The City of Hamilton operates under the jurisdiction of four Conservation Authorities (CA's), namely the Hamilton Conservation Authority (HCA), Niagara Peninsula Conservation Authority (NPCA), Conservation Halton (CH), and Grand River Conservation Authority (GRCA). These authoritative bodies play a crucial role in managing and preserving the region's natural resources, ensuring the sustainable development and protection of its environment. Additionally, the City adheres to the stormwater management criteria established by these authorities. By collaborating with these Conservation Authorities and adhering to their guidelines, the City of Hamilton demonstrates its commitment to environmental stewardship and sustainable development within its jurisdiction.

A comprehensive review of various documents has been conducted to gather relevant background information and Stormwater Management (SWM) criteria prevalent across the City. These documents included Watershed Management Plans, Subwatershed Studies, as well as Class Environmental Assessments and Master Drainage Plans. This background review has allowed for a comprehensive understanding of the context and relevant SWM criteria being established and implemented across the City, largely focusing on flood control, erosion control, water budget, and water quality.

3.2.1.1 Hamilton Region Conservation Authority

Hamilton Conservation Authority (HCA) comprises of seven (7) major watershed systems (Spencer Creek, Borer’s Creek, Chedoke Creek, Red Hill Creek, Stoney/Battlefield Creek, Stoney Creek numbered watercourses, and Urban Hamilton) whose creeks ultimately flow to Lake Ontario. Figure 3-4 shows the boundaries of the major watersheds and subwatersheds within the HCA boundary.

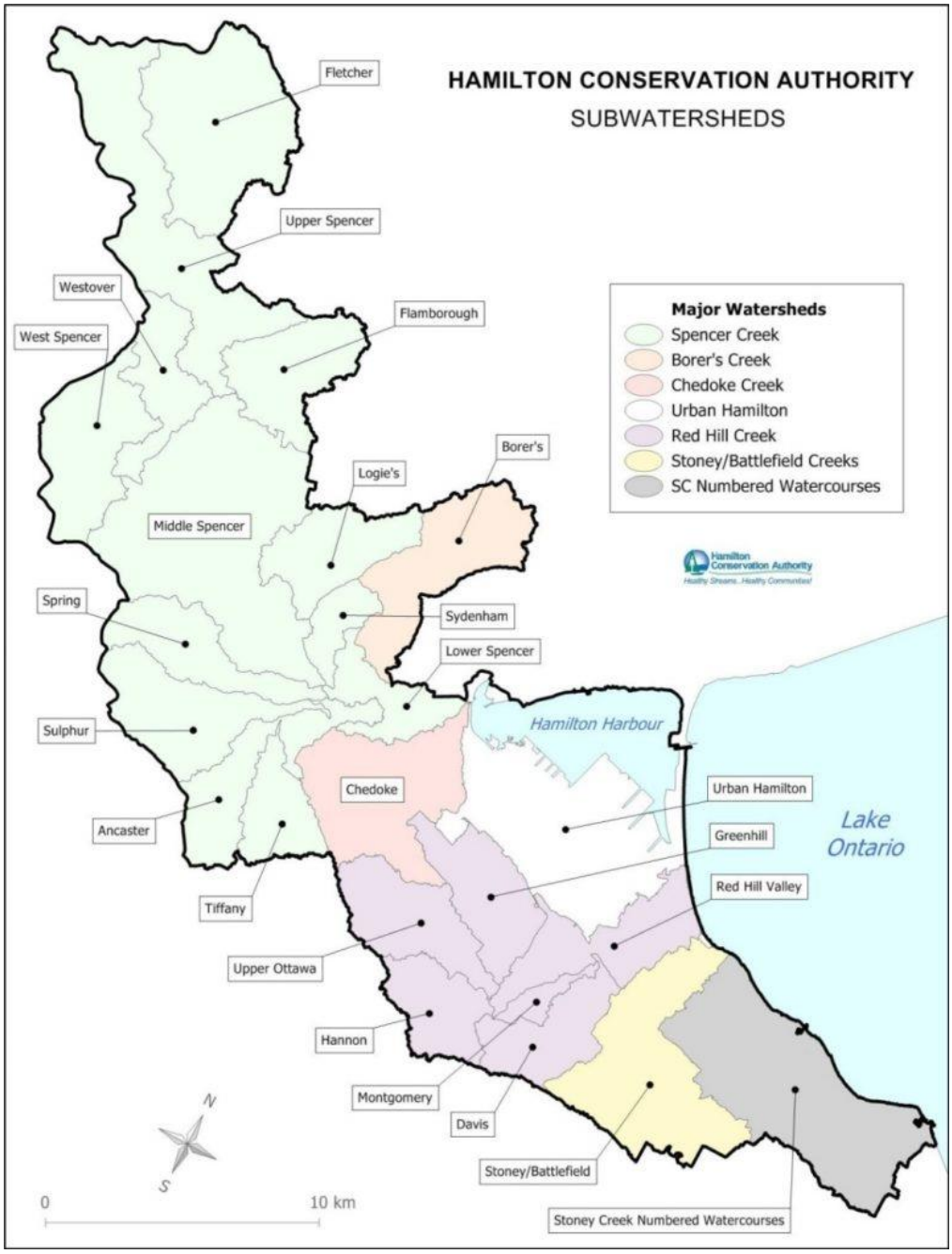


Figure 3-4: Hamilton Conservation Authority Watersheds

Various reports have been reviewed for the watershed systems within the HCA jurisdiction, and from this review a total of thirteen (13) reports were found to have information regarding SWM criteria; these included applicable studies for the Spencer Creek, Borer's Creek, and Chedoke, and Stoney/Battlefield Creek, Urban Hamilton, and Red Hill Creek watershed systems. Table 3-2 summarises the number of reports reviewed and its respective type for each watershed.

Table 3-2: Type and Number of Studies Reviewed within HCA Jurisdiction

Watersheds	No. of Studies	Type of Study	Quantity
Spencer Creek	1	Subwatershed Study	1
Borer's Creek	1	Master Drainage Plan	1
Chedoke Creek	1	Remediation Mitigation Workplan	1
Urban Hamilton	2	SWM Master Plan	1
		Shoreline and breakwater improvements Class EA	1
Red Hill Creek	5	Subwatershed Study	1
		Watershed Plan	2
		Class EA	1
		MDP / Class EA	1
Stoney / Battlefield Creek	1	Class EA	1
Stoney Creek Numbered Watercourses	2	SWM Master Plan	1
		Secondary Plan	1
TOTAL			13

After reviewing the selected reports, it was found that Borer's Creek, Red Hill Creek, and Stoney Creek have SWM criteria for most of the four (4) types of criteria (flood control, erosion control, water balance, and water quality). For the studies completed for the Urban Watersheds and Chedoke Creek systems, limited SWM criteria was found. Spencer Creek SWM criteria was found only for the Middle Spencer subwatershed but none for the remaining 12 subwatersheds. Table 3-3 provides a summary of the SWM criteria available per watershed as found in the respective studies.

Table 3-3: SWM Criteria Available per Watershed within HCA Jurisdiction

Watersheds	Subwatershed	Source	Flood Control	Erosion Control	Water Balance	Water Quality
Spencer Creek	Middle Spencer	Mid-Spencer / Greensville Rural Settlement Area Subwatershed Study (Aquafor Beech Limited, April 2016)	✓	✓	✓	-
Borer's Creek	-	Waterdown North MDP (Philips Engineering Ltd., February 2007)	✓	✓	-	✓
Chedoke Creek	-	Chedoke Creek Water Quality Improvement Framework Report (GM Blue Plan Engineering / Wood plc, April 2021)	-	-	-	✓
Urban Hamilton	-	Hamilton West Harbour Shoreline & Breakwater Class Environmental Assessment: Environmental Study Report (Dillon Consulting Limited, April 2013)	-	-	-	✓
		Stoney creek urban boundary expansion lands parcels a and b stormwater management master plan (Philips Engineering Ltd., January 2008)	-	-	-	✓
Red Hill Creek	Upper Ottawa	Mountain Brow Boulevard / Central Mountain Stormwater Management Class EA (Philips Engineering Ltd., September 2003)	-	-	-	✓

Watersheds	Subwatershed	Source	Flood Control	Erosion Control	Water Balance	Water Quality
	Hannon	Upper Hannon Creek Master Drainage Plan Municipal Class Environmental Assessment (AECOM, October 2017)	✓	✓	✓	✓
	Davis	Davis Creek Subwatershed Study (Philips Engineering Ltd., October 2006)	✓	✓	-	✓
	Red Hill Valley	Red Hill Creek Watershed Plan (Philips Planning and Engineering Limited, October 1997)	✓	-	-	✓
	Montgomery	Montgomery Creek Class EA (Philips Engineering Ltd., December 2004)	-	✓	-	✓
Stoney / Battlefield Creek	-	Stoney Creek and Battlefield Creek Flood and Erosion Control Class Environmental Assessment (Philips Engineering Ltd., November 2011)	✓	✓	-	✓

The general findings for the SWM criteria identified within the studies reviewed for the HCA jurisdiction is summarized as follows:

- **Flood Control:** stormwater runoff in post-development conditions is to be controlled to that of pre-development from 2 to 100-year events
- **Erosion Control**: Several crucial points related to stormwater management and erosion control were identified. Firstly, the implementation of erosion threshold analysis and critical discharge analysis is deemed necessary. Additionally, the Davis Creek Subwatershed Study offers valuable information regarding the extended detention volume for each stormwater management facility. It provides insights into the required detention volumes to control the flow rates of stormwater effectively. Furthermore, erosion control measures are primarily focused on preserving and sustaining the existing erosion potential.
- **Water Balance:** The objective is to prioritize the maintenance or enhance of pre-development groundwater recharge, encompassing both on-site and off-site areas. This approach ensures the preservation and enhancement of natural groundwater replenishment processes, promoting sustainable water resource management.
- **Water Quality:** The specified watersheds, including Ancaster Creek, Borer's Creek, Chedoke Creek, Red Hill Creek, Spencer Creek, and Tiffany Creek, require an enhanced Level 1 of water quality treatment, targeting an 80% total suspended solids (TSS) removal. Whereas Battlefield Creek and Stoney Creek call for a normal level of water quality treatment, aiming for a 70% TSS removal.

In addition, the HCA Planning & Regulation Policies and Guidelines (2011), provides the following SWM criteria in general (i.e., not for specific watersheds):

- **Flood** Control: Post-development to pre-development controls for 2 through 100-year events.
- **Erosion Control:** Not specified.
- **Water Balance:** Maintain or enhance pre-development water balance conditions.
- **Water Quality:** Water quality requirements are to be based on fisheries habitat assessments.

3.2.1.2 Niagara Peninsula Conservation Authority

The Niagara Peninsula Conservation Authority (NPCA) has sixteen (16) major watersheds within its jurisdiction. Only three (3) watershed systems, Upper Welland River, Twenty Mile Creek and Upper Forty Mile Creek, are within the City of Hamilton. The map of the NPCA watersheds is shown in Figure 3-5.

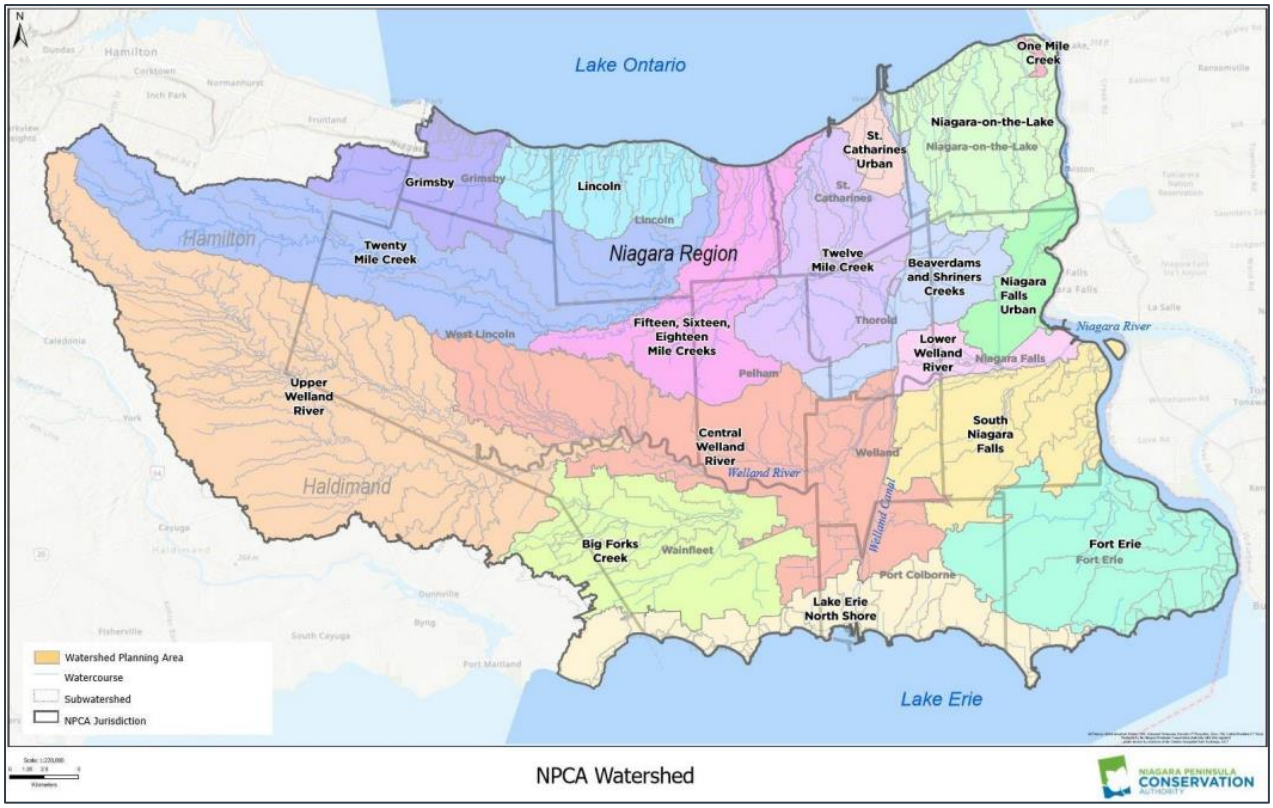


Figure 3-5: Niagara Peninsula Conservation Authority Watersheds

Two (2) studies were found to be related to SWM criteria within the Twenty-Mile Creek and Welland River watersheds, which are both Watershed Plans. Table 3-4 provides the type and number of studies reviewed.

Table 3-4: Type and Number of Studies Selected within NPCA Jurisdiction

Watersheds	No. of Studies	Type of Study	Quantity
Twenty-Mile Creek	1	Watershed Plan	1
Welland River	1	Watershed Plan	1
TOTAL			2

Both watershed plans provide a characterization of the watershed systems, and primarily focus on the ecological aspects of watershed management. There is limited direction available for SWM criteria and is rather focused on general recommendations regarding best management practices to be applied across the watershed systems. In the Twenty-Mile Creek Watershed Plan the water quality criteria were found to be specific to the respective watershed system, which recommended a suspended sediment concentrations below 25 mg/L when and where possible. Whereas the Upper Welland River Watershed Plan also provided some guidance with respect to water balance criteria, as a result of the Tier 1 Water Budget and Water Quantity Stress Assessment which was completed for all of the

NPCA jurisdiction in 2010. Table 3-5 provides a summary of the SWM criteria available for the two watersheds.

Table 3-5: SWM Criteria Available per Watershed within NPCA Jurisdiction

Watersheds	Source	Flood Control	Erosion Control	Water Balance	Water Quality
Twenty-Mile Creek	Twenty Mile Creek Watershed Plan (NPCA, 2006)	-	-	-	✓
Welland River	Upper Welland River Watershed Plan (NPCA, 2011)	-	-	✓	✓

In addition to the applicable Watershed Plans, the NPCA Stormwater Management Guidelines (2010) provides the following SWM criteria in general (i.e., not for specific watersheds):

- **Flood Control:** Post-development to pre-development controls for 2 through 100-year events.
- **Erosion Control:** 4-hour Chicago design storm over 24-hour extended detention and drawdown of the 25 mm event.
- **Water Balance:** Replicate or maintain pre-development infiltration volumes, during and post-development, in order to maintain groundwater recharge.
- **Water Quality:** Enhanced Level 1 of water quality treatment (80% TSS Removal) on all watercourses containing Type 1 – critical fish habitat. Normal water quality treatment (70% TSS Removal) for all SWM facilities

3.2.1.3 Grand River Conservation Authority

The Grand River Conservation Authority (GRCA) has eight (8) major watersheds within its jurisdiction. These include Fairchild Creek, Southern Grand River, Upper Grand River, Conestogo, Speed-Eramosa River, Central Grand River, Nith River, Southern Grand River, Whitemans Creek. Of the various systems, only the Fairchild Creek and Southern Grand River watersheds are within the City of Hamilton boundary.

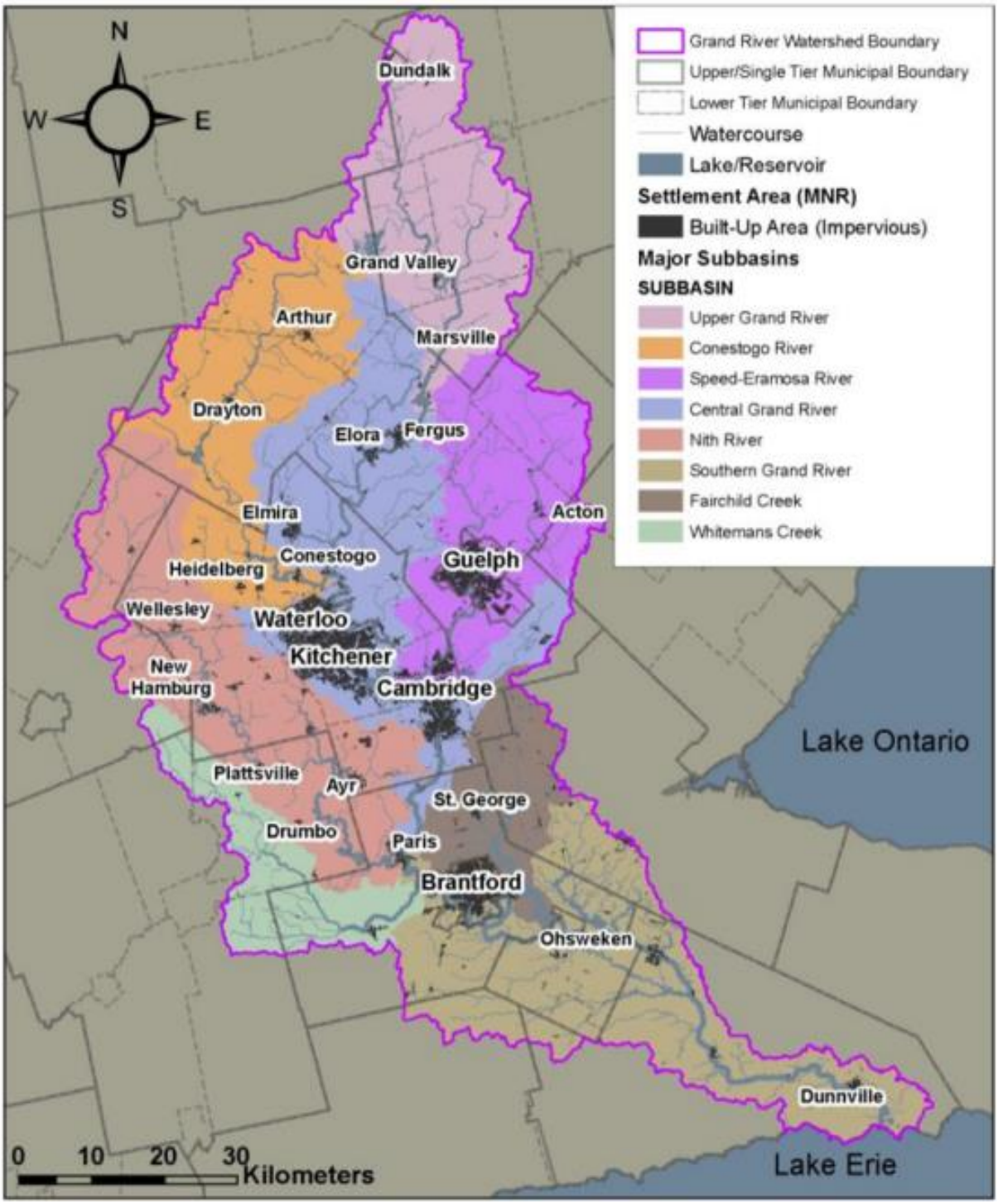


Figure 3-6: Grand River Conservation Authority Watersheds

Two (2) reports have been reviewed for these systems within the GRCA jurisdiction; they include a general water management plan for both watersheds and a subwatershed characterization study for Fairchild Creek Watershed. Table 3-6 provides the type and number of studies selected.

Table 3-6: Type and Number of Studies Selected within GRCA Jurisdiction

Watersheds	No. of Studies	Type of Study	Quantity
Fairchild Creek	1	Subwatershed Characterization Study	1
Southern Grand River	1	Water Management Plan	1
TOTAL			2

From the studies reviewed, it was generally found that these watershed plans are largely high level and do not reflect specific SWM criteria on a watershed scale. These studies primarily discuss overarching management strategies for the watershed / subwatershed system and discuss initiatives to be implemented by the GRCA to protect the systems within their jurisdiction. Unlike other CAs in Ontario, GRCA does not have a SWM Guideline which outlines specific requirements for SWM; as such, applicable criteria are often referred to the applicable municipal guideline when completing development application reviews for permit applications within their jurisdiction.

Table 3-7: SWM Criteria Available per Watershed within GRCA Jurisdiction

Watersheds	Source	Flood Control	Erosion Control	Water Balance	Water Quality
Fairchild Creek	Grand River Watershed Water Management Plan (Grand River Conservation Authority, 2014)	-	-	-	-
	Fairchild Creek Subwatershed Characterization Study (Grand River Conservation Authority, September 2016)	-	-	-	-
Southern Grand River	Grand River Watershed Water Management Plan (Grand River Conservation Authority, 2014)	-	-	-	-

3.2.1.4 Conservation Halton

Conservation Halton (CH) has nine (9) major watersheds within its jurisdiction. These include Grindstone Creek, Bronte Creek, North Cootes Paradise, Burlington Urban Creeks, North Shore, Oakville East Urban Creeks, Oakville West Urban Creeks, and Sixteen Mile Creek. Of those, only four (4) watersheds are within the City of Hamilton; these include Grindstone Creek, Bronte Creek, North Cootes Paradise, and North Shore watershed systems. Figure 3-7 shows the CH major watersheds.

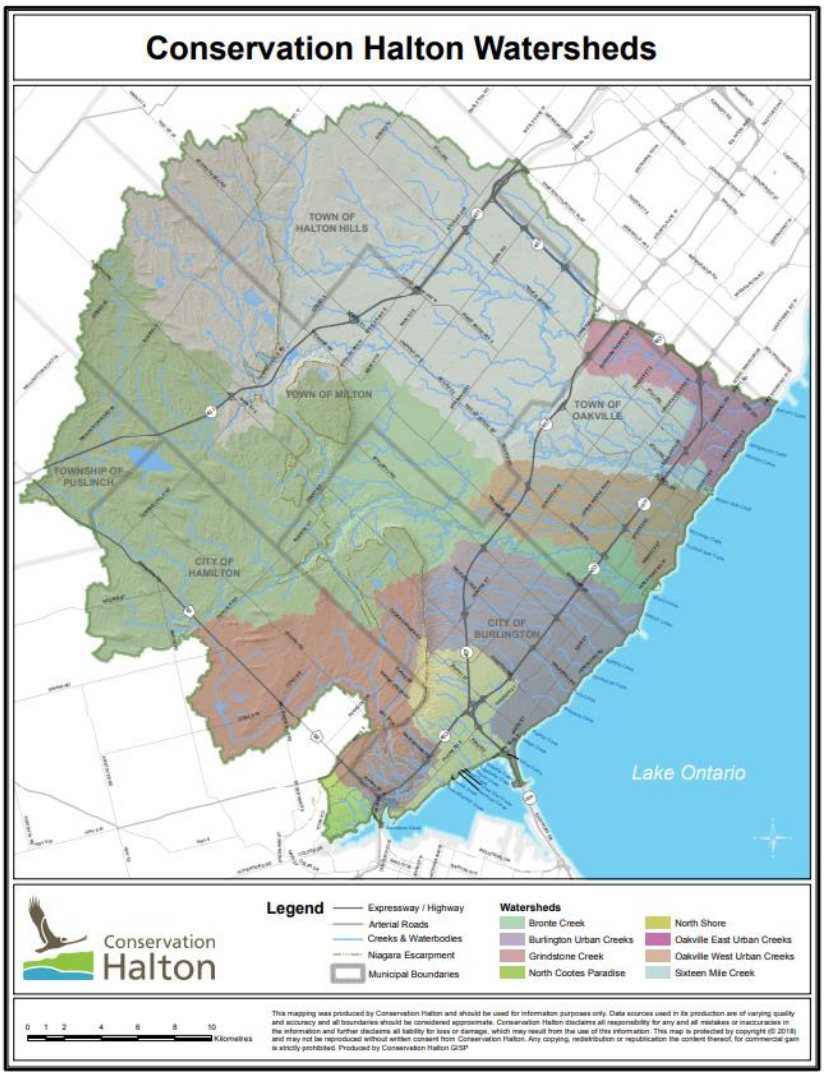


Figure 3-7: Conservation Halton Watershed

Among the four (4) major watersheds within the City, only the North Cootes Paradise watershed does not have a report associated to SWM criteria. For the remaining watersheds, subwatershed studies were available and have been reviewed accordingly. Table 3-8 provides the type and number of studies selected for each watershed.

Table 3-8: Type and Number of Studies Selected within CH Jurisdiction

Watersheds	No. of Studies	Type of Study	Quantity
Grindstone Creek	1	Subwatershed Study	1
Bronte Creek	1	Subwatershed Study	1
North Cootes Paradise	0	-	0
North Shore	1	Subwatershed Study	1
TOTAL			3

Table 3-9 provides a summary of the SWM criteria available from the reviewed studies.

Table 3-9: SWM Criteria Available per Watershed within CH Jurisdiction

Watersheds	Subwatershed	Source	Flood Control	Erosion Control	Water Balance	Water Quality
Grindstone Creek	-	Grindstone Creek Watershed Study (Conservation Halton, June 1998)	-	-	-	✓
Bronte Creek	Bronte Creek	Bronte Creek Watershed Study (Conservation Halton, March 2002)	-	-	-	✓
	Kilbride Creek		-	-	-	✓
	Mountsberg Creek		-	-	-	✓
	Strabane Creek		-	-	-	✓
North Cootes Paradise			-	-	-	-
North Shore	Hager-Rambo Creek	North Shore Watershed Study (Conservation Halton, March 2006)	-	-	-	-
	Indian Creek		-	-	-	-
	Falcon Creek		-	-	-	-
	Edgewater-Stillwater Creek		-	-	-	-
	West Aldershot		-	-	-	-

Generally, limited SWM criteria was found within the respective reports. In the Grindstone Creek and Bronte Creek watersheds, specific guidance for water quality was found in the reports, whereby in the Grindstone Creek Watershed it is recommended an enhanced water quality treatment (80% TSS removal). The Bronte Creek Watershed Study identifies two (2) vulnerable fish species, Redside Dace and Silver Shiner, which would require an enhanced level of water quality control. The North Shore Watershed Study largely focused on overarching characterization of the ecosystems and described monitoring efforts across the watershed; this study also identified visionary management strategies to be applied across the watershed, but overall lacked any specifics regarding SWM criteria.

In addition to the previous reports listed in Table 3-9, CH Guidelines for Stormwater Management Engineering Submissions (Conservation Halton, 2021) identify the following general criteria:

- **Flood Control:** Post-development to pre-development controls for 2 through 100-year events.
- **Erosion Control:** Use at least 24-hour extended detention and drawdown of the 25 mm event, where an erosion study is not required. An erosion threshold assessment will typically be required.
- **Water Balance:** Replicate or maintain pre-development infiltration volumes during and post-development.
- **Water Quality:** Enhanced Level 1 (80% TSS Removal).

3.2.2 Hamilton-Specific Criteria

In addition to the studies initiated by the local Conservation Authorities, a review of previous City of Hamilton studies has also been completed to identify the general trends and approaches to SWM implemented as part of preceding studies. This included a review of various Environmental Assessments and Environmental Study Reports, to support various infrastructure and development planning applications. Table 3-10 summarizes the numbers of studies reviewed per type of study.

Table 3-10: Type and Number of Studies Reviewed within City

Type of Study	Quantity
Municipal Class Environmental Assessment	4
Road Class EA	4
Class Environmental Assessment	3
Block Servicing Strategy	2
Environmental Project	1
Stormwater Source Control Policy	1
MDP / Class EA	1
TOTAL	**16**

There is varying application and detail with respect to applicable SWM guidance depending upon project type / purpose and completion year. Table 3-11 summarizes the studies which had referenced or applied available SWM criteria.

Table 3-11: SWM Criteria Available within City Studies

Source	Flood Control	Erosion Control	Water Balance	Water Quality	LID
Block 2 Servicing Strategy for the Fruitland – Winona Secondary Plan Lands (Aquafor Beech Ltd, September 2018)	✓	✓	✓	✓	✓
Block Servicing Strategy Fruitland Winona Secondary Plan Block 3 (Urbantech West, A Division of Leighton-Zec West Ltd., March 2020)	✓	✓	✓	✓	✓
Waterdown Road Corridor (Craven Avenue to Dundas Street) Class Environmental Assessment (Dillon Consulting Limited, April 2012)	-	-	-	✓	-
Hamilton Bus Maintenance and Storage Facility Environmental Project Report (IBI GROUP, January 2020)	✓	-	-	✓	-
Mohawk Road Class Environmental Assessment (CIMA, December 2019)	✓	-	✓	✓	-
Garner Road/Rymal Road and Garth Street Improvements Municipal Class Environmental Assessment Study (SNC Lavalin, February 2014)	✓	-	-	✓	-
New East-West Road Corridor Class Environment Assessment Environmental Study Report (Dillon Consulting Limited, April 2012)	-	-	-	✓	-
Southcote Road (Garner Road to Golf Links Road) Environmental Study	✓	-	-	-	-

Source	Flood Control	Erosion Control	Water Balance	Water Quality	LID
Report (Dillon Consulting Limited, June 2019)					
Upper Hannon Creek Master Drainage Plan Municipal Class Environmental Assessment (AEOCOM, October 2017)	✓	✓	✓	✓	✓

Of the studies that were reviewed, as well as the Comprehensive Engineering Guidelines (ref. Hamilton, 2019) which sets the general standards for SWM applications in the City, the following can be generalized as the trends for the application of SWM:

- **Flood Control:** Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events. All newly developed or redeveloped sites must examine and manage their possible consequences on local and regional floods. The City of Hamilton's policy in areas where no watershed plan has been completed is to require that runoff peak flows be controlled to pre-development levels or less, unless identified through appropriate modeling and analysis that uncontrolled flow will not have a negative impact on flood conditions on downstream properties and watercourse systems. In some areas, post-development discharge from development areas must meet the unitary flow criteria established through a Subwatershed or Master Drainage Study to ensure the conservation of any sensitive natural systems.
- **Erosion Control:** Provide an extended detention drawdown based on the erosion threshold target unit flow rates (if available). In areas with Watershed, Subwatershed or Master Drainage Plan, the developer must provide appropriate protection in accordance with them, as well as the policies of the appropriate Conservation Authorities, and possibly the Niagara Escarpment Commission. In areas where no Subwatershed Plan exists, it would be the developer's obligation to provide erosion protection in accordance with Provincial Guidelines, unless it can be proved via adequate modeling and/or study that the proposed development will not have a harmful effect on stream stability.
- **Water Balance:** Retention requirements vary between 1 to 5 mm per event depending on native soil type / minimum applied. The standards for water balance is to safeguard groundwater, baseflow, and natural features such as wetlands and woodlots.
- **Water Quality**: Enhanced (Level 1) treatment: 80% Total Suspended Solids (TSS) Removal. Similarly, the TRCA's requires all watercourses and bodies of water within its jurisdiction to have an Enhanced level of water quality protection, which is equivalent to 80% TSS removal. Water quality treatment performance

must conform to Provincial requirements (ref. Stormwater Management Planning and Design Manual, MOE-CC, 2003; Water Management Policies, Guidelines Provincial Water Quality Objectives (Blue Book), MOE-CC, 1994), City of Hamilton and Conservation Authority Requirements. Three degrees of protection are provided depending on the watershed, with the objective of maintaining or improving current aquatic habitat.

— **LID BMPs**: Indicates some implementation requirements and barriers are mentioned for different LIDs and that different geotechnical investigation activities required for some LIDs. Refers to the LID Design Guide Version 1.0 (CVC, 2010).

4 GOALS AND OBJECTIVES

4.1 Process

In the context of the GSG, “Goals” represent the aspirational outcomes established for the GSG, while “Objectives” represent the supporting actions or outcomes necessary to achieve those goals. Goals and Objectives have been developed for the Study to inform the contents of the GSG, as well as inform stormwater management within the City.

It is important that these goals align with all relevant policies and plans, as well as reflect local priorities and existing conditions. Accordingly, the following provincial, municipal and Conservation Authority guidance has been reviewed:

- Provincial
  - Provincial Policy Statement
  - Growth Plan
  - Niagara Escarpment Plan
  - Draft LID SWM Guidance Manual
- Municipal
  - Urban & Rural Official Plan
  - Hamilton Climate Change Impact Adaptation Plan
  - Comprehensive Development Guidelines and Financial Policies Manual
- Conservation Authority Documents
  - Hamilton Today review (e.g. Subwatershed Studies, Master Drainage Plans)

4.2 Development of Goals and Objectives

4.2.1 Water Quality and Water Quantity

The following section identifies relevant policies found in guidance documents related to the protection of water quality and water quantity.

SECTION	PROVINCIAL POLICY STATEMENT (2020) POLICIES
1.6.6.7	Planning for stormwater management shall; c) minimize erosion and changes in water balance, and prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure

SECTION	PROVINCIAL POLICY STATEMENT (2020) POLICIES
	f) promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development
2.2.1	Planning authorities shall protect, improve or restore the quality and quantity of water by; i) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces

SECTION	A PLACE TO GROW: GROWTH PLAN FOR THE GREATER GOLDEN HORSESHOE (2020) POLICIES
3.2.7.1	Municipalities will develop *stormwater master plans* or equivalent for serviced *settlement areas* that: a) are informed by *watershed planning* or equivalent c) characterize existing environmental conditions d) examine the cumulative environmental impacts of stormwater from existing and planned development, including an assessment of how extreme weather events will exacerbate these impacts and the identification of appropriate adaptation strategies

SECTION	NIAGARA ESCARPMENT PLAN (2017) POLICIES
1.6.8.9	Growth and development in Minor Urban Centres shall be *compatible* with and provide for: g) compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning
1.7.5.9	Growth and development in Urban Areas shall be *compatible* with and provide for: g) compliance with the targets, criteria and recommendations of applicable water, wastewater and stormwater master plans, approved watershed planning and/or subwatershed plan in land use planning
2.6.9	Development shall protect the quality and quantity of groundwater and surface water

SECTION	DRAFT LID STORMWATER MANAGEMENT GUIDANCE MANUAL (2022) POLICIES
8.2.1	There are often co-benefits of utilizing vegetation-based stormwater management facilities. They include green space for the people as well as habitat for animals, fish, insects, and other organisms. While the needs,

SECTION	DRAFT LID STORMWATER MANAGEMENT GUIDANCE MANUAL (2022) POLICIES
	views and any requirements of local community and agencies should be considered, the primary function of managing and controlling stormwater must be maintained through maintenance activities.

Goals and Objectives

1 Protect, improve or restore the quality and quantity of water

a Establish minimum capture and treatment criteria, for water balance and water quality, while supporting flood control and erosion control requirements.

i Create consistent alignment with criteria identified in existing plans (e.g. stormwater master plans, subwatershed studies, master drainage plans)

ii Define criteria for areas within Hamilton where no existing plans are in place

iii Maximize the extent of vegetation and pervious surfaces through encouraging green over grey infrastructure

b Minimize sediment and erosion during construction

c Support an integrated treatment train approach by minimizing stormwater flows and reliance on stormwater ponds, and promoting stormwater best practices including LID and GI

4.2.2 Sustainability

The following section identifies relevant policies found in guidance documents related to creating sustainable and resilient communities through LID and GI.

SECTION	A PLACE TO GROW: GROWTH PLAN FOR THE GREATER GOLDEN HORSESHOE (2020) POLICIES
3.2.1.2	Planning for new or expanded *infrastructure* will occur in an integrated manner, including evaluations of long-range scenario-based land use planning, environmental planning and financial planning, and will be supported by relevant studies and should involve: d) considering the *impacts of a changing climate*
4.2.10.2	In planning to reduce greenhouse gas emissions and address the *impacts of a changing climate*, municipalities are encouraged to: a) develop strategies to reduce greenhouse gas emissions and improve resilience through the identification of vulnerabilities to climate change, land use planning, planning for *infrastructure*, including transit and energy, *green infrastructure*, and *low impact development*, and the conservation objectives in policy 4.2.9.1

SECTION	NIAGARA ESCARPMENT PLAN (2017) POLICIES
2.12	The objective is to design and locate infrastructure so that the least possible impact occurs on the Escarpment environment and to encourage green infrastructure and low impact development, where appropriate. *3. Green infrastructure* and *low impact development* should be considered where appropriate to complement *infrastructure*

SECTION	URBAN HAMILTON OFFICIAL PLAN (2013) POLICIES
B.3.6.2	Air quality and climate change have significant direct and indirect impacts on community health, the environment, and the economy of Hamilton. Addressing climate change requires two complementary actions: mitigation (i.e., reduction) and adaptation. Several goals and policies of this Plan, both directly and indirectly contribute to the improvement of air quality and reduce greenhouse gases: f) enhancing vegetative cover g) reducing the heat island effect through the use of reflective roofs, green roofs, natural landscaping, and increasing the tree canopy
B.3.7.2	The City shall support energy efficient and environmental designed *development* through: j) water and storm water conservation / management practices such as green roofs, water recycling systems, urban storm water swales, etc. m) other environmental development standards that encourage energy efficiency and environmental design as contained in the City's approved engineering policies and standards and master planning studies, and are supported by the City's financial incentive programs

ACTION	CITY OF HAMILTON CLIMATE CHANGE IMPACT ADAPTATION PLAN (2022) POLICIES
1.3 (ID#3)	Conduct more studies or reviews to determine flooding and other risks throughout the City & develop plans (e.g. relocating sites where appropriate) to improve the resilience of infrastructure (i.e. buildings, roads, water/wastewater infrastructure, etc.) to climate-related risks from extreme weather and temperatures

Goals and Objectives

2 Create sustainable and resilient communities

a Prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure

b Site design should integrate, protect and enhance environmental features and landscapes

c Reduce greenhouse gas emissions, the heat island effect and support energy efficient and environment design through LID and GI

d Development should work towards the long-term goals of low carbon communities, net-zero communities and increased resilience to climate change, through maximizing opportunities for the use of GI and appropriate LID

4.2.3 Community Benefits

The following section identifies relevant policies found in guidance documents related to building livable, attractive, and economically prosperous communities.

Community Benefits Policies

SECTION	NIAGARA ESCARPMENT PLAN (2017) POLICIES
2.12.2	*Infrastructure* shall be sited and designed to minimize the *negative impact* on the *Escarpment environment*. Examples of such siting and design considerations include, but are not limited to the following: *e) visual impacts* from *infrastructure* should be minimized by siting, structural design, colouration and landscape planting and/or vegetation screening

SECTION	URBAN HAMILTON OFFICIAL PLAN (2013) POLICIES
B.3.3.2.8	Urban design should promote environmental sustainability by: b) integrating, protecting, and enhancing environmental features and landscapes, including existing topography, forest and vegetative cover, green spaces and corridors through building and site design c) encouraging on-site storm water management and infiltration through the use of techniques and technologies, including storm water management ponds, green roofs, and vegetated swales
B.3.3.10.8	Parking lots shall be paved with hard surfaces to reduce dust and promote improved air quality. The use of permeable pavement systems or other low impact development practices is encouraged for stormwater management, when technically possible

Goals and Objectives

3 Build livable, attractive and economically prosperous communities

a Create attractive public and private spaces

i Visual impacts from infrastructure should be minimized by siting, structural design, colouration and landscape planting and/or vegetation screening

ii Promote environmental sustainability through urban design by integrating, protecting, and enhancing environmental features and landscapes through site design

b Encourage innovative community design and technologies

4.2.4 Implementation

The following section identifies relevant policies found in plans and guidance related to the effective implementation of the GSG.

Implementation Policies

ACTION	CITY OF HAMILTON CLIMATE CHANGE IMPACT ADAPTATION PLAN (2022) POLICIES
1.1 (ID#1)	Develop requirements for the incorporation of Low Impact Development (LID) features and green infrastructure into new development and redevelopment projects, and consider watershed and landscape scales in the development of plans and objectives Supporting Actions: - Identify and prioritize green infrastructure sites as part of stormwater management planning, including a vulnerability assessment - Incorporate Green Infrastructure into asset management plans with multi-year budgets

Goals and Objectives

4 Support effective implementation of the GSG

a Identify technical considerations to support site-specific LID BMP selection (e.g., site size, site conditions, development type)

b Demonstrate design guidance / tools through case studies to support development industry application

c Provide monitoring and maintenance considerations, including guidance that supports developing a maintenance program that optimizes program resources

d Align with Provincial and Municipal policies and guidelines

i Develop requirements for the incorporation of LID and GI into new development and redevelopment projects, and consider watershed and landscape scales in the development of plans and objectives

ii Expand rain water capture (i.e. rain barrels, cisterns, etc.) as an irrigation source for more localized food production (i.e. backyard farming, urban gardens, soft landscapes, etc.)

4.3 Summary of Goals and Objectives

The following is a summary of the goals and objectives to establish a framework for the GSG, and context for future action.

Goal 1: Protect, improve or restore the quality and quantity of water

1 Establish minimum capture and treatment criteria, for water balance and water quality, while supporting flood control and erosion control.

a Create consistent alignment with criteria identified in existing plans (e.g., stormwater master plans, subwatershed studies, master drainage plans)

b Define criteria for areas within Hamilton where no existing plans are in place

c Maximize the extent of vegetation and pervious surfaces through encouraging green over grey infrastructure

2 Minimize sediment and erosion during construction

3 Support an integrated treatment train approach by minimizing stormwater flows and reliance on stormwater ponds, and promoting stormwater best practices including LID and GI

Goal 2: Create sustainable and resilient communities

1 Prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure

2 Site design should integrate, protect and enhance environmental features and landscapes

3 Reduce greenhouse gas emissions, the heat island effect and support energy efficient and environment design through LID and GI

4 Development should work towards the long-term goals of low carbon communities, net-zero communities and increased resilience to climate change, through maximizing opportunities for the use of GI and appropriate LID

Goal 3: Build livable, attractive and economically prosperous communities

1 Create attractive public and private spaces

a Visual impacts from infrastructure should be minimized by siting, structural design, colouration and landscape planting and/or vegetation screening

b Promote environmental sustainability through urban design by integrating, protecting, and enhancing environmental features and landscapes through site design

2 Encourage innovative community design and technologies

Goal 4: Support effective implementation of the GSG

1 Identify technical considerations to support site-specific LID BMP selection (e.g., site size, site conditions, development type)

2 Demonstrate design guidance / tools through case studies to support development industry application

3 Provide monitoring and maintenance considerations, including guidance that supports developing a maintenance program that optimizes program resources

4 Align with Provincial and Municipal policies and guidelines

a Develop requirements for the incorporation of LID and GI into new development and redevelopment projects, and consider watershed and landscape scales in the development of plans and objectives.

b Expand rain water capture (i.e. rain barrels, cisterns, etc.) as an irrigation source for more localized food production (i.e. backyard farming, urban gardens, soft landscapes, etc.)

5 Hamilton Retention Criteria Framework

5.1 MECP Framework

As described in the preceding sections, the MECP has released the Draft Low Impact Development Stormwater Management Guidance Manual in January 2022, and it is expected to be implemented in practice across the province. Several municipalities have already begun its implementation as the approaches described within the Draft LID SWM Guidance Manual are integrated with the new Consolidated Linear Infrastructure (CLI) ECA permission framework to replace the previous Environmental Compliance Approvals (ECA) system for low-risk municipal stormwater management projects. This demonstrates the recent shift in SWM approvals and guidance material available at the Provincial level, which are expected to be adopted and implemented at the local municipal scale.

The Draft LID SWM Guidance Manual offers flexible guidance for the implementation of a holistic treatment train approach to stormwater management in Ontario. This approach incorporates source, conveyance, and end-of-pipe controls that are tailored to meet the specific needs of local communities. By emphasizing the preservation of natural hydrology, the guidance aims to enhance the protection and sustainability of water resources as part of the development process. The document promotes a hierarchical approach to implementation, prioritizing better site design practices and pollution prevention, followed by the design and integration of SWM promoting retention/infiltration, LID filtration, and conventional practices.

The Draft LID SWM Guidance Manual provides performance guidance utilizing a Runoff Volume Control Targets (RVCT), based upon the local 90th percentile event. The 90th percentile event refers to the volume of rainfall that is not exceeded in 90% of all runoff-producing rainfall events. In other words, in 90% of rainfall events, the runoff volume will be less than that of the 90th percentile event. This metric serves as the basis for planning and designing source controls, such as LID BMPs for runoff volume control. The goal is to capture and treat the runoff from the 90th percentile event, as it has been found to be the most effective approach in maintaining the natural hydrologic cycle and managing water quality impacts.

The Draft LID SWM Guidance Manual provides the Rainfall Frequency Spectrum (RFS) across the province, which determines the local 90th percentile event for each region across the Province (ref. Figure 5-1). For the City of Hamilton, the local RVCT would be 28-29 mm, which would act as the design event for LID BMPs and water balance / water quality control.

It should also be noted that in Section 3.4 of the Draft LID SWM Guidance Manual, MECP recognizes the importance of higher-level studies, such as watershed plans, subwatershed studies, and Municipal Drainage Plans (MDPs), in providing guidance for stormwater management. The guideline states that:

"the Runoff Volume Control Target does not change water quantity control requirements related to flood control or erosion control identified through watershed, subwatershed, stormwater management / master drainage plans completed following the Municipal Class Environmental Assessment Master Planning process."

Furthermore, the Draft LID SWM Guidance Manual acknowledges that the various practices identified in the hierarchical approach may be used to fulfill the stormwater management requirements specified in these higher-level studies, beyond that of the RVCT. Further details regarding the components of the hierarchical approach to SWM and LID BMP application to achieve the RVCT are provided in the subsequent section.

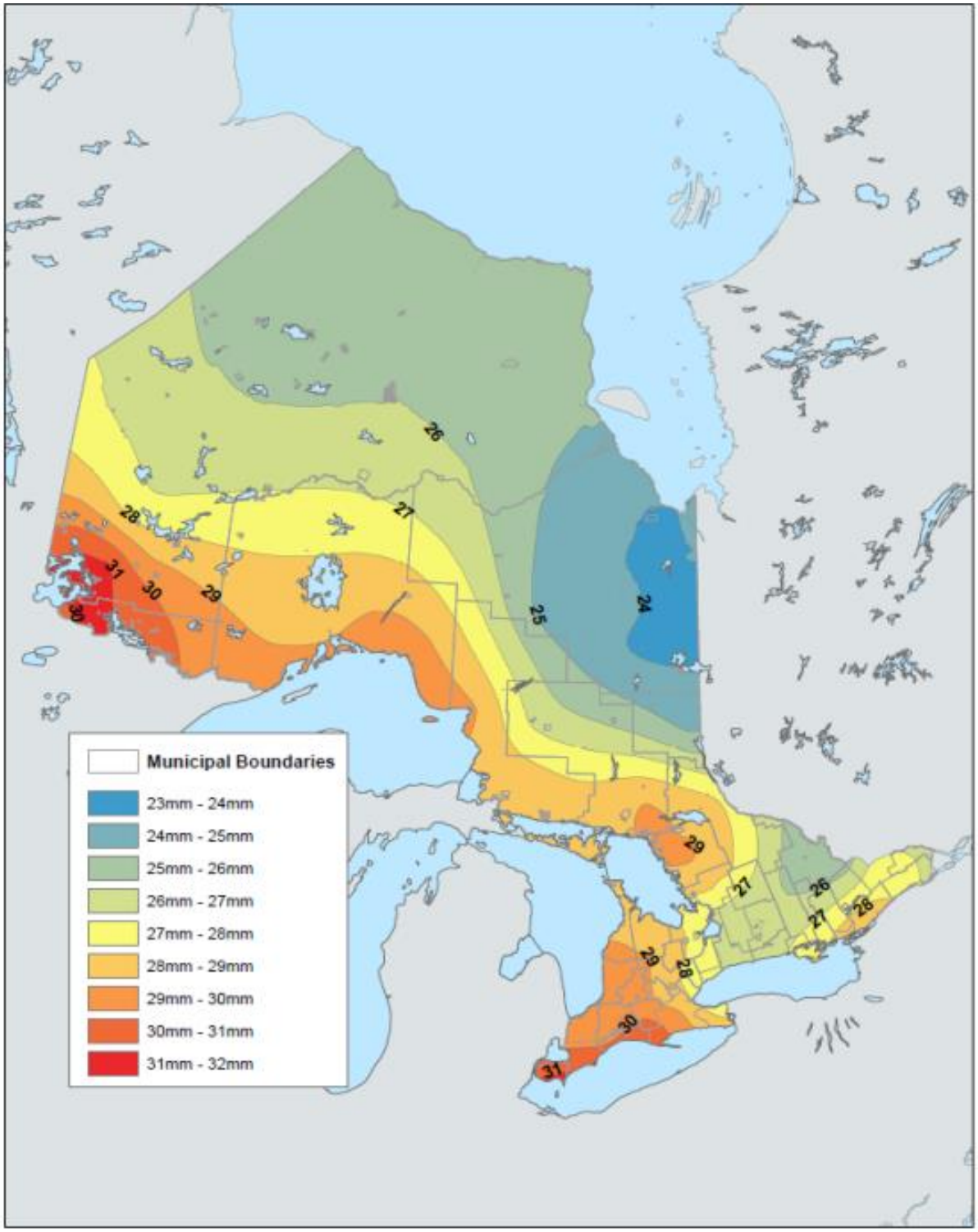


Figure 5-1: Regionally Specific 90th Percentile Precipitation Event Runoff Volume Control Target – Precipitation Isohyets (ref. MECP, 2022)

5.1.1 Hierarchal Approach

Structural LID BMPs are physical facilities designed and constructed or installed to prevent or reduce the discharge of pollutants directly or indirectly into stormwater, receiving waters, or stormwater conveyance systems, using infiltration, biofiltration, evapotranspiration, or capture and reuse. Structural LID BMPs are used to comply with a variety of stormwater management requirements. The MECP's Draft LID SWM Guidance Manual identifies the following hierarchies / priorities for achieving SWM criteria, these include:

- Better Site Design and Pollution Prevention
- Control Hierarchy Priority 1 – Retention (infiltration, evapotranspiration, re-use)
- Control Hierarchy Priority 2 – LID Filtration
- Control Hierarchy Priority 3 – Conventional Treatment (end-of-pipe treatment)

The above hierarchy promotes SWM practices which achieve water balance and water quality at the source, while maintaining flexibility in the selection and design of LID BMPs to support the overall site design based upon a range of considerations for both site constraints and design requirements. Further description of each hierarchy is provided as follows:

- **Better Site Design and Pollution Prevention:**
  - Land use practices play a crucial role in minimizing and reducing impervious cover, and several effective strategies can be implemented to achieve this objective. These strategies include preserving natural areas, implementing site reforestation efforts, adopting open space design principles, and incorporating innovative site designs that aim to decrease the extent of impervious areas. Visual impacts from infrastructure should also be minimized by siting, structural design, colouration and landscape planting and/or vegetation screening
  - Examples of innovative site designs could involve the utilization of narrower streets and slimmer sidewalks, among other approaches. Moreover, implementing best practices in land use management can effectively reduce pollutant generation and mitigate the risk of spills. By employing these measures, stakeholders can proactively manage land use to minimize impervious cover, leading to more sustainable and environmentally friendly development practices.
- **Priority 1: Retention:**
  - Implementing LID BMPs which provide onsite retention is the priority for recommended approaches to manage stormwater effectively. These practices utilize various mechanisms of retention, such as infiltration, evapotranspiration, and/or re-use to replenish shallow and/or deep

groundwater, return collected rainwater to the atmosphere, and utilize harvested rainwater. Examples of LID retention practices include bioretention systems, rain gardens, green roofs, permeable pavement, and rainwater harvesting techniques, among others.

  - Functionally, these practices aim to reduce runoff volumes from the site, contribute to stream baseflow, and preserve the existing hydrologic cycle as much as possible. Additionally, LID retention practices provide water quality benefits, including consistent pollutant control, thermal mitigation, and reduction of Combined Sewer Overflows (CSOs). By incorporating these practices, stakeholders can effectively manage stormwater, mitigate environmental impacts, and enhance the overall sustainability of the site.

- **Priority 2: LID Filtration:**
  - Implementing LID BMPs which provide physical filtration and pollution removal is an effective approach to manage stormwater quality control before site runoff is released into municipal sewer networks or surface waters. Examples of LID technologies include biofiltration systems, enhanced grassed swales, and manufactured filtration systems.
  - These practices reduce runoff volume through processes such as absorption, material wetting, and increased depression storage. However, their primary function is to treat runoff through physical filtration, thereby improving water quality.
- **Priority 3: Conventional Treatment:**
  - Conventional stormwater management practices include end-of-pipe technologies that employ filtration, hydrodynamic separation, and/or sedimentation. Examples of such practices include extended detention wet ponds, constructed wetlands, oil-grit separators, and manufactured treatment devices, among others.
  - These practices, commonly referred to as end-of-pipe facilities following the 2003 Ministry of the Environment (MOE) Guidelines, primarily focus on treating and managing runoff rather than reducing its volume. Functionally, these practices are designed to achieve water quality benefits as outlined in the 2003 MOE Guidelines, utilizing treatment processes and sedimentation mechanisms. Additionally, some of these systems also provide erosion and flood control capabilities depending upon their ultimate design.

Through the hierarchical approach, it is expected that Better Site Design practices are employed as the first stage of site plan design to ensure sustainable design choices are selected at the initiation of the site design. Following the finalization of a site plan concept, a review of opportunities for LID BMPs can be completed to support the overall SWM strategy for the site. Following the hierarchy, it is expected

that Priority 1 (Retention) LID BMPs are applied on site to the maximum extent possible, which would then be supplemented by Priority 2 (Filtration) if required, and lastly with Priority 3 (Conventional) to support any additional treatment and/or SWM criteria needs (i.e., erosion / flood control) (ref. Figure 5-2). The goal is to incorporate treatment train processes to achieve the RVCT and other governing SWM criteria, which provide flexibility in the selection and design of SWM strategies and encouraging the implementation of LID BMPs as part of standard practices.

The Draft LID SWM Guidance Manual acknowledges that certain site-specific constraints may limit the full implementation of specific source controls and practices for stormwater management. In situations where limitations, restrictions, or constraints exist, the focus should be on planning and implementing runoff volume control to the maximum extent possible (MEP) using all available and reasonable approaches. Potential constraints or limitations may include but are not limited to:

- Presence of karst or bedrock formations
- High groundwater levels
- Contaminated soils
- Prohibitions or restrictions outlined in Source Protection Plans
- Areas with high inflow/infiltration (I/I) to sanitary systems

In cases where constraints prevent the full implementation of a particular type of LID BMP, such as infiltration practices, alternative forms of LID BMPs should be considered. This may involve options like rainwater harvesting or increased filtration measures to mitigate the impacts of stormwater runoff and meet the necessary stormwater management objectives within the given constraints.

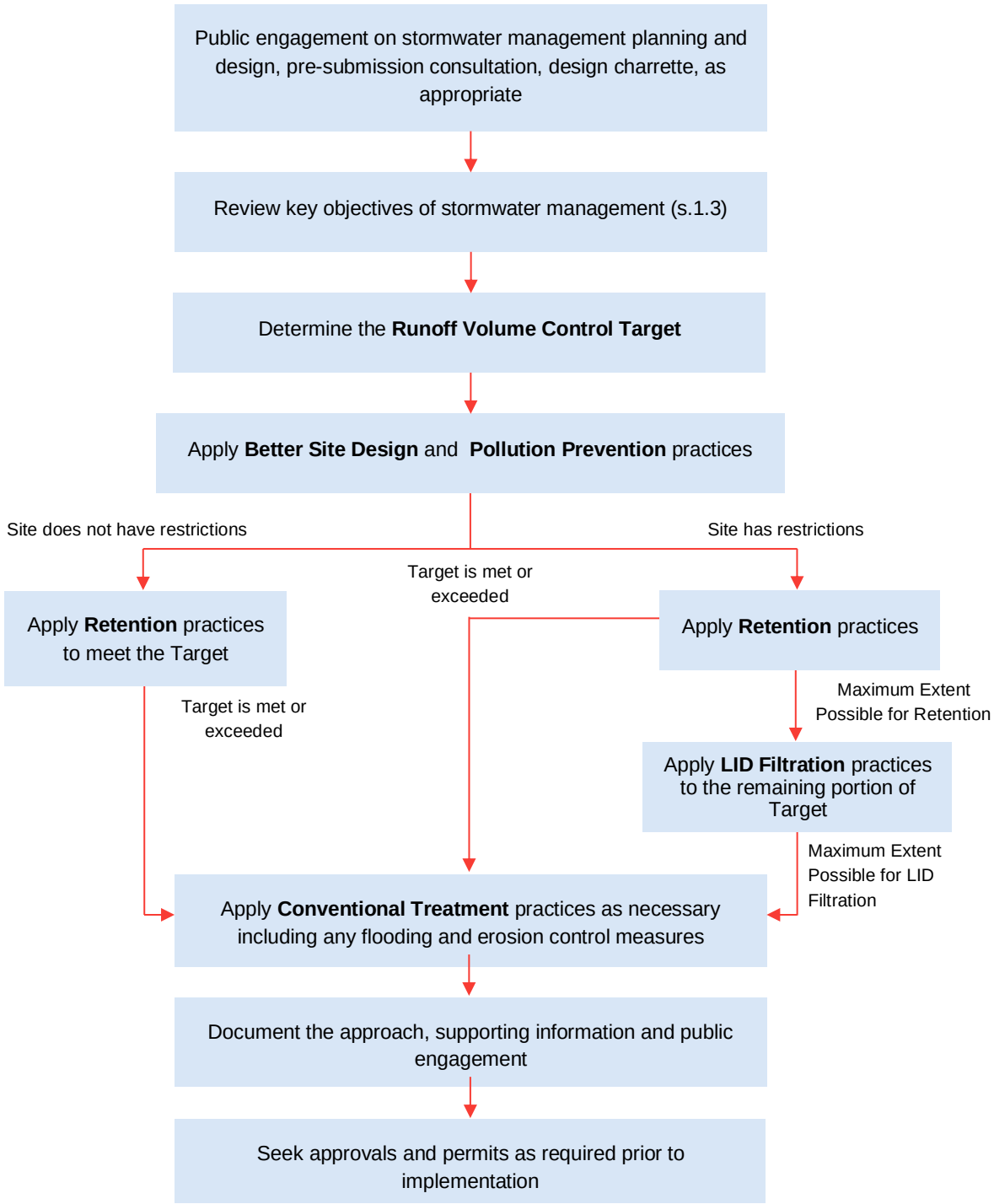


Figure 5-2: Steps for Applying the Runoff Volume Control Target Hierarchy

5.2 City Of Hamilton Specific Targets

Based on directives from Hamilton City Council and the provincial government, the City of Hamilton is committed to building “greener”. This commitment is supported by a recent letter from the Ministry of Municipal Affairs & Housing (MMAH) dated February 28th, 2023, which outlines future enhancements to the Ontario Building Code pertaining to green building standards and encourages municipalities to develop their own green standards. To support these objectives, the City is developing the GSG to articulate its vision for a sustainable, resilient, and greener community. The GSG helps to establish a set of preferred practices related to LID BMP strategies and will define criteria for the application of green practices in areas such as water quality and water balance, in accordance with provincial guidance.

The City Council has expressed its aspiration for a greener community with a reduced reliance on traditional grey infrastructure for stormwater management (SWM), by encouraging all new development to incorporate some form of "green" SWM practices. However, given the diverse nature of the lands and development forms within the City, a minimum capture concept is necessary, as not all areas can accommodate the same amount of capture.

As described in the preceding section, the MECP has established the 90th percentile Runoff Volume Control Target (RVCT) criteria across the province, which for the Hamilton area would equate to a capture of 28 to 29 mm. Currently, consistent subwatershed-specific sizing criteria are not available for most areas of the City, and there is limited general guidance in place, such as acceptable practices and over-control criteria from the Industrial, Commercial, and Institutional (ICI) Guidelines. To support providing a consistent guidance requirement for all new development across the City, the City of Hamilton is intending to establish minimum capture requirements, consistent with the approaches taken by other neighboring municipalities in southern Ontario (ref. Section 2.5.1).

In order to provide a Hamilton specific minimum capture criterion, the following elements have been considered:

- **Honouring Science-Based Targets determined as part of Local Studies**
  - In future Secondary Plans for greenfield areas, local Subwatershed Studies (SWS) will be required to determine the potential impacts and management strategies required for the proposed development. These studies will play a critical role in providing scientifically grounded targets for source controls, enabling the achievement of water quality and water balance objectives. In cases where specific local science-based targets for water quality and water balance capture are not available, the Province is advocating for a

standardized amount of capture based on its 90th percentile approach. Consequently, if the proposed development lands have undergone a formal or approved contemporary SWS assessment, the determination of the required amount and form of capture for water quality and water balance will be based on the guidance provided within the SWS documentation.

- **General Understanding of Combined and Separate Systems**
  - Hamilton has a mix of separated and combined sewer systems to capture and convey stormwater runoff. Separate systems directly drain stormwater into the environment, such as streams, wetlands, harbors, or lakes. In contrast, combined systems collect stormwater, along with sanitary effluent, and transport the water to the City's Wastewater Treatment Plant (WWTP) during non-storm periods. Combined systems are more prevalent in older parts of Hamilton, particularly in the dense coverage areas like the old downtown core (ref. Section 3.1.2).
  - As stormwater runoff in combined sewer systems is ultimately treated at the WWTP, the current requirements for capture and water quality treatment are generally lower compared to separate sewer systems that discharge directly into the environment. However, considering the City's Flooding and Drainage Implementation Framework, (2022) which plans to potentially separate combined systems in the future (within 20+ years), the warrants for capture and treatment may shift in the future to align with the criteria for separate systems.
  - It should also be noted that development pressures may be different depending on the sewer system type (age of infrastructure / neighborhood). Combined systems often experience redevelopment and infill/intensification, while separate systems can involve both redevelopment through infill/intensification as well as greenfield (new) development. Opportunities and strategies for SWM for a site may vary accordingly. Centralized and planned SWM retrofits are more commonly implemented in combined systems and those separate systems facing redevelopment pressures. Newly developing areas (greenfield) typically offer fewer constraints, providing more opportunities for implementing on-site source controls in alignment with the guidance provided by the Ministry of the Environment, Conservation and Parks (MECP).
- **Recognizing Site Size**
  - The City acknowledges that small sites often face greater constraints when it comes to effectively planning for the implementation of surface-based green infrastructure. Recognizing this, the City supports a reduced minimum target for retention on smaller sites that are below a defined threshold compared to larger sites. This approach acknowledges the challenges posed by limited

space and other site-specific limitations that may hinder the full implementation of green infrastructure practices on smaller sites. By adjusting the minimum target for retention based on site size, the City aims to strike a balance between promoting sustainable stormwater management practices and accommodating the unique constraints faced by smaller development sites.

5.2.1 Application Hierarchy

As described in Section 5.1, the Province has implemented a hierarchical approach to the development of a stormwater management strategy to achieve the RVCT, consisting of retention as the first priority, followed by filtration as the second priority, and conventional measures as the third priority. In line with this framework, the City is actively encouraging project proponents to achieve a minimum “Water Quality Retention Target” (WQRT) through on-site retention, utilizing its defined criteria for eligible "green" practices, specifically those that are surface-based and incorporate filter media. To fulfill the remaining volume of capture, proponents have the option to implement either filtration or conventional measures, as dictated by the requirements outlined in the governing Subwatershed Studies (SWS) or the Provincial guidelines based on the 90th percentile Runoff Volume Control Target (RVCT).

As such, the City proposes the implementation of a "Decision-tree" approach to establish stormwater management (SWM) criteria for green practices on new or redeveloping sites. This approach involves considering several key factors. Firstly, the determination is made whether the development is within a combined or separate drainage system. Secondly, it is assessed if the development falls under the guidance provided by an approved Subwatershed Study, and finally, the site size is evaluated to determine if it is greater or smaller than 0.5 hectares.

Based on these considerations, the minimum Water Quality Retention Target requirements are established as follows and in Table 5-1:

For developments located within combined sewersheds:

- Site size < 0.5 hectares: Minimum Water Quality Retention Target of 2.5 mm
- Site size > 0.5 hectares: Minimum Water Quality Retention Target of 5 mm

For developments located within separate sewersheds:

- Site size < 0.5 hectares: Minimum Water Quality Retention Target of 5 mm
- Site size > 0.5 hectares: Minimum Water Quality Retention Target of 10 mm

Table 5-1: Recommended Hamilton Specific Criteria

Sewershed Type (Combined or Separated)	Subwatershed Study? (Y / N)	Site Size (ha)	Minimum Water Quality Retention Target (mm)	Total Runoff Volume Control Target (RVCT)	Better Site Design	Priority 1 *Water Quality by Green Infrastructure Through Retention*	Priority 2 *LID Filtration*	Priority 3 *Conven-tional*
Combined	Y	> 0.5 ha	5 mm	Per SWS +	Yes	5 mm **	Application per SWS Guidance	
		< 0.5 ha	2.5 mm	Per SWS +	Yes	2.5 mm **		
	N	> 0.5 ha	5 mm	29 mm	Yes	5 mm **	Applicants Choice of Method to meet RVCT	
		< 0.5 ha	2.5 mm	29 mm	Yes	2.5 mm **		
Separated	Y	> 0.5 ha	10 mm	Per SWS +	Yes	10 mm *	Application per SWS Guidance	
		< 0.5 ha	5 mm	Per SWS +	Yes	5 mm *		
	N	> 0.5 ha	10 mm	29 mm	Yes	10 mm *	Applicants Choice of Method to meet RVCT	
		< 0.5 ha	5 mm	29 mm	Yes	5 mm *		

1. + If SWS RVCT did not incorporate a WQ component and is less than the Minimum WQ Capture Target, then Applicants must satisfy the WQ Minimum Capture Target.
2. Subject to Physical and Land Use Constraints.
3. ** For Combined Systems, Subsurface Retention Practices are also acceptable

By following this decision-tree approach, the City aims to provide clear and consistent guidelines for the minimum retention criteria expected to be achieved through site design applications in conjunction with the provincial total RVCT requirements, and considers the specific characteristics of the site and the drainage system in which it is located. It should be noted that these reflect the minimum capture requirements, but it is the City's expectation that if a proposed site is conducive to infiltration, then best efforts would be made by the designers to maximize the application of Priority 1 (retention practices) in accordance with MECP's RVCT approach.

Once the applicable criteria have been established, the designer is required to complete an evaluation of the various LID BMP strategies available and applicable to the respective site. Across the industry there are a wide variety of SWM practices which can be designed to achieve varying levels of source control, these can generally be grouped into the following categories:

- **Surface based** – bio-swales, rain gardens, bioretention, tree pits, etc.
- **Sub-surface based** – open bottom tanks, infiltration trenches, soakaway pits, etc.
- **Others** – green roofs, blue roofs, water reuse/cisterns, etc.

The City of Hamilton's philosophy to "greening" emphasizes the application of surface-based techniques, which include a filter media component, to achieve

minimum targets from both a water quality and retention perspective. The use of subsurface strategies is supported to meet the balance of the RVCT requirements as part of a treatment train approach, beyond the specified Water Quality Retention Target volumes.

To support the identification of recommended green practices, a list has been compiled based upon the review of the following key LID BMP resources applicable in Ontario and the Hamilton area:

- The LID Wiki (Sustainable Technologies Evaluation Program (STEP), May 2022)
- Draft Low Impact Development Stormwater Management Guidance Manual (Ministry of the Environment, Conservation and Park (MECP), January 2022)
- Input from Hamilton Specific Guidance including:
  - The Comprehensive Development Guidelines and Financial Policies Manual (2019)
  - The Innovative Stormwater Source Control Policy for ICI Land Uses (April, 2013)

These are summarized in Table 5-2, with further detail provided with respect to each type of LID BMP and the associated requirements for their respective selection and design in Section 7.

Table 5-2: Recommended Green Practices

Priority Category		LID BMP Type
Priority 1A - Retention (Surface)	Vegetated Systems	Bioretention System
		Rain Gardens
		Bioswale
		Green Roofs
		Soakaways / Infiltration Trenches with Filter Media (at Surface)
		Soil Cells & Tree Trenches
	Other	Permeable Pavement
		Compost / Soil Amendments
Priority 1B - Retention (Subsurface / Collection)		Perforated Pipes
		Rainwater Harvesting
		Blue Roofs
		Soakaways, Infiltration Trenches and Chambers (Piped)
Priority 2 - Filtration		Biofiltration
		Enhanced Grassed Swale
		Manufactured Filters
		Priority 1 (Surface) Feature with an Impermeable Liner / Underdrain
Priority 3 - Conventional		Dry Pond

Priority Category	LID BMP Type
	End-of-Pipe Wet Facility (Wet Pond/Wetland/Hybrid)
	Manufactured Treatment Devices
	Parking Lot Storage
	Rooftop Detention Storage

5.3 Case Studies

In order to support the understanding and application of the GSG criteria, a total of five (5) case studies have been developed which are based upon real-world examples using site plan applications submitted and approved within the City of Hamilton. These case studies have included a review of the proposed SWM strategy identified as part of the site plan design and provide commentary on what the requirements would be for both the City's minimum Water Quality Retention Target and the Provincial RVCT. The proposed SWM strategy is then compared against what the GSG / MECP criteria would require and offers suggested alternatives for implementing LID BMPs on-site to achieve these emerging criteria.

A total of five (5) case studies have been developed which identify the following site conditions / situations:

- Case Study #1 – Large Commercial Site in a Separated Sewershed (no SWS)
- Case Study #2 – Small Residential Site in a Separated Sewershed (no SWS)
- Case Study #3 – Large Commercial Site in a Separated Sewershed (with a SWS)
- Case Study #4 – Small Mixed-Use Site in a Combined Sewershed (no SWS)
- Case Study #5 – Large Mixed-Use Site in a Combined Sewershed (no SWS)

These are intended to demonstrate the range in options available to achieve both the City's minimum Water Quality Retention Target identified as part of the GSG, as well as the meeting the Provincial RVCT. It should be noted that this review of these existing site plan designs is not to suggest that they do not meet the necessary requirements, as they were approved prior to the development of the GSG requirements herein. These are rather to demonstrate which approaches may be considered as part of future applications, and to aid designers in the understanding the various of options available to implement innovative treatment train solutions for SWM.

The case studies are attached in **Appendix C** for further review.

5.4 Consultation Overview

Consultation was undertaken throughout the development of the GSG with parties who will be both implementing and administering the GSG, in order for the GSG to reflect Hamilton specific considerations, such as legislative requirements, environmental considerations and constructability factors.

Consultation was undertaken at the following key decision-making points:

- Project Introduction & Background Review
- Industry Scan of Best Practices
- Hamilton Today & Goals and Objectives
- Hamilton Specific Preliminary Criteria

Consultation included meetings in the form of presentations and open Q&A periods, followed by email correspondence with the following parties:

- Core City Team
- Broader City Team
- Agencies and Non-Governmental Organizations
- Development Industry

Consultation feedback is further summarized in Appendix D.

6 REVIEW OF LID BMP PRACTICES

6.1 Summary of Common LID BMPs

Low Impact Development (LID) is a stormwater management approach that seeks to minimize the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of small structural practices that mimic natural or predevelopment hydrological processes in urban development, to minimize runoff, reduce stormwater volume, and improve water quality. The sources of information of LID SWM guidelines reviewed are the following:

- Low Impact Development Stormwater Management Planning and Design Guide (Sustainable Technologies Evaluation Program (STEP), May 2022)
- Low Impact Development Stormwater Management Guidance Manual (Ministry of the Environment, Conservation and Park (MECP), January 2022)
- Stormwater Management Planning and Design Manual (Ministry of the Environment (MOE), 2003)
- Low Impact Development Best Management Practices Design Guide (City of Edmonton, December 2014)

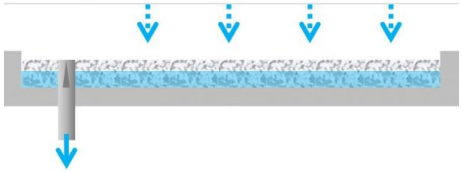
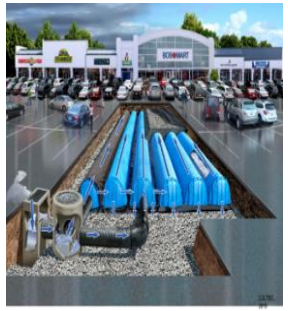
Table 6-1 provides a brief description of the most common LID practices and their respective images. This is intended to be used as a long-list of applicable practices which are to be further reviewed and screened as part of the site design process. Additional details related to the functional and land use considerations which inherently impact the selection process of the LID BMP are further described in subsequent sections.

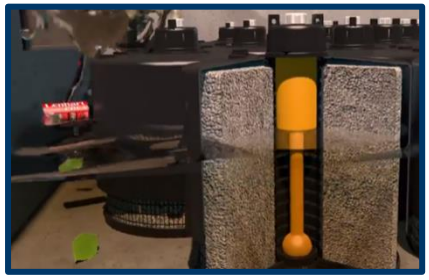
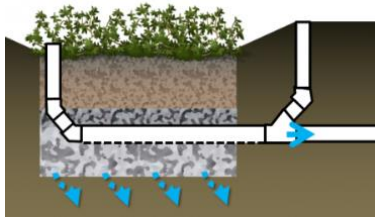
Table 6-1: Brief Description of Most Common LID Practices

Priority Category	LID BMP Type	Images	Definition / Description
Priority 1A - Retention (Surface - Vegetated)	Bioretention	 	Vegetated stormwater practices that temporarily store roof and pavement runoff in depressed planting beds or vertical-walled structures. It can be design for full infiltration, partial infiltration, or filtration only (biofilter or stormwater planter), based of native soil infiltration rate and physical constraints.
	Rain Gardens[2]		An open area landscaped feature or garden. Rain gardens are typically on of the most common LID BMP and are typically applied within park setting, parking lots, at commercial and institutional buildings as well as on residential properties
	Bioswale	 	They can be thought of as an enhanced grass sw.ale that incorporates an engineered soil (i.e., filter media or growing media) bed and optional perforated pipe underdrain or a bioretention cell configured as a linear open channel. They are open channels designed to convey, treat and attenuate stormwater runoff

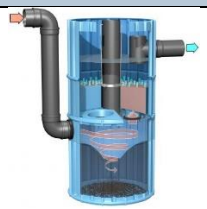
Priority Category	LID BMP Type	Images	Definition / Description
	Green Roofs	 	Layer of vegetation and planting medium installed on top of a conventional flat or sloped roof. They store temporarily rainwater in the planting medium and ponding areas. They can be used for water quality, water balance and peak flow control.
	Soakaways / Infiltration Trenches with Filter Media (at Surface)[1]		Rectangular or circular trenches lined with geotextile fabric and filled with clean granular stone or other void forming material. They typically service an individual lot and receive only roof and walkway runoff. Can be filed with uniformly graded, washed stone that provides 30 to 40% void space, or A non-woven needle punched, or woven monofilament geotextile fabric.
	Soil Cells & Tree Trenches	 	Tree BMPs can encompass several practices. **Tree trenches** are linear tree planting structures featuring supported impermeable or permeable pavements that promote healthy tree growth while also helping to manage runoff. **Tree Boxes** are similar to bioretention systems (but smaller) as they use vegetation and amended soils to filter and retain stormwater. **Tree pits** are located within the road right of way and can be designed to take runoff from the sidewalk or street.

Priority Category	LID BMP Type	Images	Definition / Description
Priority 1A - Retention (Surface - Other)	Permeable Pavement[2]	 	Permeable pavement is an alternative pavement system to conventional asphalt or concrete pavement. A permeable pavement system has pore spaces or joints that allow stormwater to pass down through the pavement layer such that surface runoff is reduced or eliminated. The stormwater then enters a stone base for infiltration into underlying native soil or is temporarily detained for flood control purposes.
	Compost / Soil Amendments[2]		Compost or soil amendments are tilled or mixed into existing soils thereby enhancing or restoring soil properties by reversing the loss of organic matter and compaction. They also are used to make Hydrologic Group C and D soils suitable for on-site stormwater BMPs such as downspout disconnection, filter strips, and grass channels, etc.
Priority 1B - Retention (Subsurface / Collection)	Perforated Pipes	 	A stormwater conveyance system that features pipe that is perforated along its length and installed in a granular bedding which allows infiltration of water into the native soil through the pipe wall as it is conveyed. They can be used in place of almost any conventional storm sewer pipes where topography, water table depth, and runoff quality conditions are suitable.

Priority Category	LID BMP Type	Images	Definition / Description
	Rainwater Harvesting	 	Is the process of intercepting, conveying and storing rainfall for future use. The rain that falls upon a catchment surface, such as a roof, is collected and conveyed into a storage facility, which can be reuse for irrigation (i.e., local food production / gardening) or other non-potable uses. It can reduce stormwater runoff volume and pollutant load and can also help reduce demand on municipal treated water supplies.
	Blue Roofs[1]		Blue roof systems temporarily capture rainwater using the roof as storage and allow it to evaporate and/or to be used for non-potable requirements (i.e. irrigation, toilet flushing, truck washing) and ultimately offset potable water demands. Any remaining water can be gradually released into the municipal stormwater system reducing peak flow rates.
	Soakaways, Infiltration Trenches and Chambers (Piped)	 	Include a range of proprietary manufactured, modular structures installed underground to create large void spaces that temporarily store and infiltrate runoff into the underlying native soil. They are well suited to sites where available land area is limited, or where it is desirable for the facility to have a minimal surface footprint.

Priority Category	LID BMP Type	Images	Definition / Description
Priority 2 - Filtration	Biofiltration		Biofiltration uses an organic filtration media with vegetation to remove pollutants. Runoff is first diverted into a sedimentation basin, where particulate pollutants are removed via gravity settling. This is followed by filtration through a 0.5m layer of vegetated media.
	Enhanced Grassed Swale[2]		Enhanced grass swales incorporate design features such as modified geometry and check dams that improve the contaminant removal and runoff reduction functions of simple grass channel and roadside ditch designs. A dry swale is a design variation that incorporates an engineered soil media bed and optional perforated pipe underdrain system.
	Manufactured Filters		Proprietary media filtration systems are available in a number of configurations and designs, but all remove pollutants from stormwater by directing the runoff flow through a bed of media. This media may be chemically inert, targeting suspended solids particles and associated particulate pollutants, or may use ion exchange or other sorption processes to remove dissolved pollutant constituents.
	Priority 1 (Surface) Feature with an Impermeable Liner / Underdrain[1]		Features with an impermeable liner/underdrain is a popular choice in areas with 'tighter' soils where infiltration rates are < 15 mm/hr. Including a perforated pipe in the reservoir aggregate layer helps to empty the facility between storm events, which is particularly useful in areas with low

Priority Category	LID BMP Type	Images	Definition / Description
			permeability soils. Facilities designed with an impermeable liner (filtration only facilities) can be used to treat runoff from pollution hot spots.
Priority 3 - Conventional	Dry Pond[1]	 	Dry ponds are a useful tool for managing flooding during larger storm events. They are well suited to being placed downstream of other smaller distributed BMPs for occasional backup flood protection. Where possible they should be integrated into amenity space, given that users rarely wish to continue outdoor activities during such intense rainstorm.
	End-of-Pipe Wet Facility (Wet Pond / Wetland / Hybrid)[4]	 	End-of-pipe stormwater management facilities receive stormwater from a conveyance system (ditches, sewers) and discharge the treated water to the receiving waters. The purpose of end-of-pipe SWMPs is to control the impacts of urbanization which remain after lot level and conveyance controls have been applied. Wet ponds are the most common end-of-pipe stormwater management facility employed in Ontario. They are less land-intensive than wetland systems and are normally reliable in operation, especially during adverse conditions.

Priority Category	LID BMP Type	Images	Definition / Description
	Manufactured Treatment Devices[5]		Manufactured treatment devices (MTDs) are end of pipe devices that specifically target the treatment and removal of large particle suspended solids and associated pollutants from stormwater runoff to achieve regulatory water quality objectives.
	Parking Lot Storage[4]		Parking lots can be used to store runoff to reduce peak flow rates in storm sewer systems. It is generally applicable to commercial and industrial lots. It has been widely applied for infill developments to mitigate the need for downstream storm sewer size increases.
	Rooftop Detention Storage[4]		Flat building roofs can be used to store runoff to reduce peak flow rates to storm sewer systems. It is generally applicable to large flat commercial and industrial rooftops. Rooftop storage is widely applied for infill development scenarios to mitigate the need for downstream storm sewer size increases.

1- Images and description obtained from the STEP LID guidelines
2- Images and description obtained from the MECP LID guidelines
3- Images and description obtained from the TRCA/CVC LID guidelines
4- Images and description obtained from the Stormwater Management Planning and Design Manual, Government of Ontario
5- Images and description obtained from the STEP Wiki and Design Criteria for Manufactured Treatment Devices, City of Toronto

6.2 Functional Considerations

Once the short-list of typical LID measures has been determined based upon the proposed project type, a further review of the functional considerations and physical site constraints of the short-listed LID measures should be completed for the preliminary site plan design to determine if the site / servicing design can support the specific design criteria of the selected LID measures. Aspects that should be considered include but are not limited to the following:

- Does the proposed drainage plan meet the maximum drainage area requirements for the selected LID BMP?
- Can the minimum head elevation be provided for functionality?
- Can the proposed servicing plan support the alignment and inlet/outlet requirements for the LID measure?
- Is there sufficient space to support the selected LID measure?

In addition to the functional site considerations noted above, there are several factors which should be considered when reviewing the specific LID BMP design constraints. These have been identified as part of the Draft LID SWM Guidance Manual (ref. MECP, 2022) and include a screening against the relative Control Hierarchy to identify which practices might have the most to least opportunity for implementation when certain constraints are prevalent on the site. These are summarized in Table 6-2 (ref. MECP, 2022).

Table 6-2: Opportunities for Implementation of LID Practice or Treatment for Different Constraints (ref. MECP, 2022)

CONTROL HIERARCHY	IMPLEMENTATION OPPORTUNITY						
	1	1	1	2	2	3	3
CONSTRAINT	**Infiltrati**	**ET**	**Re-use**	**LID Filtratio**	**Filtratio**	**Hydro-dynamic Separati**	**Sedime ntation**
• *Shallow bedrock† and Karst;*	L	M	S	S	S	S	S
• *High groundwater† or areas where increased infiltration will result in elevated groundwater levels which can be shown through an appropriate area specific study to impact critical utilities or property (e.g., susceptible to flooding);*	L	M	S	S	S	S	S

CONTROL HIERARCHY	IMPLEMENTATION OPPORTUNITY						
	1	1	1	2	2	3	3
CONSTRAINT	**Infiltrati**	**ET**	**Re-use**	**LID Filtratio**	**Filtratio**	**Hydro-dynamic Separati**	**Sedime ntation**
• *Swelling clays or unstable sub-soils;*	S	M	M	M	M	M	S
• *Contaminated soils (e.g., Brownfields);*	L	M	M	M	M	M	S
• *High Risk Site Activities including spill prone areas;*	L	M	M	M	M	M	M
• *Prohibitions and or restrictions per the approved source protection plans and where impacts to private drinking water wells and /or Vulnerable Domestic Well Supply Areas cannot be appropriately mitigated;*	L	M	M	M	M	M	M
• *Flood risk prone areas or structures and/ or areas of high inflow and infiltration (I/I) where wastewater systems (storm and sanitary) have been shown through technical studies to be sensitive to groundwater conditions that contribute to extraneous flow rates that cause property flooding / sewer back-ups and where LID BMPs have been found to be ineffective;*	S	M	M	M	M	M	M
• *For existing Linear infrastructure where reconstruction is proposed and where surface and subsurface areas are not available based on a site-specific assessment completed by a qualified person.*	S	S	-	S	S	S	L
• *For developments within partially separated wastewater systems where reconstruction is proposed and where based on a site-specific assessment completed by a qualified person can be shown to:* – *Increase private property flood risk liabilities that cannot be mitigated through design,* – *Impact pumping and treatment cost that cannot be mitigated through design,* – *Increase risks of structural collapse of sewer and ground systems due to infiltration and the loss of pipe and/or pavement support that cannot be mitigated through design,*	L	M	M	M	M	M	M
• *Surface water dominated or dependant features including but not limited to marshes and/or riparian forest wetlands which derive the all or a majority of their water from*	S	S	S	S	M	M	M

CONTROL HIERARCHY	IMPLEMENTATION OPPORTUNITY						
	1	1	1	2	2	3	3
CONSTRAINT	Infiltrati	ET	Re-use	LID Filtratio	Filtratio	Hydro-dynamic Separati	Sedime ntation
surface water, including streams, runoff, and overbank flooding. Surface water dominated or dependant features which are identified through approved site specific hydrologic or hydrogeologic studies, and/or Environmental Impact Statements (EIS) may be considered for a reduced volume control target. Pre-consultation with the MECP and local agencies is encouraged;							
• *Existing urban areas where risk to water distribution systems has been is identified and substantiated by a qualified person through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;*	S	M	M	M	M	M	M
• *Existing urban areas where risk to life, human health, property or infrastructure has been is identified and substantiated by a qualified person through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;*	S	S	S	S	S	S	S
• *Water reuse feasibility study has been completed to determine non-potable reuse of stormwater for onsite or shared use. Potable reuse of water is beyond the scope of the LID Guidance Manual but may be considered on case specific basis.*	M	M	M	M	-	-	-
M = Most Opportunity, S = Some Opportunity, L = Least Opportunity † May limit infiltration capabilities if bedrock and groundwater is within 1m of the proposed facility invert per Table 3.4.1 of the LID Stormwater Planning and Design Guide (2010, V1.0 or most recent). Detailed assessment or studies are required to demonstrate infiltration effects and results may permit relaxation of the minimum 1m offset.							

As these design considerations are reviewed in conjunction with the site plan, the selected LID BMP measures may be further screened, or the strategy may need to be refined to support the selected features and ensure the selection and proposed design meets both City and Provincial targets. Depending upon the size of the site, the physical conditions of the site may differ depending upon the proposed location of LID BMP measures. Therefore, it is the responsibility of the proponent to review and iterate

through the screening process to ensure that any potential physical restrictions to the type of LID measure are confirmed and incorporated into the preliminary design as required.

Depending upon the type of LID BMP selected, there are a range in hydrologic and environmental functions which these practices can support. Table 6-3 summarizes the ability of each LID BMP practice to perform hydrologic and SWM functions, through flood and quality control, conveyance, infiltration and groundwater recharge, evapotranspiration, and detention. These functions demonstrate the importance of implementing treatment train approaches, so that various aspects of SWM criteria and maintaining the hydrologic cycle can be satisfied using and designing a variety of practices to achieve multiple benefits.

Table 6-3: Hydrologic Function of LID Practices

Priority Category	LID BMP Type	FLOOD CONTROL	QUALITY CONTROL	CONVEYANCE	INFILTRATION/ GROUNDWATER RECHARGE	EVAPOTRANSPIRATION	THERMAL MITIGATION
Priority 1A - Retention (Surface - Vegetated)	Bioretention	-	✓	✓	✓	✓	✓
	Rain Gardens	-	✓	✓	✓	✓	✓
	Bioswale	-	✓	✓	✓	✓	✓
	Green Roofs	-	✓	-	✓	✓	✓
	Soakaways / Infiltration Trenches with Filter Media (at Surface)	-	✓	✓	✓	-	✓
	Soil Cells & Tree Trenches	-	✓	✓	✓	✓	✓
Priority 1A - Retention (Surface - Other)	Permeable Pavement	-	✓	✓	✓	-	✓
	Compost / Soil Amendments	-	✓	✓	✓	✓	✓
Priority 1B - Retention (Subsurface / Collection)	Perforated Pipes	-	✓	✓	✓	-	✓
	Rainwater Harvesting	-	-	✓	✓	-	✓
	Blue Roofs	✓	✓	✓	-	✓	✓
	Soakaways, Infiltration Trenches and Chambers (Piped)	-	✓	✓	✓	-	-
Priority 2 - Filtration	Biofiltration	-	✓	-	✓	-	-
	Enhanced Grassed Swale	-	✓	✓	✓	✓	✓
	Manufactured Filters	-	✓	-	-	-	-
	Priority 1 (Surface) Feature with an Impermeable Liner / Underdrain	-	✓	✓	-	✓	✓
Priority 3 - Conventional	Dry Pond	✓	✓	-	-	-	-
	End-of-Pipe Wet Facility	✓	✓	-	-	-	✓

Priority Category	LID BMP Type	FLOOD CONTROL	QUALITY CONTROL	CONVEYANCE	INFILTRATION/ GROUNDWATER RECHARGE	EVAPOTRANSPIRATION	THERMAL MITIGATION
	(Wet Pond/Wetland/Hybrid)						
	Manufactured Treatment Devices	-	✓	-	-	-	-
	Parking Lot Storage	✓	-	-	-	-	-
	Rooftop Detention Storage	✓	-	-	-	-	-

6.3 Land Use Considerations

The recommended approach for the implementation of infiltration type LID BMP measures for private developments are to be first based on the source of the stormwater to be directed into the infiltration LID BMP. The main sources of runoff include the following:

- **Vegetated and rooftop runoff:** As vegetated and rooftop runoff are a relatively clean source of runoff; these sources are permitted to be conveyed or treated using infiltration-based practices regardless of the land use activities proposed for the project site.
- **Pollution hot spot runoff:** Pollution hot spot runoff is never permitted to be conveyed or treated using infiltration-based practices given the high potential for soil and groundwater contamination.
- **Paved area runoff:** The water quality characteristics of runoff from paved areas, including parking lots and walkways, ranges widely depending on the land use activities of the project site.

Table 6-4 must be consulted to determine the appropriate recommendation based upon the ultimate land use condition for the proposed development (paved area runoff).

The Comprehensive Development Guidelines and Financial Policies Manual (City of Hamilton, 2019) provides the following City perspective regarding suitability and constraints of available Stormwater management practices as shown below.

- *Source controls are supported by the City of Hamilton when feasible, which feasibility should be determined in a Subwatershed Study or Master Plan. If there is no study or it is not applicable, the source control should be applied as a Best Management Practice (BMP).*
- *Biofilters, green roofs, and pervious pipe systems are supported on a case-by-case basis by The City of Hamilton Stormwater Master Plan, Class Environmental Assessment Report (City-wide) (2007).*
- *Porous and pervious pavements should be used only for specialized applications as defined in the MOE-CC 2003 guidelines. It is recommended a flow restrictor pipe for all outlet control structure designs.*
- *Pervious pipe systems should be allowed by the City of Hamilton only for specialized applications as defined in the MOE-CC 2003 guidelines. Proponent must ensure no impact on the road base by trapped water and must provide sufficient clearance from drinking water systems.*
- *Enhanced grassed swales are supported by the City, and must meet the minimum length, velocity, flow depth, and slope criteria from the MOE-CC 2003 guidelines.*

— *Infiltration trenches should follow the MOE-CC 2003 guidelines for the design. The City of Hamilton shall require an easement from City property to the infiltration trenches to ensure maintenance is being provided by the townhouse condominium corporation. The infiltration capacity should be based on the soil condition.*

These perspectives should be taken into consideration by designers when reviewing the LID BMP options available and completing a screening / selection process for their respective sites, and the City should be consulted as part of the selection and design process to determine feasibility.

Table 6-4: Application of LID BMPs for Different Land Use Types

Category	LID Practice	Low Density Residential	Mixed Use & High Density Residential	Commercial & Institutional	Industrial	Open Space & Environmental Protection Areas
Priority 1A - Retention (Surface - Vegetated)	Bioretention	●	●	●	○	◉
	Rain Gardens	●	◉	◉	○	◉
	Bioswale	●	●	●	○	◉
	Green Roofs	○	●	●	●	✖
	Soakaways / Infiltration Trenches with Filter Media (at Surface)	◉	◉	◉	◉	◉
	Soil Cells & Tree Trenches	○	●	●	◉	○
Priority 1A - Retention (Surface - Other)	Permeable Pavement	●	●	●	✖	✖
	Compost / Soil Amendments	●	●	◉	◉	◉
Priority 1B - Retention (Subsurface / Collection)	Perforated Pipes	◉	◉	◉	◉	◉
	Rainwater Harvesting	○	●	●	●	✖
	Blue Roofs	○	●	●	●	✖
	Soakaways, Infiltration Trenches and Chambers (Piped)	◉	◉	◉	◉	◉
Priority 2 - Filtration	Biofiltration	○	●	●	◉	○
	Enhanced Grassed Swale	◉	●	●	◉	○
	Manufactured Filters	○	○	◉	○	○
	Priority 1A (Surface) Feature with an Impermeable Liner / Underdrain	●	●	●	●	○
Priority 3 - Conventional	Dry Pond	●	●	●	●	○
	End-of-Pipe Wet Facility (Wet Pond/Wetland/Hybrid)	●	●	●	●	○
	Manufactured Treatment Devices	●	●	●	●	✖
	Parking Lot Storage	○	◉	●	●	✖
	Rooftop Detention Storage	○	●	●	●	✖
●	= Usually very well suited for application on this land use. Check design specifications.					
◉	= May be suitable for application on this land use, if project or hydrologic conditions allow. Check design specifications.					
○	= Usually not for application on this land use but may be appropriate in limited situations. Check design specifications.					
✖	= Not suitable for land use.					

It should be noted that the City is not intending to prescribe specific solutions on private property, and does not intend to monitor, inspect, maintain or ensure operation of LID BMP measures on private property, except where it may be required to ensure compliance with City by-laws.

That said, designers should be critical of their selection of LID BMP measures used for lot level control under private ownership, ensuring that they;

- *Are difficult to remove or otherwise compromise;*
- *Provide pre-treatment to the greatest extent possible;*
- *Are designed to provide a maximum asset lifespan;*
- *Require minimal maintenance that does not require effort or resources outside of the scope of the anticipated owner;*
- *Provide for monitoring devices as required; and,*
- *Mitigate potential impacts/ nuisance issues (basement moisture / flooding etc.).*

The intention of providing this long-list of LID BMPs is to allow designers greater opportunities for developing creative solutions to achieve the required level of service for stormwater management. Therefore, if the intention is for the Private Property owner to maintain ownership of the LID BMP and be responsible for the life cycle maintenance, the LID BMP should be selected from the long-list of options in accordance with the land use applicability screening and any functional considerations required for the specific site design.

6.4 Design Guidance

6.4.1 LID BMP Design Resources

The City will continue to study the evolution of industry practices as well as monitor the progress of LID BMP implementation within the municipality. Additional standards or guidelines will be made available through the City of Hamilton website as they are developed.

Guidance material for design, construction and maintenance of LID BMPs is available through additional resources including MECP, TRCA/CVC LID guidelines and the Sustainable Technologies Evaluation Program (STEP) website. Specific documents that should be consulted prior to development include:

- Draft Low Impact Development Stormwater Management Guidance Manual (2022)
- Stormwater Management Planning and Design Manual (2003)
- Low Impact Development Construction Guide (2012);

— Low Impact Development Monitoring and Performance Assessment Guide (2015);
— Low Impact Development Retrofit Guides (Road and Public Land) (2014); and,
— Draft Contractor's and Inspector's Guide for Low Impact Development (2014).

Additional resources which can be used to support the analysis of LID measure design and implementation on a site include the following:

— STEP's LID Treatment Train Tool (TTT)
— STEP's Life Cycle Costing Tool

It is encouraged that the Sustainable Technologies Low Impact Development Stormwater Management Planning and Design Guide website be referenced for further information. This resource acts as a compilation of data and is continually updated with current and relevant information as it is made available.

6.4.2 Long-Term Operations & Maintenance Guidance

Long-term operations & maintenance (O&M) of LID BMPs is critical to both the proper water quality function and the overall community aesthetic of the system. Defining responsibility (e.g., specific City department, private owner, etc.) and budgeting for long term O&M early in the planning and design process will help ensure long term success of the LID BMP.

Specific O&M requirements have not been identified as part of the current GSG, however there are several key existing resources available which outline specific requirements and considerations for each type of LID BMP. This includes information from the Sustainable Technologies Evaluation Program (STEP) Low Impact Development Stormwater Inspection and Maintenance Guide, which provides O&M guidance related to the following:

— Owner responsibilities;
— Routine vs. rehabilitative maintenance;
— Common components of LID measures to be inspected; and,
— Comprehensive inspection checklist that provides maintenance guidance and schedule organized by common component.

The City will continue to review and identify additional standards or guidelines related to O&M procedures specific to LID BMPs. As these advance, they will be made available through the City of Hamilton website and communicated publicly.

6.4.3 Preliminary LID BMP Submission Requirements

As part of any site plan application, it is expected that a SWM Report or Technical Memorandum be prepared to demonstrate the SWM Strategy proposed for the site. As part of this submission, information regarding the LID BMP design process should include but is not limited to the following:

- Background Review / Data Summary
- Characterization of Existing Site Conditions (i.e., Drainage Patterns, Subsurface Conditions, etc.)
- Summary of Applicable Design Criteria for the Subject Site (Minimum Water Quality Retention Target (WQRT) and Provincial RVCT)
- Description of the Project Type, Ultimate Form, and Resultant SWM Impacts
- Documentation of Better Site Design Strategies and the LID BMP Screening and Selection Process
- Preliminary Design Details for the Selected LID BMP Measure
- A Spill Contingency Plan and Remediation Requirements
- Operations & Maintenance Requirements for the Selected LID BMP Measure
- Drawings / Figures demonstrating the Proposed Subcatchments Contributing to the LID BMP Measure
- Standard Details for the Preliminary LID BMP Design

The City may request to view additional site-specific information that is not included in this list based on the individual project. If the project is working through the EA process, the City may also request to complete a secondary review at time of detailed design. Details related to information and submission requirements should be confirmed with the City as part of pre-consultation throughout the project.

7 Implementation Requirements and Next Steps

The City of Hamilton (the City) has prepared City-wide Green Standards and Guidelines (GSG) to specifically guide ***private development*** applications by providing a decision methodology and implementation considerations to inform the selection of LID BMPs in order to achieve both the minimum retention criteria identified by the City, as well as the emerging criteria identified by the Province. As part of this initiative, there are a number of implementation requirements which the City should consider as part of the next steps for the implementation of the GSG; these include but are not limited to the following:

- **7.1 Engage with Industry / Stakeholders through GSG Implementation**
  - The GSG represent a new and formal approach to SWM on private development sites. During the preparation of the current GSG report, industry representatives and other stakeholders have provided numerous comments and input which has helped to shape the guidance herein.
  - Due to the innovative practices and procedures being advocated in the GSG, it has been recommended that as the City implements the GSG, both City staff and industry proponents can review what works and what does not and what amendments, if any, need to be made to improve/support the implementation of the GSG. As such, it is suggested that as part of the implementation of the GSG, there be opportunities for engagement with development proponents and their representatives to provide feedback to the City as part of the use/application of the GSG for private development applications.
- **7.2 Receive Feedback and Update/Amend GSG to Develop "Guideline Only" Document**
  - It is envisaged that proponents and City staff engaged in the development review process will provide input to the City on the GSG through the course of its implementation. This process is expected to include both informal and formal intake of commentary which would then be reviewed by the City, as well as internal reviews and processes completed by City staff to measure the success of the GSG implementation (e.g., score card). This external and internal feedback can then be used to determine potential amendments to the guidance within the GSG to align with City goals.
  - Once vetted and appropriately considered, the GSG may be updated to reflect the input received and supported. It is then expected that a condensed

"Guideline only" document of the final GSG would be prepared for use by practitioners and City staff.

- **7.3 Create Formal Policy and bring to City Council for Adoption**
  - Due to the need to provide an added weight and significance to the City's intent to build "greener", it is recommended to establish a set of formal policies around the GSG. Policies should consider the GSG goals and objectives and align with the most recent upper tier legislative requirements, include minimum retention criteria and a range of LID BMP considerations, and define implementation mechanisms based on consultation with City staff in Hamilton Water and Planning and Economic Development. Following the implementation of the GSG, it is expected that City staff will have a good awareness and understanding of how best to structure the policy aspects of the City's greening goal. Once again, it is strongly recommended that the draft policy be reviewed by the industry and other stakeholders to ensure all interests are addressed and appropriately accommodated.
- **7.4 Develop Complement to Private-side GSG with Guidance for Public Works/Lands**
  - As noted throughout this document, the current GSG are focused on private development requirements. Clearly private lands are not the only lands which are contributing to runoff in urban conditions, hence publicly controlled and owned lands must also be considered in establishing appropriate GSG for public works and lands. Most notable are roadways, and work is already underway as part of the City's Complete Streets initiatives which acknowledges the role of source controls along linear roadway systems. Notwithstanding, other public land such as parks and community facilities are also in need of guidance for managing impacts to stormwater. As such, the City is planning to prepare a complement to the private side GSG for public works and lands.
- **7.5 Consider a Cash-in-lieu Program/Approach for potentially Highly Constrained or Impractical Sites**
  - City Council and Staff highly encourage all new development to have some form of green infrastructure. The current GSG have numerous examples of efforts and means to address stormwater management needs in constrained systems as does draft guidance from the Province. That said, over the course of consultation with industry partners, it has been indicated that some form of cash-in-lieu program/approach may be considered in the future for highly constrained or impractical sites. While the metric and determinants of what constitutes "highly constrained and impractical" have not been developed, it is not uncommon for other jurisdictions to offer such a program to facilitate system improvements on a

broader scale to off-set local impacts. The City can therefore consider the need or applicability of a Cash-in-lieu option as part of the implementation phase of the GSG.

- **7.6 Develop a Catalogue/Inventory Process to document Private Green Practices**
  - It is recommended that the City establish an internal process to digitally document the form and properties of green practices which can be used to monitor and enforce private sector stormwater management, as well as support future analytical modelling of system performance and climate change resiliency planning.
- **7.7 Develop a Monitoring Program for Private Green Practices**
  - As part of development applications (draft plans and site plans), the City should prescribe a form of monitoring of the green practices to ensure that they are working as intended. There is various industry guidance on monitoring practices that can be referenced and structured to meet the needs of Hamilton.
- **7.8 Develop O&M Measures and Enforcement for Private Green Practices**
  - In order to be functional long-term, green practices need to be properly operated and maintained. The industry has developed various approaches for O&M as well as Erosion & Sediment Control construction requirements depending on the form of BMP (ref. STEP, TRCA/CVC, etc.). It is suggested that the City review these approaches, and throughout the implementation phase, consult with the industry on what works and what does not, and whether there are any issues with construction processes, O&M and enforcement that should be considered as part of future guidance.

REFERENCES

The following reference list includes key LID Design and Guidance resources utilized as part of the GSG report development. Any studies or other policy documents reviewed as part of the background review component of this study are referenced in the report body.

AMEC Environment & Infrastructure a division of AMEC Americas Limited. "Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses." 2013.

Aquafor Beech Limited . *Stormwater master Plan* . City of Hamilton: City of Hamilton, 2007.

Aquafor Beech Limited & Dillon Consulting. *Low Impact Development Technical Guidance Report*. City of Ottawa, 2021.

Aquafor Beech Limited. *Integrated Stormwater Management Master Plan*. City of Kitchener, 2016.

Bureau of Environmental Services. *Stormwater Design Manual*. City of Portland, 2020.

City of Barrie. "Infiltration Low Impact Development Screening Process." 2017.

City of Boulder. "Owner's Guide to Stormwater Control Measure (SCM) Maintenance." 2020.

City of Burlington. "Sustainable Building and Development Guidelines ." 2021.

City of Calgary . "Stormwater Management & Design Manual." 2011.

City of Calgary. "Stormwater Source Control Practices Handbook." 2007.

City of Edmonton. "Low Impact Development Best Management Practices Design Guide 2014.

City of Halifax. "Stormwater Management Standards for Development Activities." 2020.

City of Hamilton. "Comprehensive Development Guidelines." 2019.

City of Topeka. "Stormwater BMP Design Handbook." 2023.

City of Toronto. "Toronto Green Streets Technical Guidelines." 2017.

City of Vancouver. "Stormwater Source Control Design Guidelines." 2012.

—. "The Citywide Integrated Stormwater Management Plan – Volume 2, Best Practice Toolkit." 2016.

Conservation Halton. "Conservation Halton Guidelines for Stormwater Management Engineering Submissions." 2021.

County of Los Angeles Department of Public Works. "Low Impact Development Standards Manual." 2014.

Credit Valley Conservation & Toronto and Region Conservation Authority. "Low Impact Development Stormwater Management Planning and Design Guide." 2010.

Credit Valley Conservation. "CVC Stormwater Management and Low Impact Development Monitoring and Performance Assessment Guide." 2015.

—. "Draft Contractor's and Inspector's Guide for Low Impact Development." 2014.
—. "Low Impact Development Construction Guide." 2012.
—. "Low Impact Development Public Land Retrofits: Optimizing Your Infrastructure Assets through Low Impact Development." 2014.
—. "Low Impact Development Road Retrofits: Optimizing Your Infrastructure Assets through Low Impact Development." 2014.
Dylewski, Katie L., et al. "Low Impact Development Handbook for the State of Alabama." 2007.
Grand River Conservation Authority. *Consolidated Policies for Implementing Ontario Regularion 150/06*. Cambridge, 2015.
Hamilton Conservation Authority. "Planning & Regulation Policies and Guidelines." 2011.
Metropolitan Government Nashville and Davidson County. "Low Impact Development Stormwater Management Manual - Volume 5." 2021.
Ministry of Environment, Conservation, and Parks . *Municipal Consolidated Linear Infrastructure Environmental Compliance Approvals*. 12 June 2023.
—. "Stormwater Management Planning and." 2003.
Ministry of the Environment, Conservation, and Parks. "DRAFT Low Impact Development Stormwater." 2022.
—. "Low Impact Development Stormwater Management Guidance Manual (Draft) ." 2022.
—. *Stormwater Management Planning and Design Manual*. March 2003.
Minnesota Pollution Control Agency. *Minnesota Stormwater Manual Wiki*. 23 January 2023.
New York City Environmental Protection. *New York City Stormwater Manual*. New York City, 2022.
Niagara Peninsula Conservation Authority. "Stormwater Management Guidelines." 2010.
Public Utilities Board "Managing Urban Runoff Drainage Handbook." 2013.
Sustainable Technologies Evaluation Program (STEP). *Low Impact Development Stormwater Management Planning and Design Guide* . May 2022.
Water by Design. *Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands*. Brisbane: South East Queensland Healthy Waterways Partnership, 2010.
Wood Environment & Infrastructure Solutions. *Stormwater Management Design Guidelines*. City of Burlington, 2020.
Wood Environment and Infrastructure. *Stormwater Management Manual*. Augusta: Augusta - Richmond County , 2020.

APPENDIX

A LEGISLATIVE REVIEW

APPENDIX

The following table identifies a list of all documents reviewed as part of this Legislative Review.

Summary of Information Reviewed

Section	Information
1.1	**Federal Guidance**
1.1.1	Achieving a Sustainable Future – A Federal Sustainable Development Strategy (FSDS) For Canada 2019 to 2022
1.1.2	Canadian Environmental Protection Act
1.1.3	Canadian Fisheries Act
1.1.4	Canadian Environmental Assessment Act
1.1.5	Species at Risk Act
1.1.6	Canadian Navigable Waters Act
1.2	**Provincial Guidance**
1.2.1	**Provincial Policy**
1.2.1.1	Provincial Policy Statement
1.2.1.2	A Place to Grow: Growth Plan for the Greater Golden Horseshoe
1.2.1.3	A Made-in-Ontario Environment Plan
1.2.1.4	Building Code
1.2.1.5	MECP Consolidated Linear Application
1.2.1.6	Niagara Escarpment Plan
1.2.2	**Provincial Legislation**
1.2.2.1	Ontario Water Resources Act
1.2.2.2	Provincial Water Quality Objectives
1.2.2.3	Ontario Clean Water Act
1.2.2.4	Ontario Brownfields Act
1.2.2.5	Ontario Emergency Management Act
1.2.2.6	Ontario Water Opportunities Act
1.2.2.7	Municipal Act
1.2.2.8	Ontario Drainage Act
1.2.2.9	Endangered Species Act
1.2.2.10	Lakes and Rivers Improvement Act
1.2.2.11	O. Reg. 406/19 On-Site and Excess Soil Management
1.2.3	**Provincial Agency Guidelines and Requirements**
1.2.3.1	MOE Stormwater Management Planning and Design Manual
1.2.3.2	MECP Low Impact Development Stormwater Management Guidance Manual (Draft)
1.2.3.3	MNRF Natural Channel Systems: Adaptive Management of Stream Corridors in Ontario
1.2.3.4	MNRF Natural Hazards: Technical Guides for Rivers and Stream Systems
1.2.3.5	Watershed Planning in Ontario (Draft)

Section	Information
1.2.3.6	MTO Drainage Management Manual
1.2.3.7	MTO Highway Drainage Standards
1.2.3.8	MTO Stormwater Management Requirements for Land Development Proposals
1.2.3.9	Comprehensive Engineering Guidelines
1.3	**Conservation Authority Guidance**
1.3.1	**Hamilton Conservation Authority**
1.3.1.1	HCA Strategic Plan 2019-2023
1.3.1.2	HCA Planning Regulation Policies and Guidelines
1.3.2	**Conservation Halton**
1.3.2.1	CH Policies and Guidelines for the Administration of O.Reg 162
1.3.2.2	CH Guidelines for Stormwater Management Engineering Submissions
1.3.2.3	CH Guidelines for Landscaping and Rehabilitation Plans
1.3.3	**Niagara Peninsula Conservation Authority (NPCA)**
1.3.3.1	NPCA Policy Document: Land use planning and Review Policy
1.3.3.2	NPCA Stormwater Management Guidelines
1.3.3.3	NPCA Erosion and Sediment Control Guideline for Urban Construction
1.3.3.4	NPA Lake Ontario Shoreline Management Plan
1.3.4	**Grand River Conservation Authority (GRCA)**
1.3.4.1	GRCA Consolidated Policies for Implementing O.Reg 150/06
1.3.4.2	GRCA Policies and Procedures for Compliance with Consolidated Policies
1.4	**Municipal Policies, Plans and Strategies**
1.4.1	Rural Hamilton Official Plan
1.4.2	Urban Hamilton Official Plan
1.4.3	Urban Hamilton Official Plan Amendment 167
1.4.4	Hamilton Climate Emergency Declaration
1.4.5	Hamilton Climate Change Impact Adaptation Plan
1.4.6	Recharge Hamilton: Community Energy and Emissions Plan
1.4.7	Taking Action on Climate Change in Hamilton – A Community Plan
1.4.8	Corporate Climate Change Task Force
1.4.9	Water and Wastewater Master Plan
1.4.10	Stormwater Management Master Plan
1.4.11	Water, Wastewater, and Stormwater Master Plan (Under Development – targeted for 2023 completion)
1.4.12	Flooding and Drainage Improvement Framework
1.4.13	Guidelines for Hydrogeological Studies and Technical Standards for Private Standards
1.4.14	Storm Drainage Policy and Guidelines for Stormwater Infrastructure Design
1.4.15	Development Charges Background Study
1.4.16	Complete Streets Design Guidelines
1.4.17	Hamilton Eco-Industrial Design Guidelines

1.3 Federal Guidance

APPENDIX

The following federal policies or acts have been reviewed in order to provide guidance for stormwater management at the local level:

1.1.1 Achieving a Sustainable Future – A Federal Sustainable Development Strategy (FSDS) For Canada 2019 to 2022

1.1.2 Canadian Environmental Protection Act

1.1.3 Canadian Fisheries Act

1.1.4 Canadian Environmental Assessment Act

1.1.5 Species at Risk Act

1.1.6 Canadian Navigable Waters Act

1.3.1 Achieving a Sustainable Future – A Federal Sustainable Development Strategy (FSDS) for Canada 2019 to 2022, 2019

Achieving a Sustainable Future (2019) sets out goals and commitments for achieving sustainability guided by the Federal Sustainable Development Act (2008). It sets out 13 aspirational goals to support Canada's sustainable development vision. Of these goals, the following six have been considered relevant to stormwater management:

- Pristine Lakes and Rivers: Clean and healthy lakes and rivers support economic prosperity and the well-being of Canadians
- Clean Drinking Water: All Canadians have access to safe drinking water and, in particular, the significant challenges Indigenous communities face are addressed
- Connecting Canadians With Nature: Canadians are informed about the value of nature, experience nature first hand, and actively engage in its stewardship
- Safe and Healthy Communities: All Canadians live in clean, sustainable communities that contribute to their health and well-being

Medium-term targets and short-term milestones support each goal. Action plans describe what will be done to achieve the goals and targets. Meanwhile, cross-cutting priorities such as conducting robust and thorough environmental assessments, respecting the rights of Indigenous peoples, ensuring that environmental effects are fully considered in policy, plan and program development, and implementing strong environmental legislation, will support progress in all areas of the FSDS.

1.3.2 Canadian Environmental Protection Act, 1999

The Canadian Environmental Protection Act, 1999 was enacted for the purpose of "pollution prevention and the protection of the environment and human health in order to contribute to sustainable development". In 2001, Environment Canada determined that road salts were entering

the environment in large amounts and posed a risk to plants, animals, birds, fish, lake and stream ecosystems and groundwater. The report recommended that salt be designated as toxic under the Act. Furthermore, Environment Canada assembled a working group that developed the “Code of Practice for the Environmental Management of Road Salts” released in 2004. This document recommends that road authorities prepare salt management plans that identify actions they will take to improve their practices in salt storage, general use on roads and snow disposal.

1.3.3 Canadian Fisheries Act, 1985

Subsection 36(3) of the Canadian Fisheries Act (R.S., 1985, c. F-14) prohibits the deposit of a deleterious substance into water frequented by fish. A deleterious substance includes harmful chemicals but also sediment and water at an increased temperature. This can have an impact on the design and management of stormwater facilities to ensure sediment removal efficiencies are maintained and outflow water temperature is not overly heated.

1.3.4 Canadian Environmental Assessment Act, 2012

Canadian Environmental Assessment Act (CEAA) 2012 focuses on requiring federal level environmental reviews for projects that have the potential to cause significant adverse environmental effects in areas of federal jurisdiction including federal lands, migratory birds or migratory bird sanctuaries, fish and fish habitats and other aquatic species.

CEAA 2012 applies to physical activities as described (under the Act) in the Regulations Designating Physical Activities (the Regulations). Should a project not appear on the list of Regulations, and it is likely to cause significant adverse environmental effects, and/or there are public concerns about these types of effects, the federal Minister of the Environment may designate a project to fulfill the EA requirements under CEAA 2012.

CEAA 2012 respects the constitutional responsibilities of other jurisdictions and is not intended to replicate or assess environmental effects covered under another jurisdiction (i.e., provincial or municipal areas of jurisdiction). Since 2004, Canada and Ontario have had an agreement on EA cooperation pursuant to each other’s respective EA acts. CEAA 2012 also contains enabling provisions to help encourage EA cooperation between jurisdictions by substituting the EA process of another jurisdiction for that which would normally be conducted by Canadian Environmental Assessment Agency (CEA Agency).

1.3.5 Species at Risk Act, 2002

The purpose of the Species at Risk Act (SARA) is to prevent wildlife species in Canada from disappearing, to provide for the recovery of wildlife species, and to manage species to prevent further risk to their status. Only species listed as Threatened, Endangered, or Extirpated under Schedule 1 are afforded both individual and habitat protection under the SARA. On provincial lands, SARA legislation does not apply, except for Migratory Birds that also fall under schedule 1 of SARA (not including their habitat) and aquatic species. Notably, prohibitions can be applied if provincial legislation or voluntary measures do not adequately protect federally listed species and their

residence. Generally, compliance with provincial ESA legislation will satisfy the requirements under the SARA.

1.3.6 Navigable Waters Act, 1985

The Canadian Navigable Waters Act (R.S.C., 1985, c. N-22) aims to protect Canadian waterways that the public has the right to travel on and applies to all levels of government and the public. The Act identifies works that are allowed and prohibited within navigable waters, obstruction of navigable waters, deposits and dewatering, studies and collection of information, Indigenous knowledge, agreements and arrangements, registries, regulations and orders, administration and enforcement.

1.4 Provincial Guidance

The following provincial policies, legislation, guidelines and regulatory information have been reviewed which are considered to provide relevant guidance for stormwater management:

1.2.1 Provincial Policy

1.2.2 Provincial Legislation

1.2.3 Provincial Agency Guidelines and Requirements

1.4.1 Provincial Policy

The following Provincial policies has been reviewed:

1.2.1.1 Provincial Policy Statement

1.2.1.2 A Place to Grow: Growth Plan for the Greater Golden Horseshoe

1.2.1.3 A Made-in-Ontario Environmental Plan

1.2.1.4 Building Code

1.2.1.5 MECP Consolidated Linear Application

1.2.1.6 Niagara Escarpment Plan

1.4.1.1 Provincial Policy Statement, 2020

The Provincial Policy Statement (PPS) (2020) provides policy direction and sets the framework for regulating land use planning and development, in order to protect resources of provincial interest, public health and safety, and the quality of the natural and built environment.

The PPS provides policy directions regarding the management of infrastructure, and notes that it should be efficiently provided, prepare for the impacts due to climate change, and optimize existing

infrastructure. The PPS identifies that planning authorities should promote green infrastructure to complement grey infrastructure.

The PPS identifies that planning for stormwater management shall:

a) be integrated with planning for sewage and water services and ensure that systems are optimized, feasible and financially viable over the long term.

b) minimize, or, where possible, prevent increases in contaminant loads

c) minimize erosion and changes in water balance, and prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure.

d) mitigate risks to human health, safety, property and the environment.

e) maximize the extent and function of vegetative and pervious surfaces.

f) promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development.

The PPS identifies actions that planning authorities must undertake in order to protect, improve or restore the quality and quantity of water, including planning at the watershed scale, preparing for climate change, restricting development as required, and minimizing stormwater volumes and contaminant loads. The PPS identifies restrictions on development and site alteration in areas of natural hazards, and states that planning authorities should promote green infrastructure to complement infrastructure.

1.4.1.2 A Place to Grow: Growth Plan for the Greater Golden Horseshoe, 2019

A Place to Grow: Growth Plan for the Greater Golden Horseshoe (Growth Plan) (2019) provides direction on growth and development within the Greater Golden Horseshoe, while supporting the economy, protecting the environment and improving quality of life.

The Growth Plan provides the following guidance on stormwater management:

- Recommends municipalities develop stormwater master plans, which:
  - consider watershed planning, low impact development, green infrastructure and stormwater retrofits
  - identify existing environmental conditions and stormwater facilities
  - assess stormwater impacts due to existing and planned development and consider life cycle costs of stormwater infrastructure
  - include an implementation and maintenance plan
- Recommends development proposals be supported by stormwater management plans
- Identifies Municipalities sharing an inland water source or receiving water body to protect, improve or restore water quality and quantity by coordinating potable water, stormwater, and wastewater systems

- Recommends planning of stormwater infrastructure be informed by watershed planning
- Addresses stormwater runoff and pollutant loadings by recommending the use of lot-level stormwater controls in areas adjacent to key hydrologic features and key natural heritage features
- Recommends Settlement Area Boundary Expansions to consider stormwater master plans

1.4.1.3 A Made-in-Ontario Environment Plan, 2018

A Made-in-Ontario Environment Plan (2018) provides policy direction which aims to protect air, land and water, address litter and waste, reduce greenhouse gas emissions and prepare for climate change. The Plan is guided by three main principles, *Clear Rules and Strong Enforcement, Trust and Transparency* and *Resilient Community and Local Solutions*.

The A Made-in-Ontario Environment Plan's guidance in relation to stormwater management and reporting is to:

5. Update municipal stormwater policies to be written in plain language
6. Update stormwater financing and investment policies to be more adaptable to new innovative technologies and practises
7. Review land use policies in order to update policies related to climate change. These policies will help address stormwater management

The A Made-in-Ontario Environment Plan identifies investments of up to $7 billion in projects over the next 10 years (to 2028 +/-) such as improving local stormwater systems at a federal, provincial and municipal level over a ten-year span. The Plan also recommends working with conservation authorities to address flooding and other natural hazard issues.

1.4.1.4 Building Code Act, 1992

The Ontario Building Code (OBC) outlines requirements for acceptable building standards. The code covers requirements for handling stormwater runoff captured by building rooftops, including the appropriate use of flow control roof drains, downspouts, and storm building drains. Flow control drains can be used to temporarily detain stormwater on a building rooftop, provided the rooftop is designed to withstand the load of the stored water. Stormwater drainage from buildings systems shall be connected to a public storm sewer, combined sewer, or another designated storm outlet, however, cannot be connected to a designated sanitary sewer. It is the responsibility of a municipality's council to enforce the OBC.

1.4.1.5 MECP Consolidated Linear Application

The MECP adopted a Consolidated Linear Infrastructure (CLI) permission approach in 2022 to replace the Environmental Compliance Approvals (ECA) framework for low-risk municipal stormwater management projects. As part of this new procedure, instead of ECAs for individual stormwater

management projects, a single CLI ECA will be issued for all of a municipality's stormwater management works. The-purpose of CLI ECA is to reduce administration and provide consistent regulatory requirements in Ontario. The CLI ECA sets the approach for municipalities to comply with the Ontario Water Resources Act (OWRA) through a consolidated process for their SWM system and thereby also reinforces the responsibility of municipalities to review third-party applications for compliance.

The CLI ECA will require alignment with the MECP's Draft LID Guidance upon approval (i.e., application of the 90th percentile RVCT), in absence of local studies. Furthermore, each municipalities' CLI ECA application needs to include information on the following:

- System description, collection system by diameter, SWM facilities by type
- Details on Storm sewersheds (area and outfalls) and treatment level
- Master Plans and Watershed / Subwatershed Plans

SWM infrastructure listed within the Municipality's CLI ECA will be subject to the same MECP requirements, which includes requiring older SWM infrastructure to be improved to current requirements, where possible during renewal of infrastructure. The-City of Hamilton will be responsible for ensuring that third-parties (i.e., developers) meet the performance criteria of the CLI ECA in designing and constructing SWM infrastructure. In addition, should a project proposed by a third-party deviate from the performance criteria in the CLI ECA, a direct application to the MECP would be required to receive approval and thereby amend the City's CLI ECA.

At the time of preparing the GSG, the City has received the draft documents for both Sanitary and Stormwater CLI ECAs from the MECP. Over 2023, the City will be providing the MECP with proposed wording for conditions specific to the CLI ECA. Following engagement with the Province, the new CLI ECA framework for the City of Hamilton will be rolled out once the proposed conditions are approved by the MECP.

APPENDIX

1.4.1.6 Niagara Escarpment Plan, 2017

The Niagara Escarpment Plan (2017) builds on the policies in the Provincial Policy Statement, and provides additional land use planning policies for the maintenance of the Niagara Escarpment and land in its vicinity. This Plan provides land use designations to outline how land shall be used throughout the Niagara Escarpment Plan jurisdiction and identifies development criteria for proposed developments. The NEP includes the following guidance in relation to LID:

- Development within Minor Urban Centres, Urban Areas, and Recreation Areas should work towards the long-term goals of low carbon communities, net-zero communities and increased resilience to climate change, through maximizing opportunities for the use of green infrastructure and appropriate low impact development.
- Green infrastructure and low impact development should be considered where appropriate to complement infrastructure.

1.4.2 Provincial Legislation

The following Provincial legislation have been reviewed:

1.2.2.1 Ontario Water Resources Act

1.2.2.2 Provincial Water Quality Objectives

1.2.2.3 Ontario Clean Water Act

1.2.2.4 Ontario Brownfields Act

1.2.2.5 Ontario Emergency Management Act

1.2.2.6 Ontario Water Opportunities Act

1.2.2.7 Municipal Act

1.2.2.8 Ontario Drainage Act

1.2.2.9 Endangered Species Act

1.2.2.10 Lakes and Rivers Improvement Act

1.2.2.11 O. Reg. 406/19 On-Site and Excess Soil Management

1.2.2.12 Bill 109: More Homes for Everyone Act

1.2.2.13 Bill 23: More Homes Built Faster Act

1.4.2.1 Ontario Water Resources Act, 1900

:

The Ontario Water Resources Act (OWRA, RSO 1900 and amendments) prohibits activities that introduce pollutants into natural waterbodies, such as creeks, rivers and lakes: “Every person that discharges or causes or permits the discharge of any material of any kind into or in any waters ... that may impair the quality of the water… is guilty of an offence” (Section 16.(1)).

The OWRA gives the Ontario Ministry of the Environment, Conservation and Parks (MECP) the authority to regulate water supply, sewage disposal and to control sources of water pollution, which includes surface waters and groundwater in Ontario. The MECP issues Environmental Compliance Approvals under Section 53 of the OWRA for the treatment and disposal of sewage by municipal and private systems, which includes Stormwater Management (SWM) facilities. Stormwater is defined as “sewage” under the OWRA. Stormwater facilities constructed prior to the mid-1950s (when the OWRA was first applied) would not have received approval. A Director, as defined in the OWRA, has the power to order the owner of a sewage works (e.g., a municipality owning a SWM pond or a storm sewer system) that may discharge deleterious material into a watercourse to carry out works or activities to reduce or alleviate the water quality impairment. This power has not been applied to municipalities for normal operation of storm sewer and SWM systems, although it could be.

Current practices demonstrate that although regulatory agencies (e.g., MECP, MNRF, and Conservation Authorities) encourage retrofit controls, they have not enforced a formal requirement. However, a formal obligation for retrofit controls could be applied through the discretionary powers of MECP. The main impetus has been that municipal staff has accepted the premise that watercourses are part of the natural environment and must be protected and rehabilitated as part of their infrastructure management responsibility.

1.4.2.2 Provincial Water Quality Objectives

Provincial Water Quality Objectives (PWQO) are the numerical and narrative criteria which serve as chemical and physical indicators representing a satisfactory level for Ontario’s surface and ground waters under the OWRA, based on public health and aesthetic considerations. The PWQO are intended to provide guidance in making water quality management decisions, and are often used as the starting point in deriving requirements included in Provincial Environmental Compliance Approvals (ECAs). They are also used to assess ambient water quality conditions, infer use impairments, assist in assessing spills, and monitoring the effectiveness of remedial actions.

1.4.2.3 Ontario Clean Water Act, 2006

The Ontario Clean Water Act (2006) ensures communities are able to protect their municipal drinking water supplies through developing collaborative, locally driven, science-based protection plans (i.e., Source Protection Plans). Under this Act, communities are required to identify existing and potential threats to their current and future water supplies and take action to reduce or eliminate the significant threats and risks. This requires municipalities to work in collaboration with regional government and Conservation Authorities, leading to programs and criteria to be developed and incorporated into City policies.

APPENDIX

The City of Hamilton falls within the boundaries of four Source Protection Areas, each managed by respective Source Protection Committees. The following Source Protection Plans identify threats to sources of municipal drinking water supplies and inform City policy:

- Halton Region and Hamilton Region Source Protection Areas Source Protection Plans (2017)
- Grand River Source Protection Plan (2022)
- Niagara Peninsula Source Protection Plan (2013)

1.4.2.4 Ontario Brownfields Act, 2004

The Ontario Brownfields Act (2004) addresses the clean-up process for proposed redevelopment in brownfields, which are abandoned, idle or under-utilized commercial or industrial properties where past activities have caused known or suspected environmental contamination. The Brownfields Act incorporates a number of technical documents that specify soil and groundwater remediation criteria and laboratory analytical protocols.

1.4.2.5 Ontario Emergency Management Act, 2002

The Ontario Emergency Management Act, revised and amended from the Emergency Plans Act through Bill 148 in 2002, legally mandates that municipalities implement risk-based emergency management programs and as part of this, perform hazard and impact risk assessments, including assessments of weather-related risks, to critical infrastructure. These emergency management programs consist of emergency plans, training programs and exercises, public education and any other element prescribed by regulation. Municipalities are required to review and, if necessary, update these emergency management plans on an annual basis. This regulation has particular application to a municipality's SWM program given its role in drainage and mitigating the effects of weather-related flooding.

1.4.2.6 Ontario Water Opportunities Act, 2010

The Ontario Water Opportunities Act (2010) is intended to guide clean water technology, services and conservation efforts, as well as promote innovative and cost-efficient solutions for drinking water, sewage and stormwater system challenges. Under this Act, municipalities and other water service providers are required to prepare municipal Water Sustainability Plans. Grant funding programs have also been initiated to stimulate innovative municipal water sustainability research, planning and commercialization of new technologies, as well as support public education and awareness about water conservation.

One of the documents to emerge from the Water Opportunities Act that is relevant to the GSG is the Draft Low Impact Development Stormwater Management Guidance Manual developed by the MECP (ref. Section 5.2.3.2).

1.4.2.7 Municipal Act, 2001

:

The Municipal Act, SO 2001, authorizes municipalities to pass by-laws, implement programs, provide services and actions pertaining to stormwater, for the purposes of preventing damage to property resulting from flooding, and protection and conservation of the environment. It authorizes entry to land for inspection, testing and sampling of discharge for the same reason.

1.4.2.8 Ontario Drainage Act. 1990

The Ontario Drainage Act (1990) allows municipalities to collect funds to make minor improvements, deepening, widening or extending a drain to an outlet. Municipal Drain assessments are only intended for water quantity works (i.e., to provide conveyance capacity to the drainage outlet) with costs apportioned based on drainage area and runoff. Water quality / source water improvement projects, planning studies, and other (typically) urban drainage issues generally fall under the OWRA (ref. 5.2.2.1) rather than Drainage Act.

1.4.2.9 Endangered Species Act, 2007

The Endangered Species Act (ESA) (2007) provides science-based assessment, automatic species protection, and habitat protection to protect species at risk of disappearing from Ontario. Under Section 9 of the ESA, species are afforded individual protection, providing they are listed as Threatened, Endangered, or Extirpated on the Species at Risk in Ontario list. Section 10 of the ESA is in place to protect the habitat of Threatened or Endangered species only, where no damage is permitted to the habitat of those species unless under the authorization of the Ministry of the Environment, Conservation and Parks (MECP) by way of registration or permit. Destruction of Species at Risk and their habitats constitutes a contravention of the Endangered Species Act.

1.4.2.10 Lakes and Rivers Improvement Act, 1990

The Lakes and Rivers Improvement Act (LRIA) identifies requirements for the management, protection, preservation, and use of the waters of the lakes and rivers in Ontario, and the protection of the fish, wildlife, and other natural resources which depend on them. The natural amenities of the lakes and rivers, including their shores and banks and the interests of riparian owners are also protected by this Act. This Act further protects persons and property by providing the Minister of Natural Resources and Forestry (MNRF) legislative authority to govern the design, construction, operation, maintenance, and safety of dams in Ontario. The LRIA defines dams as a structure or work forwarding, holding back or diverting water, including dike, diversion, channel alteration, artificial channel, culvert or causeway. Section 14 of the LRIA requires approval from the Minister for the location of the dam, and its plans and specifications. Approval requires applicants to provide a statement showing the purpose, type and size of dam, whether the dam will be permanent or temporary, quantity of water held and the rate of flow of water that may be diverted. Applications must also include a diagram showing the proposed location of the dam, any area to be flooded any the land that may be affected by the flooding. Once location is approved an application for the approval of the plans and specifications of the plan can be submitted.

1.4.2.11 O. Reg. 406/19 On-Site and Excess Soil Management, 1990

APPENDIX

Ontario Regulation 406/19 (O.Reg 406/19) details how excess soil is managed during construction or development projects. This regulation details requirements for any projects that may require the removal of soil from a project site. Section 8 of O.Reg 406/19 details a notice must be filled with the registry before any project area soil is removed. The notice should include a description of the project and project area, contact information of project leaders, an estimate of the amount of soil removed, and the location of where the excess soil is intended to be deposited, Additionally, Section 12 states a sampling and analysis plan must be prepared before a notice is filed. Section 13 of the Regulation requires an Excess Soil Destination Report must also be prepared, including an identification of where the excess soil will be located and its alternate location, as well as an estimate of the quality and quantity of the soil deposited at each location.

1.4.2.12 Bill 109: More Homes for Everyone Act (2022)

The Province enacted Bill 109 – *More Homes For Everyone Act* (Bill 109) in April 2022. The Act is based on the premise that reduced housing affordability is a result of insufficient housing supply. The objective of the Act is to reduce “red tape”, streamlining both the development approvals process and review timelines. The Act includes modifications to the following Provincial Acts: Planning Act, Development Charges Act, New Home Construction Licensing Act, Ontario New Home Warranties Plan Act and City of Toronto Act.

Bill 109 includes the following new requirements:

- Municipalities to partially or fully refund Site Plan Control (SPC) & Zoning By-law Amendment (ZBL-A) application fees which do not receive a decision within the allocated timeframe.
    - 60 – 120 days for SPC review
    - 120 – 240 days for ZBL-A and OPA review
- SPC decisions have been delegated to City planning staff rather than City Council (City Council was previously the approving body).
- New Community Infrastructure and Housing Accelerator tool – allows City Council to request the Minster make a decision on a planning matter, which would not need to comply with policy (similar to Ministerial Zoning Orders).
- Requires public reporting on development applications, approvals and other financial matters.
- Requires Community Benefit Charges By-laws be reviewed every 5 years.
- Ministerial discretion to refer all Official Plan matters to Ontario Land Tribunal (OLT).

1.4.2.13 Bill 23: More Homes Built Faster Act (2022)

The Province enacted Bill 23 – *More Homes Built Faster Act* in November 2022. Similar to Bill 109, Bill 23 is based on the premise that reduced housing affordability is a result of insufficient housing

supply. The objective of the Act is to reduce development application requirements to reduce the timelines and costs of developments and increase the number of homes being built in Ontario.

Bill 23 includes significant modifications to the following Provincial Acts: Planning Act, Conservation Authorities Act, Development Charges Act, Municipal Act, New Home Construction Licensing Act, Ontario Heritage Act, Ontario Land Tribunal Act, Ontario Underground Infrastructure Notification System Act, City of Toronto Act, and Supporting Growth and Housing in York and Durham Regions Act. Included below are summaries of the relevant acts and changes which would potentially affect the planning process in Ontario, and subsequently have impacts within Hamilton.

Planning Act (1990)

The Planning Act (1990) sets out rules for land use planning in Ontario and provides the basis for policy tools that can be used by a municipality to make local planning decisions, including Official Plans, Zoning By-laws, Site Plan Control (SPC), and Plans of Subdivision. SPC is of specific relevance as this authorizes a municipality to examine the design and technical aspects of a proposed development to ensure it is attractive and compatible with the surrounding area, and contributes to the economic, social, and environmental vitality of the City. The following change, among others, has been made to the Planning Act through Bill 23:

- Minister may amend an Official Plan if the plan is likely to adversely affect a matter of provincial interest.
- Residential developments of 10 units or less are no longer subject to Site Plan Control.
- The exterior design of a building is no longer subject to Site Plan Control.
- Restrictions on the amount of park land dedication requirements.
- Restrictions on the amount of community benefit charge requirements.
- Conservation Authorities and select Upper-tier Municipalities are no longer able to participate in planning processes, including the appeal process, with exceptions.

Conservation Authority Act (1990)

The Conservation Authority Act, administered by the Ministry of Natural Resources and Forestry (MNRF), “provides the organization and delivery of programs and services that further the conservation, restoration, development and management of natural resources and watersheds in Ontario” (Section 0.1). The following change, among others, has been made to the Conservation Authority Act through Bill 23:

- Conservation Authorities may not provide a program or service related to reviewing and commenting on certain matters (i.e., comments are restricted to items that affect unstable soil or bedrock, and exclude comments related to pollution prevention and the conservation of land).

Development Charges Act (1997)

The Development Charges Act authorizes a municipality to impose development charges through a by-law to pay for increased capital costs required from the increased needs for servicing that arise

from development to the area for which the by-law applies. The following changes, among others, have been made to the Development Charges Act through Bill 23:

— Exemptions / restrictions from Development Charges for the creation of affordable / attainable residential units, non-profit housing developments and for inclusionary zoning residential units.
— Restrictions on items that can be charged through Development Charges (e.g. certain studies).

1.4.3 Provincial Guidelines and Requirements

The following Provincial guidelines and requirements have been reviewed:

1.2.3.1 MECP Stormwater Management Planning and Design Manual

1.2.3.2 MECP Low Impact Development Stormwater Management Guidance Manual (Draft)

1.2.3.3 MNRF Natural Channel Systems: Adaptive Management of Stream Corridors in Ontario

1.2.3.4 MNRF Natural Hazards: Technical Guides for Rivers and Stream Systems

1.2.3.5 Watershed Planning in Ontario (Draft)

1.2.3.6 MTO Drainage Management Manual

1.2.3.7 MTO Highway Drainage Standards

1.2.3.8 MTO Stormwater Management Requirements for Land Development Proposals

1.2.3.9 MECP Municipal Wastewater and Stormwater Management in Ontario Discussion Paper

1.2.3.10 MECP Subwatershed Planning Guide (Draft)

1.2.3.11 MECP Interpretive Bulletin

1.4.3.1 MECP Stormwater Management Planning and Design Manual, 2003

The Ministry of Environment, Conservation and Parks (MECP, formerly Ministry of Environment (MOE)) produced the Stormwater Management Planning and Design Manual (SWMPDM) in 2003. The SMWPDM is intended to provide guidance on the procedural and technical aspects of SWM practices as they are planned and designed to achieve the SWM development criteria for a site. The SWM development criteria, as outlined in the SWMPDM, include water balance, water quality, erosion control, and water quantity criteria.

Water balance criteria are intended to offset the reduction in groundwater recharge resulting from urbanization. Modelling should be completed to determine the water balance requirements for a site. Where computer modelling is not completed, the SWMPDM provides an outline of the Thornthwaite and Mather method (1957) which determines the potential and actual amount of the hydrologic cycle

components (i.e., precipitation, evapotranspiration, runoff, and infiltration) for various soil types and vegetation covers.

Water quality criteria are intended to protect receiving habitats from deleterious substances that are entrained in stormwater runoff from a site. Water quality protection is based on a reduction of total suspended solids (TSS) loading. The level of protection required for a site is to be based on the characteristics of the receiving waters. There are three (3) levels of protection: Enhanced Protection (80% TSS removal), Normal Protection (70% TSS removal), and Basic Protection (60% TSS removal). Table 3.2 in the Manual outlines the water quality storage volume requirements for site, which is dependent on the imperviousness and SWM BMP type selected for the site (i.e., infiltration, wetland, wet pond, hybrid wet pond / wetland).

Erosion control criteria are intended to protect receiving waters from erosion potential created by the change in hydrologic characteristic associated with urbanizing a site. Erosion protection requirements are to be determined based on the characteristics of the receiving waters. Erosion protection is commonly provided in an end-of-pipe facility or infiltration SWM BMP.

Water quantity criteria are intended to offset the increase in peak flow rates from a site resulting from urbanization. The generally accepted criteria is to control post-development peak flows to pre-development levels for the 2 year, 5 year, 10 year, 25 year, 50 year, and 100 year return period storm events. Water quantity control is typically provided in an end-of-pipe facility.

The SWMPDM also provides guidance on the selection and design of SWM BMPs to achieve the aforementioned criteria. SWM BMPs are split into three categories; lot-level controls, conveyance controls, and end-of-pipe controls. Lot-level controls are controls at the source of the runoff. These include BMPs such as reduced lot grading, rooftop storage, and disconnection of roof leaders. Conveyance controls are controls that form part of a site's conveyance system, such as grassed swales and pervious pipe systems. End-of-pipe controls are controls located at the end of a storm sewer system and receive drainage from the majority of the site. End-of-pipe controls include wet ponds, wetland, dry ponds and infiltration basins.

1.4.3.2 MECP Low Impact Development Stormwater Management Guidance Manual (Draft), 2022

The Government of Ontario has created the DRAFT Low Impact Development Stormwater Management Guidance Manual (2022) (LID Guidance Manual) as a method to outline guidance for low impact development (LID) methods and protect waterways and water quality, reduce flood risks and potential for damage, and increase resilience to increasing climate change events throughout the Province of Ontario. The Draft Manual outlines specific criteria for stormwater volume control requirements, selecting water budget and water modelling tools, groundwater protection considerations from infiltration based Low Impact Development (LID) Best Management Practices (BMPs), criteria for model selection, and climate change considerations regarding future scenarios, and risks and vulnerabilities.

The LID Guidance Manual provides performance guidance on Runoff Volume Control Target using the 90^{th} percentile precipitation event where the rainfall amount ranges from 23 mm to 32 mm based

on local precipitation patterns throughout Ontario. These figures were determined through hourly rainfall analysis using a 12-hour minimum inter-event time. Stormwater management measures should be utilized in a hierarchical approach that target runoff retention followed by LID filtration and then conventional stormwater management. The purpose for these guidelines is for municipalities, developers, and other interested parties to utilize in order to implement green infrastructure and practices that infiltrate, evapotranspire, or harvest and reuse stormwater.

1.4.3.3 MNRF Natural Channel Systems: Adaptive Management of Stream Corridors in Ontario, 2001

The Ministry of Natural Resources and Forestry's (MNRF's) natural channel systems document (2001) introduced MNRF's framework to the environmental management of river and stream systems in Ontario. The document can be used by municipalities as a guide for environmental asset management, which includes river and stream systems. The framework is intended to assist proponents from the start to the finish of environmental asset management by providing guidance on identification of issues, planning and environmental assessment, detailed analysis and design, implementation, monitoring, evaluation, and adjustment.

1.4.3.4 MNRF Natural Hazards: Technical Guides for Rivers and Stream Systems (Flooding Hazard Limit & Erosion Hazard Limit), 2002

The MNRF provides planning and technical guidelines for the establishment and management of natural hazards as they relate to river and stream systems including flooding, erosion, and slope stability. Policies are aimed at directing development away from natural hazards where there is a risk to public safety or a risk of property damage. The Natural Hazard Policies are applied under the Provincial Policy Statement, which is issued under the Planning Act and administered by the MNRF.

The technical guide covering erosion hazard limits (2002) outlines the process to establish the erosion hazard limit for confined and unconfined watercourse systems. The erosion hazard limit is comprised of a toe erosion allowance, a slope stability allowance, and an erosion access allowance. This document is a key document applied by Conservation Authorities in establishing primary development setbacks from watercourses.

The technical guide covering flooding hazards (2002) outlines provincial policies with respect to flooding hazards, including design standards, and requirements for hydrologic and hydraulic analyses. This guideline is a key document applied by Conservation Authorities in the development of regulated area (i.e., the flooding hazard limit) mapping, and also in the management of Regional Storm flows. Policies outlined in the technical guide specific to Municipalities require Municipalities and planning boards to show or describe flood plain lands in their official plans and incorporate policies to address new development consistent with the Provincial Policy Statement.

1.4.3.5 Watershed Planning in Ontario (DRAFT), 2018

The Watershed Planning in Ontario document (Draft February 2018) was developed to assist municipalities with implementing the requirements of the following land use plans and policies: the Growth Plan for the Greater Golden Horseshoe, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan, and the Niagara Escarpment Plan, and the Provincial Policy Statement, as it pertains to watershed planning. The document outlines best practices for watershed delineation and characterization, establishing watershed goals / objectives, setting requirements for developments, implementing the watershed plan, monitoring, and indigenous consultation.

1.4.3.6 MTO Drainage Management Manual, 1997

The Ministry of Transportation (MTO) Drainage Management Manual (1997) is a technical document providing guidance and reference material for the design of various stormwater drainage systems (i.e., infrastructure), including bridges and culverts, roadways, roadside ditches, stormwater facilities, etc. Recommendations on suitable design methodologies are also provided to assist proponents in achieving the specific goals of their development plan. MTO nomographs and inlet capacity charts are frequently referenced for municipal design projects.

1.4.3.7 MTO Highway Drainage Standards, 2008

The MTO Highway Drainage Standard (2008) is a compilation of MTO's documented design standards for highway drainage infrastructure. The document outlines specific criteria for conveyance capacity requirements of roadways and watercourse crossings, design and layout of storm sewers and inlets, longitudinal and cross-fall grades for roadways, selection of armouring solutions to resist erosion / scouring, debris, fish passage, etc.

1.4.3.8 MTO Stormwater Management Requirements for Land Development Proposals, 2016

Where municipal developments are bordered by MTO lands, MTO mandates that proposed SWM plans be submitted to MTO for review, and an MTO approval must be granted prior to development. The MTO SWM Requirements for Land Development Proposals document (2016) outlines the submission requirements necessary to obtain MTO approvals. Requirements are focused around assessing drainage related impacts to the MTO lands, caused by the proposed land development.

1.4.3.9 MECP Municipal Wastewater and Stormwater Management in Ontario Discussion Paper (2022)

The MECP prepared the Municipal Wastewater and Stormwater Management in Ontario Discussion Paper in 2022 to stimulate discussion and seek feedback on potential policy approaches for a variety of topics related to wastewater, stormwater management, and water conservation. The Paper recognizes a need for clear guidance related to stormwater management that encourages the use of green stormwater infrastructure. The Paper suggests solutions to modernize stormwater management in Ontario such as performance measures that provide an outcome-based approach for managing stormwater management systems. Examples of practices that should be implemented include requiring on-going inspection and maintenance of infrastructure and managing stormwater through green stormwater infrastructure/LID in combination with conventional stormwater management.

APPENDIX

1.4.3.10 MECP Subwatershed Planning Guide (Draft) (2022)

The MECP prepared the Draft Subwatershed Planning Guide (2022) to support cohesive stormwater management throughout the Province and to update current guidance from 1993 around Subwatershed Planning.

This Guide was prepared in order to serve as a method for implementing land use policies related to watershed and subwatershed planning in coordination with planning for water, wastewater and storm water servicing, water resources, drinking water source protection and climate change resilience. The document provides details to guide municipalities in creating subwatershed plans that algin with the goals and objectives of other provincial plans.

> **1.2** This guide promotes consistent application of provincial policies and programs and offers a valuable administrative, planning and technical framework for:
>
> (1) Protecting, improving, or restoring the quality and quantity of water in a watershed.
>
> (2) Mitigating potential risk to drinking water sources.
>
> (3) Mitigating potential risk to public health or safety or of property damage from flooding and other natural hazards and the impacts of a changing climate.
>
> (4) Clarifying roles and responsibilities among municipalities, provincial ministries and conservation authorities.

The Guide does not provide specific guidance related to onsite controls, however, does identify LID BMPs as stormwater management strategy a municipality should consider when preparing the implementation and management strategies section of their subwatershed plans.

> **3.3.3** Any environmental assessment and/or master planning processes that are required for water, wastewater or stormwater infrastructure within the subwatershed area should be aligned with the findings and recommendations of the subwatershed plan… Various management practices are outlined to guide how the following (in many cases related) matters will be addressed;
>
> (1) LID BMP

1.4.3.11 MECP Interpretive Bulletin (2015)

In 2015, the MECP, then known as the Ministry of the Environment and Climate Change, released the *Interpretation Bulletin: Ontario Ministry of Environment and Climate Change Expectations Re: Stormwater Management* to outline the Ministry's emphasis on source control measures to replicate a site's natural hydrology and provide further guidance for stormwater management plans and practices. The 2015 MECP Interpretation Bulletin was subsequently updated by the CLI ECA. The 2015 Interpretation Bulletin however remains relevant to municipalities specifically to encourage LID measures to be implemented on sites not subject to the CLI ECA. Please refer to section 2.2.1.5 for a summary of the CLI ECA.

The Bulletin states that conventional stormwater management practices can allow precipitation runoff to convey contaminants into natural ecosystems, reducing the water quality of streams, fish and wildlife habitat, and other aquatic resources. To maintain water quality, MECP emphasized an approach to control precipitation where it falls by employing techniques for LID, such as lot level and conveyance measures. LID techniques can be applied to reduce the volume of runoff from urban areas and help maintain the hydrologic cycle, an important aspect of development as urbanization increases throughout Ontario. Furthermore, as climate change continues to impact municipalities, newly constructed stormwater management facilities are expected to perform under conditions substantially different than historically.

Prior to the CLI ECA, natural hydrology as part of the performance criteria was not directly reflected in the ECA applications submitted to MECP for stormwater management systems. As noted above, the 2015 MECP Interpretation Bulletin, encouraged ECA applicants to use LID practices and to arrange pre-consultation sessions with MECP, relevant approving municipalities, and local conservation authorities, allowing opportunities for the incorporation of LID practices to be considered early in the development process during the watershed and subwatershed planning phase, as opposed to during the detailed stormwater management plan submission. The new CLI ECA process requires the foregoing as part of the system performance criteria and applicants “must” consider LID practices as part of the recommended stormwater management controls.

The principles for LID stormwater management practices are outlined in the Ontario Environmental Protection Act (EPA); Ontario Water Resources Act; Water Management Policies, Guidelines, Provincial Water Quality Objectives (PWQO) of the Ministry of the Environment and Climate Change (also referred to as the “Blue Book”); and Stormwater Management Planning and Design Manual published in March 2003. Since 2015, MECP has expected that stormwater management plans will follow findings of any watershed, subwatershed, and/or environmental management plans and apply LID practices to maintain the natural hydrologic cycle as much as possible.

APPENDIX

1.5 Conservation Authority Guidance

Conservation Authorities play an important role in regulating development to protect the natural environment and water resource system across municipal boundaries. The City of Hamilton falls within the jurisdiction of four conservation authorities, each of which administers polices and plans to regulate development within their jurisdiction.

1.3.1 Hamilton Conservation Authority (HCA)

1.3.2 Conservation Halton (CH)

1.3.3 Niagara Peninsula Conservation Authority (NPCA)

1.3.4 Grand River Conservation Authority (GRCA)

1.5.1 Hamilton Conservation Authority

The following Hamilton Conservation Authority (HCA) documents have been reviewed:

1.3.1.1 HCA Strategic Plan 2019 - 2023

1.3.1.2 HCA Planning and Regulation Policies and Guidelines

1.5.1.1 HCA Strategic Plan 2019-2023, 2019

The HCA Strategic Plan identifies priority areas for the development and implementation of programs, projects, and actions throughout the 2019 to 2023 period. These priority areas include water management, organizational excellence, natural heritage conservation, conservation area experience, and education & environmental awareness.

The water management priority area identifies goals related to developing climate change goals, maintaining and enhancing flood control infrastructure to address flooding and work to augment low flow conditions, and investing in programs to address the impacts of nutrient and sediment loading on watershed streams, creeks, rivers and receiving water bodies.

1.5.1.2 HCA Planning and Regulation Policies and Guidelines, 2011

The HCA Planning and Regulations Policies and Guidelines provides guidance for planning and development activities as they relate to lands within the HCA's jurisdiction. This document includes polices related to watershed planning, stormwater management, natural hazards, natural heritage, and source water protection. Section 12.1 outlines general policies that are required for any SWM proposal within the Authority's watershed. This section states each proposal should utilize BMP's, and should provide all opportunities for protection and rehabilitation of natural features and their ecological functions.

:

1.5.2 Conservation Halton

The following Conservation Halton (CH) plans and policies have been reviewed:

1.3.2.1 CH Policies and Guidelines for the Administration of O.Reg 162

1.3.2.2 CH Guidelines for Stormwater Management Engineering Submissions

1.3.2.3 CH Guidelines for Landscaping and Rehabilitation Plans

1.5.2.1 CH Policies and Guidelines for the Administration of O.Reg 162, 2020

The CH Policies and Guidelines for the Administration of O.Reg 162 provides policy direction for lands within the CH jurisdiction. This document includes policies for the management of watercourses, valley lands hazardous lands and wetlands.

Policy objectives relevant to this Study include:

- Participation in comprehensive environmental studies to inform planning and development related decisions
- Planning and implementation of infrastructure to protect, restore and enhance the hydrologic function of watercourses. This includes implementation of stormwater management infrastructure providing water quality protection, water quantity protection, and erosion protection
- Restrictions on development limits and activities to protect valley lands, wetlands, significant habitat of endangered species and threatened species, fish habitat, woodlands, wildlife habitat, significant areas of natural and significant interest, and sensitive groundwater features

1.5.2.2 Conservation Halton Guidelines for Stormwater Management Engineering Submissions, 2021

The CH Guidelines for Stormwater Management Engineering submissions identifies regulatory and technical requirements, including SWM criteria and objectives, SWM practices, and hydrologic management requirements. Included in Section 3.1 of the document is a subsection on LID techniques. This section encourages the use of LID techniques in SWM strategies and defers to the Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) Low Impact Development Stormwater Planning and Design Wiki Guide to guide LID techniques.

1.5.2.3 Conservation Halton Guidelines for Landscaping and Rehabilitation Plans, 2021

The CH Guidelines for Landscaping and Rehabilitation Plans identifies regulatory and technical requirements, including the general requirements and project specific standards for planting and landscaping plans. Appendix 1, Section A indicates LID as a design consideration for approvals and recommends submissions include suitability of LID for proposed projects.

1.5.3 Niagara Peninsula Conservation Authority (NPCA)

The following Niagara Peninsula Conservation Authority (NPCA) plans and policies have been reviewed:

1.3.3.1 NPCA Policy Document: Land Use Planning and Review Policy

APPENDIX

1.3.3.2 NPCA Stormwater Management Guidelines

1.3.3.3 Erosion and Sediment Control Guideline for Urban Construction

1.3.3.4 Lake Ontario Shoreline Management Plan

1.5.3.1 NPCA Policy Document: Land Use Planning and Review Policy, 2020

The NPCA Land Use Planning and Review Policy document provides the principals, objectives, and policies for the administration of the NPCA's mandate under O.Reg 155/06. This document provides a guide for decision making for NPCA staff, landowners, developers, municipal planners and residents, and includes detailed policies to manage flooding, erosion, development and infrastructure. Chapter 12 of this document encourages the use of LID and green infrastructure for climate change adaptation and mitigation.

1.5.3.2 NPCA Stormwater Management Guidelines, 2010

The NPCA Stormwater Management Guidelines provides a long-term plan to guide the safe and effective management of runoff in urban and urbanizing areas through the use of detailed SWM, erosion, and sediment control policies for existing and proposed development in the NPCA watershed. This document encourages maximizing opportunities for SWM at the site level, citing LID as the recommended approach within the NPCA watershed. Section 7 of this document outlines SWM BMP's, which support source and lot level quantity control, conveyance controls, and end-of-pipe controls. This section also encourages the use of permeable pavements, rain gardens, buffers, filter strips and other LID practices within the NPCA watershed.

:

1.5.3.3 Erosion and Sediment Control Guidelines for Urban Construction, 2006

The Erosion and Sediment Control Guidelines for Urban Construction provide proponents and practitioners with a review of erosion and sedimentation processes, elements of an effective erosion and sediment control plan, and offers methods to manage erosion and sediment control. This document identifies key roles and responsibilities, environmental management and details on developing an erosion and sediment control plan, which includes the report, drawings, worksite isolation plan and a spill control and response plan.

1.5.3.4 Lake Ontario Shoreline Management Plan, 2009

The NPCA Lake Ontario Shoreline Management Plan provides a guidance on managing shoreline hazards along Lake Ontario. These shoreline hazards include flooding, wave uprush, erosion, and dynamic beach hazards. The plan then identifies methods to manage these hazards to protect the shoreline and reduce adverse environmental impacts.

1.5.4 Grand River Conservation Authority (GRCA)

The following Grand River Conservation Authority (GRCA) plans and policies have been reviewed:

1.3.4.1 GRCA Consolidated Policies for Implementing O.Reg 150/06

1.3.4.2 Policies and Procedures for Compliance with Consolidated Policies

1.5.4.1 GRCA Consolidated Policies for Implementing O.Reg 150/06, 2015

The GRCA Consolidated Policies for Implementing O.Reg 150/06 outlines policies used by the GRCA to manage the watershed, and provides guidance for planning and development activities. This document includes policies on river or stream valleys, wetlands, the Lake Erie shoreline and water management reservoirs. Section 8.1.14 provides policies for Stormwater Management, and includes regulations related to Stormwater Management Facilities.

1.5.4.2 Policies and Procedures for Compliance with Consolidated Policies, 2009

This document compliments the consolidated polices for implementing O.Reg 150/06 by outlining the policies and procedures for compliance followed by the GRCA when inspecting approved activities, investigating possible and confirmed violations under the Regulation, and initiating court proceedings, if necessary.

1.6 Municipal Policies, Plans and Strategies

Municipal guidance directs stormwater management through strategic policies found in Plans, Strategies and Guidelines. The following municipal documents have been reviewed:

1.4.1 Rural Hamilton Official Plan

1.4.2 Urban Hamilton Official Plan

1.4.3 Urban Hamilton Official Plan Amendment 176

APPENDIX

1.4.4 Hamilton Climate Emergency Declaration

1.4.5 Hamilton Climate Change Impact Adaptation Plan

1.4.6 Recharge Hamilton: Community Energy and Emissions Plan

1.4.7 Taking Action on Climate Change in Hamilton – A Community Plan

1.4.8 Corporate Climate Change Task Force

1.4.9 City-Wide Water and Wastewater Master Plan

1.4.10 Stormwater Management Master Plan

1.4.11 Water, Wastewater, and Stormwater Master Plan (Under Development Targeted for 2023 completion)

1.4.12 Flooding and Drainage Improvement Framework

1.4.13 Guidelines for Hydrogeological Studies and Technical Standards for Private Standards

1.4.14 Storm Drainage Policy and Guidelines for Stormwater Infrastructure Design (2004)

1.4.15 Development Charges Background Study

1.4.16 Complete Streets Design Guidelines

1.4.17 Hamilton Eco-Industrial Design Guidelines

1.4.18 Airport Employment Growth District (AEGD) Wastewater System Capacity Allocation Policy

1.4.19 Comprehensive Development Guidelines and Financial Policies Manual

1.6.1 Rural Hamilton Official Plan, 2013

The Rural Official Plan (2013) provides policy direction for the Rural areas in the City of Hamilton, and contains policies related to natural and cultural heritage, transportation, infrastructure and community services. Chapter B, entitled Communities, contains policies that direct the physical shape and quality of the built, natural, social and cultural environments, specifically Section 3.7 which identifies policies for energy and environmental design, as identified below:

3.7.1 The City shall support energy efficient, low impact, and environmental designed development through:

j) water and storm water conservation/management practices such as green roofs, water recycling systems, etc.

m) other environmental development standards that encourage energy efficiency and environmental design as contained in the City's approved engineering policies and standards and master planning studies, and are supported by the City's financial incentive programs

Chapter C contains designations and land use policies that apply in both rural and urban areas to provide consistent approaches to how open spaces, natural heritage, transportation, and infrastructure areas are managed. Subsections within section 2.12 identifies specific policies for managing water resources, as included below:

C2.12.1 The City shall protect, improve or restore the quality and quantity of water by using the watershed as the ecologically meaningful scale for planning and minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts. At such time as source water protection policies are developed in accordance with the Clean Water Act, the City will amend this Plan

C2.12.2 The City shall promote efficient and sustainable use of water resources, including practices for water conservation and sustaining water quality

C2.12.3 Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved, or restored. Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions

1.6.2 Urban Hamilton Official Plan, 2013

The City of Hamilton Urban Official Plan (2013) provides policy direction and guidance on the management of communities, land use changes and physical development over the next 30 years. The City of Hamilton has recently undergone a Municipal Comprehensive Review (MCR), a required process for the municipality to update policies and guidelines in their Official Plan. Policies related to LID have been updated during the MCR process to further encourage green infrastructure and sustainability. A detailed review these policies can be found in section 4.4.3 of this report.

Chapter B of the Urban Official Plan details policies that strive to create complete communities that are healthy, diverse, and vibrant. Policies in Chapter B promote environmental sustainability, as outlined in the following sections:

B.3.3.2.8 Urban design should promote environmental sustainability by:

b) integrating, protecting, and enhancing environmental features and landscapes, including existing topography, forest and vegetative cover, green spaces and corridors through building and site design

c) encouraging on-site stormwater management and infiltration through the use of techniques and technologies, including stormwater management ponds, green roofs, and vegetated swales

B.3.3.10.8 Parking lots shall be paved with hard surfaces to reduce dust and promote improved air quality. The use of permeable pavement systems or other low impact development practices is encouraged for stormwater management, when technically possible

1.6.3 Urban Hamilton Official Plan Amendment 167, 2022

The City of Hamilton has recently undergone a Municipal Comprehensive Review (MCR), a required process for a municipality to update policies and guidelines in their Official Plan. Official Plan Amendment (OPA) 167 is a means for the MCR to introduce updates to the Official Plan. As of November 4, 2022, the Ministry of Municipal Affairs and Housing made the decision to approve amendment 167, and changes to the Urban Official Plan. In the context of LID, Chapters B and C have seen significant updates to further encourage LID within the City of Hamilton, as identified below:

Chapter B

B.3.3.2.8 Urban design should promote the reduction of greenhouse emissions, ability to adapt to the *impacts of a changing climate* now and in the future, and protect and enhance the natural urban environment by:

c) encouraging on-site storm water management and infiltration through the use of techniques and technologies, including storm water management ponds, green roofs, vegetated swales, and other *low impact development techniques* and *green infrastructure*

d) encouraging the use of Leadership in Energy and Environmental Design (LEED), R2000 Home, Passive House, Canadian Green Building Council's Zero Carbon Standard, or other environmental building rating tools and techniques that reduce energy consumption and greenhouse gas emissions for buildings and infrastructure for all *development* and *redevelopment*

B.3.3.10.8 Parking lots shall be paved with hard surfaces to reduce dust and promote improved air quality. The use of permeable pavement systems or other *low impact development* and *green infrastructure* practices is encouraged for storm water management, when technically possible.

B.3.7.3 The City shall develop and update Sustainable Building and Development Guidelines, including a development checklist, to promote energy efficient development and redevelopment proposals, and implement the Guidelines through the development approvals process.

Chapter C

C.5.3.18 The City shall implement actions and strategies that will reduce greenhouse gas emissions and address climate change adaptation goals, including but not limited to:

a) assessing *infrastructure* risks and vulnerabilities and identify actions and investments to address these challenges

b) undertaking stormwater management monitoring, analysis and planning that assess the *impacts of a changing climate* and incorporate the appropriate actions, which may include *green infrastructure* and *low impact developmen*t

C.5.4.1 The City shall maintain and update a Stormwater Master Plan, which is informed by the policies of Section C.2.8 – Watershed Planning, and provides direction for:

d) incorporate *low impact development* and *green infrastructure*, in accordance with Section C.5.6 – Green Infrastructure

e) identify the need for stormwater retrofits, where appropriate

f) identify the full life cycle costs of the stormwater *infrastructure*, including maintenance costs, and develop options to pay for these costs over the long-term

C.5.6.1 The City will encourage the use of *green infrastructure* in accordance with Section B.3.3 – Urban Design, including but not limited to:

a) The incorporation of *low impact development* techniques, such as:

i) rainwater harvesting, rain gardens, and bioswales

ii) permeable pavements

iii) green roofs

1.6.4 Hamilton Climate Emergency Declaration

Hamilton declared a Climate Emergency in March of 2019. This kickstarted the multi-departmental "Climate Change Task Force" that will identify ways to achieve net-zero carbon emissions by 2050. The declaration requires the creation of a multi-departmental Corporate Climate Change Task Force comprised of City of Hamilton Staff, tasked with investigating and identifying green initiative investments and returns for the community, as well as identifying gaps in current City programs and projects.

1.6.5 Hamilton Climate Change Impact Adaptation Plan, 2022

The Climate Change Impact Adaptation Plan was created with International Council for Local Environmental Initiatives (ICLEI) – Local Governments for Sustainability, a global network of local and regional governments committed to sustainable urban development, using their Building Adaptive and Resilient Communities (BARC) framework. This plan was made with extensive consultation with various City departments, community organizations such as local businesses and environmental organizations, and institutions such as school boards and post-secondary academic institutions. This plan identifies four themes of resilient adaptations, objectives for each theme, and actions to carry out the objective, as included below:

1. **Built Environment:** The first objective for this theme focuses on incorporating climate change into future land use, development and construction through the incorporation of LID features and green infrastructure into new development and redevelopment projects. Other actions include developing guidelines and incentives to improve resiliency in buildings and conduct more studies to determine flooding and other extreme weather risks. The second objective for this theme is to reduce transportation disruptions due to extreme weather events by improving winter travel conditions and encouraging safer travel practices.
2. **People and Health:** This theme identifies objectives related to protecting vulnerable populations avoid or reduce health impacts of extreme weather, improving community preparedness and resilience to respond to climate risks, monitor and plan for the potential introduction of new vectors and increased vector-borne illnesses in the community, and creating conditions that minimize health and safety risks to outdoor workers and community members.
3. **Natural Environment, Agriculture and Water:** Objectives for this theme include proactively conserving and protecting surface water and groundwater sources, improve the diversity and resilience of urban trees and forests, and strengthen food security in the City.
4. **Energy and Economy:** This final theme focuses objectives on enabling local businesses and organizations to plan for climate related risks and improving the resilience of energy infrastructure to weather-related disruption.

This plan outlines an implementation schedule which identifies approximate timelines for each action, immediate next steps, lead organizations taking charge of the action, monitoring metrics and the priority impacts addressed.

1.6.6 ReCharge Hamilton: Community Energy and Emissions Plan, 2022

Recharge Hamilton is a Community and Energy Emissions Plan, and acts as part 1 to the City of Hamilton's Climate Change Strategy. The plan identifies five areas of transformation to lead Hamilton to net-zero, as listed below:

1. Innovating Our Industry: actions that support the city's industry in decarbonizing
2. Transforming Our Buildings: actions that support retrofitting existing buildings to be energy efficient and encourage fuel switching
3. Changing How We Move: actions that focus on increasing the modal split of transit and reducing automobile dependency
4. Revolutionizing Renewables: actions that promote renewable energy generation
5. Growing Green: actions that promote carbon sequestration through the growth of the City's tree canopy and preserving the City's existing natural heritage features

Of relevance is the fifth area of transformation, Growing Green, as it encourages naturalized elements within the city through green infrastructure projects such as natural bio swales and rain gardens to facilitate rainwater capture.

1.6.7 Taking Action on Climate Change – A Community Plan, 2015

The Taking Action on Climate Change in Hamilton is a community-based plan that encourages the implementation of climate change mitigation and adaptation techniques. To achieve this, the plan identifies 10 priorities for action. Priority 4, found in section 3 of the plan, is to revise and update municipal infrastructure guidelines to prioritize LID as a preferred method for stormwater management. This is through encouraging LID and designing built areas with absorbent green spaces and permeable hard surfaces to reduce the risks associated with extreme weather events.

Section 6 revisits the topic of LID during its discussion of actions to address climate change. This section identifies near term initiatives, implementers, supporting implementers, funding sources, and timeline. Near term initiatives identified in this section related to LID include:

- Reducing the impacts of new developments and manage stormwater runoff through LID and create a separate stormwater rate structure, restructure funding mechanisms to separate stormwater rates from water rates to create equity between residential and commercial / industrial users
- Encourage / facilitate the use of storm water best management practices on private property (rain barrels, rain gardens, green roofs, disconnecting downspouts)
- Develop updated flood mapping and publicize to promote awareness of risk

1.6.8 Corporate Climate Change Task Force, 2019

The Corporate Climate Change Task Force Report provides a foundation for a corporate-wide climate change framework. This document identifies 9 goals related to buildings, active and sustainable travel, transportation, planning, protection of the natural environment, climate adaptation, health, and education. Each goal highlights high impact actions, areas of focus for further work, a reporting timeline, and the city department that will lead action. These high impact actions provide an avenue for businesses in the City to reach the City's goal for 50% carbon neutrality by 2030, and complete neutrality by 2050.

1.6.9 Water and Wastewater Master Plan, 2006

The Water and Wastewater Master Plan was completed by the City of Hamilton in 2006, and will be replaced by the Water, Wastewater, and Stormwater Master Plan upon its release in 2023. The Water and Wastewater Master Plan provides the City with a waster and wastewater servicing strategy in support of the preferred growth option, identified the Growth Related Integrated Development Strategy (GRIDS). The GRIDS process identifies ideal places for growth in the City to identify strategies to fund the servicing of those areas, considering environmental priorities, social issues, economic opportunities, and population.

1.6.10 Stormwater Management Master Plan, 2007

The Stormwater Management Master Plan provides a practical framework for managing the City's existing storm sewer systems, and provides strategies to protect, enhance, and restore the natural resources of Hamilton's watersheds. This document identifies study areas, goals, alternatives, and provides a preferred stormwater management strategy as well as strategies for implementation. Chapter 10 of the Stormwater Management Master Plan identifies BMP's to facilitate growth in development areas, including source control measures, conveyance control measures, end of pipe measures, and stream restoration measures. Chapter 11 of the plan provides implementation strategies, with sections 11.3.2 and 11.3.3 outlining the steps to a source control program and conveyance control program. Section 11.3.6 of the plan identifies the initial steps for a BMP program for proposed development, including:

- Undertaking subwatershed studies to refine the recommendations of this study, to address the impacts of urbanization and to determine the preferred approach
- Review recent approaches in other jurisdictions
- Promote a progressive approach for integrating stormwater management measures into subdivision / site planning and design
- Using the Working Groups to update and modify current standards and policies
- Update funding approaches and requirements to reflect new approaches
- Consider incentives (credits) for progressive submissions

This plan suggests successful implementation requires changing the mindset of consultants, the municipality, developers, and agencies with respect to the current approach for undertaking stormwater management. It also suggests developing a progressive approach for integrating stormwater management measures into subdivision / site planning and design, as well as modifying existing municipal and agency policies and standards.

1.6.11 Water, Wastewater, and Stormwater Master Plan, 2023

The Water, Wastewater, and Stormwater Master Plan is a strategic and comprehensive growth and infrastructure planning study that will provide a basis for decision making to shape growth in the City of Hamilton. This plan is currently under development with expected release in 2024 and will replace the existing Water and Waster Master Plan and Stormwater Management Master Plan, reviewed in sections 2.4.10 and 2.4.11. Notably, the various infrastructure plans are working to define the infrastructure needs to the 2051 planning horizon and will include details on the requirements for both greenfield and infill / intensification development.

1.6.12 Flooding and Drainage Improvement Framework (2022)

The “Flooding and Drainage Improvement Framework” (the Framework) was initiated in 2021 and involved a holistic review of the City’s combined sewer system, with the goal of developing a framework that outlines a long-term management strategy to address existing flooding and drainage issues. The Framework is structured to provide a high-level roadmap and actionable next steps for the City to better plan for a program of long-term capital improvements and to coordinate these improvements and upgrades within the combined sewer system. The main purpose of the Framework was to review the combined sewer system, on a sewershed basis, in order to establish a better understanding of the local system’s configuration, performance, and potential contributors to flooding, leading to an identification of priorities including potential short and long-term solutions.

The key objectives of the Framework are as follows:

- Holistic review of the recommendations from the Draft Flooding and Drainage Master Servicing Study (FDMSS) for the combined sewer system
- Identification of potential issues
- Develop long-term management vision` and objectives
- Identify short-term localized upgrade options to address priority flooding issues
- Provide basis for prioritization of the upgrade options
- Provide preliminary costing and timeline details to support the short and long-term capital planning process
- Provide a framework and high-level roadmap to support the implementation of recommended solutions

The Framework recommendations are based on a high-level screening and prioritization of available management options with the goal of establishing an overall strategy to address both short and long-term flooding and drainage issues.

1.6.13 Guidelines for Hydrogeological Studies and Technical Standards for Private Services

3.3.4.: Stormwater management infrastructure shall be designed in accordance with City of Hamilton, Criteria and Guidelines for Stormwater Infrastructure Design and Stormwater Management Planning and Design Manual, Ministry of Environment (2003). Where applicable the Hydrogeological Study Report should identify:

a) requirements for stormwater quantity and quality control measures

b) suitable outlet for minor and major system flows including external drainage areas

c) opportunities to provide groundwater recharge through infiltration and other LID components if conditions (existing soil, topography, water quality etc.) permit

d) locations of stormwater management facilities, infiltration galleries, and easements

1.6.14 Storm Drainage Policy and Guidelines for Stormwater Infrastructure Design, 2004

The Storm Drainage Policy specifies storm drainage requirements to be applied to all new land development, re-development lands, and City of Hamilton capital works projects. This policy provides upper-level direction and municipal requirements, and is intended for a broader audience, which includes the public, planners developers and engineers.

Section 3.2.1 of the Storm Drainage Policy states active infiltration measures, such as soakaway pits and rear yard ponding, will be most applicable in permeable soils areas and their use will require supporting soils. It also states passive measures such as disconnection of roof leaders shall be implemented in all areas unless specific constraints preclude these measures. Section 3.2.3 includes policies on stormwater management and states all new development shall implement a stormwater quality management strategy, which considers surface runoff and groundwater in compliance with the existing provincial and municipal policies.

1.6.15 Development Charges Background Study, 2019

The City of Hamilton 2019 Development Charges Update provides a background of stormwater review for water and wastewater, roads, and stormwater development charges in the City of Hamilton. This study provides an overview of the changes and updates affecting the determination process for the stormwater component of the development charges from the 2014 - 2018 period.

Section 3.31 supports LID BMP to complement traditional stormwater management techniques as they have the potential to reduce the scale and scope of conventional end-of-pipe stormwater management systems. The City, through this development charge, has set up an initial Low Impact Development Credit Pool in the amount of $1,500,000, which will be managed through policy created by the City and evolved over time. This section also identifies challenges to implementing LID measures in Hamilton such as the fact that these measures are typically “on-lot” within private control, outside of the direct control of the Municipality. The City is currently updating the 2019 DC By-Law and expects its formal release in 2024 Q1.

1.6.16 Complete Streets Design Guidelines, 2022

The Complete Streets Manual (2022) provides guidelines to creating great public places by integrating design of the right-of-way with surrounding community to create a holistic network of streets and public space. This manual acts as a resource for individuals involved in the planning, design, or maintenance of Hamilton’s roadways. This document provides a detailed overview of creating safe walkable streets in urban and rural areas and discusses the various elements that goes into creating complete streets.

This document details the process of undertaking a complete streets design, elements and typologies to complete streets, and using the complete streets concept to design intersections. Of relevance to this study is section 3.6 which identifies green infrastructure as an element of complete streets. Section 3.6.1 encourages prioritizing low impact stormwater management features such as rain gardens and permeable pavements to complement the traditional storm sewer system by filtering, storing, and reducing runoff near the source of precipitation. Section 3.6.3 further encourages the use of LID as a method for managing the City's operating costs and increasing energy efficiency of the storm water system. This section also identifies certain green infrastructure models as a means to increase the attractiveness of the streetscape and its multifunctional use as a traffic calming device.

1.6.17 Hamilton Eco-Industrial Design Guidelines, 2010

The purpose of the Eco-Industrial Guidelines to provide an integrated set of principles and measures to guide development in the Airport Employment Growth District. The document identifies nine principles related to eco-industrial design elements and includes associated measures for each. These principles include transportation, energy, water and wastewater, stormwater management, materials and resources, economic sustainability, social sustainability, site development, and food production. Though the guidelines are focused within the Airport Employment Growth District of Hamilton, the document provides both optional and required LID measures that can be easily utilized throughout the City. Specifically, Section 2.3 and 2.4 outlines measures for water and wastewater conservation and stormwater management, such as the use of source control measures, conveyance control measures, and end of pipe measures.

1.6.18 Airport Employment Growth District (AEGD) Wastewater System Capacity Allocation Policy (2020)

The City of Hamilton, as the Development Approval Authority, determines and allocates wastewater conveyance and treatment capacity for all approved development. Development approvals cannot and should not be granted or development rights conferred upon a property without receiving servicing allocation, particularly wastewater capacity allocation. This policy notes that where there is limited wastewater capacity available, as in the AEGD, policies and guidelines for the allocation of this capacity are necessary to "provide a consistent, fair, equitable and financially sustainable process" in which wastewater capacity can be managed and aligned with the City's growth strategy and priorities.

Hamilton City Council through the adoption of the Term of Council Priorities, Economic Development Action Plan, Official Plan, annual budgets and other City policy, has provided the framework and guiding principles in determining the capacity allocation priorities. Priorities such as Economic Prosperity and Growth, Clean and Green, and Built Environment and Infrastructure are key in establishing these priorities.

The AEGD Wastewater Capacity Allocation Policy includes the following articles:

- Purpose and Intent;
- City of Hamilton's Role in Determining Wastewater Capacity Allocation;

APPENDIX

— Infrastructure Sustainability Criteria;
— Considerations and Requirements;
— Wastewater Capacity Allocation Confirmation Letter from City;
— Public Interest Projects;
— Revocation of Wastewater Capacity Allocation; and
— Municipal Control;

The long-term servicing strategy for the AEGD is set out in the Water and Wastewater Master Plans which were approved as part of the Ontario Municipal Board decision. These Master Plans are comprised of two Servicing Phases. The development of the Phase One Servicing Area was based on existing Municipal water and wastewater servicing infrastructure provisions at the time of the AEGD approval. Phase Two Servicing Area is dependent on the extension of the Dickenson Road Wastewater Trunk Sewer project.

While there is minimal residential development within the AEGD, the following sections are considered relevant to stormwater management:

Article 1 – The City's Role in Determining Wastewater Capacity Allocation

1 The City, as the provider and operator of the wastewater treatment and conveyance system is the owner of the system capacity. As such, the City approves wastewater system capacity (conveyance and treatment) based on the assigned population densities of the area and a per capita per day value of water consumption plus an infiltration index.

2 The City, as the approval authority, grants wastewater system capacity allocation to lands through approval of development applications regulated by the Planning Act, a change of use through a building permit application, or application for servicing permit.

3 In consultation with the development community, the City administers a Staging of Development Program in accordance with the Urban Hamilton Official Plan (Chapter F, Section 3.6) for development proposals including those within the Catchment Area (see attached **Appendix A**).

4 The City determines the available wastewater system capacity on an on-going basis and grants available capacity in consultation with applicants / developers based on a set of sustainability criteria and other considerations and requirements which guide decisions on allocation.

Article 2 – Infrastructure Sustainability Criteria:

1 Infrastructure Sustainability Criteria, as defined below, will be used as a guide in determining the merits of allocating wastewater capacity in the Catchment Area by establishing if the development proposal:

- Maintains and optimizes the use of existing City infrastructure;
- Minimizes the cost for provision of new City infrastructure;
- Facilitates the development of complete communities;
- Supports other City policies such as the Corporate Strategic Plan to promote economic prosperity and growth; the Official Plan, the AEGD Secondary Plan, Zoning By-law, the Economic Development Strategy and all relevant Master Plans; and,
- Demonstrates an ability to readily develop/proceed.

Article 3 – Considerations and Requirements

2 The Policy will generally apply to any development application that results in approval to physically develop or service land and/or reduces available wastewater system capacity. Applications such as Formal Consultation, Re-zoning and Official Plan Amendments would not qualify on their own for wastewater allocation under the Policy because these applications do not result in approval to physically develop or service land.

3 Allocation of capacity is premised on the basis that adequate downstream conveyance capacity availability has been verified to the satisfaction of the City.

4 A wastewater generation report must be submitted to support allocation of wastewater capacity. The report, including sanitary sewer capacity assessment calculations, shall be prepared based on the engineering parameters and methodologies specified in the City's Development Guidelines and Standards, Adequate Services By-law and provincial regulations.

5 Additional wastewater capacity allocation (i.e. over and above the existing use) required for residential redevelopment / infill projects is generally limited to the as-of-right zoning designation of the property.

1.6.19 Comprehensive Development Guidelines and Financial Policies Manual (2019)

The Comprehensive Development Guidelines and Financial Policies Manual (2019) details development engineering requirements in relation to:

- Subdivision and site plan process requirements;
- Sanitary sewers and wastewater treatment;
- Storm sewers and stormwater management;
- Watermains and water supply;
- Roadways, including asphalt pavement, curbs, subdrains, sidewalks, walkways, retaining walls, fencing and noise barriers;
- Tree planting and sodding of boulevards;
- Lot grading;
- Street lighting and municipal consent for construction of utilities; and
- Financial policies.

APPENDIX

These engineering requirements should be followed during any new development process and comply with provincial and municipal policies. Under this policy, building permits would only be issued after the Site Plan has been approved, as per:

B.6. Building Permits

Building permits will be issued after Site Plan Approval has been granted and may require the posting of securities. As part of the Concurrent Review Process, there is a waiver that must be signed, see Appendix N – Acknowledgement for Concurrent Building Permit Review Process. Refer to Submission Requirements and Application Form for Site Plan Control.

Further, the engineering requirements for site plan approval include stormwater management, noting that uncontrolled stormwater runoff may result in flooding, soil erosion, and pollution of watercourses. The general standards for stormwater management encourage utilizing on-site stormwater management through the following guidelines (B.8.9):

- Drainage must remain internal to the site unless otherwise approved.
- Every parking area, where storm sewers are available, shall be drained in accordance with Section 9 of By-Law No. 06-026.
- Townhouses, commercial and industrial buildings cannot connect roof leaders to the storm sewers unless the applicant provides a site design, including an appropriate Stormwater management study prepared by a qualified Engineer (City of Hamilton Site Plan Control, Draft Grading Plan Requirements)

Section G of this policy details stormwater management design characteristics and developed in cohesion with the Storm Drainage Policy, best management practices, and provincial standards. The City supports the implementation of source controls where feasible, which would usually be determined in a Subwatershed Study or other form of Master Plan. However, if such studies do not exist or are not applicable to the proposed development, the Proponent shall consider the application of source controls as a BMP. Further, a Development Impact Monitoring Plan should be submitted and approved by the City, with optional input from the Conservation Authorities and Niagara Escarpment Commission. The purpose of the monitoring plan is to reduce or eliminate adverse impacts due to changes to runoff quality and quantity.

To manage flooding from new development or redeveloped areas, this policy has the following components in Section G.5.3.1:

- All newly developing or redeveloping areas must assess their potential impacts on local and regional flooding, mitigate accordingly. In areas where no watershed plan has been completed, it is the policy of the City of Hamilton to require that runoff peak flows are controlled to pre-development levels or less, unless the Proponent can demonstrate through appropriate modelling and analysis that uncontrolled flow will not cause detrimental impacts on flood conditions on

downstream properties and watercourse systems. Before the City will accept any increase in runoff rates, it must also receive endorsement from the agencies having jurisdiction. In certain site-specific circumstances, the City may require that post development flows be controlled to less than pre-development levels. As such, discussion regarding the over-control of post development flows would be required with the City.

- Where Watershed, Subwatershed or Master Drainage Plans have been completed, the Development Proponent will be required to comply with the recommendations of the specific plan. Any variations will need to be appropriately supported by detailed analysis and also be approved by any agencies having jurisdiction.

Alternatively, if on-site stormwater management cannot be provided by the Proponent, cash-in-lieu can be given towards off-site stormwater management infrastructure in a different area of the City. Usually this would only apply towards low sensitivity receiver, limited rehabilitation opportunities, and very small development or infill.

APPENDIX

B BACKGROUND REVIEW

REVIEW OF INDUSTRY PRACTICES – KEY FINDINGS

ONTARIO

SUSTAINABLE TECHNOLOGIES EVALUATION PROGRAM (STEP)

Low Impact Development Stormwater Management Planning and Design Guide (STEP, 2022)

LID BMP Fact Sheets

Please find below a collection of the most common LID Best Management Practices for both Development, Planning and Design. These fact sheets provide helpful details on:

- Design Considerations
  - Geometry and Site Layout
  - Pre-Treatment (if applicable)
  - Conveyance and Overflow
  - Proper Landscaping Techniques
  - Access Structures, etc.
- Construction
  - Soil Disturbance and Compaction
  - Erosion Sediment Control (ESC)
  - Excavation
  - Base Construction (if applicable), etc.
- Planning Considerations
  - Soil
  - Wellhead Protection (if applicable)
  - Karst (if applicable)
  - Site Topography
  - Setback Distances
  - Proximity to Underground Utilities, etc.

The fact sheets also include helpful details on overall, general specifications associated with key materials of the given LID installation, associated pictures, plan and profile views of LID cross section schematics, etc. These fact sheets are to be used to help practitioners understand the benefits and key details associated with the implementation of these various LID practices and offers a great introductory look into appropriate LID practices for their given needs.

Low Impact Development Life Cycle Costing Tool

Accurately estimating the life cycle costs for low impact development (LID) practices can be a complicated process. The LID Life Cycle Costing Tool (LCCT) helps make this process easier and allows users to produce realistic cost estimates based on user-specified LID design and operation and maintenance assumptions. The LCCT provides cost estimates for the construction, inspection, and maintenance of LID stormwater practices over 25- and 50-year timeframes.

TORONTO

Toronto Green Streets Technical Guidelines (City of Toronto, 2017)

3.4. Technical Drawings

Guideline Drawings have been prepared for most of the options listed in the GI Selection Tool. The drawings contain the information necessary to develop site specific construction details, including:

- Materials - Standards and Depth/Sizing Calculations
- Geometry and Site Layout
- Underdrains • Conveyance / Overflow
- Monitoring Wells
- Plant Material

4.0. Selection Tools

The GI Selection Tool assists users to identify a palette of GI options for a site given its specific characteristics. A sub-tool called the Vegetation Selection Tool has also been provided as part of this guideline to identify appropriate plant material for vegetated GI options. The GI Selection Tool is excel-based system. This screening process allows for a palette of viable GI options to be identified based on specific site criteria.

5.1. Operations & Maintenance

The Sustainable Technologies Evaluation Program (STEP) LID Life Cycle Costing Tool provides an effective mechanism to assist City staff in generating planning-level estimates of life-cycle costs including construction, inspection, maintenance and rehabilitation. Additional budget considerations should include:

- Any increase in costs to maintain GI options over and above what would have been required in a "business-as-usual" case;
- Opportunities to synthesize GI and routine maintenance regimes;
- Additional equipment and staffing requirements; and,
- Education and training for all O&M staff.

6.1.2. Monitoring Approach

Depending on the type of GI, monitoring may be undertaken as part of inspection work prior to assumption and periodically throughout the operating phase to comply with ECA conditions, support the City's (stormwater) infrastructure asset management program and inform revisions to improve design standards/specifications. The TRCA LID I&M Guide (TRCA, 2016) is the definitive resource document on the topic of LID operation, inspection and maintenance in Ontario. The guide provides detailed guidance on indicators to inspect / test / monitor, standard sampling procedures and testing methods, acceptance criteria / triggers for follow-up action and repair / rehabilitation work required for each type of LID BMP through construction and operating phases of their life cycles. The Guide recommends continuous performance monitoring for stormwater infiltration practices as part of assumption inspections during the establishment / warranty period and performance verification inspections every 15 years post-construction at a minimum. The recommended framework is designed to rely on visual indicators that can be assessed by all levels of staff and includes inspection types, frequencies and testing indicators.

BURLINGTON

Stormwater Management Design Guidelines (Wood Environment & Infrastructure Solutions, 2020)

6.1.4.5. Low Impact Development Best Management Practices (LID BMPs)

The City of Burlington encourages proponents to implement LID BMPs wherever practical to address the requisite water quality control criteria for their site as well as complementary benefits for water balance and erosion control. Potential LID BMPs which are supported by the City include (but are not limited to):

- Bioretention areas and bioswales
- Vegetated filter strips
- Enhanced grassed swales
- Permeable pavements (asphalt, concrete, and paving stones)
- Soakaway pits and infiltration chambers
- Exfiltration pipes
- Pre-fabricated modules (including soil retention cells) and tree pits
- Green Roofs

The selection and design of LID BMPs must consider site characteristics, including but not limited to:

- Local groundwater table elevation (seasonal maximum)
- Subsurface soil type(s) and associated permeability/infiltration capacity (minimum soil infiltration rate of 15mm/hr).
- Depth to bedrock

- Sub-surface utility conflicts
- Existing zoning and land use, including legacy contamination sites
- Existing groundwater use including downgradient groundwater receptors (e.g. private wells, wetlands, source water protection areas, etcetera)
- Long term Operations and Maintenance requirements

LID BMPs are also supported by the City of Burlington to address erosion control and water balance retention requirements. Acceptable on-site locations for LID BMPs are to be established in consultation with City staff based on the preceding site characteristics and justified to the satisfaction of the City. Where subsurface LID BMPs are proposed, it is recommended that an additional water quality treatment measure be placed upstream, to prevent clogging and improve long term functionality.

OTTAWA

Low Impact Development Technical Guidance Report (Aquafor Beech Limited & Dillon Consulting, 2021)

2.2. General LID Constraints

Any proposed development site may contain a number of general constraints which may restrict the use of LID approaches or result in the use of alternatives to obtain design targets. While a variety of these constraints may occur in a location, site investigations completed early within the project schedule allow for identification of any such constraints as well as time to incorporate design alterations to address any identified constraints. While not necessarily all geotechnical or hydrogeological in nature, the general constraints to LID include:

1. Low hydraulic conductivity soils;
2. Sensitive clays or unstable sub-soils;
3. High groundwater or areas where increased infiltration will result in elevated groundwater levels which can be shown to impact critical utilities or private property;
4. Shallow bedrock and areas of blasted bedrock;
5. Karst or micro-karst;
6. Areas proximal to existing development on private services, particularly where shallow potable water wells may be present;
7. Contaminated soils (i.e. Brownfields);
8. High Risk Site Activities including spill prone areas. Infiltration-based LID practices should not accept runoff from catchment areas that are associated with high risk site activities;
9. Prohibitions and or restrictions per the approved Source Protection Plans;
10. Flood risk prone areas where wastewater systems have been shown through technical studies to be sensitive to groundwater conditions that contribute to extraneous flow rates that cause property flooding / sewer back-ups and where LID BMPs have been found to be ineffective;
11. Surface water dominated or dependent features including but not limited to marshes and/or riparian forest wetlands which derive the all or a majority of their water from surface water, including streams, runoff, and overbank flooding. Surface water dominated or dependent features which are identified through approved site specific hydrologic or hydrogeologic studies, and/or Environmental Impact Statements (EIS) may be considered for a reduced volume control target. Consultation with the MECP and local agencies is required;
12. Existing urban areas where risk to life, property or infrastructure has been identified through an appropriate area specific study;
13. Limitations on Available Area to implement the LID on-site;
14. Existing utilities;
15. Mature Trees; and,
16. Typical Ratio of Impervious drainage area to treatment area facility.

3.3: Geotechnical Investigations

Investigation requirements to support LID implementation overlap in part with the required geotechnical investigations to support development. The City Geotechnical Investigation and Reporting Guidelines for Development Applications

outlines the geotechnical requirements for site plan approval, plan of condominium, building permits, and draft plans of subdivision. The investigations required for LID measures should be completed coincident with the required geotechnical investigations. The extent of the geotechnical investigation may be increased based on soil conditions present at the site.

3.5.3: High Groundwater

In Ontario the required vertical separation between a practice and the water table or bedrock is frequently cited as 1 meter. This comes from the 2003 Stormwater Management Planning and Design Manual. Per the TRCA Wiki "whilst this is a great rule of thumb, like all aspects of LID, this 1 m figure might require amendment on a site-by-site basis. In areas where a 1.0 m separation cannot be provided, or where conditions dictate that an even greater separation may be warranted, additional discussion and/or analysis specific to the physical characteristics of the site and the proposed design should be completed.

BARRIE

Infiltration Low Impact Development Screening Process (City of Barrie, 2017)

2.0. Proposed Approach

The first step is a location suitability screening that considers drinking water vulnerable areas and the general water quality characteristics of the stormwater to be infiltrated. If based on these two factors the infiltration facility is deemed permitted the project can immediately proceed to the third step of the process. However, if it has been deemed permitted with conditions it will require to go through the second step of the screening process. During the second screening the application or project must meet additional requirements set by the Infiltration LID Working Group. Finally the third step of the process ensures that all other legislative requirement, including federal and provincial requirements as well as City of Barrie policies and standards are met. In all cases where infiltration LIDs are not appropriate given conditions, consideration should be given to filtration and storage type LIDs.

The first step of the screening process is designed to screen areas where infiltration LIDs would be suitable based on Source Water Protection vulnerable area, and the general water quality characteristics of the stormwater to be infiltrated in the LID facility. To complete this task we must first determine what type of project is being proposed: a linear development or a major or non-major development. The type of project going forward will affect the first step of the process and the recommendation for implementing infiltration type LIDs.

Requirements from the first step of the screening process will fall within one of the following categories. Stormwater is:

1. Infiltration based practices are **permitted**
2. Infiltration based practices are **permitted with conditions**
3. Infiltration based practices are **not permitted**

The practices that are deemed permitted with conditions will continue to the second step of the screening process, where the Infiltration LID Working Group will outline additional criteria to be satisfied. When stormwater is not permitted to be conveyed or treated using infiltration based practices, filtration or storage type features should be considered.

TRCA/CVC

Low Impact Development Stormwater Management Planning and Design Guide (TRCA/CVC, 2010)

3.4. The Low Impact Development Design Process

The ultimate goal of LID is to maintain natural or predevelopment hydrologic conditions, including minimizing the volume of runoff produced at the site (i.e., neighbourhood, subdivision or individual lot).

Step 1: Define Environmental Design Criteria

A detailed description of the design criteria that need to be defined is provided in the respective CVC and TRCA Stormwater Management Criteria documents. The criteria are required in order to:

- preserve groundwater and baseflow characteristics.

- prevent undesirable and costly geomorphic changes in the watercourse.
- prevent any increases in flood risk potential.
- protect water quality.
- maintain an appropriate diversity of aquatic life and opportunities for human uses.

The design criteria required to protect, enhance or restore the environmental resources can be grouped under the following five categories:

- Flood Protection
- Water Quality
- Erosion Control
- Recharge
- Natural Heritage Systems

Step 2: Screen Potential Best Management Practices

A number of factors need to be considered when screening the suitability of a given location within a development site for application of stormwater BMPs. The use of LID BMPs should be considered first to meet the design criteria before the use of end-of-pipe BMPs.

Step 3: Selection of Suite of Best Management Practices

In order to assess if the selected suite of BMPs effectively meet the design criteria either computer models or simple spreadsheet models should be used. Model selection will be based on the size and type of development. A wide range of simple to complex computer models such as Visual OTTHYMO, SWMM, SWMMHYNO, HSP-F and QUALHYMO are available.

Step 4: Assessing the Effectiveness of the Selected Suite of Best Management Practices

Once the suite of best management practices have been selected and the models have been run, a comparison of the results and the environmental design criteria can be made. An iterative approach, which involves adjusting the size or adding/deleting BMPs should be used until the environmental design criteria are met. The project can then proceed to the detailed design stage.

4.0. Design of Structural Low Impact Development Practices for Stormwater Management

This chapter of the guide contains overviews, design templates, maintenance requirements and cost estimates for the following structural LID practices for stormwater management:

4.1 Rainwater harvesting;
4.2 Green roofs;
4.3 Roof downspout disconnection;
4.4 Soakaways, infiltration trenches and chambers;
4.5 Bioretention;
4.6 Vegetated filter strips;
4.7 Permeable pavement;
4.8 Enhanced grass swales;
4.9 Dry swales; and
4.10 Perforated pipe systems.

Recommended maintenance practices for each LID practice, together with base construction costs are provided where information is available. It should be noted that several of the practices as described in this guide have only been implemented for a few years. Construction, operation and maintenance costs will therefore need to be updated as these practices become more commonplace in Ontario.

MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)

Low Impact Development Stormwater (Ministry of the Environment, Conservation and Park, 2022)

3.2.5. Flexible Treatment Optional For Sites with Restrictions

Meeting the Runoff Volume Control Target through retention practices (Control Hierarchy Priority 1) or LID filtration practices (Control Hierarchy Priority 2) should be attempted for all sites. However, this may not be feasible for every site as a result of site-specific constraints. If such is the case, runoff volume control to the maximum extent possible (MEP) should be planned and implemented, using all known available and reasonable approaches, including the methods as described within this manual, given the site restrictions. For example, volume control is achievable on these sites via re-use and evapotranspiration practices even when partial or no infiltration is possible.

Should pre-design investigation (case specific analysis) undertaken by the proponent or consultation by the proponent with the subject municipality, conservation authority, or the MECP as part of the environmental approval pre-consultation and/or pre-design investigation identify that volume targets are not achievable; the proponent should consider and present to the responsible authority the merits of relocating project elements to address varying soil conditions and other constraints. As well, runoff volume control to the maximum extent possible (MEP) should be planned and implemented.

4.2.7. Desigining for Minimal Impact on Groundwater Quality

When designing infiltration-based LID BMPs that use filter media for treatment (e.g. bioretention) it is important to consider the Cation Exchange Capacity (CEC) of the filter media. The CEC represents the number of exchangeable cations per dry weight that a soil can hold and is the primary mechanism for heavy metals removals from infiltrated stormwater. Filter media should have a CEC of greater than 10 meq/100g per the LID Stormwater Planning and Design Guide. In general, the CEC value of media increases with fines (clay) content and organic matter. Organic matter can have a 4 to 50 times higher CEC per given weight than clay because the source of negative charge organic matter differs from that of clay-based materials. Organic matter CEC is known as pH-dependent CEC, meaning that as pH increases (alkaline soils) the CEC will increase and vice versa.

When designing infiltration-based LID BMPs on sites where chloride loading is a concern a different mitigation approach must be taken. This approach focuses primarily on administrative and operational modifications to reduce salt loading. Salt management planning sets out a procedural and policy framework for the implementation of new technologies, practices, and equipment to reduce the use of salt while providing safe site conditions during the winter months.

5.0. LID Modelling Approaches

There are four (4) basic model classes from which a project proponent could select for detailed analysis of LID BMPs. Broadly, each class reflects a family of tools with a similar level of explanatory power. The classification of the model types follows a basic hierarchy:

- Class A: represents simple monthly or annual water budget tools suitable for small development sites (e.g., 0 to 20 ha in size) or specific LID BMPs.
- Class B: captures more sophisticated hydrologic models and surface runoff models that can explicitly represent small scale features on an event or continuous daily or hourly time step.
- Class C: models and tools incorporate a more rigorous understanding of the local and regional groundwater system and can simulate the movement of subsurface flow.
- Class D: types attempt to consider the surface water and groundwater systems in one analysis, either by coupling surface water (Class B) or groundwater (Class C) models or by applying integrated tools which consider both domains simultaneously. This hybrid class recognizes that in some instances, multiple models or approaches may be required to meet all the requirements of a given project.

It should be noted that there are numerous subclasses by which to characterize the general model types. Rather than going through a comprehensive discussion of all types of models and all model classification schemes, this section focusses on models and methods typically applied in Ontario to analyze surface water and groundwater flows that are

directly applicable to stormwater management, cumulative impact assessments to groundwater recharge and streamflow, and LID feature design and analysis.

7.3. Erosion and Sediment Controls Practices

Table A.1. Summary of Erosion Control Practices and Sediment Control Practices

Erosion Control BMPs	Sediment Control BMPs

Diversion Structures
• Slope drains
• Diversion berms
• Conveyance channels
 	
Erosion Control Methods
• Soil Roughening
• Seeding or turf establishment – sprayed, drilled or spread
• Turf Reinforced Mats (TRMs)
  ○ For drainage channels/ conveyance
• Soil binders - tackifier or polymers
• Rolled Erosion Control Products (RECP)
  ○ For hillsides
• Mulch application (wet or dry)
  ○ Dry mulches such as straw, hay, compost, RECPs or Rock
  ○ Wet mulches such as shredded wood, corn stalk fiber with or without tackifier or polymers
	Perimeter Controls
	• Silt fence barrier
	• Fiber log/ roll
	• Compost socks
	• Compost berms
	
	Check Structures
	• Straw bale barrier- check dam
	• Rock check dam
	• Geosynthetic check structure
	
	Inlet barriers
	• Rock bags
	• Curb inlet “sump barriers’
	• Curb opening to vegetated areas
	• Area bale/ rock barrier
	• Inlet inserts
	
	Stabilized Construction Access controls
	• Vehicle tracking pad/ mud mat
	• Entrance Grates or ridge systems
	• Tire washing
	• Traffic routes and signage for site traffic and heavy machinery
	• Signage to delineate LID BMPs and allowable storage and stockpiling areas

9.0. Monitoring, Performance Verification, and assumption Protocols

Monitoring includes observing and checking on the progress or function of an activity, facility or a system and its effect on the environment. Monitoring activities can include inspecting, observing, measuring and sampling activities (with samples sent for laboratory analysis). Monitoring often informs decision making about any action that may be needed.

The analysis of the monitoring information assists to understand whether the LID activity, facility or system is functioning as designed or intended and the effect the LID practice is having on the environment as well as people’s ability to use, enjoy and benefit from Ontario’s lakes, streams and groundwater.

Table A.2.: Stormwater Monitoring Components and Parameters

Monitoring Component	Parameter
Hydraulics (at facility)	• Capacity • Outlet design flows • Retention
Flow Rates (in sewers)	• Peak flow rates • Base flow

Monitoring Component	Parameter
Hydrology (in receiving stream)	• Time series flows (continuous flows) • Spot flows • Flood flows
Hydrogeology	• Infiltration /recharge • Water Balance
Water Quality (LID BMPs)	• Sediment removal • Outlet concentrations • Event mean concentrations • Contaminant loadings
Water Quality (in receiving stream)	• In stream concentrations • Contaminant loadings • Dry and wet events
Erosion & Fluvial Geomorphology (at facility- inlet/outlet – pre/post)	• Retention volume • Flow duration • Outlet Design Flows
Erosion & Fluvial Geomorphology (upstream/ downstream & at ref. site)	• Channel Stability • Erosion indicators • Rapid Geomorphic assessment. • Detailed Geomorphic
Aquatic Habitat & Communities (at facility- inlet/outlet – pre/post)	• Aquatic invertebrate collection
Aquatic Habitat & Communities (upstream/downstream & at ref. site)	• Aquatic invertebrate collection • Habitat parameters • Habitat suitability measures

CANADA

CALGARY

Stormwater Management and Design Manual (2011)

7.5.2 Urban Runoff Water Quality Models

When choosing a computer model, it is important to consider the data and model limitations. Water quality computer models are relatively complex and require experienced personnel for their application. As well, quality models tend to be less accurate than quantity models, so expectations must reflect these limitations to avoid high modelling costs that do not yield the anticipated results.

8.6.1 Physical Site Constraints

Soil Suitability: Soil suitability is a major consideration when designing BMPs, particularly when designing infiltration facilities and wet facilities or ponds. A soil investigation is required to determine whether the soil is suitable. Soil surveys, where available, also provide useful soil type information. Calgary has a high degree of clay and clay-type soils (i.e., silty clays) which affect soil infiltration rates. Typically, soils with less than a permeability of 6.80 mm/hr[64] are not suitable for infiltration BMPs. However, there are different areas in Calgary where the soils might be suitable (i.e., gravel beds near rivers), and infiltration BMPs could be appropriate. Infiltration and/or percolation into the subsoil is not permitted if the runoff is contaminated with highly mobile constituents as assessed by an environmental specialist with The City of Calgary's Environment & Safety Management business unit.

Depth to Water Table: The effectiveness of infiltration BMPs is impacted by the depth to the water table. High water tables affect the movement of water from the BMP to the underlying soil. The size and shape of the BMP, along with the hydrological properties of the soil, determine the impact of the water table elevation on infiltration performance. For

screening purposes, soils having high water tables less than 1.20 m below the ground surface are unsuitable for infiltration.

Depth to Bedrock: The depth of bedrock is an important consideration for infiltration BMPs. A shallow depth to bedrock can impede exfiltration of water from BMPs into the underlying soil. As well, the depth to bedrock might impact the excavation process for ponds.

Topography: The topography or slope of a site will limit the type of BMP that can be utilized on a particular site. Slopes for grassed swales and porous pavement should not be steeper than 5% to be effective. Infiltration trenches should be limited to flatter areas, and should not be used in fill sites due to the risk of slope failure.

Drainage Area: The size of the drainage area to be served by a BMP is an important consideration. If the drainage area is too large, the BMP will not be effective. In this situation, other BMPs or a combination of BMPs should be utilized to be more efficient and/or cost effective.

8.7 Cold Climate Impacts

Designing effective stormwater BMPs is not an easy task. Cold climates present additional challenges that make some traditional BMP designs less effective or unusable. Care should be taken when designing BMPs for Calgary's cold climate and chinooks.

Table A.3.: Cold Climate Challenges

Climatic Conditions	BMP Design Challenges
Cold Temperatures	• Pipe or flow control freezing • Permanent pool ice-covered • Reduced biological activity • Reduced oxygen levels during ice cover • Reduced settling velocities.
Deep Frost Line	• Frost heaving • Reduced soil infiltration • Pipe freezing.
Short Growing Season	• Short time period to establish vegetation • Different plant species appropriate to cold climates than moderate climates.
Snowfall	• High runoff volumes during snowmelt and rain-on-snow events • High pollutant loads during spring melt. • Impacts of road salt/de-icers. • Snow management could affect BMP storage.

8.8 Operation and Maintenance

All BMPs require inspection and maintenance to ensure proper operation. However, there can be a significant difference between BMPs in the degree of maintenance they require for efficient performance. Selection of a BMP should consider maintenance requirements in terms of cost, responsibility, feasibility, and access. The first screening consideration should be the frequency of maintenance required for the BMP. Limited staff resources and lack of maintenance can result in ineffective BMP operation. In general, infiltration type SCPs will require the most maintenance to ensure that the media does not become clogged. Sediment control systems installed upstream of infiltration SCPs will help with their long-term maintenance. Regularly scheduled maintenance will also help alleviate problems. Maintenance costs are the second screening consideration that should be considered. Currently, the City of Calgary does not have an adequate record of maintenance costs for BMPs, other than those for ponds. However, information from other municipalities can be used as a general guideline. Maintenance costs are borne by landowners for BMPs on private property. Regular inspection and maintenance must be scheduled for all BMPs. Until maintenance data becomes more widely available, the frequency and scope of the inspections and maintenance will have to be developed by trial and error.

VANCOUVER

The Citywide Integrated Stormwater Management Plan – Volume 2, Best Practice Toolkit

1.0. Best Management Practice Toolkit

The BMP Toolkit provides an introduction to a range of common best practices to improve rainwater management. These tools are in common use in other jurisdictions around Metro Vancouver, the Pacific Northwest, and in developed areas around the world.

The Toolkit BMPs are:

- Absorbent Landscapes
- Infiltration Swales
- Rain Gardens & Infiltration Bulges
- Pervious Paving
- Green Roof
- Tree Well Structure
- Rainwater
- Infiltration Trench
- Water Quality Structures
- Detention Tanks
- Daylighted Streams
- Constructed Wetlands

The Toolkit includes key description of purpose, graphics and diagrams to show scope and application, key design principles, limitations and sizing variables, and maintenance and operations considerations.

Stormwater Source Control Design Guidelines (City of Vancouver, 2012)

Water Balance Models

Water Balance Model Powered by QUALHYMO The Water Balance Model Powered by QUALHYMO (WBM) has been developed jointly by an InterGovernmental Partnership that includes federal, provincial and local government representatives, as well as consultants and industry partners. The WBM is designed for larger scale land use simulations, allowing users to model the impacts of land use planning decisions and stormwater source controls at a watershed or basin scale. The WBM can also be applied at a site scale for source control facility sizing.

The SWMM model (RUNOFF, RECEIV, GRAPH and TRANSPORT modules) was originally developed in 1971 by the US Environmental Protection Agency (EPA). Since that time the model has been updated numerous times (added TRANSPORT and EXTRAN modules) and now incorporates routing of flows from one surface to another, e.g. from pavement to rain garden, which is needed for Source Control modelling.

Detail Design of Stormwater Source Controls

Plan Details (one or more views) for Stormwater Source Controls should show the features listed in the Plan Detail Checklist, as appropriate to the design.

Considerations and Constraints for Stormwater Source Controls

Limitations and Precautions to Implementing Source Controls

- Hazardous Slopes
- Overflows
- Groundwater Protection
- Utility Trenches: Permeable utility trenches that intercept source controls should be sealed off with low permeability trench dams. This prevents accumulated water from short-circuiting through the utility trench potentially causing damage down-slope.

EDMONTON

Low Impact Development Construction, Inspection & Maintenance Guide (City of Edmonton, 2016)

Table A.4.: Construction Tasks for Bioretention, Bioswale and Naturalized Drainage Way Facility

Bioretention	Bioswale	Naturalized Drainage Way
- Cleaning and grubbing - Pre-treatment - Excavation - Scarification (if specified) - **Rough Grade** - **Geotextile (if specified)** - **Underdrain (if specified)** - **Overflow Drain (if specified)** - **Reservoir Course** - **Graded Filter Layer (if specified)** - **Curbing (if specified)** - **Amended Soil Media** - **Finish Grading** - **Erosion Control Matting** - **Plant Material Verification** - **Plant Material Installation** - **Mulch (if specified)** - Adjacent Vegetation	- Clearing and Grubbing - Pre-treatment - Excavation - Scarification (if specified) - Rough Grade - Geotextile (if specified) - Underdrain (if specified) - Overflow Drain (if specified) - Reservoir Course - Graded Filter Layer (if specified) - Curbing (if specified) - Amended Soil Media - Grade Control Structures - Finish Grading - Erosion Control Matting - Riprap - Plant Material Verification - Plant Material Installation - Mulch (if specified) - Adjacent Vegetation - Fencing (if specified)	- Clearing and Grubbing - Pre-treatment - Excavation - Scarification (if specified) - Rough Grade - Geotextile (if specified) - Underdrain (if specified) - Overflow Drain (if specified) - Reservoir Course - Graded Filter Layer (if specified) - Amended Soil Media - Grade Control Structures - Finish Grading - Erosion Control Matting - Riprap - Plant Material Verification - Plant Material Installation - Mulch (if specified) - Adjacent Vegetation

Table A.5.: Recommended Training Levels for LID Maintenance

		Typical Activities		
		Parks	**Drainage**	**Transportation**
Training Level	**Low** – New hire with basic LID orientation	• trash/debris/ sediment removal • raking • seeding grass • replacing sod • top-ups to mulch or soil • emptying trash cans • adding trash cans	• trash/debris/sediment removal • emptying trash cans	• snow removal • changes to snow storage • location(s)

		Typical Activities		
		Parks	**Drainage**	**Transportation**
	Medium – 2-5 years maintenance experience with LID	• weeding (non-native species present) • removal, addition or replacement of mulch/soil/plant material	• minor concrete repairs • regrading • inlet modification • pipe flushing • cleaning pre-treatment devices	• minor concrete repairs • regrading • cleaning pre-treatment devices
	High – Highly specialized personnel with relevant education (e.g. post-secondary background in horticulture or engineering)	• pruning • treat diseased plants • stabilization via matting or stone • installation of flow • spreaders • improvements in contributing drainage • area • replanting of entire facility • weeding (native species present)	• stabilization via matting or stone • improvements or revision to contributing drainage area • inlet/outlet replacement • major concrete repairs • concrete replacement	• major concrete repairs • concrete replacement

HALIFAX

Stormwater Management Standards for Development Activities (July 2020)

2.1.1. Stormwater Balance Requirements

- Retain on site stormwater runoff generated from the first 10 mm depth of a rainfall event
- Stormwater runoff generated after the first 10 mm of an event is to be balanced to ensure matching of the pre and post-development stormwater runoff conditions for the 1:5-year return design storm and the 1:100-year return design storm

2.2.1 Stormwater Quality Requirements

- Average removal of 80% of Total Suspended Solids (TSS) on an annual loading basis from all stormwater runoff leaving the development site based on the post-development level of imperviousness.

2.3.1 Erosion Control Requirements

- The applicant is required to submit a temporary erosion and sediment control plan to demonstrate the erosion control measures for the site during construction.

3.2 Hierarchy Approach

The Hierarchy Approach was adopted as part of the guiding principles used in establishing the objectives for this document.

The applicant shall demonstrate that the Stormwater Management Plan for the proposed development implements the hierarchy approach within the private stormwater management of the development site, as described below:

- **Source Control** practices retain stormwater where it reaches the site (i.e. retain rain where it falls). Source controls at the lot level are the preferred method for controlling the impacts of stormwater.
- **Conveyance Control** such as private vegetation swales and/or infiltration systems, can limit the flow as it moves across the site.
- **End-of-Pipe Control**, considered the last treatment opportunity prior to leaving the sites, shall be implemented if source and conveyance controls are unable to achieve the necessary level of stormwater quality and quantity control targets

Considerations

- Available space
- Soil permeability and soil infiltration rate
- Proximity of groundwater table
- How the system will function in colder months
- The pathway of precipitation if the storage is full or otherwise blocked

4.3 Maintenance Requirements

Monitoring of operating conditions and maintenance inspections are required for most stormwater management facilities (BMPs). The property owner is responsible to maintain the designed performance of the private stormwater management system.

GLOBAL

NEW YORK, NEW YORK

New York City Stormwater Design Manual (2022)

4.1 Practice Types

SMPs are systems that are designed to protect, restore, or mimic the natural water cycle within built environments by retaining, detaining, and/or treating stormwater runoff. In this manual, SMPs are categorized in two ways: first, by their primary function and second, by their surface type.

SMP Functions

Runoff that enters an SMP is typically managed via one or more of the following physical processes:

- **Infiltration** – water is captured and infiltrated into the underlying soils (sometimes referred to as exfiltration).
- **Evapotranspiration (ET)** – water is captured and evaporated or transpired back into the atmosphere. Reuse – water is captured and reused for purposes other than SMP irrigation (which can reduce water storage potential of other SMPs).
- **Filtration** – water passes through a filtration medium to remove various pollutants.
- **Detention** – water is temporarily stored and released at a lower flow rate.

Among the five primary functions, infiltration, ET, and reuse SMPs are considered retention-based practices because they aim to eliminate or reduce the total volume of runoff leaving the site. The other two functions, filtration SMPs and some extended detention SMPs, are considered treatment-based practices because they aim to remove pollutants from runoff before it ultimately leaves the site.

SMP Surface Types

In addition to primary function, SMPs can be further categorized by one of two surface types:

- **Vegetated SMPs** – practices with a planting media that supports vegetation.

- **Non-vegetated SMPs** – practices without vegetation, such as permeable hardscapes, permanent ponds, enclosed systems, or subsurface systems.

4.2 Selecting an Appropriate System

Designers must select and design practices to meet all applicable stormwater management requirements outlined in Chapter 2. This subsection includes guidance on selecting practices to meet the water quality criterion (WQv), runoff reduction criterion (RRv), and no net increase criterion (NNI). This guidance follows an SMP hierarchy based on several guiding principles.

The SMP hierarchy was created with two goals: first, to create a clear and consistent approach for the selection of SMPs throughout the City and second, to guide designers toward practices that are most effective at meeting the City's goals for stormwater management and co-benefits. The SMP hierarchy follows three logical steps:

1. (CSS & MS4) – use vegetated retention practices to meet requirements, or up to the maximum extent practicable.
2. (CSS & MS4) – use non-vegetated retention practices to meet requirements, or up to the maximum extent practicable.
3. (CSS) – meet any remaining requirements using either vegetated or non-vegetated detention practices. (MS4) – meet any remaining requirements using either vegetated or non-vegetated treatment practices.

There are five potential site constraints that may impact the feasibility of SMPs, defined as follows:

- Soil constraints – permeability tests indicate that soil infiltration rates are less than 0.5 in/hr, limiting the use of infiltration practices.
- Subsurface constraints – boring tests indicate that the bottom of practice would be less than three feet from the groundwater table or bedrock, limiting the use of most practices, except those enclosed in concrete with adequate anchoring, as determined by an engineer.
- Hotspot constraints – land use or soil conditions increase the risk of runoff contamination, limiting the use of infiltration practices, or those without liners. (see criteria below).
- Surface constraints – regulations require the use of paved surfaces, limiting the use of vegetated practices. As an example, regulations for parking and/or egress requirements.
- Space constraints – required setbacks from structures, utilities, property lines, existing trees, or other site features limits the use of practices at the ground level. General siting criteria for on-site projects can be found in Appendix C.

GreenHUB: DEP's web-based application with data management capabilities that provides asset management for the green infrastructure practices citywide over their lifecycle, where designers upload the Project Tracking Spreadsheet.

PORTLAND, OREGON

Stormwater Management Manual (2020)

1.3 Stormwater Management Requirements

Stormwater management requirements for infiltration, water quality treatment and flow control vary depending upon the receiving system. Projects must complete site investigations to determine the appropriate receiving system for that site. Considerations include the site's geologic characteristics and the available storm system.

Portland has three primary receiving systems for disposal and conveyance of stormwater. BES ranks use of these systems for stormwater management in the Infiltration and Discharge Hierarchy in Section 1.3.3 of this Manual. They are listed below in order of preference (with 1 being the most preferred):

1. Onsite infiltration.
2. Surface water systems or separated storm systems that ultimately drain to surface water.

3. Combined sewers that convey water to the wastewater treatment plant.

1.3.2. Facility Selection: Vegetation and Infiltration

The City's stormwater management approach prioritizes vegetation and infiltration to meet stormwater requirements and to maximize environmental, system and urban design benefits. Designers must evaluate and use vegetated and infiltration facilities to the maximum extent practicable. Vegetation and infiltration provide numerous environmental benefits.

1.3.3 Infiltration and Discharge Hierarchy

Full onsite infiltration, Level 1, is required to the maximum extent practicable for sites with design infiltration rates of 2 in/hr or more, unless site constraints prevent infiltration, or the site qualifies for the eco-roof exception per Section 3.2.1.1. If full onsite infiltration is not practicable, offsite discharge to a storm-only or combined sewer is allowed (Level 2 or 3). For Level 2 (offsite discharge to a storm system), water quality treatment is always required, and flow control is also required in most situations. For Level 3 (offsite discharge to a combined system), flow control is required. Pre-development conditions are based on an undeveloped site (i.e., Lewis and Clark era) rather than current conditions at the site.

2.1.2 Design Approach

The City allows three approaches to design stormwater facilities: Simplified, Presumptive, and Performance. It is the applicant's responsibility to determine which design approach to use. The Bureau of Environmental Services (BES) has the authority to require the use of the Presumptive or Performance Approach.

2.2.4 Setbacks

The following summarizes the minimum standards for setbacks. Setbacks can be increased at the discretion of BES. Other geotechnical requirements and codes, including the State Plumbing Code and the City of Portland Zoning Code, may require additional setbacks.

Setback Requirements

Setbacks are required for infiltration facilities (except for permeable pavement), filter strips, downspout extensions, and ponds. See Table 2-1 for standard setbacks for infiltration facilities. Rain gardens, filter strips, downspout extensions, and ponds have facility-specific setback requirements.

SINGAPORE

Managing Urban Runoff Drainage Handbook (2013)

2.3 ABC Waters Design Guidelines

The ABC Waters programme, launched in 2006, is a strategic stormwater management strategy which aims to enhance environmental aesthetics and improve the quality of water by harnessing the full potential of our waterbodies. This is done by integrating the waterways and waterbodies with the surrounding environment to create community spaces and a sustainable living environment.

The ABC Waters design guidelines were developed based on the following principles:

a) Mitigating the impact of urbanisation by retention and/or detention of runoff and minimising impervious areas through the implementation of ABC Waters design features.

b) Improving runoff water quality from the development site into the receiving environment.

c) Integrating stormwater treatment into the landscape by incorporating multiple-use corridors that maximise the aesthetics and recreational amenities of developments.

d) Protecting and enhancing natural water systems within the development site.

3.4 General Design Considerations for Stormwater Detention and Retention

Other than determining the volume of runoff to be detained or retained on-site to meet the requirements stipulated in the COP, designing a stormwater drainage system requires careful analysis of the space availability, topography, site obstructions as well as other considerations like maintenance and safety.

3.4.3 Site Obstructions

The design of the stormwater drainage system needs to take into consideration obstructions and constructed givens on-site, which may be above ground or below ground. Underground obstructions like pipes and services could create potential space constraints for the implementation of subsurface detention elements. If these obstructions create space constraints, they can be relocated and/or re-designed so that a balance can be achieved. If not, the stormwater drainage system would have to work around these barriers, making the most of the available space to effectively convey runoff from the site, whilst reducing peak flows.

If the site has existing stormwater drains, they can be retrofitted or substituted with more naturalised conveyance elements like vegetated swales or bioretention swales. If the site constraints are too significant, other detention or retention options can be introduced or intensified. Stormwater management is a composite system, and a combination of elements can be developed to address the opportunities and constraints of each site.

5.2.2. Operations and Maintenance Issues for Source Solutions

All components of the stormwater drainage system must be monitored on a regular basis and the frequencies of maintenance should be adjusted to the site-specific conditions and customised according to the experience gained from operating and maintaining the stormwater drainage system and records kept. These should be reviewed periodically.

MOBILE, ALABAMA

LID Handbook for the State of Alabama (2007)

Alabama Regulatory Requirements

Sizing Criteria	Description
Water Quality	Treat the runoff from 80% of the storms that occur in an average year. This is the runoff resulting from a rainfall depth of approximately 1”-1.5” (fi rst fl ush) depending on the location in Alabama. For more information on the fi rst fl ush, see Appendix A on Stormwater Hydrology.
Channel Protection	Provides extended detention of the 1-yr storm event released over a period of 24 hours to reduce bankfull flows and protect downstream channels from erosive velocities and unstable conditions.
Overbank Flood Protection	Provides peak discharge control of the 25-year storm event such that the post-development peak rate does not exceed the predevelopment rate, resulting in reduced overbank flooding.
Extreme Flood Protection	Evaluates the effects of the 100-year storm on the management system, adjacent property, and downstream properties and facilities. Manages the impacts of the extreme storm event through detention controls and/or floodplain management.

Constraint Consideration

Table A.6.: Potential Environmental Regulatory Constraints

Natural	Man-made
- Steep slopes - Compacted soils - Jurisdictional wetlands - Stream channels - 100-year floodplains - Existing riparian buffers - Forest conservation areas - Critical areas - Endangered/threatened species - Water table depth - Shallow depth to bedrock	- Existing infrastructure right of ways - Electrical lines - Fiber optic cable - Sewer lines - Water lines - Other utilities - Roads - Septic drain fields - Wells

AUGUSTA, GEORGIA

Stormwater Design Manual (2020)

3.5.2 Performance Standard, Design Criteria, and Related Policies

1. **The use of LID practices**. LID practices shall be implemented to the maximum extent practicable to reduce the volume of stormwater runoff. The LID Practice Usage Form, provided in Appendix C, shall be completed and submitted with the SWMP. (More information on LID practices is available in the LID Practice Fact Sheets provided in Chapter 4 of this Manual.)
2. **Stormwater quality protection standard**. Applicable land developments shall be designed, constructed and maintained to retain the Runoff Reduction Volume (RRv) using GI-IMPs. The RRv is defined as the first 1.0 inch of rainfall on the site. RRv must be calculated using the equations provided in Chapter 5 of this Manual. Design specifications for GI-IMPs are provided in Chapter 6

   If the entire RRv cannot be retained on-site using GI-IMPs, the remaining stormwater from a 1.2 inch rainfall on the site shall be treated to achieve 80% TSS removal of the Water Quality Volume (WQv). Treatment of the WQv shall be provided using appropriate IMPs. The WQv and the % TSS removal must be calculated using the equations provided in Chapter 5 of this Manual. Design specifications for IMPs are provided in Chapter 6.
3. **SWMP requirements when the RRV cannot be fully retained on the site.** Augusta recognizes that hydrologic, topographic, geographic and other conditions may limit or exclude the use of GI-IMPs. The management of the entire RRv on the site may not be possible.

4.2 The LID Implementation Process

Step 1: Establish & collaborate with a multi-disciplinary site design team.
Step 2: identify and delineate natural resource, features, and conservation areas.
Step 3: layout site to preserve conservation areas and minimize stormwater impacts.
Step 4: use various techniques to reduce impervious cover.
Step 5: utilize natural features and conservation areas to manage stormwater.
Step 6: begin stormwater infrastructure and IMP design.

“Build With the Land” Design Techniques

The stormwater LID practices that can be used at this stage primarily deal with the location and configuration of impervious surfaces or structures on the site, and their location relative to natural features and preservation/conservation areas. These LID practices include the following:

- Fit the design to the terrain
- Locate the development in less sensitive areas
- Reduce the elimites of clearing and grading
- Utilize open space development
- Consider creative development design

The goal of site design techniques that “build with the land” is to position the elements of the development project in such a way that the site design (placement of buildings, parking, streets and driveways, lawns, undisturbed vegetation, buffers, etc.) is optimized for effective stormwater management. That is, the site design takes advantage of the site’s natural features, including those placed in conservation areas, as well as any site constraints and opportunities (topography, soils, natural vegetation, floodplains, shallow bedrock, high water table, etc.) to prevent both on-site and downstream stormwater impacts.

ADDITIONAL GLOBAL EXAMPLES

City	Link / Source
Los Angeles, California	LID BMP Design Guide (2014)
Minnesota, USA	Minnesota Stormwater Manual Wiki (2023)
Nashville, Tennessee	Stormwater Management Manual – LID (2021)
Topeka, Kansas	Stormwater Design Handbook (2023)
Boulder, Colorado	Owners LID Post Construction Maintenance Guide (2020)
Queensland, Australia	Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands (2010)

LID FUNCTIONS

Table A.4. Hydrologic Function of LID Practices

Practice	Flood Control	Quality Control	Conveyance	Infiltration/ Groundwater Recharge	Evapo-transpiration	Detention
Amended Topsoil	✓	✓	✓	✓	✓	✓
Green Roofs	✓	✓		✓	✓	✓
Tree BMPs	✓	✓	✓	✓	✓	✓
Rainwater Harvesting	✓		✓	✓		
Perforated Pipes	✓	✓	✓	✓		✓
Permeable Pavement	✓	✓	✓	✓		✓
Soakaways, Infiltration Trenches and Chambers	✓	✓	✓	✓		✓
Bioretention	✓	✓	✓	✓	✓	✓
Grassed Swales	✓	✓	✓	✓	✓	✓
Biofilters/Bioswales	✓	✓	✓	✓	✓	✓

Table A.5. SWM Function of LID Practices

Practice	Flood Control	Quality Control	Erosion Control	Water Balance	Thermal Mitigation
Amended Topsoil	✓	✓	✓	✓	
Green Roofs	✓	✓	✓	✓	✓
Tree BMPs	✓	✓	✓	✓	✓
Rainwater Harvesting	✓			✓	✓
Perforated Pipes	✓	✓	✓	✓	✓
Permeable Pavement	✓	✓	✓	✓	✓
Soakaways, Infiltration Trenches and Chambers	✓	✓	✓	✓	✓
Bioretention	✓	✓	✓	✓	✓
Grassed Swales	✓	✓	✓	✓	✓
Biofilters/Bioswales	✓	✓	✓	✓	✓

Table A.6. Hamilton Conservation Authority SWM Criteria

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
Spencer's Creek	Middle Spencer	- Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events	- Erosion threshold analysis and critical discharge analysis are required.	- The target for new development is to maintain or enhance pre-development groundwater recharge both on-site and off-site.	- Enhanced (Level 1) standard of water quality treatment is the current standard for Middle Spencer Creek as established in the Hamilton Harbour Remedial Action Plan. - Mid Spencer Creek supports a diverse warm/cool water fish community. - Aquafor Beech Limited characterized the Natural Heritage System (NHS) for the Mid-Spencer subwatershed. - Refer to the City of Hamilton's Rural Official Plan. - Refer to the Mid-Spencer Creek Stewardship Action Plan.	Subwatershed Study	Mid-Spencer/Greensville Rural Settlement Area Subwatershed Study, Aquafor Beech Limited, April 2016
	Ancaster	Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events			- Enhanced (Level 1) treatment based on the City of Hamilton and conservation authority design criteria. - If species at risk are identified within the influence zone of construction activities, MNR will be contacted to determine how specimens of such species should be treated. - In accordance with the agreement and Department of Fisheries and Oceans's Risk Management Framework, the Hamilton Conservation Authority and Niagara Peninsula Conservation Authority will complete an aquatic effects assessment to determine potential impacts of the proposed work on fish and fish habitat during the Detail Design phase for the project. This process includes an assessment to determine the level of risk (high or low) that any residual effects after the application of mitigation pose to fish/fish habitat, and thus the likelihood of requiring a Fisheries Act Authorization for the proposed works.	Secondary Plan	Urban Hamilton Official Plan, Volume 2 - B.2, City of Hamilton, September 2013
Chedoke Creek	-				- The updated SWM Policy for Redevelopment Sites in the Chedoke Watershed will provide specific targets for removal which at a minimum will be required to reach Provincial Guidance (Enhanced – 80% TSS removal). - The municipal (MEA) Master Planning study will involve an assessment of potential locations across the Chedoke	Subwatershed Study	Chedoke Creek Water Quality Improvement Framework Report, GM Blue Plan Engineering / Wood plc, April 2021
						Remediation Mitigation Workplan	Cootes Paradise Work Plan, Wood plc, July 2021
						Secondary Plan	Urban Hamilton Official Plan, Volume 2 - B.6, City

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
					Watershed for stormwater retrofit projects to improve the runoff water quality and reduce the deposition of urban contaminants into Chedoke Creek		of Hamilton, February 2021
Urban Hamilton	-				- The preferred solution to manage stormwater in the West Harbour Waterfront Recreation Master Plan study area is to reduce the amount of stormwater generated on site through source controls and enhanced swales, or other appropriate stormwater management technology (Enhanced quality control for frequent storms (5yr event), Potential enhanced treatment of >80% Total Suspended Solids removal). - The Hamilton Conservation Authority is responsible for reviewing projects to identify any impact to fish and fish habitat and working with proponents to identify mitigation measures.	Recreation Master Plan	Hamilton West Harbour Waterfront Recreational Master Plan Phase 1 Summary, City of Hamilton, October 2006
						Shoreline and breakwater improvements Class EA	Hamilton West Harbour Shoreline & Breakwater Class Environmental Assessment: Environmental Study Report,, Dillon Consulting Limited, April 2013
	Hannon	Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events	-Four reaches were considered to be sensitive or highly prone to erosion (HC1-A, HC1-D, HC2, and HC3). - Erosion threshold analysis was carried out to determine the duration for which the critical channel flowrates are exceeded. After analysing the the implementation of SWM facilities and LID measures, the reach HC-3 still exceeds the still exceedes the erosion threshold value. Ensure the HC-3 erosion threshold exceedance duration is maintained at existing values through (i) Over control of upstream developments through increased LID targets OR (ii)	- The water balance for the Study Areas was developed in accordance with Section 3.2 of the 2003 MOECC Stormwater Management Planning and Design Manual (MOECC SWM Manual). - Based on the calculations provided in Table 29 (AECOM, 2017), under future conditions the evapotranspiration and runoff are expected to decrease by approximately 3 and 5 %, respectively, and infiltration is expected to increase by approximately 14 %, as a result of the additional infiltration due to LIDs. - Updated water balance assessment at the site scale based on finalized	- Enhanced protection level (80 % TSS removal). - Lot-level SWM facilities will provide water quality benefits and peak flow control. - The Hannon Creek reaches are within a cultivated corn field and do not provide direct fish habitat, but do contribute flow to downstream reaches during spring runoff and periods of significant rainfal. - Refer to the Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (TRCA / CVC-2010). - The Provincial Policy Statement (PPS) provides for enhanced protection of the environment by identifying the significance of the natural heritage system and water resources, including natural hazards and water quality, air quality and energy use. - The fish communities of Hannon Creek and Upper Davis Creek were sampled in 1995 and from 1997 to 2000 (ESG 2001a). In 1995 brook stickleback (Culaea inconstans) and goldfish (Carassius auratus) were captured in these watercourses, and from 1997 to 2000 brook stickleback were captured in these watercourses. No other species are recorded as present in either of these subwatersheds upstream of the escarpment.	Secondary Plan	Urban Hamilton Official Plan, Volume 2 - B.5, City of Hamilton, May 2021
						Subwatershed MDP/Class EA	Upper Hannon Creek Master Drainage Plan Municipal Class Environmental Assessment, AECOM, October 2017

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
			Stream restoration works to reduce erosion potential of stream reach. - Table 18 and Table 33 summarizes the Erosion Threshold Values. - An erosion threshold analysis for additional maintained watercourses where erosion may be of a significant potential concern, based on further review with the Hamilton Conservation Authority at the time of development planning. -The Hannon Creek appeared to have undergone a continued phase of stream degradation and channel erosion.	development, SWM and LID designs, is required by private land developers.			
	Davis	- Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events -The Davis Creek stormwater quantity control facility has been refined as part of a preliminary design initiative (ref. Design Brief, November 2003). - The volume of stormwater quantity management storage necessary to mitigate impacts on peak flow rates (flooding) resulting from	- Table 7.9 provides the required extended detention (erosion control) volume for each stormwater management facility, on an impervious hectare basis, and associated extended detention flow rate control, for the optimized stormwater management condition. - The required storage volume for erosion control has been initially based on targeting no net	- Existing levels of infiltration should be maintained on a subcatchment scale. Detailed site specific assessments will be required at the time of development to ensure local variability's are incorporated into the management strategy.	- The Enhanced level of water quality control (80% TSS removal) has been established through discussions with the City of Hamilton and Hamilton Conservation Authority. - The proposed on-line Davis Creek facility needs to consider fisheries movement. - Stormwater quality facilities to be designed to meet 'Enhanced' sizing criteria (MOE 2003). - The fish communities of Hannon Creek and Upper Davis Creek were sampled in 1995 and from 1997 to 2000 (ESG 2001a). In 1995 brook stickleback (Culaea inconstans) and goldfish (Carassius auratus) were captured in these watercourses, and from 1997 to 2000 brook stickleback were captured in these watercourses. No other species are recorded as present in either of these	Subwatershed Study	Davis Creek Subwatershed Study, Philips Engineering, 38991

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
		proposed development has been assessed based on a three step process as follows: i) Initial estimation of flood control storage based on a design storm event basis. ii) Evaluate the proposed stormwater management sizing on the basis of continuous simulation and frequency analysis, verification with respect to erosion control function also completed at this step). Storage-Discharge relationships adjusted as required to achieve the required result. iii) Evaluate the performance of the "final" storage values based on the 100-year return period design storm.	increase in erosion exposure at the six erosion assessment locations. - The required erosion control flow rate has been verified by ensuring that local peak flow rates for annual return frequency events are maintained or reduced.		subwatersheds upstream of the escarpment.		
Stoney/Battlefield Creeks	-	-No flood control is currently provided in Stoney Creek and Battlefield Creek via stormwater management quantity controls, therefore frequency flows from developed lands are not attenuated. - The existing development within Stoney Creek and Battlefield Creek does not have stormwater quantity management, as it generally preceded this management practice in the City of Hamilton	- To assess the potential viability of long-term erosion control through stormwater management, erosion critical flows have been determined for both Battlefield Creek and Stoney Creek. The critical flow represents the point at which sustained flows will tend to entrain and transport sediment. - Key erosion issues in the subwatershed are related to several factors including confinement of the		- The known fish community of Stoney Creek below the escarpment, consisted of goldfish, lake chub, common carp, blacknose dace, white sucker, central mudminnow, and pumpkinseed. - Water quality within both Stoney Creek and Battlefield Creek has been noted as reasonable, with improvements in closer proximity to Lake Ontario. - Water quality improvements have been recommended as part of the 2004 Master Plan, including five stormwater management facilities, four of which are storm sewer outfall retrofits. Baseflow augmentation, riparian plantings and erosion control would also provide water quality improvements.	Flood and Erosion Control Class EA	Stoney Creek and Battlefield Creek, Flood and Erosion Control Class Environmental Assessment, AMEC, September 2011

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
			channel by previous development, lack of historical application of stormwater management, locations of valley wall contact and existing structures that are failing. - Both creeks are highly spatially constrained, particularly immediately downstream of King Street, due to private development, resulting in limited opportunity for sustainable creek improvements in the short-term. Recommended erosion control works are therefore limited to localized measures.				
Stoney Creek Numbered Watercourses	-	- The Hamilton Conservation Authority had requested that the post-development runoff from the subject lands be controlled to pre-development levels.	Intended to be compatible with Subwatershed Planning Study (Aquafor Beech Limited) direction and standards		- Provide stormwater quality control in accordance with current Provincial standards for “Normal” treatment, as per criteria provided in the Stormwater Quality Management Strategy, Community of Stoney Creek, Master Plan. -Watercourse No. 9 is considered a warm water habitat. Water quality within Watercourse No. 9 has been considered reasonable based on benthos sampling done in the past.	SWM Master Plan	Stoney creek urban boundary expansion lands parcels a and b stormwater management master plan, Philips Engineering, January 2008
			- A fluvial geomorphological assessment to determine the erosion hazard. limits. - Refer to the Stoney Creek Urban Boundary Expansion (SCUBE) Subwatershed	- Hydrogeological assessment required.	- For source water protection refer to the Clean Water Act (2006), policies of the Source Protection Plan for the Halton Region and the Hamilton Region Source Protection Areas (Halton-Hamilton Source Protection Committee, 2017a), and the MECP’s Source Protection Information Atlas (Ministry of the Environment, Conservation and Parks, 2020).	Secondary Plan	Urban Hamilton Official Plan, Volume 2 - B.7, City of Hamilton, September 2021

Watershed	Sub-watershed	Criteria				Type	Source
		Flood control	Erosion	Water Balance	Water Quality		
			Study (Aquafor Beech, 2013) for erosion control to determine critical flows.				

Table A.7. Analyzed Sources for LID Guidance for Engineering Design in the City of Hamilton

City of Hamilton Past Studies				Criteria				
Type	Title	Autor	Date	Flood control	Erosion	Water Balance	Water Quality	LID
Block Servicing Strategy	Block 2 Servicing Strategy for the Fruitland – Winona Secondary Plan Lands	Aquafor Beech Ltd	September 11, 2018	Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events	-Ponds will require extended detention for erosion control - Provide an extended detention drawdown volume based on the erosion threshold target unit flow rate	The water balance requirements vary between 1 to 3 mm per event depending on native soil type. Measures such as disconnection of downspouts, pervious pavements or soakaway pits may be used to meet these requirements	Enhanced (Level 1) treatment	- It is only indicated the different geotechnical investigation activities (Borehole, piezometers, lab soil testing, soaked CBR test, In-Situ hydraylic conductivity testing) required for some LIDs (Pervious pavements, bioretention, soakaway pits, infiltration chamber, downspout disconnection - Refer to the Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (CVC, 2010)
Block Servicing Strategy	Block Servicing Strategy	Urbantech West, A Division of Leighton-Zec West Ltd.	March 2020	Attenuate post-development peak flows to pre-development peak flow rates for the 2 through 100-year storm events	Provide a drawdown time for the extended detention volume within a range of 24-48 hours per MECP criteria.	Refer to the SCUBE Study for the infiltration targets to meet water balance requirements related to groundwater recharge - post to pre water balance required.	Enhanced (Level 1) treatment	- Some implementation requirements and barriers are mentioned for different LIDs - Refer to STEP for monitoring and maintenance requirements
Class Environmental Assessment	Cherry Beach Shoreline Protection Class Environmental Assessment	City of Hamilton	September 2014	No flood control mentioned.	No erosion control mentioned.	No water balance control mentioned.	No water quality control mentioned.	No LID criteria/requirements mentioned
Class Environmental Assessment	Ancaster Elevated Water Reservoir Schedule 'B' Class	WSP	March 2017	No flood control mentioned.	No erosion control mentioned.	No water balance control mentioned.	No water quality control mentioned.	No LID criteria/requirements mentioned

City of Hamilton Past Studies				Criteria				
Type	**Title**	**Autor**	**Date**	**Flood control**	**Erosion**	**Water Balance**	**Water Quality**	**LID**
	Environmental Assessment Project File Report							
Environmental Project	Hamilton Bus Maintenance and Storage Facility Environmental Project Report	IBI GROUP	January 3, 2020	The 100-year post-development peak flow will be required to be controlled to the 5-year pre-development flow rate	No erosion control mentioned.	It is mentioned that "Low impact development measures will be implemented to promote infiltration, when appropriate"	Enhanced (Level 1) treatment based on the City of Hamilton Comprehensive Development Guidelines and Financial Policies Manual (2018)	It only mentions that LIDs will be implemented when appropriate and list some of them. But LID criteria/requirements are not mentioned
Municipal Class Environmental Assessment	Municipal Class Environmental Assessment and Conceptual Design of Elevated Water Storage Facility and Pumping Station for Pressure District 7	Cole Engineering Group Ltd (COLE)	August 2019	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.
Municipal Class Environmental Assessment	Valley Inn Bridge Municipal Class Environmental Assessment Project File Report	Stantec Consulting Ltd	July 2021	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.	Stormwater Management details not included in the assessment.
Municipal Class Environmental Assessment	Birch Avenue: Schedule B Municipal Class Environmental Assessment	IBI GROUP	January 28, 2020	Some potential peak flow reduction measures were considered. However, flood control criteria is not mentioned	No erosion control mentioned.	No water balance control mentioned.	No water quality control mentioned.	It is mentioned to install an underground infiltration system as an alternative solution by using LID. However, LID criteria / requirements are not mentioned
Municipal Class Environmental Assessment	Environmental Assessment Study – King Street West (Dundas) Bridge #248	WSP	November 23, 2017	Stormwater Management details not included in the assessment (bridge replacement).	Stormwater Management details not included in the assessment (bridge replacement).	Stormwater Management details not included in the assessment (bridge replacement).	Stormwater Management details not included in the assessment (bridge replacement).	Stormwater Management details not included in the assessment (bridge replacement).
Stormwater Source Control Policy	Innovative Stormwater Source Control Policy for Industrial, Commercial And Institutional Land Uses	AMEC Environment & Infrastructure a division of	April 2013	Attenuate post-development peak flows to pre-development peak flow rates	All IC&I sites shall be designed to incorporate source control for erosion control.	Implement source control to maintain the average annual pre-developed water balance and	Enhanced (Level 1) treatment	- Refer to the MOE 2003 Guidelines and the CVC/TRCA 2010 Guidelines - It is provided a table summarizing

City of Hamilton Past Studies				Criteria				
Type	**Title**	**Autor**	**Date**	**Flood control**	**Erosion**	**Water Balance**	**Water Quality**	**LID**
		AMEC Americas Limited		for the 2 through 100-year storm events	Rooftop storage or parking lot storage shall not be used to provide erosion control.	groundwater recharge		the stormwater management function provided by each LID - It is provided a table indicating the preferred LID for different land use, based on spatial constraints, functionality, issues, operation and maintenance - It is mentioned the hydrological models PCSWM and EPA SWM as examples of analythical methods - Appendix A provides an assessment of LID BMP analytical technique for subwatersheds (Farrell/Scheckenberger, November 2009)
Master Drainage Plan Municipal Class Environmental Assessment	Upper Hannon Creek Master Drainage Plan Municipal Class Environmental Assessment	AEOCOM	October 2017	No flood control mentioned.	No erosion control mentioned.	No water balance control mentioned.	No water quality control mentioned.	No LID criteria/requirements mentioned
Class Environmental Assessment	Waterdown Road Corridor (Craven Avenue to Dundas Street) Class Environmental Assessment	Dillon Consulting Limited	April 2012	No flood control mentioned.	No erosion control mentioned.	No water balance control mentioned.	Normal (Level 2) stormwater treatment level (70% TSS removal)	No LID criteria/requirements mentioned

APPENDIX

C GSG CASE STUDIES

Case Study #1		
Background Information	**Site Address:**	15 Ambitious Court (DA-20-034) - Red Hill Business Park in the Hannon area of Hamilton
	Site Type:	Industrial, Commercial and Institutional
	Report Source:	Storm Water Management Report, prepared for Vicano Developments Limited by IBI Group – July 26th, 2021
	Sewershed Type:	Separated Sewershed
	Subwatershed System & Subwatershed Study (SWS):	Hannon Creek Subwatershed - No SWS Available
Proposed Development Information	**Project Description:**	The subject lands are part of a larger development application (i.e., Red Hill Business Park), that was supported by the Functional Servicing Report (FSR) completed by Amec Foster Wheeler in 2017. The current Stormwater Management report demonstrates how the proposed site application has been designed to meet the design criteria outlined in the original development application (ref. FSR, 2017). The site consists of a multi-unit industrial plaza with an approximate site area of 3.64 ha (+/-). The plans include two (2) single-story industrial buildings, multiple entrances, and rear loading docks. Each building will feature multiple entrances, and rear loading docks located at the rear of the structures with a total ground floor area of approximately 10,669 sq m (+/-).
	Development Type:	New Development
	Existing Site Conditions:	Agricultural field (assumed 0% impervious)
	Site Size:	3.64 ha (On-Site = 2.74 ha + External = 0.90 ha)
	Proposed Imperviousness:	56.5 % (On-Site = 75%, External = 0%)
	Proposed Stormwater Management (SWM):	**Stormwater Management Strategy:** The previously approved application for the larger development application (ref. FSR, Amec Foster Wheeler, 2017) determined allowable unitary flow rates for the total site to ensure that post-development flows are controlled to within 5% of the existing conditions. The application of these unitary release rates would achieve the quantity control requirements for the site, including both flood control and erosion control criteria based upon discussions with the Hamilton Conservation Authority. In addition to quantity control requirements, the site design must also achieve both water quality and water balance criteria, which has an established infiltration target of approximately 9,664 m^3 (+/-) per year, based upon the preceding FSR for the total development area. To meet the SWM targets for the site, the proposed stormwater management strategies include rooftop storage, surface ponding within perimeter swales, infiltration within the bioswales, and Oil-Grit-Separators (OGS) units prior to discharging to the storm sewer within the road right-of-way. Further details on the proposed strategies are provided in the following sections. **Flood Control & Erosion Control:**

Case Study #1		

		• **Criteria**: The flood control and erosion control criteria require the implementation of quantity control measures to match the established unitary flow rates.
		• **Achieved by**:
		  ○ Rooftop Storage: The proposed development includes rooftop storage for Building A (up to 510m^3) and Building B (up to 550m^3). The rooftop runoff from each building is controlled using multiple Zurn Z105 Control-Flo roof drains with two weirs per drain. This rooftop storage helps capture and control stormwater runoff from the buildings.
		  ○ Swale Ponding: The re-graded swales on site are designed to provide ponding areas that can hold up to 1,800m^3 of stormwater runoff. These swales incorporate knockout and orifice structures, as well as individual overflow weirs to maintain a 0.3m freeboard during all storm events. The swales collect and detain stormwater before releasing it to the existing storm sewer on Ambitious Court.
		  ○ Infiltration and Quality Control: The swales are underlain with clearstone and filter media to allow for the infiltration of runoff and to provide quality control. This helps manage the quantity of runoff and promotes better water infiltration into the ground.
		
		Water Quality:
		• **Criteria:** The water quality criteria required the control of site runoff to meet enhanced (Level 1) quality treatment standards with a target of 80% TSS removal.
		• **Achieved by:** The proposed treatment train consists of infiltrative bioswales and an OGS unit. The runoff is first filtered through the bioswales around the perimeter of the site, followed by the OGS unit, prior to discharging to the existing storm sewer.
		  ○ The oil/grit separator unit is sized based on the ETV Particle Size Distribution to achieve 60% TSS removal.
		  ○ The remaining 20% TSS removal is provided by the bioswales, which provide 50% TSS removal based upon their design criteria. The combined efficiencies through the treatment train process achieve the Enhanced Level of water quality treatment.
		
		Water Balance:
		• **Criteria:** the criteria for water balance involves achieving a designed infiltration volume of 246.6m^3, based upon a 9 mm capture target across the total on-site area of 2.74 ha (developed, not external) to address the infiltration deficit identified through the preceding FSR (ref. Amec Foster Wheeler, 2017).
		• **Achieved by:** The water balance criteria is achieved by implementing infiltrative bioswales, as follows:
		  ○ The design assumes an infiltration rate of 3mm/hr, which is based on the estimated hydraulic conductivity from the Geotechnical Investigation completed for the site.
		  ○ The proposed bioswales consist of a 0.36 m deep stone reservoir which provides 250m^3 of storage for infiltrating surface runoff, which meets the required design volume.

Case Study #1		

	Proposed Low Impact Development (LID) Measures:	**Bioswales:** Three (3) bioswales are proposed to satisfy both the infiltration volume target and the water quality target for the site; details include:
		
		• Front Swale (Catchment 200):
		  ○ Length = 117m, Width = 4.7m, Clearstone Depth = 0.36m
		  ○ Equating an approx. Storage Volume = 79.2 m^3
		• Rear Swale (Catchment 201):
		  ○ Length = 233.5m, Width = 4m, Clearstone Depth = 0.36m
		  ○ Equating an approx. Storage Volume = 134.5 m^3
		• Outlet Swale (Catchment 202):
		  ○ Length = 167.1m, Width = 1.5m, Clearstone Depth = 0.36m
		  ○ Equating an approx. Storage Volume = 36.1 m^3
		• The cross-section of the bioswales includes topsoil/seed, filter media, pea gravel and clearstone reservoir. Seeing as these bioswales are designed with a filter media component, this allows for filtration and pollutant removal before infiltration through the clearstone beds.

Application of the GSG	**GSG Targets:**	**Total Runoff Volume Control Target (RVCT):**
		• As per the Draft MECP Guidelines, the applicable total RVCT for the Hamilton Area is 28 to 29 mm, which for this site, would equate to a total runoff volume of approximately 576-596 m^3 (+/-) for the impervious area of the current site. This RVCT volume is to be achieved through the application of the Provincial Hierarchical Approach, consisting of Priority 1 (Retention), Priority 2 (Filtration) and Priority 3 (Conventional).
		
		Minimum Water Quality Retention Target:
		• Based upon the site details, the following can be concluded to support the identification of the applicable Minimum Water Quality Retention Target (WQRT):
		  ○ Separated sewershed
		  ○ No governing subwatershed study
		  ○ The site area is greater than 0.5 ha
		• Based upon this information, the resulting minimum WQRT would be **10 mm**. The equivalent storage volume associated with the minimum WQRT is:
		  ○ Total Site Area = 3.64 ha
		  ○ Site imperviousness = 56.5%
		  ○ This would equate to an approximate WQRT storage volume of 206 m^3 (+/-).

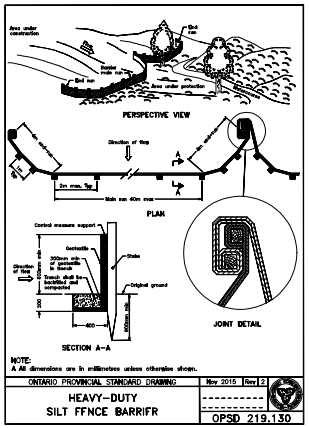
<table>
<tr><th colspan="3">Case Study #1</th></tr>
<tr><td rowspan="2"></td><td>SWM Strategy Relation to GSG Requirements:</td><td>The proposed SWM strategy provides a total infiltration storage of 250 m^3, which would slightly exceed the 10mm minimum WQRT volume of 206m^3. The proposed SWM strategy achieves this infiltrative volume through bioswales, which includes a filter media layer for pollutant removal, to have both water quality and retention benefits, hence based on the City's definition of "green infrastructure" would meet City requirements.

Therefore, the proposed SWM strategy meets the GSG requirements through the application of the following practices:
<u>Priority 1 (Retention):</u> The minimum WQRT volume is achieved through infiltrative bioswales which include a filter media component, achieving both water quality and retention benefits. The proposed design exceeds the minimum WQRT and represents approx. 12 mm of runoff depth on the impervious area, equating approx. 40% of the total RVCT (28-29 mm).
<u>Priority 3 (Conventional Treatment):</u> The excess runoff is treated through an OGS unit as an end of pipe conventional treatment measure which removes sediment, debris, oil, and other pollutants from stormwater runoff prior to leaving the site. OGS units are sized/designed to achieve specified pollutant removal efficiencies for 90% of average annual runoff and can therefore support the remaining water quality treatment through physical filtration as part of the treatment train.</td></tr>
<tr><td>Suggested Alternatives / Applications to meet the GSG Requirements:</td><td>While the proposed design achieves the minimum WQRT criteria, there are optional alternatives to meet the WQRT, as well as ways to achieve the total RVCT through the application of LID BMP treatment train processes. Some examples available to this site include but are not limited to the following:

<u>Priority 1 (Retention) Options:</u>
<u>Permeable pavements:</u> since the site includes the construction of a new parking lot, permeable pavement systems can allow additional stormwater to infiltrate through the pavement surface, which would help reduce runoff and promote groundwater recharge. These systems could be installed in the parking lot areas at the front of the property, as these are primarily for small vehicular traffic, and could provide an aesthetic curb appeal depending upon the type of pavers selected.
<u>Green / Blue Roofs:</u> for industrial / commercial developments, the site designs often include large building / rooftop footprints. The installation of green roofs / blue roofs can further reduce stormwater runoff through evapotranspiration, as well as mitigate the heat island effect common in industrial areas with large impervious areas.
<u>Rainwater harvesting:</u> should rooftop storage be implemented, harvesting the rainwater collected through the rooftop storage can further increase the retention volume by capturing rainwater on-site, which would manage stormwater runoff and the collected water could be utilized on-site for non-potable uses, including landscaping, toilets, car washing, etc., reducing the demand for potable water.
<u>Priority 2 (Filtration) Options:</u>
<u>Lined Bioretention:</u> while the proposed site has incorporated bioswales, the native soil conditions are not overly conducive for maximizing infiltrative practices. Therefore, options may exist to implement lined bioretention</td></tr>
</table>

Case Study #1		
		features or those with an underdrain for partial infiltration, to achieve the filtration component of the design, prior to discharging to the storm sewer. These could be implemented in the landscaped areas of the parking lot or maximized through the deepening of the bioswales to achieve a larger storage volume. These are provided as contextual options to demonstrate the flexibility in Stormwater Management designs to achieve both the City and Provincial requirements, promoting additional treatment train processes to benefit water quality and the local hydrologic cycle.

As Proposed SWM Strategy



EROSION AND SEDIMENT CONTROL NOTES:

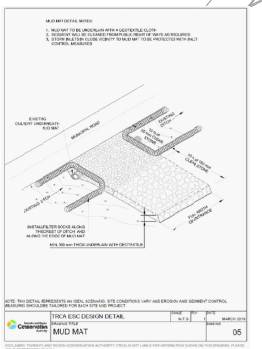
1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO DEVELOPMENT AND MAINTAINED THROUGHOUT THE CONSTRUCTION PROCESS, UNTIL ALL DISTURBED AREAS HAVE BEEN REVEGETATED.
2. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED AFTER EACH RAINFALL TO THE SATISFACTION OF AUTHORITY STAFF & THE CITY OF HAMILTON.
3. ANY DISTURBED AREA NOT SCHEDULED FOR FURTHER CONSTRUCTION WITHIN 45 DAYS WILL BE PROVIDED WITH A SUITABLE TEMPORARY MULCH AND SEED COVER WITHIN 7 DAYS OF THE COMPLETION OF THAT PARTICULAR PHASE OF CONSTRUCTION.
4. ALL DISTURBED AREAS SHALL BE REVEGETATED WITH PERMANENT COVER IMMEDIATELY FOLLOWING COMPLETION OF CONSTRUCTION.
5. SILT FENCE TO BE AS PER OPSD 219.130.
6. ADDITIONAL SILT CONTROL LOCATIONS MAY BE REQUIRED AS DETERMINED BY THE CITY OF HAMILTON.

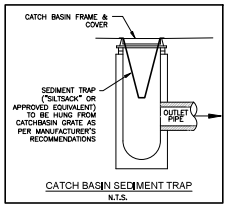
100 year pond area
Rear Swale
Rooftop Storage
Rooftop Storage
Outlet Swale
100 year pond area
Front Swale
100 year pond area
OGS Stormceptor
AMBITIOUS COURT

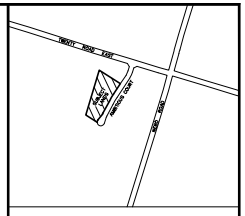
PROPOSED INDUSTRIAL BUILDING A
15 AMBITIOUS COURT
AREA = 5,127.5 sq.m.
(55,191 sq.ft.)
UNIT 1 AREA = 560.0 sq.m. (6,028 sq.ft.) FFE = 219.30
UNIT 2 AREA = 1,829.5 sq.m. (19,693 sq.ft.) FFE = 219.15
UNIT 3 AREA = 2,741.2 sq.m. (29,506 sq.ft.) FFE = 219.00

PROPOSED INDUSTRIAL BUILDING B
11 AMBITIOUS COURT
AREA = 5,541.8 sq.m.
(59,651 sq.ft.)
UNIT 1 AREA = 2,447 sq.m. (26,339 sq.ft.) FFE = 219.80
UNIT 2 AREA = 3,094.1 sq.m. (33,305 sq.ft.) FFE = 219.80

PROPOSED FENCE
PROPOSED FENCE AND GATE
TRENCH DRAIN OUTLET
MH1
MH2
MH3
MH4
MH5
MH6
SAN. MH 1
SAN. MH 2
SAN. MH 3
SAN. MH 4
CB7
CB6
OGS







LEGEND

- SILT FENCE AS PER OPSD 219.130
- EXISTING/PROPOSED CATCHBASIN WITH SEDIMENT PROTECTION
- MH2 EXISTING/PROPOSED STORM MANHOLE WITH SEDIMENT PROTECTION
- MH2A EXISTING/PROPOSED SANITARY MANHOLE WITH SEDIMENT PROTECTION
- MUD MAT

NOT FOR CONSTRUCTION

SOURCE:
TOPOGRAPHIC SURVEY INFORMATION OBTAINED FROM WEST & RUUSKA LTD., DWG. No. V190217, DATED NOVEMBER 26, 2019.

ELEVATION NOTE:
ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE DERIVED FROM CANSEL CAN-NET REAL TIME NETWORK OBSERVATION, UTM ZONE 17, NAD83 (CSRS)(2010)

SCALE
1:400 (m)

DESIGN BY: R. DE JONG | CHECKED BY: C. ANDERS
DRAWN BY: S. CARLSON | DATE: 2021-03-15

#	DATE	BY	DESCRIPTION
4	2021-08-05	JH	ISSUED FOR THIRD SUBMISSION
3	2021-06-07	SEC	ISSUED FOR SECOND SUBMISSION
2	2021-03-31	SEC	ISSUED FOR CLIENT REVIEW
1	2021-01-05	MA	SITE PLAN SUBMISSION

DRAWING ISSUE RECORD

APPROVALS

IBI GROUP
200 East Wing-360 James Street North
Hamilton ON L8L 1H5 Canada
tel 905 546 1010 fax 905 546 1011
ibigroup.com

VICANO DEVELOPMENTS LIMITED

15 AMBITIOUS COURT
DA-20-034

EROSION AND SEDIMENT CONTROL PLAN

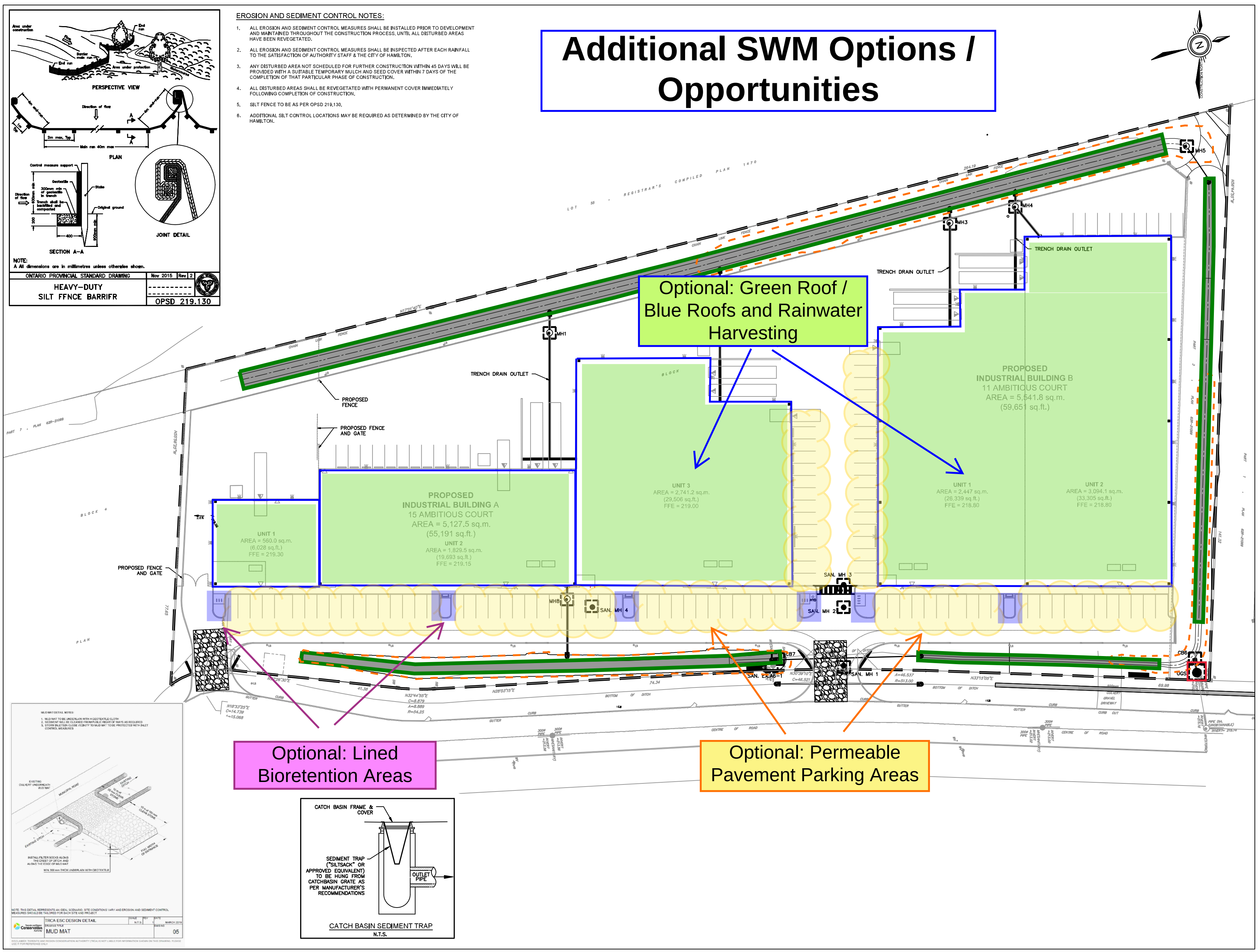
FILE NUMBER: 123421 | SHEET NUMBER: ESC

LAST SAVED BY: JoeHubert, Thursday, August 5, 2021 2:01:27 PM PLOTTED BY: Joe Hubert, Thursday, August 5, 2021 2:15:16 PM

Additional SWM Options / Opportunities

EROSION AND SEDIMENT CONTROL NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO DEVELOPMENT AND MAINTAINED THROUGHOUT THE CONSTRUCTION PROCESS, UNTIL ALL DISTURBED AREAS HAVE BEEN REVEGETATED.
2. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED AFTER EACH RAINFALL TO THE SATISFACTION OF AUTHORITY STAFF & THE CITY OF HAMILTON.
3. ANY DISTURBED AREA NOT SCHEDULED FOR FURTHER CONSTRUCTION WITHIN 45 DAYS WILL BE PROVIDED WITH A SUITABLE TEMPORARY MULCH AND SEED COVER WITHIN 7 DAYS OF THE COMPLETION OF THAT PARTICULAR PHASE OF CONSTRUCTION.
4. ALL DISTURBED AREAS SHALL BE REVEGETATED WITH PERMANENT COVER IMMEDIATELY FOLLOWING COMPLETION OF CONSTRUCTION.
5. SILT FENCE TO BE AS PER OPSD 219.130.
6. ADDITIONAL SILT CONTROL LOCATIONS MAY BE REQUIRED AS DETERMINED BY THE CITY OF HAMILTON.



KEY MAP - N.T.S.

LEGEND

- SILT FENCE AS PER OPSD 219.130
- EXISTING/PROPOSED CATCHBASIN WITH SEDIMENT PROTECTION
- MH2 EXISTING/PROPOSED STORM MANHOLE WITH SEDIMENT PROTECTION
- MH2A EXISTING/PROPOSED SANITARY MANHOLE WITH SEDIMENT PROTECTION
- MUD MAT

NOT FOR CONSTRUCTION

SOURCE:
TOPOGRAPHIC SURVEY INFORMATION OBTAINED FROM WEST & RUUSKA LTD., DWG. No. V190217, DATED NOVEMBER 26, 2019.

ELEVATION NOTE:
ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE DERIVED FROM CANSEL CAN-NET REAL TIME NETWORK OBSERVATION, UTM ZONE 17, NAD83 (CSRS)(2010)

SCALE 1:400 (m)

DESIGN BY: R. DE JONG | CHECKED BY: C. ANDERS
DRAWN BY: S. CARLSON | DATE: 2021-07-15

#	DATE	BY	DESCRIPTION
4	2021-08-05	JH	ISSUED FOR THIRD SUBMISSION
3	2021-05-07	SEC	ISSUED FOR SECOND SUBMISSION
2	2021-03-31	SEC	ISSUED FOR CLIENT REVIEW
1	2021-01-05	MA	SITE PLAN SUBMISSION

DRAWING ISSUE RECORD

APPROVALS

IBI GROUP
200 East Wing-360 James Street North
Hamilton ON L8L 1H5 Canada
tel 905 546 1010 fax 905 546 1011
ibigroup.com

VICANO DEVELOPMENTS LIMITED

15 AMBITIOUS COURT
DA-20-034

EROSION AND SEDIMENT CONTROL PLAN

FILE NUMBER: 123421 | SHEET NUMBER: ESC

Case Study #2		
Background Information	**Site Address:**	185 Valleyview Drive (DAER-20-027) – Ancaster community of Hamilton
	Site Type:	Residential
	Report Source:	Storm Water Management Brief, prepared by Ashenhurst Nouwens & Associates Inc - April 9th, 2020
	Sewershed Type:	Separated Sewershed
	Subwatershed System & Subwatershed Study (SWS):	Sulphur Creek Subwatershed – No SWS Available Also guided by the local source control requirements for the Community of Ancaster.
Proposed Development Information	**Project Description:**	The proposed project involves the construction of a two-storey single detached dwelling with two parking spaces on a 0.1 ha (+/-) site. A soak away pit will be constructed to manage the runoff volume resulting from the new development, specifically towards the backyard of the property. The design of the soak away pit is intended to accommodate the total runoff volume resulting from a 100-year event. This ensures that the system can effectively manage a significant rainfall event while preventing flooding and water accumulation on the property.
	Development Type:	Re-development
	Existing Site Conditions:	Single family dwelling - residential unit (approx. imperviousness of 35%) – smaller unit than proposed conditions
	Site Size:	0.0968 ha
	Proposed Imperviousness:	70% (estimated)
	Proposed Stormwater Management (SWM):	**Stormwater Management Strategy:** The proposed development is required to control the total runoff volume resulting from a 100-year event based upon the local source control criteria; the post-development runoff volume for a 100-year storm event was determined to be 36.24 m^3. A soak-away pit is proposed in the backyard of the development to control the required volume, and has based sized based on a percolation rate of 50 mm/hr, considering the native soil conditions and a safety factor of 2.0, based upon the site investigation completed by Soil Mat Engineers & Consultants LTD (ref. February 27, 2020). **Flood Control:** • **Criteria**: accommodate a total 100-year runoff volume of 36.24 m^3 • **Achieved by**: ○ Soak-away pit: The total volume required to accommodate the site runoff was determined to be 60 m^3, assuming a drawdown time of 24-hours and allowing a maximum depth of 1.5 m, sized to 6 m x10 m x1.5 m deep.
	Proposed Low Impact Development (LID) Measures:	**Soak away pit:** Flood control addressed by accommodating the runoff from 2-year to 100-year storms. The construction specifications of the soak-away pit are based on the Soil Mat Engineers and Consultants report, details include: • 6 m x 10 m x1.5 m deep containing 50 mm clear stone • 150 mm perforated cleanout C/W cap • Runoff enters through a yard drain at the surface

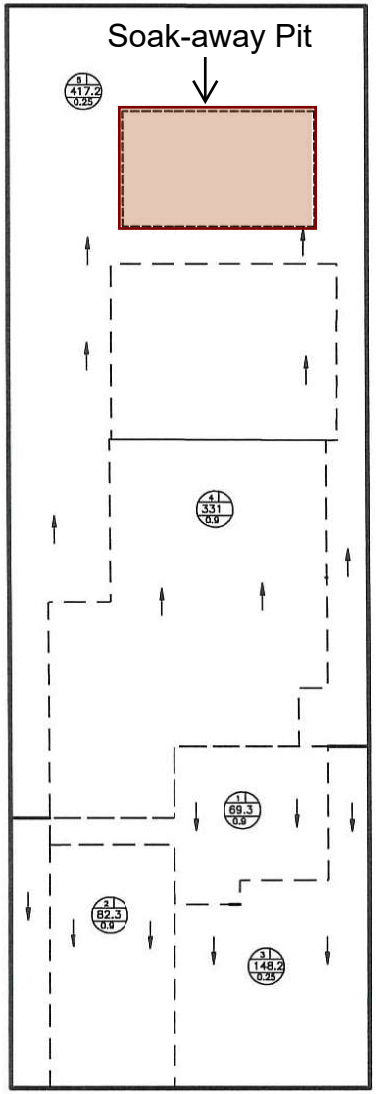
Case Study #2		
		• 0.50 m cover

Application of the GSG	**GSG Targets:**	**Total Runoff Volume Control Target (RVCT):**
		• In accordance with the Draft MECP LID Guidance, based upon the proposed site design, the total RVCT would equate to approximately 19-20 m^3 (+/-). This RVCT volume is to be achieved through the application of the Provincial Hierarchical Approach.
		
		Minimum Water Quality Retention Target:
		• Current site details to support the identification of the applicable Minimum Water Quality Retention Target (WQRT):
		  ○ Separated sewershed
		  ○ No governing subwatershed study (for water quality / water balance)
		  ○ The site area is less than 0.5ha
		• Resulting minimum WQRT would be **5 mm** with the equivalent storage volume as follows:
		  ○ Total Site Area = 0.0968 ha
		  ○ Proposed Site imperviousness = 70%
		  ○ WQRT storage volume of 3.4m^3 (+/-).

	SWM Strategy Relation to GSG Requirements:	The proposed SWM strategy provides a total infiltration storage of 36.24m^3, which would exceed the 5 mm minimum WQRT volume of 3.4m^3, as well as the total RVCT of 19-20 m^3. Therefore, the proposed SWM strategy meets the GSG requirements from a volumetric perspective, through the application of the following practices: • Priority 1 (Retention): Minimum WQRT volume is achieved through an infiltrative soak away pit. However, the soak away pit does not have a filter component to provide additional water quality filtration prior to infiltration.

	Suggested Alternatives / Applications to meet the GSG Requirements:	While the proposed design achieves the minimum WQRT criteria from a volumetric perspective, there are potential alternatives to meet the WQRT, as well as ways to achieve the total RVCT through the application of LID BMP treatment train processes. Since the natural soil has a high infiltration rate (50mm/hr), there is also capability for the system to maximize infiltration capacity. Some examples available to this site include but are not limited to:
		
		• **Priority 1 (Retention) Options:**
		  ○ Addition of a Filter Media to the Soak Away Pit: as noted previously, the proposed design includes a soak away pit consisting of clear stone material. The addition of a filter media layer, coupled with the surface capture / infiltration of the feature, would allow for an improved water quality benefit to the selected LID practice.
		  ○ Permeable pavements: the site includes a proposed asphalt driveway which can be replaced by permeable pavement especially if no heavy vehicles are expected to be using the driveway. This would allow stormwater to

Case Study #2		
		infiltrate through the pavement surface, which would further help reduce runoff and promote groundwater recharge. ○ Rain Gardens: the site being in a residential neighborhood could utilize the functional and aesthetic benefits of rain gardens. These could be implemented in either the front or back yard areas and could receive drainage from either the rooftops and/or driveway areas and be integrated as part of the landscaping plan for the site. • **Priority 2 (Filtration) Options:** ○ Enhanced grass swales: these could be placed in the periphery of the front and rear yards to increase the retention volume and provide physical filtration of the runoff as part of conveying to the drainage to its ultimate outlet. These are provided as contextual options to demonstrate the flexibility in Stormwater Management designs to achieve both the City and Provincial requirements, promoting additional treatment train processes to benefit water quality and the local hydrologic cycle.



PROPOSED POST-DEVELOPMENT DRAIAGE

COMPOSITE COEFFICIENT (C) TO THE FRONT = (151.6X0.9+148.2x0.25)/299.8 = 0.58
TOTAL AREA = 299.3m2
COMPOSITE COEFFICIENT (C) TO THE BACK = (331X0.9+417.2x0.25)/748.2 = 0.53
TOTAL AREA = 748.2m2

As Proposed SWM Strategy

1 / AREA / C — –DENOTES AREA NUMBER; –DENOTES AREA IN SQ.M.; –DENOTES RUNOFF COEFFICIENT

PLAN SHOWING PRE-DEVELOPMENT AND POST-DEVELOPMENT STORM DRAINAGE AREAS FOR 185 VALLEYVIEW DR., ANCASTER HAMILTON

SCALE : 1:250

APRIL 09, 2020
DATE

Amad Najm, P.ENG

ASHENHURST NOUWENS & ASSOCIATES INC.
PROFESSIONAL ENGINEERS & ONTARIO LAND SURVEYORS
225 KING WILLIAM STREET, SUITE 204, HAMILTON, ONTARIO L8R 1B1
TELEPHONE: (905) 529-6316
(905) 529-4314
FAX: (905) 529-6651
SINCE 1956
e-mail: anl@AshenhurstNouwens.ca

DRAWN BY	CALC'D BY	CHK'D BY	FILE No.
AN			18091 DRAINAGE AREA

Additional SWM Options / Opportunities

Optional: Add Soil Filter Layer

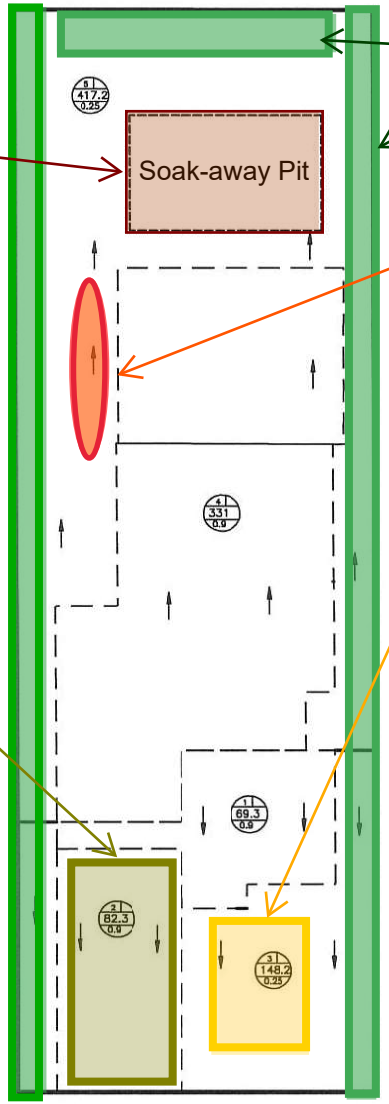
Soak-away Pit

Optional: Enhanced Grass Swales

Optional: Bioretention

Optional: Rain Garden

Optional: Permeable Pavers



PROPOSED POST-DEVELOPMENT DRAIAGE

COMPOSITE COEFFICIENT (C) TO THE FRONT = (151.6X0.9+148.2x0.25)/299.8 = 0.58
TOTAL AREA = 299.3m2
COMPOSITE COEFFICIENT (C) TO THE BACK = (331X0.9+417.2x0.25)/748.2 = 0.53
TOTAL AREA = 748.2m2

1 AREA C — –DENOTES AREA NUMBER; –DENOTES AREA IN SQ.M.; –DENOTES RUNOFF COEFFICIENT

PLAN SHOWING PRE-DEVELOPMENT AND POST-DEVELOPMENT STORM DRAINAGE AREAS FOR 185 VALLEYVIEW DR., ANCASTER HAMILTON

SCALE : 1:250

APRIL 09, 2020
DATE

Amad Najm, P.ENG

ASHENHURST NOUWENS & ASSOCIATES INC.
PROFESSIONAL ENGINEERS & ONTARIO LAND SURVEYORS
225 KING WILLIAM STREET, SUITE 204, HAMILTON, ONTARIO L8R 1B1
TELEPHONE: (905) 529-6316
(905) 529-4314
FAX: (905) 529-6651
SINCE 1956
e-mail: anl@AshenhurstNouwens.ca

DRAWN BY	CALC'D BY	CHK'D BY	FILE No.
AN			18091 DRAINAGE AREA

Case Study #3		
Background Information	**Site Address:**	9236 & 9322 Dickenson Rd (25T-202002)/DA-21-083, Glanbrook community of Hamilton
	Site Type:	Industrial, Commercial and Institutional
	Report Source:	Functional Servicing Report & Stormwater Management Brief, prepared for Panattoni Development Company by Odan Detech Consulting Engineers on March 5th, 2020 (last updated March 10th, 2023)
	Sewershed Type:	Separated Sewershed
	Subwatershed System & Subwatershed Study (SWS):	Twenty Mile Creek Tributary Area – SWS Available: Airport Employment Growth District (AEGD) Subwatershed Study and Stormwater Master Plan (ref. Aquafor Beech, April 2017)
Proposed Development Information	**Project Description:**	The proposed project is a 11.77-hectare industrial site situated north of Dickenson Road, with the Hamilton International Airport to the south and agricultural lands to the east and west. The proposed project site is located within the Twenty Mile Creek Tributary area, part of Airport Employment Growth District (AEGD). The project aims to develop a new industrial development with parking and loading bays. Access to the site will be provided from Dickenson Road and Upper James Street. A new road with a 30-m right-of-way will serve the northern portion of the development, while a future 36-m right-of-way is planned to provide access to the northern lands. The stormwater management plan for the proposed development will follow the City of Hamilton AEGD Subwatershed Study and Stormwater Master Plan (April 2017).
	Development Type:	New development
	Existing Site Conditions:	Agricultural land with a few existing residential homes (assumed 5% impervious)
	Site Size:	11.77 ha
	Proposed Imperviousness:	61%

	Proposed Stormwater Management (SWM):	**Stormwater Management Strategy:** The overall stormwater management strategy for the site was established as part of the AEGD Subwatershed Study and Stormwater Master Plan, which identified criteria for flood control, erosion control, water quality as well as water balance. Details are provided below.
		
		Flood Control:
		• **Criteria**: Provide onsite controls to achieve post- to pre-development release rates as established in the AEGD SWS.
		• **Achieved by**: The target flows are achieved through rooftop storage and subsurface storage using Cultec Storage Units.
		  ○ All rooftop areas will be used as storage; storage volume available on the rooftop is based on 90% of the rooftop area, and a ponding height of 0.15 m.
		  ○ A total of seven (7) Cultec Storage Units are proposed throughout the site to provide temporary storage and controlled release to the drainage outlets.

<table>
<tr><th colspan="3">Case Study #3</th></tr>
<tr><td rowspan="2"></td><td></td><td>Erosion Control:
Criteria: capture the runoff volume generated by a 25mm event released to the outlet over 24 hours (as per the current MOE guidelines)
Achieved by: use LID source and conveyance controls, where the frequency and duration of site outflows must not increase the instream index of erosion potential.
Water Quality:
Criteria: Enhanced Level 1 quality control (minimum 80% TSS removal).
Achieved by: combination of OGS units and various LID practices are proposed in various treatment trains across the site, including:
Enhanced Grass Swales → Bioretention
OGS units → Enhanced Grass Swales
Permeable Pavers → Enhanced Grass Swales
Clean roof runoff → Soak Away Pit
To ensure the removal of oils, each outlet will require an OGS unit or a method of removing oil spills before discharging into the downstream outlet and receiving watercourse.
Water Balance:
Criteria: Proponents will be required to maintain groundwater recharge per the pre-development conditions water balance. The AEGD study identified minimum infiltration targets depending upon the location within the subwatershed / surficial soil conditions, which was further refined through a local Hydrogeological Study completed by Terraprobe Inc. (ref. December 3, 2021).
Achieved by: the SWM system must retain and infiltrate 35% of runoff from building areas through LID measures at the site:
The capacity of proposed LID measures must be sufficient to retain and infiltrate a 5mm rainfall event at a minimum to meet pre-development water balance targets for infiltration.</td></tr>
<tr><td>Proposed Low Impact Development (LID) Measures:</td><td>Soak-away pit: A series of soak-away pits are proposed to retain and infiltrate runoff from buildings to achieve water balance as follows:
Two soak away pits proposed, one in the North Tributary (3B-R) and one in the South Tributary (3A-R), as follows:
3A-R: 60m x 10m x 0.6m - storage volume of 144m^3,
3B-R: 155m x 12m x 0.6m - storage volume of 368m^3.
Storage volumes based on porosity of 0.4 for infiltration gallery media (clear stone)</td></tr>
</table>

Case Study #3		

		• A roof capture of 12mm for the north tributary, and 14.5mm for the south tributary is required to meet the AEGD targets.
		• The percolation rate of native soils on site is 30mm/hr, but an infiltration rate of 18mm/hr was used for the soak-away pit design to be conservative.
		
		Swales (grassed with perforated pipe (enhanced), grassed without perforated pipe (dry)): The swales are used to meet the water quality criteria. They are placed either upstream or downstream of the other BMPs as a treatment train process to achieve a minimum of 80% TSS removal:
		• <u>OGS upstream and enhanced grassed swale downstream:</u> enhanced swale has a TSS removal efficiency of 80%, system has an overall removal efficiency of 90% and an infiltration volume of 77m^3-124m^3
		• The parameters of the enhanced grassed swales are as follows:
		  ○ <u>Channel ID 1:</u>
		  ▪ Channel length = 27m
		  ▪ Channel height = 1m
		  ▪ Channel bottom width = 3m
		  ▪ Side slopes = 3:1
		  ▪ Concrete weir height = 0.5m
		  ▪ Infiltration volume provided = 61m^3
		  ○ <u>Channel ID 2:</u>
		  ▪ Channel length = 13m
		  ▪ Channel height = 1m
		  ▪ Channel bottom width = 1m
		  ▪ Side slopes = 3:1
		  ▪ Concrete weir height = 0.5m
		  ▪ Infiltration volume provided = 16m^3
		  ○ <u>Channel ID 3:</u>
		  ▪ Channel length = 55m
		  ▪ Channel height = 1m
		  ▪ Channel bottom width = 3m
		  ▪ Side slopes = 3:1
		  ▪ Concrete weir height = 0.5m
		  ▪ Infiltration volume provided = 122m^3
		  ○ <u>Channel ID 4:</u>
		  ▪ Channel length = 70m
		  ▪ Channel height = 1m
		  ▪ Channel bottom width = 2m

<table>
<tr><th colspan="3">Case Study #3</th></tr>
<tr><td></td><td></td><td>

Side slopes = 3:1
Concrete weir height = 0.5m
Infiltration volume provided = 122m^3

Permeable pavers: Permeable pavers are used in combination with enhanced grassed swales to achieve the water quality targets, supporting the soak-away pits to further infiltrate the surface runoff.

<u>Permeable pavers upstream and enhanced grassed swale downstream:</u> both the permeable pavers and the enhanced swale have TSS removal efficiencies of 80%, allowing the system to have an overall removal efficiency of 90% and an infiltration volume of 75m^3 -79m^3.

Bioretention: Bioretention is used in combination with grassed swales to achieve the water quality targets:

<u>Grassed swale upstream, bioretention downstream:</u> grassed swale has a TSS removal efficiency of 50%, and the bioretention facility has a TSS removal efficiency of 80% allowing the system an overall removal efficiency of 90% and an infiltration volume of 22m^3 -25m^3.

</td></tr>
<tr><td rowspan="2">Application of the GSG</td><td>GSG Targets:</td><td>
Total runoff volume control target (RVCT):

As per the Draft MECP Guidelines, the total RVCT for the proposed site would be approximately 2016-2088 m^3 (+/-), which would be required to be treated through the Provincial Hierarchical approach.

Minimum Water Quality Retention Target:

Based upon the site details, the following can be concluded to support the identification of the applicable Minimum Water Quality Retention Target (WQRT):

Separated sewershed.
Governing subwatershed study
The site area is greater than 0.5ha

Based upon this information, the resulting minimum WQRT would be <u>10 mm</u>. The equivalent storage volume associated with the minimum WQRT is:

Site area = 11.77 ha
Site imperviousness = 60.6%
This would equate to an approximate WQRT storage volume of 713.3m^3 (+/-).

The governing SWS applicable to this site as well as the local site investigations had identified water balance requirements, as well as water quality requirements as part of preceding studies. These science-based targets exceed the minimums set through the GSG and would therefore take precedence when informing the design requirements.

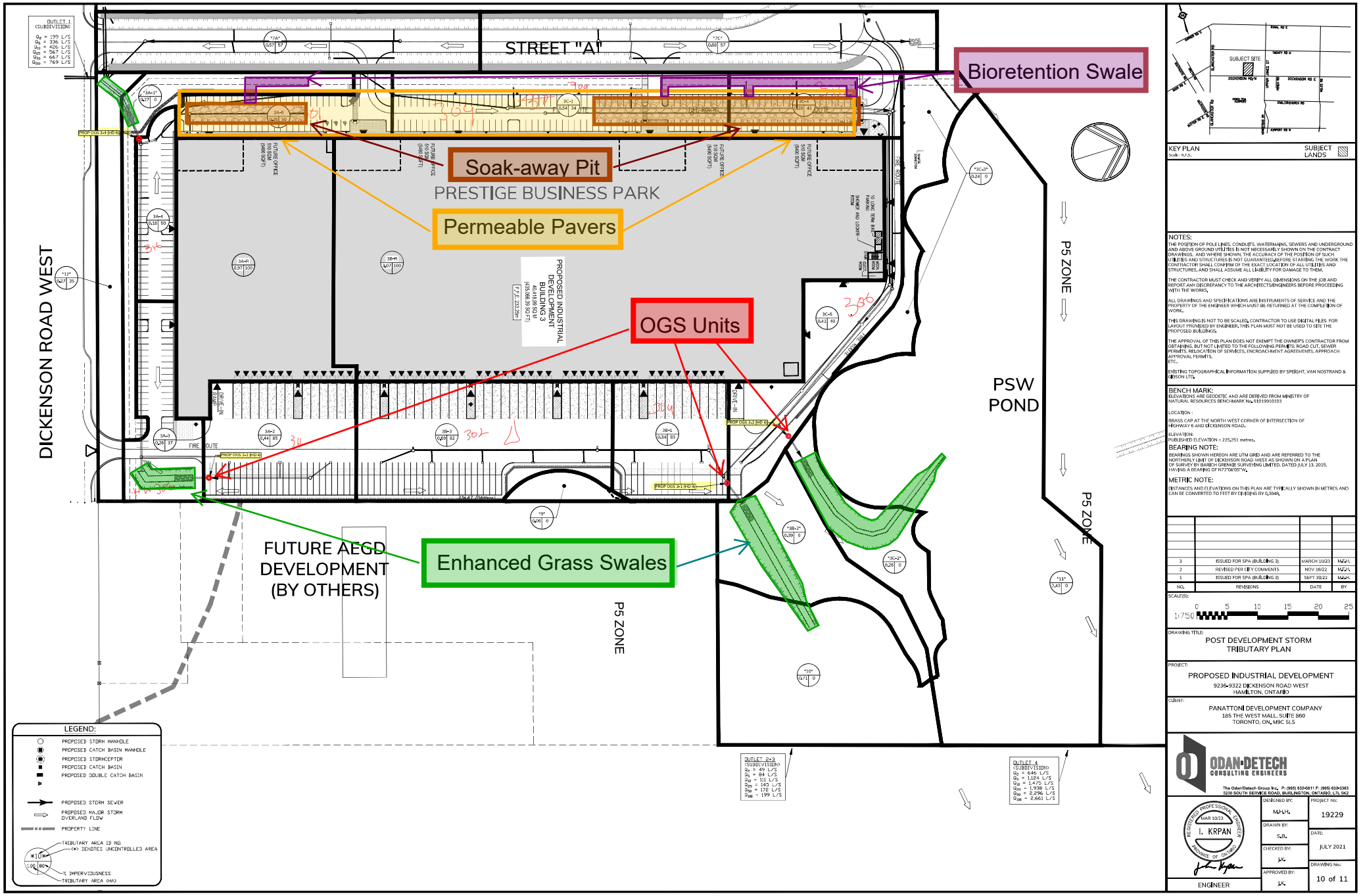
</td></tr>
<tr><td>SWM Strategy Relation to GSG Requirements:</td><td>The proposed SWM strategy provides a total infiltration storage of 1036m^3, which would exceed the 10mm minimum WQRT volume of 713.3m^3. The proposed SWM strategy achieves this infiltration volume through a combination of soak-away pits,</td></tr>
</table>

<table>
<tr><th colspan="3">Case Study #3</th></tr>
<tr><td></td><td></td><td>swales, permeable pavers, bioretention and OGS units. Through the application of these LID practices, the WQRT requirements are met, as well as the water quality and quantity criteria.

Therefore, the proposed SWM strategy would meet the GSG requirements through the application of the following practices:
Priority 1 (Retention): Minimum water quality retention target met through the combination of LID practices: swales (enhanced, dry, and grassed), permeable pavers, soak-away pits, and bioretention facilities.
Priority 2 (LID Filtration): the use of enhanced swales, grassed swales and bioretention facilities treat stormwater runoff through physical filtration for water quality through absorption.
Priority 3 (Conventional Treatment): OGS unit used as an upstream conventional treatment method, and has a TSS removal efficiency of 50%</td></tr>
<tr><td></td><td>Suggested Alternatives / Applications to meet the GSG Requirements:</td><td>While the proposed design achieves the minimum WQRT criteria through the application of various LID BMPs and has proposed treatment train processes, there are optional alternatives to meet the WQRT, as well as ways to achieve the total RVCT due to the flexible nature of SWM practices and design. Since the native sandy soils have a high infiltration rate (30mm/hr), there is capability for the system to maximize infiltration capacity through additional practices. Some examples available to this site include but are not limited to the following:

Priority 1 (Retention) Options:
Green roofs: for industrial developments, green roofs can help reduce stormwater runoff as well as mitigate the heat island effect common in industrial areas with large impervious areas.
Rainwater harvesting: while rooftop storage is implemented, harvesting the rainwater collected through the rooftop storage can increase the retention volume by capturing clean rainwater on-site, which would reduce the stormwater runoff from the site, while also reducing the demand for potable water.
Priority 2 (LID Filtration) Options:
Infiltration trenches: since the new development includes parking lots and loading bays, infiltration trenches can be designed to where there are limited strips of land between buildings or along road rights-of-way.
These are provided as contextual options to demonstrate the flexibility in Stormwater Management designs to achieve both the City and Provincial requirements, promoting treatment train processes to benefit water quality and the local hydrologic cycle.</td></tr>
</table>

As Proposed SWM Strategy



NOTES:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND UNDERGROUND AND ABOVE GROUND UTILITIES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.BEFORE STARTING THE WORK THE CONTRACTOR SHALL CONFIRM OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE ARCHITECT/ENGINEERS BEFORE PROCEEDING WITH THE WORKS.

ALL DRAWINGS AND SPECIFICATIONS ARE INSTRUMENTS OF SERVICE AND THE PROPERTY OF THE ENGINEER WHICH MUST BE RETURNED AT THE COMPLETION OF WORK.

THIS DRAWING IS NOT TO BE SCALED, CONTRACTOR TO USE DIGITAL FILES FOR LAYOUT PROVIDED BY ENGINEER, THIS PLAN MUST NOT BE USED TO SITE THE PROPOSED BUILDINGS.

THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S CONTRACTOR FROM OBTAINING, BUT NOT LIMITED TO THE FOLLOWING PERMITS: ROAD CUT, SEWER PERMITS, RELOCATION OF SERVICES, ENCROACHMENT AGREEMENTS, APPROACH APPROVAL PERMITS, ETC.

EXISTING TOPOGRAPHICAL INFORMATION SUPPLIED BY SPEIGHT, VAN NOSTRAND & GIBSON LTD.

BENCH MARK:

ELEVATIONS ARE GEODETIC AND ARE DERIVED FROM MINISTRY OF NATURAL RESOURCES BENCHMARK No. 010391010 3

LOCATION :

BRASS CAP AT THE NORTH WEST CORNER OF INTERSECTION OF HIGHWAY 8 AND DICKENSON ROAD.

ELEVATION:

PUBLISHED ELEVATION = 225.251 metres.

BEARING NOTE:

BEARINGS SHOWN HEREON ARE UTM GRID AND ARE REFERRED TO THE NORTHERLY LIMIT OF DICKENSON ROAD WEST AS SHOWN ON A PLAN OF SURVEY BY BARICH GRENKIE SURVEYING LIMITED, DATED JULY 13, 2015, HAVING A BEARING OF N77°06'05"W.

METRIC NOTE:

DISTANCES AND ELEVATIONS ON THIS PLAN ARE TYPICALLY SHOWN IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

NO.	REVISIONS	DATE	BY
3	ISSUED FOR SPA (BUILDING 3)	MARCH 10/23	M.K.H.
2	REVISED PER CITY COMMENTS	NOV 16/22	M.K.H.
1	ISSUED FOR SPA (BUILDING 3)	SEPT 30/22	M.K.H.

SCALE(S): 1:750 (0, 5, 10, 15, 20, 25)

DRAWING TITLE: POST DEVELOPMENT STORM TRIBUTARY PLAN

PROJECT: PROPOSED INDUSTRIAL DEVELOPMENT
9236-9322 DICKENSON ROAD WEST
HAMILTON, ONTARIO

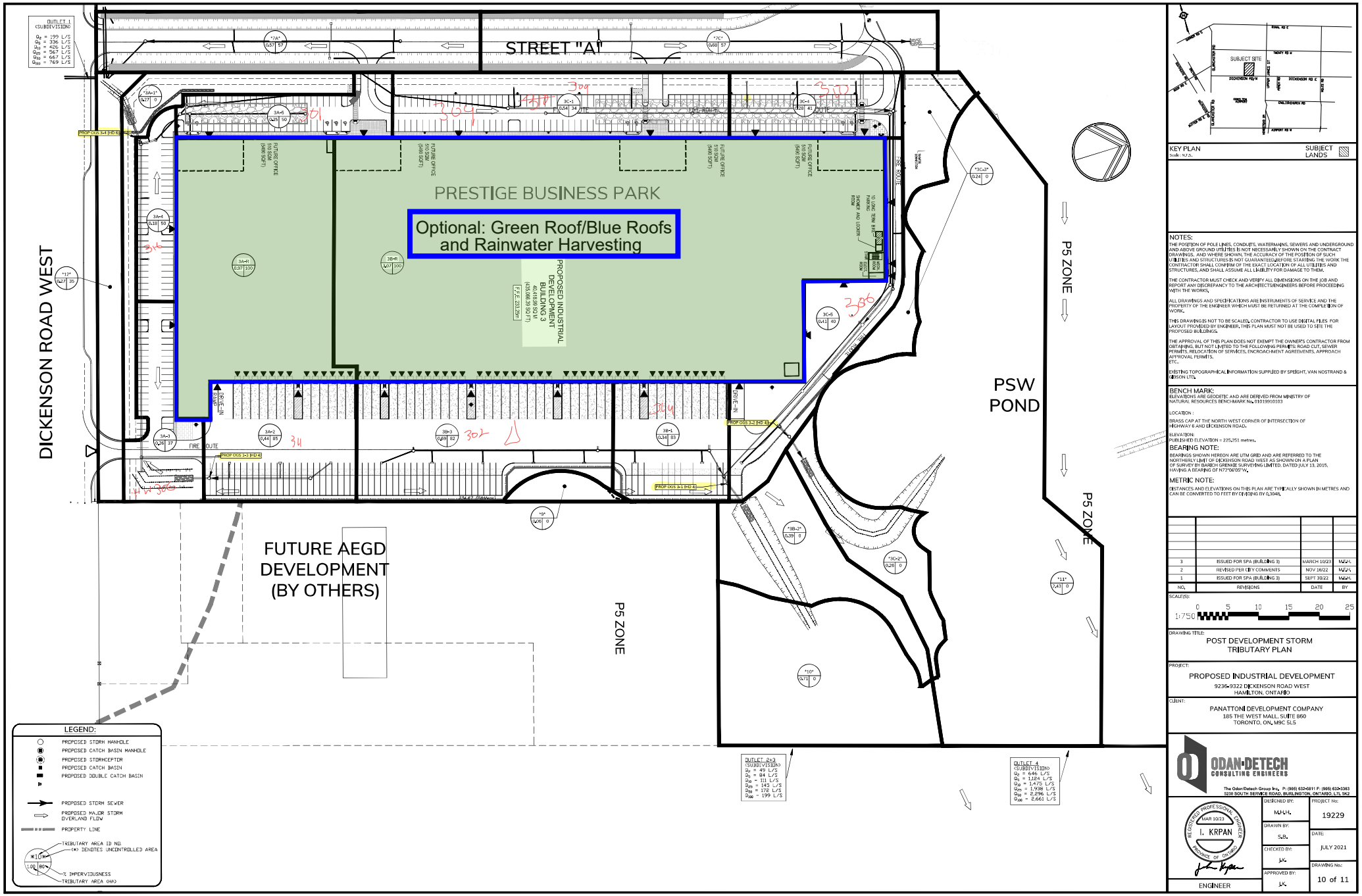
CLIENT: PANATTONI DEVELOPMENT COMPANY
185 THE WEST MALL, SUITE 860
TORONTO, ON, M9C 5L5

ODAN-DETECH CONSULTING ENGINEERS
The Odan/Detech Group Inc. P: (905) 632-8811 F: (905) 632-3383
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO, MAR 10/23, I. KRPAN
ENGINEER

DESIGNED BY: M.K.H.	PROJECT No: 19229
DRAWN BY: S.B.	DATE: JULY 2021
CHECKED BY: I.K.	DRAWING No: 10 of 11
APPROVED BY: I.K.	

Additional SWM Options / Opportunities



NOTES:

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND UNDERGROUND AND ABOVE GROUND UTILITIES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.BEFORE STARTING THE WORK THE CONTRACTOR SHALL CONFIRM THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE ARCHITECT/ENGINEERS BEFORE PROCEEDING WITH THE WORKS.

ALL DRAWINGS AND SPECIFICATIONS ARE INSTRUMENTS OF SERVICE AND THE PROPERTY OF THE ENGINEER WHICH MUST BE RETURNED AT THE COMPLETION OF WORK.

THIS DRAWING IS NOT TO BE SCALED, CONTRACTOR TO USE DIGITAL FILES FOR LAYOUT PROVIDED BY ENGINEER, THIS PLAN MUST NOT BE USED TO SITE THE PROPOSED BUILDINGS.

THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S CONTRACTOR FROM OBTAINING, BUT NOT LIMITED TO THE FOLLOWING PERMITS: ROAD CUT, SEWER PERMITS, RELOCATION OF SERVICES, ENCROACHMENT AGREEMENTS, APPROACH APPROVAL PERMITS, ETC.

EXISTING TOPOGRAPHICAL INFORMATION SUPPLIED BY SPEIGHT, VAN NOSTRAND & GIBSON LTD.

BENCH MARK:
ELEVATIONS ARE GEODETIC AND ARE DERIVED FROM MINISTRY OF NATURAL RESOURCES BENCHMARK No. 010139101O3

LOCATION :
BRASS CAP AT THE NORTH WEST CORNER OF INTERSECTION OF HIGHWAY 8 AND DICKENSON ROAD.

ELEVATION:
PUBLISHED ELEVATION = 225.251 metres.

BEARING NOTE:
BEARINGS SHOWN HEREON ARE UTM GRID AND ARE REFERRED TO THE NORTHERLY LIMIT OF DICKENSON ROAD WEST AS SHOWN ON A PLAN OF SURVEY BY BARICH GRENKIE SURVEYING LIMITED, DATED JULY 13, 2015, HAVING A BEARING OF N77°06'05"W.

METRIC NOTE:
DISTANCES AND ELEVATIONS ON THIS PLAN ARE TYPICALLY SHOWN IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

NO.	REVISIONS	DATE	BY
3	ISSUED FOR SPA (BUILDING 3)	MARCH 10/23	MJH/L
2	REVISED PER CITY COMMENTS	NOV 16/22	MJH/L
1	ISSUED FOR SPA (BUILDING 3)	SEPT 30/22	MJH/L

SCALE(S): 1:750 (0, 5, 10, 15, 20, 25)

DRAWING TITLE:
POST DEVELOPMENT STORM TRIBUTARY PLAN

PROJECT:
PROPOSED INDUSTRIAL DEVELOPMENT
9236-9322 DICKENSON ROAD WEST
HAMILTON, ONTARIO

CLIENT:
PANATTONI DEVELOPMENT COMPANY
185 THE WEST MALL, SUITE 860
TORONTO, ON, M9C 5L5

ODAN-DETECH CONSULTING ENGINEERS
The Odan/Detech Group Inc. P: (905) 632-8811 F: (905) 632-3383
5230 SOUTH SERVICE ROAD, BURLINGTON, ONTARIO, L7L 5K2

REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO, MAR 10/23, I. KRPAN, ENGINEER

DESIGNED BY: MJH/L	PROJECT No: 19229
DRAWN BY: S.B.	DATE: JULY 2021
CHECKED BY: I.K.	DRAWING No: 10 of 11
APPROVED BY: I.K.	

Case Study #4		
Background Information	**Site Address:**	315 Robert St & 219 to 247 East Ave N (SPA-22-055), community of Beasley in Hamilton
	Site Type:	Mixed use (Residential and Commercial)
	Report Source:	Storm Water Management Report, prepared for Invizij Architects Inc. by S. Llewellyn & Associated Limited on February 27th, 2020 (latest revision July 6th, 2022)
	Sewershed Type:	Combined Sewershed
	Subwatershed System & Subwatershed Study (SWS):	Urban Hamilton Subwatershed - No SWS Available
Proposed Development Information	**Project Description:**	The proposed project is 0.50ha affordable housing development, with 31 residential units at the corner of East Avenue and Roberts Street in Hamilton. The development site includes seven (7) surface parking spaces at grade, asphalt, concrete walkways, sidewalks, and landscaped areas.
	Development Type:	Re-development
	Existing Site Conditions:	Consists of multiple industrial buildings with associated gravel parking and landscaped area – 89% impervious
	Site Size:	0.5 ha
	Proposed Imperviousness:	80.3%

	Proposed Stormwater Management (SWM):	**Stormwater Management Strategy:** the proposed site is divided into 3 catchment areas (catchment 201, 202, and 203) representing the drainage areas for each part of the site. Catchment 201 represents the drainage area for the proposed building, that will be captured and controlled by a storm sewer. Catchment 202 represents the paved and landscaped areas that is controlled and captured by a storm sewer, whereas catchment 203 is runoff that is uncontrolled from landscaped areas.
		
		Quantity Control:
		• **Criteria**: The stormwater discharge rate from the site must be controlled to the 2-year predevelopment discharge rate for all storm events up to and including the 100-year event
		• **Achieved by**: Quantity controls will be achieved through both roof top controls as well as an underground storage tank, as described below.
		  ○ Catchment 201 is controlled by 12 Zurn Z-105 controlled flow roof drains on the building:
		  ▪ The building rooftop would allow a maximum ponding depth of 0.15m
		  ▪ Require 86.3m^3 of stormwater storage is required during the 100-year storm event, which can be accommodated by proposed roof ponding, having an available volume of 155.5m^3
		  ○ Catchment 202 is controlled by a 130mm diameter orifice plate located at the south invert of a 1-layer Stormbrixx SD storage tank:

<table>
<tr><th colspan="3">Case Study #4</th></tr>
<tr><td rowspan="2"></td><td></td><td>

The tank is required to provide stormwater storage during storm events up to and including 100-year storms
Require 56.3m^3 of stormwater storage during the 100-year event, which can be accommodated by proposed storage tank having an available volume of 69 m^3.

Water Quality:

Criteria: The stormwater runoff from the proposed condition site must meet Level 1 (Enhanced) stormwater quality control (80% TSS removal, 90% average annual runoff treatment)
Achieved by: Water quality measures are only being proposed for phase 3 of the site development (phases 1 and 2 have a small total driveway area thus not requiring water quality measures). This criterion will be achieved by a treatment train including OGS units:

HydroStorm HS4 are proposed to provide 88% TSS removal and 100% average annual runoff treatment and are credited for 53% of removal within the treatment train.
CB Shield inserts are proposed to be installed, which will connect the storm system upstream to the proposed Stormbrixx tank:

Contribute to the removal of TSS at an efficiency of 55% and the capture of floatables within catch basin.
Prove scour protection and reduce the resuspension of soils during heavy rain events.

Therefore, the weighted average of TSS removal from the proposed development reveals that the treatment train approach will provide 82% TSS removal and meet the water quality criterion.

</td></tr>
<tr><td>Proposed Low Impact Development (LID) Measures:</td><td>None incorporated.</td></tr>
<tr><td rowspan="2">Application of the GSG</td><td>GSG Targets:</td><td>
Total runoff volume control target (RVCT):

As per the Draft MECP Guidelines, the total RVCT for the proposed site would be approximately 112-116 m^3 (+/-), which would be required to be treated through the Provincial Hierarchical approach.

Minimum water quality retention target:

Based upon the site details, the following can be concluded to support the identification of the applicable Minimum Water Quality Retention Targets (WQRT):

Combined sewershed.
No governing subwatershed study
The site area is less than or equal to 0.5 ha

Based upon this information, the resulting minimum WQRT would be <u>2.5 mm</u>. The equivalent storage volume associated with the minimum WQRT is:

</td></tr>
</table>

Case Study #4		
		○ Site area = 0.5 ha ○ Site imperviousness = 80% ○ This would equate to an approximate WQRT storage volume of 10 m^3 (+/-).
	SWM Strategy Relation to GSG Requirements:	The proposed SWM strategy provides water quantity controls through rooftop and underground storage, as well as water quality controls through end of pipe conventional measures as summarized below: • Priority 3 (Conventional Treatment): OGS unit and CB Shield inserts are used to achieve the water quality criterion, and are conventional methods used to achieve a TSS removal efficiency of 82% However, the proposed strategy does not include any retention-based practices which would achieve the GSG requirements. No information was presented to identify the native soil conditions and whether they might be suitable for infiltrative practices, however there are other methods of implementing LID BMPs as part of the treatment train process to achieve the GSG requirements.
	Suggested Alternatives / Applications to meet the GSG Requirements:	As the proposed design would not achieve the WQRT, there are a variety of optional alternatives to meet the WQRT, a well as ways to achieve the total RVCT through the application of LID BMP treatment train process. Examples available to this site include but are not limited to the following: • **Priority 1 (Retention) Options:** ○ Permeable pavements: since the site includes the construction of a parking lot / driveways, permeable pavement systems can allow additional stormwater to infiltrate through the pavement surface, which would help reduce runoff and promote groundwater recharge. These systems could be installed in the parking lot areas at the front of the property, as these are primarily for small vehicular traffic, and could provide an aesthetic curb appeal depending upon the type of pavers selected. ○ Bioretention / Rain gardens: the implementation of a bioretention / rain garden facility as part of the landscaped areas would increase the storage volume provided for stormwater on site and will limit the amount of rainwater entering the local storm drain. These systems increase infiltration thus aiding in restoring and recharging groundwater systems as well as provide water quality benefits through filtration of runoff and can be designed as an aesthetic feature for the site. ○ Green / Blue Roofs: for industrial / commercial developments, the site designs often include large building / rooftop footprints. The installation of green roofs / blue roofs can further reduce stormwater runoff through evapotranspiration, as well as mitigate the heat island effect common in industrial areas with large impervious areas; these could be combined with rooftop controls to provide benefits to both water quantity criteria as well as the retention criteria.

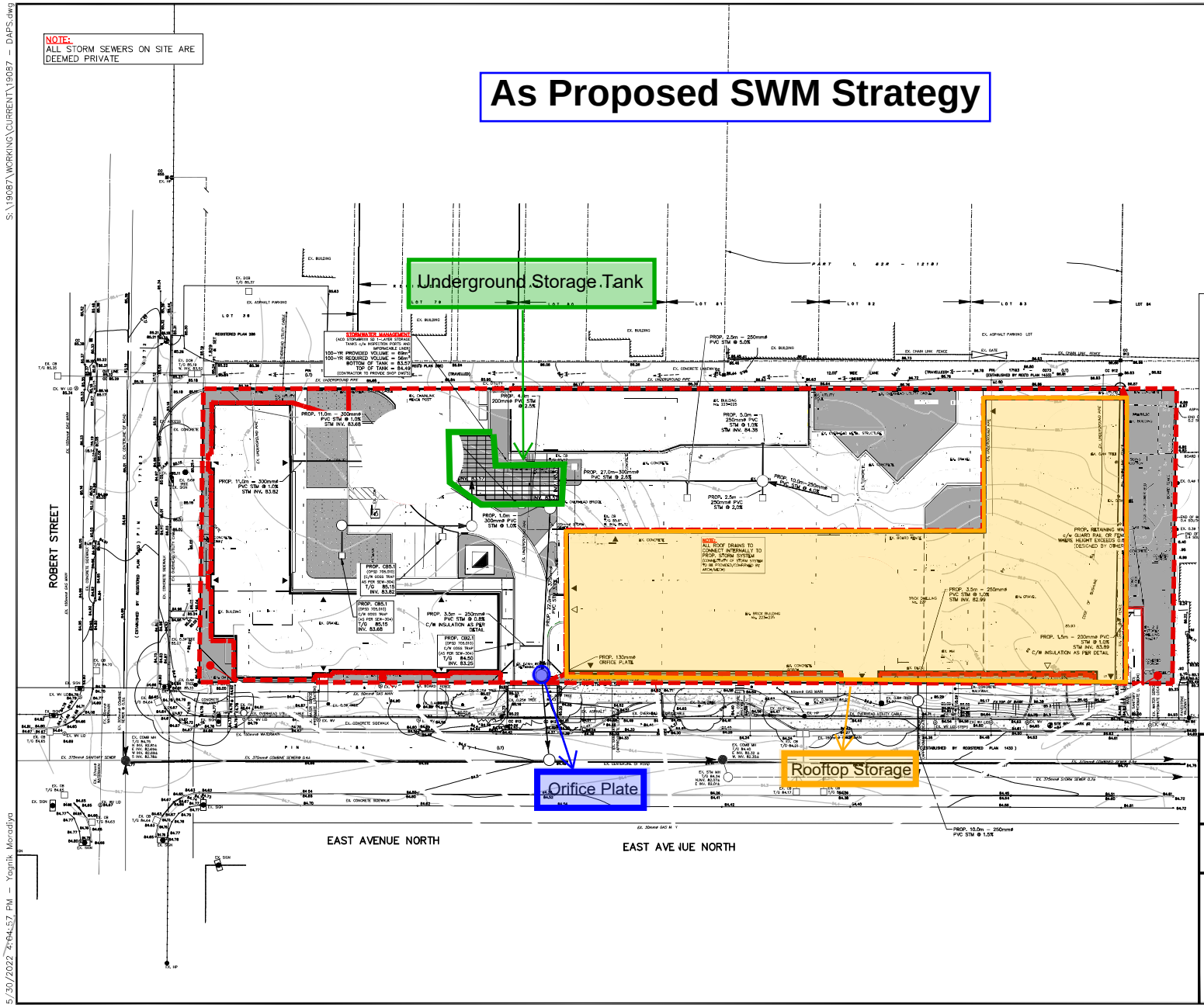
Case Study #4		
		○ Infiltration Trenches / Perforated pipes: infiltration trenches / perforated pipes can be integrated as part of the storm sewer conveyance system while allowing subsurface retention of runoff for small storm events. ○ Rainwater harvesting: while rooftop storage is implemented, harvesting the rainwater collected through the rooftop storage tanks can increase the retention volume by capturing rainwater on-site, which would manage stormwater runoff while reducing the demand for potable water. • **Priority 2 (LID Filtration) Options:** ○ Lined Priority 1 Surface Features: for sites which may not have subsurface conditions conducive to infiltrative practices (i.e., poor soils, high groundwater / bedrock, etc.) the items listed under Priority 1 (Retention) can be designed with an impermeable liner, which would eliminate any subsurface constraints and allow the LID BMPs to be designed as LID Filtration techniques (Priority 2). These could be considered for the current site to design a surface-based feature to remove pollutants from the stormwater runoff occurring from the site. These are provided as contextual options to demonstrate the flexibility in Stormwater Management designs to achieve both the City and Provincial requirements, promoting treatment train processes to benefit water quality and the local hydrologic cycle.

S:\19087\WORKING\CURRENT\19087 - DAPS.dwg

5/30/2022 4:04:57 PM - Yagnik Moradiya

NOTE:
ALL STORM SEWERS ON SITE ARE DEEMED PRIVATE

As Proposed SWM Strategy



LEGEND

IMPERVIOUS AREA

DRAINAGE BOUNDARY

101
4.90
0%
0.25

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

FIGURE 3.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN
SCALE: 1:500

PROJECT: 225 EAST AVENUE NORTH
HAMILTON, ON
PROJECT No.: 19087

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Tel. (905) 631-6978
Fax (905) 631-8927
email: info@sla.on.ca

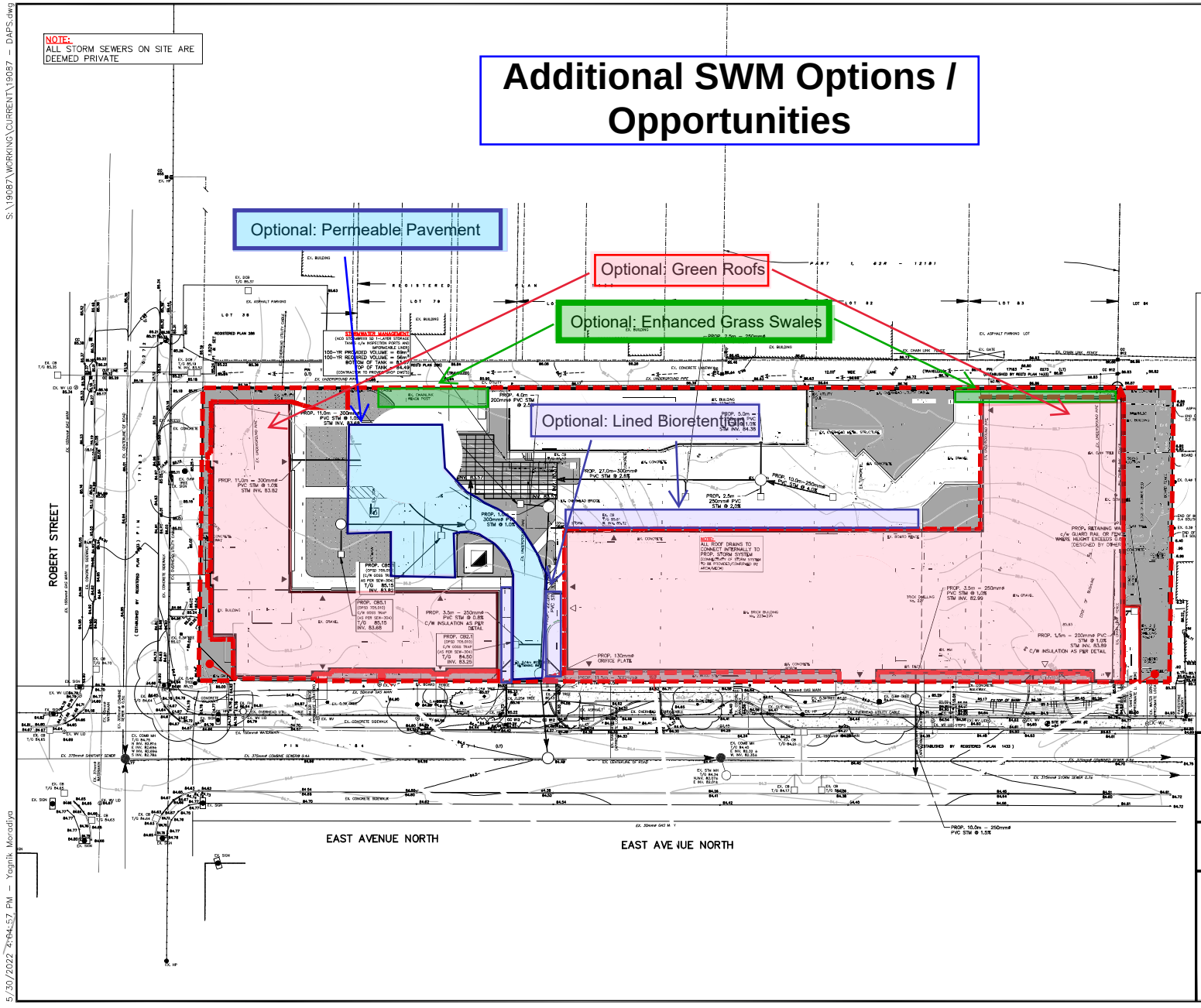
3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

S:\19087\WORKING\CURRENT\19087 - DAPS.dwg

5/30/2022 4:04:57 PM - Yagnik Moradiya

NOTE:
ALL STORM SEWERS ON SITE ARE DEEMED PRIVATE

Additional SWM Options / Opportunities



LEGEND

IMPERVIOUS AREA

DRAINAGE BOUNDARY

101
4.90
0%
0.25

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

DIRECTION OF SHEET FLOW

FIGURE 3.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN
SCALE: 1:500

PROJECT: 225 EAST AVENUE NORTH
HAMILTON, ON
PROJECT No.: 19087

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Tel. (905) 631-6978
Fax (905) 631-8927
email: info@sla.on.ca

3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

Case Study #5		
Background Information	**Site Address:**	41-61 Wilson Street & 97, 99 & 117 John Street North (DA-21-097) – The Design District Community of Hamilton
	Site Type:	Mixed use (Residential and Commercial)
	Report Source:	Functional Servicing and Stormwater Management Report, prepared for Hamilton II LP by A.J. Clarke and Associates Ltd. (AJC) on October 2021
	Sewershed Type:	Combined Sewershed
	Subwatershed System & Subwatershed Study (SWS):	Urban Hamilton Subwatershed – No SWS Available
Proposed Development Information	**Project Description:**	The proposed development located at 41 Wilson Street is approximately 0.693 ha (+/-) in size and is to include three (3) thirty-storey towers, built on a seven-storey base. The development will consist of 1,784m^2 commercial units on the first floor, and 908 residential units above. To support the development, 505 parking spaces are proposed for the site. The development site is bordered by John Street North to the east, Hughson Street North to the west, and Wilson Street to the south.
	Development Type:	Re-development
	Existing Site Conditions:	The existing site conditions include two residential buildings, paved parking area, and concrete walkways (approx. site imperviousness 100%)
	Site Size:	0.693 ha
	Proposed Imperviousness:	100%

	Proposed Stormwater Management (SWM):	**Stormwater Management Strategy:** The stormwater management strategy for the proposed site includes controlling the 100-year post-development peak flow to the 2-year pre-development flow rate, due to the site being located within a combined sewershed. Water quality control to an "Enhanced" level of treatment is required as per HCA criteria.
		
		Flood Control:
		• **Criteria**: The quantity control criteria applicable for the site is to control the 100-year post development peak flows to the 2-year pre-development flow rate (combined sewershed requirement).
		• **Achieved by**: underground storage cisterns / orifice controls to each respective outlet, as described below:
		  ○ Three (3) cisterns will be installed on-site outside the building foundation beneath the drive aisles and northwest patio. These cisterns will serve as underground storage for managing stormwater runoff.
		  ○ Orifice control will also be used in the form of 100mm, 130mm, and 95mm orifice plates (placed in downstream manhole to regulate the flow rates).
		  ○ The design of the cisterns is as follows:
		  ▪ Tower A will include a 100mm outlet control orifice will restrict the flows to 0.024 m3/s, and with the anticipated sanitary flows, it will not exceed the total allowable release rate of 0.047 m3/s. A storage requirement of 78.7m^3 is provided by the cistern.

<table>
<tr><th colspan="3">Case Study #5</th></tr>
<tr><td rowspan="2"></td><td></td><td>

Tower B will include a 130mm outlet and will restrict the flows to 0.035 m^3/s, and with the anticipated sanitary flows, it will not exceed the total allowable release rate of 0.060 m^3/s. A storage requirement of 85.7 m^3 is provided by the cistern.
Tower C will include a 95mm outlet control orifice and will restrict the flows to 0.022 m^3/s, and with the anticipated sanitary flows, it will not exceed the total allowable release rate of 0.045 m^3/s. A storage requirement of 101.5 m^3 is provided by the cistern.

Water Quality:

Criteria: To achieve an "Enhanced" or Level 1 treatment, which includes a minimum of 80% total suspended solids (TSS) removal and 90% run-off volume treatment.
Achieved by:

<u>Roof Drainage:</u> All storm runoff on the site, except for the drive aisles, will be collected through roof drainage. Since roof surfaces typically have minimal contamination, no additional water quality control measures are required for this portion of the site.
<u>Drive Aisles:</u> The drive aisles along Wilson Street and John Street North will drain to double catchbasins equipped with CB Shields. These CB Shields are designed to provide water quality control by capturing and retaining sediment and other contaminants before the stormwater enters the underground cistern storage.

</td></tr>
<tr><td>Proposed Low Impact Development (LID) Measures:</td><td>No LID measures were implemented.</td></tr>
<tr><td>Application of the GSG</td><td>GSG Targets:</td><td>
Total runoff volume control target (RVCT):

As per the Draft MECP Guidelines, the total RVCT for the proposed site would be approximately 194-201 m^3 (+/-), which would be required to be treated through the Provincial Hierarchical approach.

Minimum Water Quality Retention Target:

Based upon the site details, the following can be concluded to support the identification of the applicable Minimum Water Quality Retention Target (WQRT):

Combined sewershed.
No governing subwatershed study
The site area is greater than 0.5ha

Based upon this information, the resulting minimum WQRT would be <u>5 mm</u>. The equivalent storage volume associated with the minimum WQRT is:

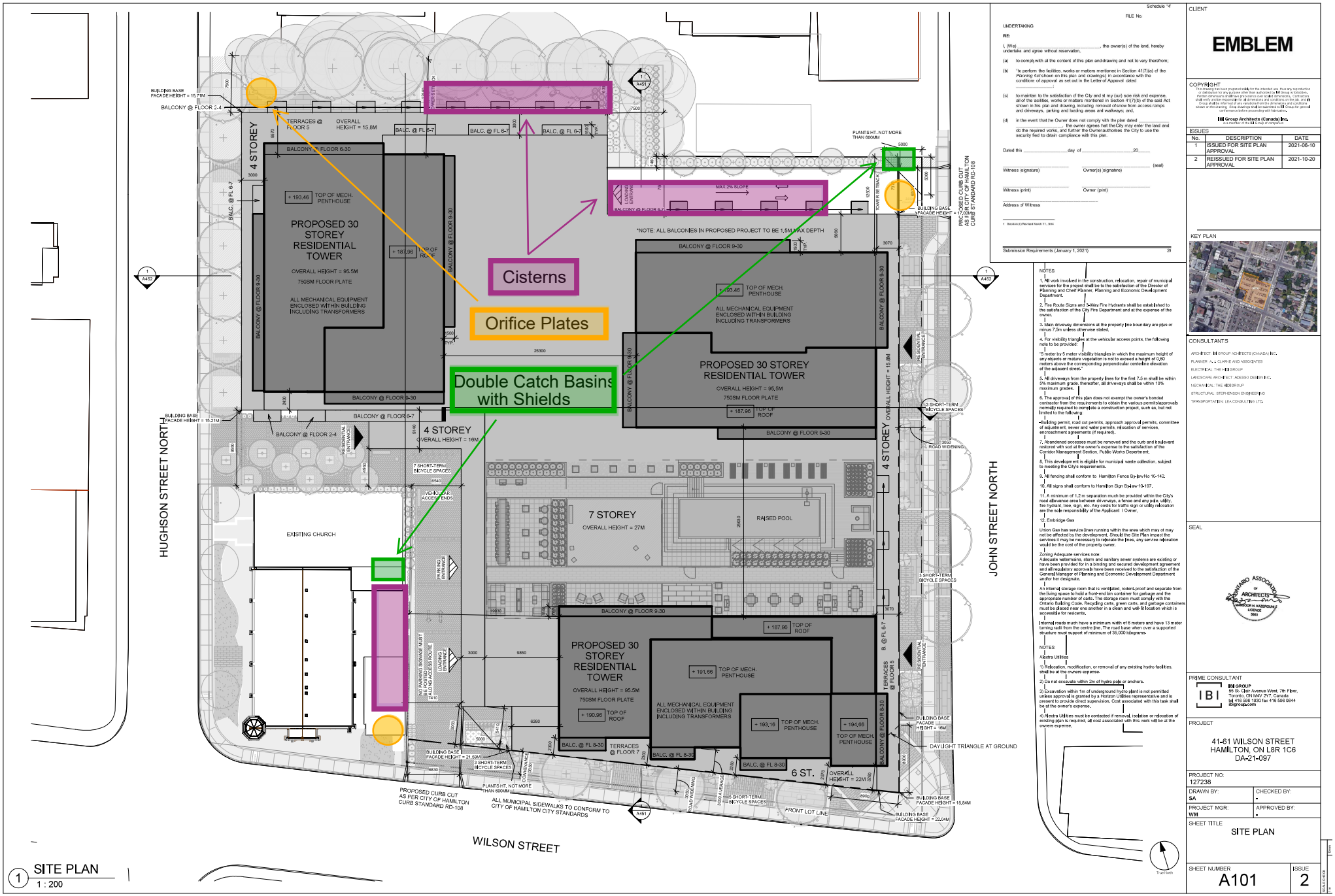
Site area = 0.693 ha
Site imperviousness = 100%

This would equate to an approximate WQRT storage volume of 34.65m^3 (+/-).
</td></tr>
</table>

Case Study #5		
	SWM Strategy Relation to GSG Requirements:	The proposed SWM strategy implements water quantity controls through underground storage tanks and orifice controls to achieve the discharge criteria identified for combined sewersheds. The driveway aisles proposed for the site are to drain to CB Shields for water quality treatment, whereas majority of the site is rooftop drainage which is considered “clean” and would not require additional quality control. The site design does not incorporate retention or LID practices, which would therefore not meet the GSG WQRT criteria. While it is understood that under existing conditions the site is fully impervious and is a parking lot, which would likely result in higher levels of contamination due to vehicular traffic than the proposed site design which is primarily rooftop areas, the WQRT criteria would apply to all proposed sites regardless of their existing conditions.

	Suggested Alternatives / Applications to meet the GSG Requirements:	There are a variety of optional alternatives to meet the WQRT, a well as ways to achieve the total RVCT through the application of LID BMP treatment train process. Some examples available to this site include but are not limited to the following:
		
		• **Priority 1 (Retention) Options:**
		  ○ Permeable pavements: since the site includes the construction of driveways, permeable pavement systems can allow additional stormwater to infiltrate through the pavement surface, which would help reduce runoff and promote groundwater recharge. These systems could be installed in the driveway aisles at the entrance of the property, as these are primarily for small vehicular traffic, and could provide an aesthetic curb appeal depending upon the type of pavers selected.
		  ○ Green / Blue Roofs: for large residential / commercial developments, the site designs often include large building / rooftop footprints, as is the case for this site. The installation of green roofs / blue roofs can further reduce stormwater runoff through evapotranspiration, as well as mitigate the heat island effect common in industrial areas with large impervious areas. For this site in particular, green roofs could be an aesthetic component to the patio design for the amenity area of the rooftop.
		  ○ Rainwater harvesting: harvesting the rainwater collected through the rooftop drainage can further increase the retention volume by capturing rainwater on-site, which would manage stormwater runoff and the collected water could be utilized on-site for non-potable uses, including landscaping, toilets, car washing, etc., reducing the demand for potable water. The current site design already incorporates underground cisterns, which could have a rainwater harvesting collection system incorporated.
		
		These are provided as contextual options to demonstrate the flexibility in Stormwater Management designs to achieve both the City and Provincial requirements, promoting treatment train processes to benefit water quality and the local hydrologic cycle.

As Proposed SWM Strategy



1 SITE PLAN
1 : 200

Schedule "4"
FILE No.
UNDERTAKING
RE:
I, (We) _____, the owner(s) of the land, hereby undertake and agree without reservation,
(a) to comply with all the content of this plan and drawing and not to vary therefrom;
(b) "to perform the facilities, works or matters mentioned in Section 41(7)(a) of the Planning Act shown on this plan and drawing(s) in accordance with the conditions of approval as set out in the Letter of Approval dated _____"
(c) to maintain to the satisfaction of the City and at my (our) sole risk and expense, all of the facilities, works or matters mentioned in Section 41(7)(b) of the said Act shown in this plan and drawing, including removal of snow from access ramps and driveways, parking and loading areas and walkways; and,
(d) in the event that he Owner does not comply with the plan dated _____, the owner agrees that the City may enter the land and do the required works, and further the Owner authorizes the City to use the security filed to obtain compliance with this plan.
Dated this _____ day of _____, 20____
Witness (signature) _____ Owner(s) (signature) _____ (seal)
Witness (print) _____ Owner (print) _____
Address of Witness _____
1 Section (3) Revised March 11, 2004
Submission Requirements (January 1, 2021) 29

NOTES:
1. All work involved in the construction, relocation, repair of municipal services for the project shall be to the satisfaction of the Director of Planning and Chief Planner, Planning and Economic Development Department,
2. Fire Route Signs and 3-Way Fire Hydrants shall be established to the satisfaction of the City Fire Department and at the expense of the owner.
3. Main driveway dimensions at the property line boundary are plus or minus 7.3m unless otherwise stated.
4. For visibility triangles at the vehicular access points, the following note to be provided:
"5 meter by 5 meter visibility triangles in which the maximum height of any objects or mature vegetation is not to exceed a height of 0.60 meters above the corresponding perpendicular centerline elevation of the adjacent street."
5. All driveways from the property lines for the first 7.5 m shall be within 5% maximum grade. thereafter, all driveways shall be within 10% maximum grades.
6. The approval of this plan does not exempt the owner's bonded contractor from the requirements to obtain the various permits/approvals normally required to complete a construction project, such as, but not limited to the following:
-Building permit, road cut permits, approach approval permits, committee of adjustment, sewer and water permits, relocation of services, encroachment agreements (if required),
7. Abandoned accesses must be removed and the curb and boulevard restored with sod at the owner's expense to the satisfaction of the Corridor Management Section, Public Works Department.
8. This development is eligible for municipal waste collection, subject to meeting the City's requirements.
9. All fencing shall conform to Hamilton Fence By-law No 10-142.
10. All signs shall conform to Hamilton Sign By-law 10-197.
11. A minimum of 1.2 m separation much be provided within the City's road allowance area between driveways, a fence and any pole, utility, fire hydrant, tree, sign, etc. Any costs for traffic sign or utility relocation are the sole responsibility of the Applicant / Owner.
12. Enbridge Gas
Union Gas has service lines running within the area which may or may not be affected by the development. Should the Site Plan impact the services it may be necessary to relocate the lines, any service relocation would be the cost of the property owner.
Zoning Adequate services note:
Adequate watermains, storm and sanitary sewer systems are existing or have been provided for in a binding and secured development agreement and all regulatory approvals have been received to the satisfaction of the General Manager of Planning and Economic Development Department and/or her designate.
An internal storage room that is ventilated, rodent-proof and separate from the living space to hold a front-end bin container for garbage and the appropriate number of carts. The storage room must comply with the Ontario Building Code, Recycling carts, green carts, and garbage containers must be placed near one another in a clean and well-lit location which is accessible for residents,
Internal roads much have a minimum width of 6 meters and have 13 meter turning radii from the centre line. The road base when over a supported structure must support of minimum of 35,000 kilograms.

NOTES:
Alectra Utilities
1) Relocation, modification, or removal of any existing hydro facilities, shall be at the owners expense.
2) Do not excavate within 2m of hydro pole or anchors.
3) Excavation within 1m of underground hydro plant is not permitted unless approval is granted by a Horizon Utilities representative and is present to provide direct supervision. Cost associated with this task shall be at the owner's expense.
4) Alectra Utilities must be contacted if removal, isolation or relocation of existing plan is required, all cost associated with this work will be at the owners expenses.

CLIENT
EMBLEM

ISSUES

No.	DESCRIPTION	DATE
1	ISSUED FOR SITE PLAN APPROVAL	2021-06-10
2	REISSUED FOR SITE PLAN APPROVAL	2021-10-20

KEY PLAN

CONSULTANTS
ARCHITECT: IBI GROUP ARCHITECTS (CANADA) INC.
PLANNER: A.J. CLARKE AND ASSOCIATES
ELECTRICAL: THE HEIL GROUP
LANDSCAPE ARCHITECT: ADESSO DESIGN INC.
MECHANICAL: THE HEIL GROUP
STRUCTURAL: STEPHENSON ENGINEERING
TRANSPORTATION: LEA CONSULTING LTD.

SEAL

PRIME CONSULTANT
IBI GROUP
55 St. Clair Avenue West, 7th Floor
Toronto, ON M4V 2Y7, Canada
tel 416 596 1930 fax 416 596 0644
ibigroup.com

PROJECT
41-61 WILSON STREET
HAMILTON, ON L8R 1C6
DA-21-097

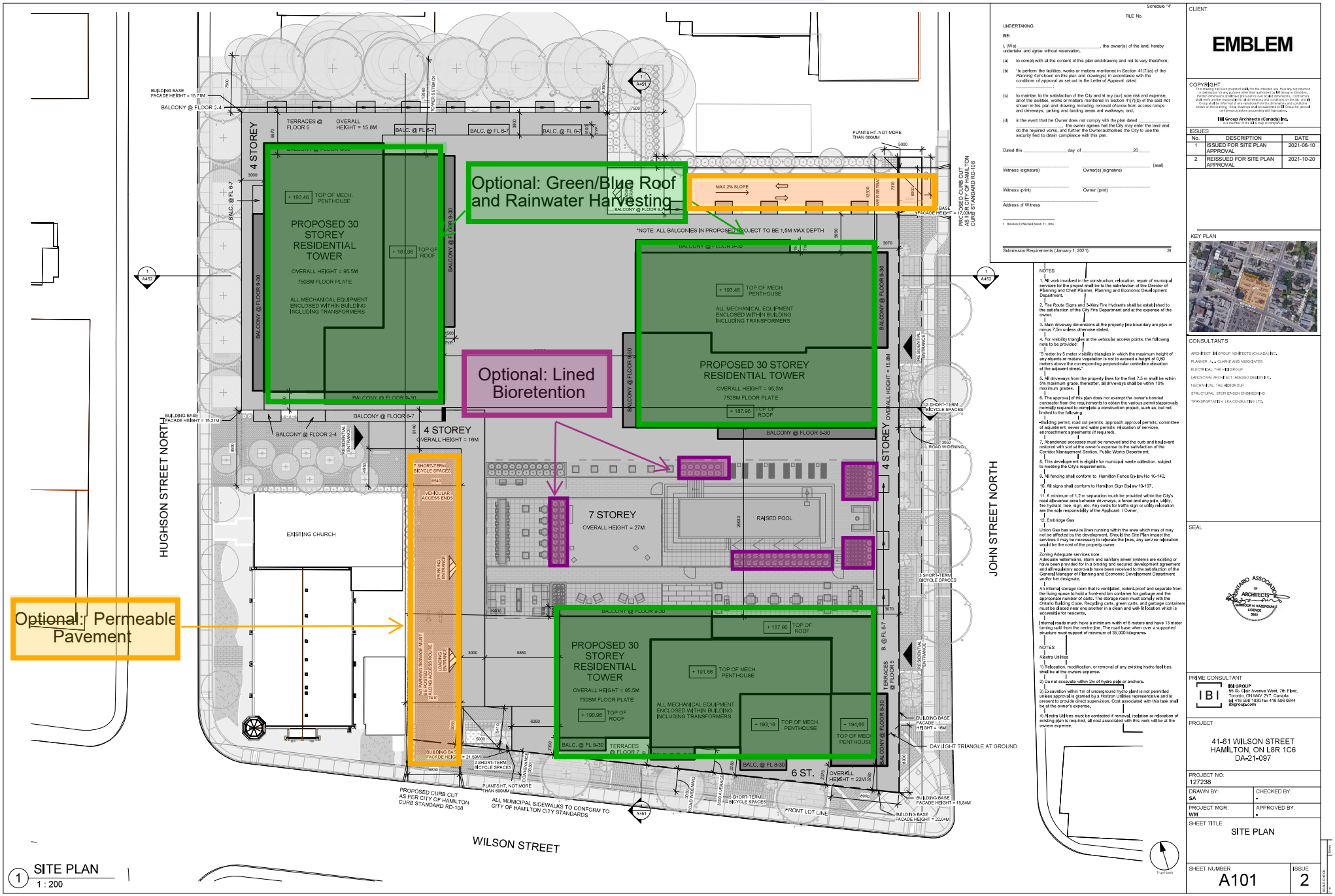
PROJECT NO: 127238
DRAWN BY: SA
CHECKED BY: -
PROJECT MGR: WM
APPROVED BY: -

SHEET TITLE
SITE PLAN

SHEET NUMBER A101
ISSUE 2

2021-10-19 6:35:45 PM

Additional SWM Options / Opportunities



1 SITE PLAN
1 : 200

Schedule "4"
FILE No.
UNDERTAKING
RE:
I, (We) _____, the owner(s) of the land, hereby undertake and agree without reservation,
(a) to comply with all the content of this plan and drawing and not to vary therefrom;
(b) "to perform the facilities works or matters mentioned in Section 41(7)(a) of the Planning Act shown on this plan and drawing(s) in accordance with the conditions of approval as set out in the Letter of Approval dated _____"
(c) to maintain to the satisfaction of the City and at my (our) sole risk and expense, all of the facilities, works or matters mentioned in Section 41(7)(b) of the said Act shown in this plan and drawing, including removal of snow from access ramps and driveways, parking and loading areas and walkways; and,
(d) in the event that he Owner does not comply with the plan dated _____ the owner agrees that the City may enter the land and do the required works, and further the Owner authorizes the City to use the security filed to obtain compliance with this plan.
Dated this _____ day of _____ 20____
Witness (signature) _____ Owner(s) (signature) _____ (seal)
Witness (print) _____ Owner (print) _____
Address of Witness _____
1 Section (2) Revised March 11, 004
Submission Requirements (January 1, 2021) 29

NOTES:
1. All work involved in the construction, relocation, repair of municipal services for the project shall be to the satisfaction of the Director of Planning and Chief Planner, Planning and Economic Development Department.
2. Fire Route Signs and 3-Way Fire Hydrants shall be established to the satisfaction of the City Fire Department and at the expense of the owner.
3. Main driveway dimensions at the property line boundary are plus or minus 7.3m unless otherwise stated.
4. For visibility triangles at the vehicular access points, the following note to be provided:
"5 meter by 5 meter visibility triangles in which the maximum height of any objects or mature vegetation is not to exceed a height of 0.60 meters above the corresponding perpendicular centerline elevation of the adjacent street."
5. All driveways from the property lines for the first 7.5 m shall be within 5% maximum grade, thereafter, all driveways shall be within 10% maximum grades.
6. The approval of this plan does not exempt the owner's bonded contractor from the requirements to obtain the various permits/approvals normally required to complete a construction project, such as, but not limited to the following:
-Building permit, road cut permits, approach approval permits, committee of adjustment, sewer and water permits, relocation of services, encroachment agreements (if required),
7. Abandoned accesses must be removed and the curb and boulevard restored with sod at the owner's expense to the satisfaction of the Corridor Management Section, Public Works Department.
8. This development is eligible for municipal waste collection, subject to meeting the City's requirements.
9. All fencing shall conform to Hamilton Fence By-law No 10-142.
10. All signs shall conform to Hamilton Sign By-law 10-197.
11. A minimum of 1.2 m separation much be provided within the City's road allowance area between driveways, a fence and any pole, utility, fire hydrant, tree, sign, etc. Any costs for traffic sign or utility relocation are the sole responsibility of the Applicant / Owner.
12. Enbridge Gas
Union Gas has service lines running within the area which may or may not be affected by the development. Should the Site Plan impact the services it may be necessary to relocate the lines, any service relocation would be the cost of the property owner.
Zoning Adequate services note:
Adequate watermains, storm and sanitary sewer systems are existing or have been provided for in a binding and secured development agreement and all regulatory approvals have been received to the satisfaction of the General Manager of Planning and Economic Development Department and/or her designate.
An internal storage room that is ventilated, rodent-proof and separate from the living space to hold a front-end bin container for garbage and the appropriate number of carts. The storage room must comply with the Ontario Building Code, Recycling carts, green carts, and garbage containers must be placed near one another in a clean and well-lit location which is accessible for residents,
Internal roads much have a minimum width of 6 meters and have 13 meter turning radii from the centre line. The road base when over a supported structure must support of minimum of 35,000 kilograms.
NOTES:
Alectra Utilities
1) Relocation, modification, or removal of any existing hydro facilities, shall be at the owners expense.
2) Do not excavate within 2m of hydro pole or anchors.
3) Excavation within 1m of underground hydro plant is not permitted unless approval is granted by a Horizon Utilities representative and is present to provide direct supervision. Cost associated with this task shall be at the owner's expense.
4) Alectra Utilities must be contacted if removal, isolation or relocation of existing plan is required, all cost associated with this work will be at the owners expense.

CLIENT
EMBLEM

ISSUES

No.	DESCRIPTION	DATE
1	ISSUED FOR SITE PLAN APPROVAL	2021-06-10
2	REISSUED FOR SITE PLAN APPROVAL	2021-10-20

KEY PLAN

CONSULTANTS
ARCHITECT: IBI GROUP ARCHITECTS (CANADA) INC.
PLANNER: A.J. CLARKE AND ASSOCIATES
ELECTRICAL: THE HDI GROUP
LANDSCAPE ARCHITECT: ADESSO DESIGN INC.
MECHANICAL: THE HDI GROUP
STRUCTURAL: STEPHENSON ENGINEERING
TRANSPORTATION: LEA CONSULTING LTD.

SEAL
ONTARIO ASSOCIATION OF ARCHITECTS
LICENCE 3960

PRIME CONSULTANT
IBI GROUP
55 St. Clair Avenue West, 7th Floor
Toronto, ON M4V 2Y7, Canada
tel 416 596 1930 fax 416 596 0644
ibigroup.com

PROJECT
41-61 WILSON STREET
HAMILTON, ON L8R 1C6
DA-21-097

PROJECT NO: 127238
DRAWN BY: SA
CHECKED BY: -
PROJECT MGR: WM
APPROVED BY: -

SHEET TITLE
SITE PLAN

SHEET NUMBER A101
ISSUE 2

2021-10-19 6:35:45 PM

APPENDIX

D CONSULTATION SUMMARY

Received From	Date Received	Feedback / Comments	WSP Team Response
Steve Robichaud, City of Hamilton (Planning Division)	April 25th, 2023	• In August, 2022, Hamilton Water staff presented the $1 B stormwater plan in response to MOE inquiries about the City's plan to deal with the combined sewers and resulting surcharging into the harbour and other receiving water courses. Given the City's direction to address this, why are differentiating between combined and separated sewers when approving new developments if we are moving towards separating the combined system – its just a matter of when this happens, not if it will happen. I understand the immediate reason relates to water quality in outfalls in separate sewer systems, but if we are incrementally moving towards a separated system as PW reconstructs roads and replaces the sewer system, but my question is: Why aren't we requiring the higher standard now to ensure that once the road is reconstructed, stormwater leaving a site will be consistent with the separated sewer system standard, not the lower combined sewer system standard?	• The City's Flooding and Drainage Improvement Framework (FDIF) 2022 does not recommend a complete separation of the City's combined sewer system, rather this is to be done strategically and will need to be assessed accordingly on a network basis. Further, the land uses in the Combined sewershed are highly urban hence locations for surface-based water quality treatment are deemed to be minimal. Lastly, the total RVCT will need to be met to achieve complete water quality control, regardless of location or drainage system in the City, hence the only difference in the criteria will be the amount for surface-based measures.
Tys Theijsmeijer, Royal Botanical Gardens	April 28th, 2023	• Combined sewer system – minimum infiltration is low given the current failings of the system, further amplified to changes/increases in precipitations. The scale of the CSOs is not appreciated or reported elsewhere and the city needs best case scenario tools to deal with them. Example, in particular I was struck by the recent media article about the Glen Rd CSO and the program to rebuild it to hopefully reduce it from an average of 24 spills/yr to 2 spills (its past unofficial report was often 0 overflows/yr).	• Please note that the total Runoff Volume Control Target (RVCT) will need to be met to achieve complete water quality control regardless of location or drainage system in the City. The criteria are not suggesting a lower water quality treatment for properties discharging to a combined sewer, but rather only the amount of the RVCT that should be treated through retention measures.
		• The 0.5 ha threshold for assessments seems sort of arbitrary, thus I am making the assumption that its sized so that if you're a small business or a homeowner you can proceed in a more straightforward fashion without a complex study.	• No – the rationale is that smaller land bases tend to be more constrained than larger land bases. The 0.5 ha threshold reflects a range of development types and sizes falling into these categories.
		• Assumption I am making - Minimum infiltration criteria will be based on existing impervious surfaces within a site vs the entire surface of the site.	• The calculation will be reflective of total imperviousness of a site regardless of the existing condition. In this way, lands previously not treated will be treated in the future providing an overall gain to the City's water quality through re-development applications.
		• Soil type not showing as a variable – i.e., permeable geography (sand and gravel) vs clay. Minimum infiltration would be a criterion that could/should adjust tied to this. Hamilton geography is somewhat unique as a municipality, crossing from sand plain and moraine in the north to clay plain in the south.	• Soil type is a functional constraint to LID practice design and not used as a screening measure for minimum capture criteria. It is noted in the hierarchy of LID practices as a potential factor in limiting the application of certain practices, this will be clarified through the documentation.
		• Maintenance of green infrastructure features – perhaps a future separate step, however as these features become habitat there then is some seasonal criteria tied to nesting things, breeding things and overwintering amphibians and turtles putting constraints on access and timing of maintenance.	• This will need to be considered in the future as part of both practices in the private and public realm.
Scott Peck, Hamilton Conservation Authority	May 10th, 2023	• As the presentation slides focus on a high-level summary of this ongoing study, we look forward to an opportunity to review draft City of Hamilton Green Standards and Guidelines for Storm Water Management documentation, once available. We expect that this more-detailed documentation will address many of our initial review comments.	• N/A
		• For sites with limitations / restrictions / constraints, Total Runoff Volume Control Target (RVCT) may be reduced to the Maximum Extent Possible (MEP), from 28 – 29 mm or that determined by a Sub-Watershed Study. • What are the expected assessment, review and approval processes involved in the use of the MEP approach? • Does the City have an expectation as to the percentage of potential sites with limitations / restrictions / constraints? • If the frequency of sites with limitations / restrictions / constraints is considerable, it is suggested that the Recommended Hamilton-Specific Criteria mention the possibility that Total Runoff Volume Control Target (RVCT) may be reduced to the Maximum Extent Possible (MEP).	• The total RVCT is to be achieved using the hierarchical approach, whereby Priority #1 (retention practices) should be applied, and if Priority #1 practices cannot meet the full requirements due to site constraints, then the design should pursue Priority #2 options, followed lastly by Priority #3. Doing so, the total RVCT can always be met, based upon the treatment train approach applied. The Maximum Extent Possible (MEP) is in reference to the application of Priority #1 features with consideration for site constraints; for example, if the full amount of capture (28-29 mm) cannot be accommodated through deep infiltration features due to high groundwater, a shallower system

Received From	Date Received	Feedback / Comments	WSP Team Response
			• can be designed to accommodate portions of the control requirement, to the maximum extent possible. • The application of the MEP approach would consist of a summary and review of the potential constraints on a site completed by the proponent, to document the data / site conditions resulting in limitations to providing the full capture amount through Priority #1 (followed by Priority #2). • No City-wide study has been done for constraints – this will be the responsibility of each development proponent on a site-by-site basis using detailed local information. • The GSG documentation will clarify the expectations of the MEP approach.
		• The presentation slides seems to suggest that the Total Runoff Volume Control Target (RVCT) of 28 – 29 mm or that determined by a Sub-Watershed Study will only include on-site retention of the minimum water quality capture target (2.5 – 10 mm, depending on the situation). The remaining amount of RVCT (19 – 26.5 mm if the Provincial 90th percentile RVCT approach is used), seems to be proposed to be met though Filtration and / or Conventional measures (end of pipe). • There may be challenges in achieving 19 – 26.5 mm of runoff volume control using Filtration and / or Conventional measures, as Conventional measures typically do not reduce runoff volume, and Filtration measures provide some runoff volume reduction but are primarily for water quality control. • If our understanding is correct, has the City considered this challenge and is satisfied that these Filtration and / or Conventional runoff volume control targets are expected to be achievable? • Or, is our understanding of the approach incorrect, and on-site retention to the extent possible (and thus above the minimum water quality capture target) will be required where suitable.	• Correct – the full suite of measures is available to meet the total RVCT – only the minimum water quality capture target varies. • It should be noted that the MECP's terminology of the "Runoff Volume Control Target" is based upon the 90th percentile event for designing SWM practices which provide both water quality and water balance benefits. This does not suggest that the full RVCT storm must always be captured/infiltrated (hence reducing the "runoff volume" explicitly), but through the application of the hierarchical approach, Priority #1 and #2 measures can provide both water quality and water balance improvements, followed lastly by Conventional Measures (Priority #3) when Priority #1 and #2 cannot be implemented. • As above, the Filtration (#2) and Conventional (#3) measures would provide water quality benefits (and potentially some water balance benefits) to contribute to the overall RVCT. It is not intended for the design of Filtration or Conventional practices to reduce runoff volumes for the residual 19-26.5 mm of the RVCT. • If a site does not have any constraints to implementing infiltrative measures, then it is expected that LID practices are to be designed to control the full RVCT amount, beyond the minimum water quality capture target.
		• Can you confirm that the City plans to develop separate Green Standards and Guidelines for Storm Water Management within City areas (public lands)?	• Yes, this is planned in the near future and will be focused on Road ROWs and further these guidelines will be expected to apply to other City properties such as parks
		• The study should provide some guidance regarding that all overland and inground LIDs and GIs require inspection and maintenance to perform according to the design. Therefore, enforcement is required to ensure the property owners follow the design requirements.	• Operation and maintenance is a matter being addressed concurrently. Opportunities to address the enforcement issue currently includes ECAs and Site Plan agreements.
Janet Engel, Conservation Halton	May 12th, 2023	• The WSP document *'Preliminary Sizing Criteria for LID/GI'* proposes water quality control criteria for LID measures. While water quality control is the purpose of the document, this can create confusion if this aspect is separated from other stormwater management requirements. Through infiltration and evapotranspiration, LID measures can provide a reduction in runoff volume and a benefit in the timing of runoff, that mitigate erosion and flooding within watercourses. We recommend the City's guidance document speak to and integrate the multi-faceted functions of LIDs.	• We agree and will seek to clarify this aspect of the guidance.
		• It is recognized that meeting infiltration targets on small sites can be challenging. It is also recognized that on large sites the recommended infiltration target of 10mm should suffice for areas with low permeability soils (e.g., silty clay tills). In the absence of a contemporary SWS,	• The guidance is considered "minimum" hence applicants will be encouraged to maximize their capture under each Tier of the hierarchy, to the extent possible.

Received From	Date Received	Feedback / Comments	WSP Team Response
		Conservation Halton supports the proposed infiltration targets for small or constrained sites, and large sites with tight soils. However, we recommend that infiltration be maximized based on additional study for large sites (>0.5 ha) with soils that are conducive to higher infiltration.	
		• Within areas regulated by the conservation authority a feature-based water balance may be required, and Conservation Halton will generally require that pre-development infiltration volumes be maintained. For control of erosion and flooding, and to minimize the hydrologic impacts to wetlands, it is preferable to infiltrate excess runoff to the extent possible rather than release the full runoff volume over a span of a few days. Other agencies (e.g., MECP, DFO, etc.) may have additional requirements within lands subject to their jurisdiction. We request the City's guidance document acknowledge that it does not replace or supersede any other federal, provincial or conservation authority legislated requirements.	• We acknowledge this aspect of water balance, and this is normally addressed through SWSs and/or MESPs. We will also clarify that all other governing legislated requirements would need to be met.
Michelle Diplock, West End Home Builders' Association	May 12th, 2023	**Constrained Sites:** • WE HBA appreciates that the City has identified that small sites are more constrained than larger sites. We support the City requiring a lesser minimum target for retention on those sites which are less than a defined threshold. However, adequately defining that threshold for all contexts will present a challenge. For example, at the proposed .5 hectare threshold depending on the density proposed, required parking, and existing site conditions (i.e. bedrock) the proposed retention methods may not be feasible. The WE HBA understands it will be the City's intent to have applicants demonstrate the non-practicability of the requirements to receive an exemption. This must be clearly identified within the guideline document itself, alongside documentation of how an application should demonstrate the need to achieve that exemption.	• The current guidance acknowledges physical constraints and requires applicants to demonstrate where these exist and how they prevent full application of the minimums. • We will strengthen this wording in the GSG and further demonstrate this through the Case Studies where possible.
		Specific Comments on Recommended Green Practices: • Including Green Roofs is currently impractical for our members to implement. The use of green roofs for water storage in the combined sewer shed in Hamilton (where green roof implementation is most feasible) is required to obtain Ministry of the Environment Conservation and Parks (MECP) approval on the storage and enter into a registered agreement on the property for maintenance. The timelines from MECP for approval are unclear and do not work with rushed construction timelines. Goals for some specific green features should not become detached from the practical reality of implementation. • Permeable pavers can present a challenge when it comes to ongoing maintenance and snow removal on sites, as well as concerns about the load bearing capacity of a roadway when it comes to waste collection. The feasibility of permeable pavement installation will be dependent on the site design and how the Green Standards Guidelines intersect with other City guidelines and requirements.	• Please note that Green roofs are only one of several measures which can be applied to sites. The City and MECP are working on the CLI ECA which is expected to expedite review and approval times as it puts more control directly to the City. • It is agreed that permeable pavers have certain physical limitations (as do other BMPs). It is expected that applicants will choose the BMP which makes most sense on their site.

Received From	Date Received	Feedback / Comments	WSP Team Response
		Questions for Consideration: • What are the differences between the MECP Low Impact Guidelines and the City of Hamilton's proposed Green Standards? Do they take precedence over the MECP Low Impact Guidelines when the project is subject to CLI approvals?	• The MECP LID Guidance (draft) is high level and describes the intent and overall objectives rather than providing details on how and what needs to be implemented – that is the intent of the GSG which prescribe Hamilton-based approaches and solutions, while maintaining alignment with the MECP's draft guidance.
		• City of Hamilton Green Standards and Guidelines for Low Impact Development, Better Site Design and Pollution Prevention (Page 14 of presentation) indicates use of narrower streets and slimmer sidewalks which currently contradicts Complete Streets Guidelines and will further reduce housing numbers when developing Townhouse type projects. How will this be resolved?	• The examples provided were generic since Better Site Design has several potential approaches which need to be considered at the outset of planning a development. Pre-consultation with City staff will be required to discuss what can and cannot be practically implemented as it is not the City's intent to restrict development.
		• Which City of Hamilton department will be responsible for reviewing stormwater management designs for both private and public developments? Who will be approving CLI ECAs.?	• The City's Growth Management Division will have the responsibility to review SWM designs for development including green development standards (stand alone on-site), and approving ECAs under the CLI ECA except for exemptions included under regulation OWRA Regulation 525/98.
		• Is the City of Hamilton planning on amalgamating lands in certain areas within the City to develop a centralized SWM facility?	• Centralized SWM facilities are not part of the GSG. Please refer to City of Hamilton Local Service Policy for centralized facilities in new growth areas.
		• What is the intent of upgrading existing infrastructure to meet new CLI requirements? Would this apply to private SWM facilities as well?	• The intent of the GSG is to provide guidance for new or re-development private SWM work. The intent is not to force or require existing private SWM systems to be upgraded unless they are part of a new application.
		• Is the City of Hamilton planning on implementing a cash-in-lieu policy for small sites that prohibit the implementation of the Green Standards?	• Cash in Lieu is not being considered at this time; however, City staff expect to report back to Council on the outcomes of consultation on the GSG following implementation specific to the level of targets achieved, commentary on best practices, and lessons learned to date…. which may identify ways to address shortfalls or opportunities to enhance conformance.
		• Do we expect to see future zoning changes to accommodate the Green Standards?	• Zoning by-laws may include references to other guidelines/requirements. The City may consider the use of zoning by-laws as part of a future initiative to improve implementation.
		• What is the extent of the City's CLI monitoring?	• MECP is currently developing guidelines on what municipalities' will need to implement in terms of monitoring – this is expected to be released in 2023 Q4 or early 2024.
		• Will the City be providing new IDF curve information based on the 28-29mm event?	• No – this is not the same concept as synthetic design storms.
		Case Studies: • Providing examples of past developments where implementation of the Green Guidelines could have been done while maintaining the form of development is critical. It will help to illustrate and identify potential challenges in advance of implementation. When reviewing these case studies	• Thank you – we agree with the intent of having Case Studies being part of the GSG.

Received From	Date Received	Feedback / Comments	WSP Team Response
		alongside the proposed guidelines an understanding of how to mitigate any potential loss of densities on sites.	
		Transition: • WE HBA recommends that a beta testing period is written into the guidelines to test the proposed guidelines upon implementation. This will give both the City and the Industry the opportunity to smooth out the process and work through any unanticipated outcomes. As well, incorporating a transition framework to the new guidelines that does not necessitate the redesign of sites already proceeding through the development process will be an important consideration. Historically, this transition date would have been set at the time of a complete application submission, however given the new application framework the City has brought forward to respond to Bill 109 the transition timeframe should be based around the formal consultation process. Further consultation with the industry on the transition policy is requested.	• The recommendations to Council will include a transition plan regarding timing of application and implementation procedure. Feedback from stakeholders and the development community is encouraged throughout the implementation of the GSG.
	May 23rd, 2023	**Constrained Sites:** • Through our membership's experience in other municipalities such as the City of Mississauga and the City of Toronto they have noted achieving even 5 mm of stormwater retention using green infrastructure can be a challenge, particularly for high-rise buildings with full-coverage underground parking areas, or high-density developments with limited pervious areas and narrow right of way areas. Therefore, retaining 10 mm of rainfall with green infrastructure such as bioretention systems, bioswales, green roofs, and infiltration trenches is likely to be impossible or impractical when balanced against other development constraints and standards. In situations where site conditions are not conducive to implementing green infrastructure (for instance, where the ground has low permeability or the water table is high), the guidelines should provide a clear path forward. One possible solution is to offer a cash-in-lieu option.	• The MECP Guidance and the draft GSG both consider these circumstances for constrained sites either due to development restrictions or physical conditions. That said, the City strongly supports some form of control in the form of GI and LID practices hence does not want to promote Cash in Lieu as a first or preferred form of treatment. The City team will continue to review implementation concerns and will likely be examining the need for a cash in lieu policy at some time in the future.
		Specific Comments on Recommended Green Practices: • There is conflicting phrasing for green roofs under Priority 1 and 3 categories, listing it as "discouraged" due to lack of municipal control. Green roofs are considered standard green infrastructure with effective retention performance that should be encouraged in separated sewer sheds. Further clarification on the City's green roof requirements in the GSG document or other guidelines is recommended. • The Green Standards Guideline document states that amended topsoil should not be the primary method of treatment or control. While we acknowledge that other retention practices should take precedence, we would like clarification on retention credit for amended topsoil as a secondary measure to close gaps for the 10mm requirement.	• The GSG will clarify the wording around Green Roofs • Technical requirements for any green practices including amended topsoil are well documented in industry literature including the amount that can be attributable for crediting. The City's specific requirements for the various practices are stated in its development manual.
		<u>Considerations for Overall Stormwater Management Strategy:</u> • The Green Standards Guidelines currently notes that Section 3.4 of the draft MECP Guidelines acknowledges the direction provided by higher-level studies (i.e., watershed plans, subwatershed studies, MDPs, etc.) and that the Runoff Volume Control Target does not change water quantity control requirements related to flood control or erosion control identified through watershed, subwatershed, stormwater management / master drainage plans. The phrase "does not change…" is taken to mean that the GSG / RVCT will not "supercede the findings of other site-or area-specific studies", versus "not allowing credit towards offsetting water quality, erosion control, or quantity control volumes". This is an important distinction, as other municipalities and the MECP have confirmed that provision of runoff volume controls can be considered to offset quality control, erosion control, and quantity volume requirements where appropriate (for example, *retaining* the 90th percentile event could significantly reduce erosion control volume requirements in a downstream stormwater management pond, but simply *filtering* the 90th percentile event may not change the total volume approaching the downstream pond).	• At this time the GSG will not credit the RVCT capture towards flood and erosion control as the hydrologic processes on-site are different from those in the receiving watercourses.

Received From	Date Received	Feedback / Comments	WSP Team Response
		• In other municipalities, developers are beginning to propose integrating storm water management ponds underneath public parks using innovative stormwater management technologies.[1] WE HBA would recommend the City's Guidelines consider and be open to the emergence of new technologies for stormwater attenuation and management.	• New technologies are being encouraged by the GSG and City staff wish to continue to promote innovation. That said underground tanks are not considered "green" hence there is the requirement for a minimum of green capture per the currently proposed guidance

[1] StormCon Engineering the Future of Stormwater: https://www.stormcon.ca/