Green Standards and Guidelines for Site Servicing (Stormwater) *(DRAFT)*

1.0 INTRODUCTION

1.1 Purpose of This Guideline

Stormwater management in Ontario has continually progressed in the last few decades in an effort to protect public health and safety, prevent property damage and improve the water quality of Ontario's lakes and rivers. Recent Provincial guidance has directed efforts to focus on managing stormwater at the source with the release of the Provincial Policy Statement in 2020 and in 2022 with the Draft Low Impact Development Stormwater Management Guidance Manual.

City of Hamilton staff have been providing technical review on development applications involving stormwater management since the introduction of Provincial planning and design guidance documents, and the City published its own "Storm Drainage Policy" in 2004, the "Eco-Industrial Design Guidelines – Airport Employment Growth District" in 2010, and "Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses Policy" in 2013.

In keeping with Council's priority "to protect our unique natural landscape and waterways and to mitigate the impacts of climate change"[1] staff have identified a need to manage the control of stormwater runoff on-site more comprehensively and systematically, while also acknowledging the need for the continued use of traditional end-of-pipe solutions.

In order to address this need, staff in Growth Management – Infrastructure Planning engaged a consultant to prepare a comprehensive assessment of the current "state of the stormwater industry" with respect to source controls and a proposed set of City focused guidelines (herein referred to as the Green Standards and Guidelines for Site Servicing (Storrmwater) or GSG). A summary of this review is provided in the WSP report (2023). 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 (LID)

To assist in the utility of these guidelines, it was 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

[1] General Issues Committee, September 20 2023 (CM23020)– 2022-2026 Council Priorities

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.

A graphic prepared by Green Infrastructure Ontario, shown in **Figure 1**, illustrates the relationship amongst the above three definitions.

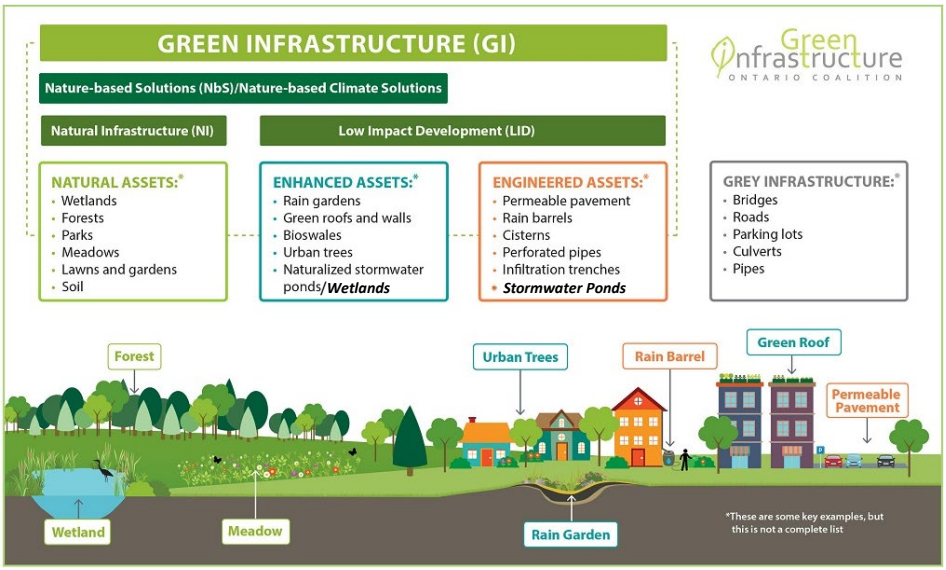

Figure 1. An illustration of how green infrastructure, natural infrastructure and low impact development best management practices relate to one another (Source: Green Infrastructure Ontario Coalition (2024)).

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.

2.0 Green Standards and Guidelines Report

The Green Standards and Guidelines Report prepared by the consultant WSP includes the following content:

1. **Review of Legislation & Industry Best Practices**: This section provided the legislative framework for Stormwater Management Guidelines preparation and outlines the Best Practices being implemented across various municipalities (i.e., Ontario, Canada, globally). Through this review of international resources, it was found that several government agencies have robust Low Impact Development Guidance material, including but not limited to:
    a. Details regarding permitting / City review processes,
    b. Flow charts / guidance related to applicable stormwater management criteria and how proponents can determine their respective site requirements,
    c. Description and check-list of hierarchical approach required for stormwater management,
    d. Long-list of stormwater management practices and Low Impact Development Best Management Practices for review and screening,
    e. Detailed screening processes for the selection and implementation of Low Impact Development Best Management Practices
    f. Fact sheets, design templates, drafting standards, etc. for each respective Low Impact Development Best Management Practice
    g. Operations, Maintenance and Monitoring guidebooks for each respective Low Impact Development Best Management Practice, and information related to compliance reporting
    h. Life-cycle costing and activity details to be implemented under private ownership
    i. Live websites to provides updates to latest information.
2. **On-Site Retention Criteria**: In addition to the elements of Low Impact Development Best Management Practices design highlighted above, a summary was prepared identifying jurisdictions (Ontario, Nova Scotia, British Columbia, Alberta, Quebec, United States) which have minimum on-site retention criteria requirements. These values ranged from, in Ontario, 5 millimetres (Niagara Region, Barrie, Mississauga and Brampton) to 12.5 millimetres (Kitchener).
3. **Hamilton Today**: This section provided 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.

4. **Development of GSG Goals & Objectives**: This section described the process followed for envisioning the GSG, and the associated Goals and Objectives being achieved through this process.
5. **Hamilton Retention Criteria Framework**: This section established 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.
6. **Review of LID BMP Practices**: This section summarized a long-list of LID BMPs, described functional / land use considerations and outlined preliminary design guidance for each practice.

Four goals were developed, after detailed review of the background information summarized above, to prepare the Green Standards and Guidelines for Site Servicing. These goals are discussed in more detail below (Section 2).

1.4 Comprehensive Development Guideline (Hamilton 2019)

The Green Standards and Guidelines for Site Servicing should be considered as accompanying and fully supporting the CDG including any future updates.

1.5 Relationship to Other City Guidelines & Related Green Initiatives

Other related City of Hamilton green initiatives directly related to this report include:

1. Stormwater Master Plan (City-wide) (May 2007)
2. Water, Wastewater and Stormwater Master Plan (in progress, will supersede May 2007 Stormwater Management Master Plan)
3. Climate Change Impact Adaptation Plan (2022)
4. Watershed Action Plan (in progress)
5. Biodiversity Action Plan (Draft, April 2023)
6. Complete Streets Design Manual (June 2022)
7. Hamilton Green Building Standards (currently being developed)

Further information regarding selected initiatives and accompanying actions are provided in **Appendix A.**

2.0 GSG GOALS & OBJECTIVES

2.1 Developing the GSG Goals & Objectives

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 were reviewed:

1. Provincial
    - Provincial Policy Statement

- Growth Plan
- Niagara Escarpment Plan
- Draft LID SWM Guidance Manual

2. Municipal
   - Urban & Rural Official Plan
   - Hamilton Climate Change Impact Adaptation Plan
   - Comprehensive Development Guidelines and Financial Policies Manual
3. Conservation Authority Documents
4. City of Hamilton Documents (e.g., Subwatershed Studies, Master Drainage Plans)

2.1 GSG Goals and Objectives

After review of the above noted policies and plans, the development of the GSG goals and objectives considered four themes:

1. Water quality and water quantity
2. Sustainability
3. Community benefits
4. Implementation

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

1.1. 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) fine 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

1.2. Minimize sediment and erosion during construction

1.3. 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

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

1.2. Site design should integrate, protect, and enhance environmental features and landscapes

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

1.4. 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

1.1. 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

1.2. Encourage innovative community design and technologies

Goal 4: Support effective implementation of the GSG

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

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

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

1.4. 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 rainwater 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.)

3.0 PROVINCIAL LID GUIDANCE

3.1 Background

The primary provincial guidance document for stormwater management planning and design was published in 2003 and is entitled "Stormwater Management Planning and Design Manual (Ministry of the Environment 2003)". Even though stormwater management has evolved over the last few decades, it remains the industry standard in Ontario. Recently, the Province initiated an effort to update part of the 2003 manual, namely the design criteria for lot level controls, otherwise known as source-controls. This work culminated with the publication of a second guidance manual entitled "Low Impact Development Stormwater Management Guidance Manual – Draft (Ministry of the Environment, Conservation and Parks 2022))". The document 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. It also 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.

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.

3.2 Provincial Runoff Volume Control Target

The Ministry's draft guidance manual stipulates a single source-control criteria referred to as the **Runoff Volume Control Target**. This target is based upon the local 90th percentile rain event, measured in millimetres and its magnitude varies across the province, ranging from 23 to 32 millimetres of rainfall as illustrated in **Figure 2**. 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. Specifically for the City of Hamilton the target is 29 millimetres. This means that from the Province's perspective, individual development sites would be expected to manage the 29 millimetre rain event by using Better Site Design, retention practices, and filtration practices and conventional treatment. For comparison, based on Hamilton's current practice for stormwater management, the Province's proposed Runoff Volume Control Target of 29 millimetres is conservative given that the smallest rainfall event used for stormwater management designs in the City as recorded at the Hamilton Airport ranges from 34 millimetres (short duration event) to 51 millimetres (long duration event)

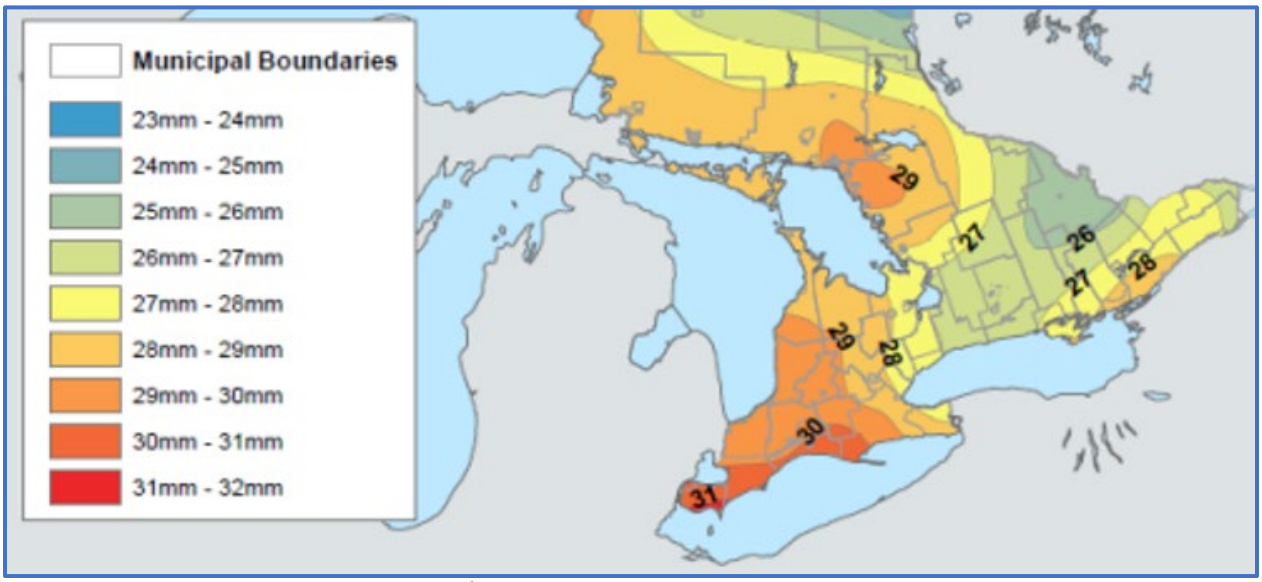

Figure 2. Regionally specific 90th percentile precipitation event runoff control volume control.

It should also be noted that text 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 (MECP 2022) 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.

3.3 Provincial 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:

A. Better Site Design and Pollution Prevention
B. Control Hierarchy Priority 1 – Retention (infiltration, evapotranspiration, re-use)
C. Control Hierarchy Priority 2 – LID Filtration
D. 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:

A. 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.

B. 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.

C. 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.

D. 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.

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.

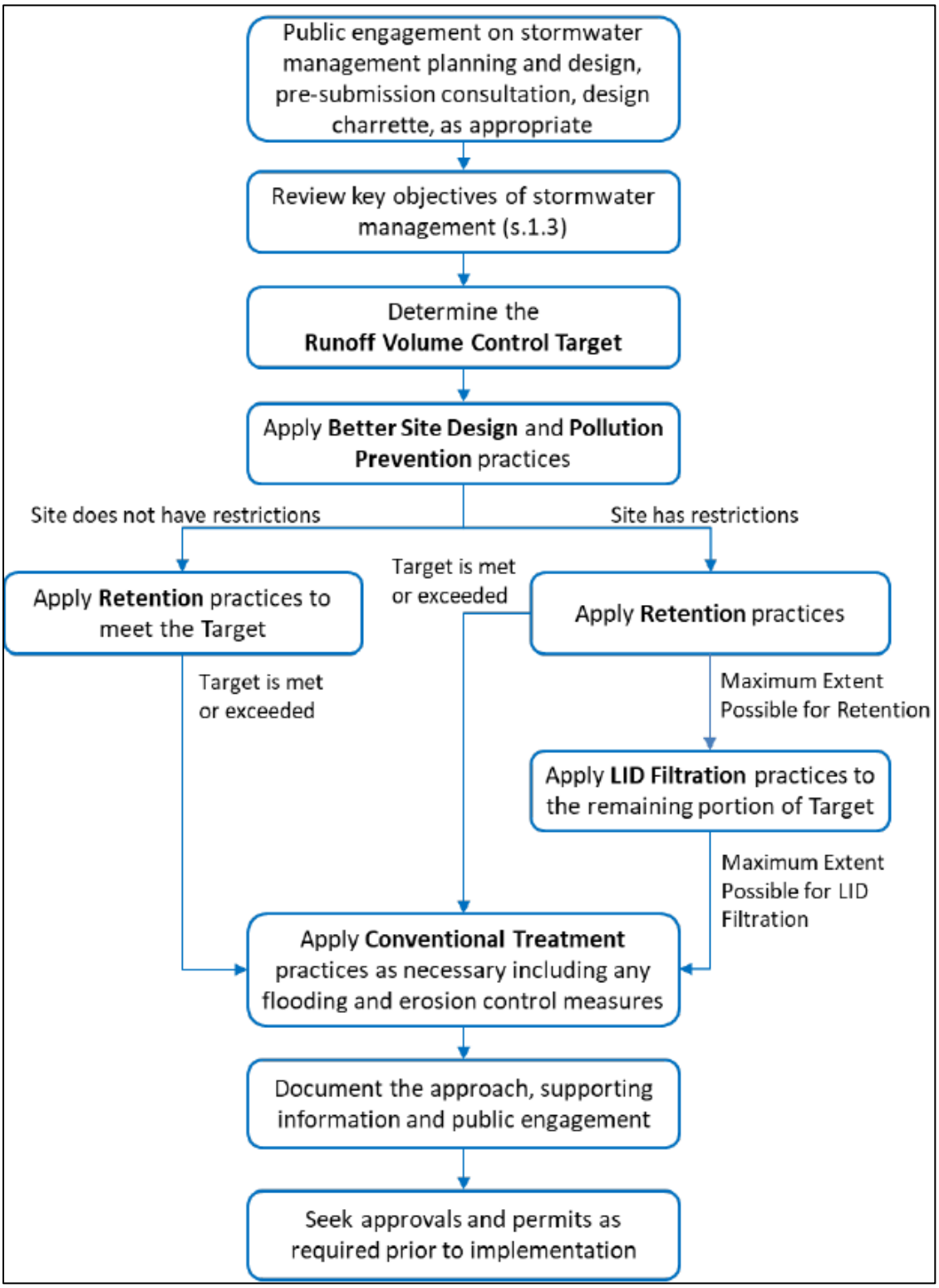

Figure 3. Steps for applying the Runoff Volume Control Target hierarchy (source: Figure 3.4, MECP (2022)).

The Draft LID SWM Guidance Manual (MECP 2022) 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** 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.

4.0 CITY OF HAMILTON LID GUIDANCE

4.1 City of Hamilton Current Practice and Future Needs

The City of Hamilton continues to develop at a rapid pace, with projections to 2051 exceeding 820,000 people. This amount of development (new greenfield and re-development) requires careful management of stormwater runoff from the impacts of urbanization (impervious / hard surfaces) on the natural environment and public safety. Further, climate change is predicted to exacerbate these impacts.

The City's current standard stormwater management requirements in relation to flooding, water quality, erosion and water balance for development applications relies on the City's Stormwater Drainage Policy (2004) and Comprehensive Development Guidelines (2019), and the Provincial Stormwater Management Planning and Design Manual (2003).

Considerable effort is invested by developers, consultants and City staff in designing, reviewing, approving, constructing and maintaining stormwater management systems. These systems are complex and comprise many elements including, but not limited to, major and minor systems, source-controls, catch basins, curbs, gutters and storm sewers (conveyance) and stormwater ponds (end-of-pipe). These features are designed and built to function in such a way as to reduce flooding, to minimize water quality and erosion impacts to local rivers and streams (final receivers of stormwater runoff) and to restore the natural water balance. One aspect of this design process is to evaluate the runoff volume generated by specified rainfall events) from a site under pre-development and post-development conditions. Given the change in land use associated with development the post-development peak flows are most often, if not

always, higher than the pre-development peak flows. Stormwater design standards requires that the post-development peak flows must be controlled to match the pre-development peak flows whenever possible.

4.2 City of Hamilton Water Quality Retention Target

In consideration of the Province's guidance concerning source-controls and better site design, retention practices, and filtration practices, the City is proposing the Green Standards and Guidelines for Site Servicing to establish minimum capture requirements, herein referred to as the Water Quality Retention Target in order to help achieve Council's goals with respect to improving water quality, climate change adaption, and biodiversity. Additional detail with respect to Low Impact Development practices related to the Water Quality Retention Target can be found in the Green Standards and Guidelines Report prepared by the consultant.

To provide a Hamilton specific minimum capture criterion, the following elements have been considered:

A. 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.

B. 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 (WSP (2023)).
- 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).

C. 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.

Applying a Water Quality Retention Target builds on the Ministry's draft guidance manual and is consistent with the approaches taken by other neighbouring municipalities in southern Ontario.

4.3 City of Hamilton Application Hierarchy

The proposed Water Quality Retention Target considers three factors when deciding the magnitude of the retention target, namely: i) is local drainage serviced by a combined or separate sewer system; ii) is the site within an area for which a subwatershed study or master drainage plan has been prepared; and, iii) is the size greater than or less than 0.5 hectares. Depending on the responses to these factors the Water Quality Retention Target will be either 2.5 millimetres, 5.0 millimetres or 10.0 millimetres. Developments subject to Site Plan control will be required to achieve this target by using Low Impact Development Best Management Practices that are surface-based and incorporate filtration.

The Water Quality Retention Targets are summarized in **Table 2**.

Table 2. Summary of Hamilton specific criteria (Water Quality Retention Target).

City of Hamilton Criteria					Provincial Criteria
Sewershed Type	**Subwatershed Study?**	**Site Size (ha)**	**Better Site Design**	**Water Quality Retention Target (mm)**	**Runoff Control Volume Target (mm)**
Combined	Yes	> 0.5	Yes	5.0[1]	29[2,3]
		< 0.5	Yes	2.5[1]	
	No	> 0.5	Yes	5.0	
		< 0.5	Yes	2.5	
Separated	Yes	> 0.5	Yes	10.0[1]	
		< 0.5	Yes	5.0[1]	
	No	> 0.5	Yes	10.0	
		< 0.5	Yes	5.0	

Note 1 If the Subwatershed Study source control criteria does not incorporate a water quality component and is less than the Water Quality Retention Target, then the Water Quality Retention Target is to be achieved.

Note 2 The 29 millimetres Runoff Control Volume Target is to be achieved by using better site design, retention practices, filtration practices and conventional treatment to the **maximum extent possible**.

Note 3 The Runoff Volume Control Target includes the Water Quality Retention Target.

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:

1. The LID Wiki (Sustainable Technologies Evaluation Program (STEP), May 2022)
2. Draft Low Impact Development Stormwater Management Guidance Manual (MECP, January 2022)
3. Input from Hamilton Specific Guidance including:
    a. The Comprehensive Development Guidelines and Financial Policies Manual (2019)
    b. The Innovative Stormwater Source Control Policy for ICI Land Uses (April 2013)

These are summarized in **Table 3**, 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 on the GSG Report (WSP 2023).

Table 3. Recommended LID Best Management Practices

Priority Category		LID BMP Type
Priority 1A – Retention (Surface)	Vegetated Systems	Bioretention System
		Rain Gardens
		Bioswale
		Green Roofs
		Soakaway Pits / 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
		Soakaway Pits, 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 (Wet Pond/Wetland/Hybrid)
		Manufactured Treatment Devices
		Parking Lot Storage
		Rooftop Detention Storage

5.0 DESIGN GUIDANCE OF LID BMP PRACTICES

5.1 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)

A brief description of the most common LID practices and their respective images is provided in Table 6-1 of the GSG Report (WSP 2023). This table is intended to be used as one example of 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 of the GSG Report (WSP 2023). As these practices are constantly evolving it is best to consult a reference like the online Low Impact Development Stormwater Management Planning and Design Guide maintained by the Sustainable Technologies Evaluation Program for up-to-date information about a specific practice.

5.2 Functional Considerations

Once the short-list of 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:

1. Does the proposed drainage plan meet the maximum drainage area requirements for the selected LID BMP?
2. Can the minimum head elevation be provided for functionality?
3. Can the proposed servicing plan support the alignment and inlet/outlet requirements for the LID measure?
4. 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 (MECP, 2022) and include a screening against the relative Control Hierarchy (Priority 1, 2 or 3) 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 of the GSG Report (ref. MECP, 2022).

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 of the GSG Report 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.

5.3 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 of the GSG Report (WSP 2023) should 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:

1. 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).
2. 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).
3. 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.
4. 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.

5. 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.
6. 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.

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:

a) Are difficult to remove or otherwise compromise;
b) Provide pre-treatment to the greatest extent possible;
c) Are designed to provide a maximum asset lifespan;
d) Require minimal maintenance that does not require effort or resources outside of the scope of the anticipated owner;
e) Provide for monitoring devices as required; and,
f) 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.

5.4 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:

1. Draft Low Impact Development Stormwater Management Guidance Manual (2022)
2. Stormwater Management Planning and Design Manual (2003)
3. Low Impact Development Construction Guide (2012)
4. Low Impact Development Monitoring and Performance Assessment Guide (2015)
5. Low Impact Development Retrofit Guides (Road and Public Land) (2014) and,
6. 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:

7. STEP's LID Treatment Train Tool (TTT)
8. 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.

5.5 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:

1. Owner responsibilities;
2. Routine vs. rehabilitative maintenance;
3. Common components of LID measures to be inspected; and,
4. 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.

5.6 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:

1. Background review / data summary
2. Characterization of existing site conditions (i.e., drainage patterns, subsurface conditions, etc.)
3. Summary of applicable design criteria for the subject site (minimum Water Quality Retention Target (WQRT) and provincial (RVCT))
4. Description of the project type, ultimate form, and resultant SWM Impacts
5. Documentation of Better Site Design strategies and the LID BMP screening and selection process.
6. Preliminary design details for the selected LID BMP measure
7. A Spill Contingency Plan and remediation requirements
8. Operations & Maintenance requirements for the selected LID BMP measure
9. Drawings / Figures demonstrating the proposed subcatchments contributing to the LID BMP measure
10. Standard details for the preliminary LID BMP design (section of each LID)
11. Site Works Certificate Form – GSG for Site Servicing (**Appendix B**)

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.

6.0 CITY OF HAMILTON CASE STUDIES

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) recently approved site plan applications were used as case studies. They were selected to represent a variety of conditions / situations and are listed in **Table 4**.

Table 4. List of case studies used in the preparation of the guidelines.

No.	Land use	Sewershed	Subwatershed Study?	Size
1	Commercial Site	Separated	No	Large
2	Residential Site	Separated	No	Small
3	Commercial Site	Separated	Yes	Large
4	Mixed-Use Site	Combined	No	Small
5	Mixed-Use Site	Combined	No	Large

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 of the Hamilton GSG Report (WSP 2023) for further review.

APPENDIX A - Selected Initiatives and Accompanying Actions

Hamilton Climate Change Impact Adaptation Plan

On March 27, 2019 Hamilton City Council declared a Climate Change Emergency. The City of Hamilton is on a mission to achieve net zero greenhouse gas emissions by 2050 and prepare for the unavoidable impacts of climate change. In August of 2022, City Council endorsed Hamilton's Climate Action Strategy, including 'Recharge Hamilton – Our Community Energy & Emissions Plan' (CEEP) and the 'Climate Change Impact Adaptation Plan' (CCIAP).

Resilient Theme #1 Built Environment

CCIAP Action 1.1

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.

Hamilton Watershed Action Plan

The City of Hamilton is taking steps toward developing a comprehensive Watershed Action Plan and reiterating its commitment to the **water quality objectives** outlined in the Hamilton Harbour Remedial Action Plan. In recent years, the City has been focusing on reducing point-source loads to Hamilton Harbour. Looking ahead, the City will focus on non-point-source contamination/loading within Hamilton's watersheds. The new Watershed Action Plan will help to identify and guide the work to address **non-point-source contamination** [stormwater] and will focus on activities that are within the care and control of the City of Hamilton.

Hamilton Biodiversity Action Plan

The Biodiversity Action Plan is a city-wide, multi-stakeholder strategy that will:

- protect Hamilton's future generations by enhancing and protecting the natural environment around us, and
- guide the protection and restoration of biodiversity through a set of proposed actions.

The BAP contains actions related to policy, regulatory and on-the-ground programs across multiple organizations. The Biodiversity Action Plan will also expand on activities already taking place and fill gaps in areas where action is currently lacking.

Key Priority 6:

Enhance local aquatic habitats through **sustainable stormwater management practices** and restoration of degraded watercourses, waterbodies and wetlands.

APPENDIX B – Draft Site Works Certification Form – LID

Separate document to be included in final version of these Guidelines.

Green Standards and Guidelines for Site Servicing
Site Works Certification Form - LID

Project Number:	
Project Name:	
Applicable Subwatershed Study:	
Sewershed (Combined or Separated):	
Total Site Area (ha):	
Total Surface Area directed to LID (ha):	

	Target	Design	Difference
Runoff Volume Control Target (RVCT, mm):	29		
Water Quality Retention Target (WQRT, mm):			
Priority 1 Retention (mm):			
Priority 2 LID Filtration (mm):			
Priority 3 Conventional Treatment (mm):			

Note: If Design < Target, provide explanation in Report/Technical Memo

Priority Category	Secondary Category	Best Management Practice Name	Number	Area	Length	Storage Layer?	Filter Layer?	Underdrain?
Priority 1A	Vegetated System	Bioretention						
Priority 1A	Vegetated System	Rain Garden						
Priority 1A	Vegetated System	Bioswale						
Priority 1A	Vegetated System	Green Roof A- intensive (>300mm depth) B - Semi-Intensive (150-300mm depth)						
Priority 1A	Vegetated System	Soakaways/Infiltration Trenches with Filter Media at Surface						
Priority 1A	Vegetated System	Soil Cells / Stormwater Planters						
		Trere Trench						
Priority 1A	Other	Permeable Pavement						
Priority 1A	Other	Compost/Soil Amendments						
Priority 1B		Perforated Pipes						
Priority 1B		Rainwater Harvesting A - Indoor (Ontario Buildig Code) B - Outdoor (Rain Barrel)						
Priority 1B		Blue Roof						
Priority 1B		Soakaway/Infiltration Trenches/Chambers (piped)						
Priority 2		Biofiltration						
Priority 2		Enhanced Grass Swale						
Priority 2		Manufactured Filters						
Priority 2		Priority 1 (Surface) Feature with Impereable Liner/Underdrain						
Priority 3		Dry Pond						
Priority 3		Wet Pond (wet pond/wetland/hybrid)						
Priority 3		Manufactured Treatment Devices						
Priority 3		Parking Lot Storage						
Priority 3		Rooftop Storage						

I, _____ of _____
certify to the City of Hamilton that the above noted Low Impatc Development Best Management Practices have been implemented and construction in accordance with all approved site plans, grading plans, stormwater management plans, site servicing plans, applicable policies and guidelines of the City of Hamilton

Professional Engineer

Signature: _____

Date: _____

Affix Seal