1.10 Non- Conventional Stormwater Management Facilities Design Criteria

1.10.1 Introduction

This document provides the City of Vaughan (the City) design criteria for the implementation of Non-Conventional Stormwater Management Facilities (SWMF's), such as underground storage tanks or super pipes, within park blocks, open space blocks, or rights-of-way (ROW), which are or will become City owned infrastructure and lands. Operations & Maintenance(O&M) requirements are also provided, as well as guidance on associated financial requirements. It is recommended that the applicant indicate their intention to implement Non-Conventional SWMF's as early as possible in the development application process, ideally during any pre-consultation discussions with the City. All submission materials provided shall be in accordance with this Criteria as well as the Non-Conventional SWMF Policy (08.C.03) and Procedure (PRC.45).

1.10.1.1 Submission Materials Overview

Table 1-23 summarizes the reports and materials that must be submitted to provide sufficient information for the review of the proposed Non-Conventional SWMF's, as well as the development stage at which they must be submitted.

Table 1-23: Submission Material Summary

Report	Level of Design	Development Stage
Non-Conventional SWMF Justification Report	• Conceptual level of detail which demonstrates viability of facility in accordance with the Non-Conventional SWMF Criteria, Policy (08.C.03), and Procedure (PRC.45).	"Initial Submission" (Can include MESP, Block Plan, Secondary Plan, and OPA/ZBA submissions, as well as Draft Plan Submissions if none of the above apply)
Functional Servicing Report	• FSR Level Detail for Non-conventional SWMF and associated facilities, grading, servicing, and modelling. • FSR level detail for site specific conditions (ex. Hydrogeological, geotechnical etc.) • Justification for product choice for Non-Conventional SWMF.	Draft Plan of Subdivision Submission
Stormwater Management Report	• Detailed design for all SWMF's • Detailed modelling • Shop drawings • Detailed sections • Engineering drawings • Refer to Section 1.1 of City Engineering Design Criteria	Detailed Design/Perfect Submission Stage
Operations & Maintenance Report	• Refer to Section 1.10.3	Detailed Design/Perfect Submission Stage
Offset Fee Calculation	• Refer to Section 1.10.4.1 • Can be submitted with Operations & Maintenance Manual or as separate memo	Detailed Design/Perfect Submission Stage

1.10.2 Design Criteria

The following criteria guides the design of Non-Conventional SWMF's in conjunction with the City of Vaughan's Engineering Design Criteria (December 2020 or most recent) and MECP's Stormwater Management Planning and Design Manual (2003 or most recent). Please refer to Section 1.1 of the City's Engineering Design Criteria for a complete list of all requirements for an Engineering Submission. All submissions must adhere to the City's overall criteria, applicable Environmental Compliance Approvals, and must not conflict with any other legislative requirements.

1.10.2.1 General Stormwater Management Criteria

The stormwater management solution shall be developed in accordance with the City's Design Criteria and Standard Drawings (December 2020 or most recent version), TRCA's Stormwater Management Criteria (April 2012 or most recent version), MECP's Stormwater Management Planning and Design Manual (2003 or most recent version), and Schedule D and E and Appendix A of the Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) (where applicable). Additional studies, including but not limited to Subwatershed Studies, Stormwater Management Master Plans, Environmental Impact Studies, and Monitoring programs should be reviewed on a site-by-site basis to ensure the standard SWM criteria requirements are refined as needed.
It should be noted that these criteria represent a minimum requirement that may be superseded by the results of further studies and local constraints.

1.10.2.2 List of Acceptable Technologies

Table 1-24 outlines acceptable Non-Conventional SWMF's that will be considered. Criteria specific to each technology type is also provided to inform product choice. Products chosen should not require Confined Space Entry for routine maintenance (as discussed in Section 1.10.3.2). Plastic facilities are acceptable provided they meet the below criteria. The use of plastic must be justified in the Functional Servicing Report submission stage. It should be noted that this document is subject to future review, which may result in the addition of other acceptable technologies.

Table 1-24: List of Acceptable Technologies

Acceptable Technology	Criteria
Cast-in-Place Concrete	• Provided concrete must meet CSA A23.1 (Concrete Materials and Methods of Concrete Construction) • Is in accordance with CSA S269.1 (Falsework and Formwork) and CSA G30.18 (Rebar) • Structural design to be sealed by P.Eng.
Pre-Cast Concrete	• Provided concrete must meet CSA A23.4 (Precast Concrete Materials Construction) • Structural design to be sealed by P.Eng.
Superpipes (Concrete)	• Must meet CSA A257 (Standards for concrete pipe and manhole sections) • Standard strength class must be specified and shall be selected in accordance with OPSD 807.010 for Height of Fill • Structural design to be sealed by P.Eng.
Polymeric (plastic) Chamber	• Meets CSA B184 Series of Standards for Polymeric subsurface stormwater management structures and/or be approved by the City's Products and Standards Committee. • Meets ASTM F2787 (Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chamber) OR

	ASTM F2418 (Standard Specification for Polypropylene Corrugated Stormwater Collection Chambers). • To be completely lined with minimum two layers of woven geotextile with minimum 1400 N grab tensile strength, 533 N tear resistance and 4600 N Puncture CBR. • Structural design to be sealed by P.Eng.

1.10.2.3 Overall SWMF Design Requirements

The following is a list of overall principles and design criteria for the implementation of all Non-Conventional Stormwater Management Facility (SWMF) Types. The Stormwater Management Report must address each item listed below. Any product-specific requirements shall be adhered to by the designer. For requirements specific to different use cases, please refer to the relevant sections below:

- The proposed stormwater management solution and design of the Non-Conventional SWMF must be sealed by a Professional Engineer licensed to practice in Ontario and documented in a design report appropriate to the stage of development.
- The proposed SWMF must only collect, receive, and control stormwater runoff, not sanitary or combined sewage.
- The proposed SWMF must be entirely located on municipally owned lands and shall not discharge to non-municipally owned land without the express written consent of landowner receiving the drainage.
- Quality control criteria must be met prior to runoff entering the quantity control portion of the Non-Conventional SWMF, which shall be achieved through an upstream treatment train approach.
    - OGS units shall only be credited for a maximum TSS removal of 60%, provided they have been sized using ETV Canada Particle Size Distribution (PSD).
    - Isolator/separator rows or baffle walls within underground storage tanks will be considered for quality control, however, it must also be accompanied by other pre-treatment strategies upstream of the SWMF. The volume contained in the isolator/separator rows or by the baffle walls shall not be counted towards quantity control storage.
- Quality controls included in treatment train must be included on the City of Vaughan Approved Technology List and/or be verified by ETV Canada.
- Quality control facilities (e.g., Oil Grit Separator (OGS) Units) will be designed using the entire range dataset of ETV Canada Particle Size Distribution or distribution otherwise specified by the City of Vaughan.
- No infiltration credit will be given for Non-Conventional SWMF's. A separate infiltration facility may be located upstream or downstream of the Non-Conventional SWMF.
- Infiltration facilities downstream of the Non-Conventional SWMF may be credited for water balance only, since quality control criteria must be met upstream of the SWMF.
- Iinfiltration facilities upstream of the Non-Conventional SWMF may be credited for water balance and/or water quality control, depending on design specifics.
- Infiltration facilities may not be located within the park block unless they are designed to exclusively treat runoff from the park.
- Standing water will not be acceptable within the Non-Conventional SWMF, including:
    - Permanent pools
    - Retention
- The Non-Conventional SWMF may provide extended detention in the facility, provided existing drawdown criteria is met. The minimum orifice diameter for the outlet shall be 100 mm. The number of orifices should be minimized as much as possible to reduce O&M requirements and costs.
- A stone layer is required above and below the proposed facility to facilitate drainage around the facility.
- The SWMF must be able to accommodate a dual drainage system.
    - Non-Conventional SWMF's must be sized for major system flows.

  - Pre-treatment (quality control of 80% TSS removal) is only required for minor system flows (5-year storm events and lower). Pre-treatment of major system flows is not required.
  - The access points to the Non-Conventional SWMF shall not be used for flow conveyance.
- Outlet locations shall be approved by the City of Vaughan (and TRCA where required).
- Service life of chosen Non-Conventional SWMF product must be a minimum of 100 years. This must be documented by a qualified Professional Engineer.
- Facilities shall be positively sloped, with a minimum slope of 0.3% to facilitate complete drainage and flushing. A minimum slope of 0.5% is preferred. Facilities that require pumping of active storage volumes (outside of O&M) will not be approved.
- The maximum distance between maintenance access points into the Facility shall be 60 m, or as determined by available maintenance equipment.
- At least one maintenance access point shall be provided directly above or beside all outlet and inlet structures.
- "Hybrid" facilities (e.g., the combined use of a Non-Conventional SWMF with above ground storage) will be considered, provided the following criteria is met:
  - Above ground storage shall not be located within the Park Block and must be in a discrete pond block. Any accompanying pond block must meet all existing City criteria.
  - Quality Control criteria must be met prior to any runoff entering the Non-Conventional SWMF.
- Emergency outlet locations, route and capacity of major system receiver shall be analysed and identified. Emergency outlets shall be able to convey the highest design inflow rate of the facility, while maintaining a minimum 0.30 m freeboard.
- Polymeric (plastic) Chambers:
  - Must be lined with double layer of woven geotextile to ensure stability of stone layer.
  - Manifolds shall be a minimum of 1200 mm in diameter to allow for access.
  - All row connections shall be a minimum of 600 mm in diameter and inverts shall match the chamber bottom elevation to permit flushing.
  - For polymeric (plastic) chamber facilities, the O&M Manual shall demonstrate that on-site stockpiling of overlying materials during replacement is possible. Stockpile locations must not interfere with park facilities/features and must be located within open space areas. Topsoil, fill and granular materials shall have separate stockpiles.
- Proposed facilities must be able to withstand a minimum traffic rating of the Canadian High Bridge Design Code (CHBDC) CL-625ONT.

On-site groundwater conditions are to be assessed by a Geotechnical Engineer prior to Detailed Design to confirm groundwater elevations in relation to the proposed Facility depth. A Qualified Engineer will determine whether buoyancy analysis is required to show whether the system can withstand hydraulic uplift conditions. Hydrogeological inspections must support the use of a Non-Conventional SWMF.

1.10.2.3 (a) SWMF's Located in Right-of-Ways

Non-Conventional SWMF's may be implemented within right-of-way's (ROW), which will provide conveyance and detention for runoff from the contributing drainage area. The SWMF design should ensure that all existing City of Vaughan Design Criteria for Roads can be met and shall not be modified to accommodate a Non-Conventional SWMF.

1.10.2.3 (b) General

Inlets and Outlets
The proposed on-site storm sewer system will serve as an inlet to the facility.

Sizing
The length of the pipe and diameter or height and span will be a function of the storage required to meet required discharge rates for the site.

Layout & Locations
Non-Conventional SWMF's in ROWs should be located in the typically approved storm sewer alignment under the roadway asphalt. Alternative locations may be acceptable (i.e., under boulevards) providing separation/offset requirements are satisfied under standard ROW cross-sections. The applicant shall provide a modified ROW cross-section if they are proposing to shift the facility from the typically approved storm sewer alignment, shall consider all crossings in the design of the system, and be responsible for coordination with other utility providers. Plan and Profiles will be required to show all clearances are met.

Facilities should be located within proximity to fire hydrants to supply flushing water for sediment removal.

If located within the asphalt of the right-of-way, facilities are to be located 1.5 m west or south of the road center line from the centreline of pipe, in a separate trench. On crescent roads, or roads with multiple bends, the facility position may follow the same relative side of the road allowance. The minimum horizontal clearance between the outside wall of the adjacent sewer pipes shall be 800 mm.

Curvilinear alignment through deflection at joints of the facilities within manufacturer's specifications are permitted with acceptance from the City.

Minimum clearances between the facility and other services shall be provided in accordance with MECP guidelines. Minimum horizontal and vertical separations between facilities and watermains are established in MECP's Procedure F-6-1.

Additional considerations and consultations shall be required with local service providers to ensure there are no conflicts between other proposed services, utilities, or underground infrastructure.

The ROW width shall not be expanded to accommodate facilities. Detailed cross sections shall be required to demonstrate that the facility fits within the proposed ROW, while achieving all required offsets.

Facility Depth
The facility shall have a minimum of 1.2 m cover to the top of the stone layer, per City of Vaughan Engineering Criteria. Maximum depth specifications are product-dependent and shall not be exceeded.

Facility By-Pass
A by-pass pipe should be provided to redirect flows around the Facility during maintenance, where possible. Per **Section 1.3.5.6** of the City's Design Criteria, the by-pass shall be designed to convey the peak flow from the 2-year return period storm event and in accordance with the Stormwater Management Planning and Design Manual ("Maintenance By-pass" in Section 4.7 of 2003 edition).

Valves should be avoided as a by-pass option to reduce maintenance requirements and costs. Less maintenance intensive options, such as stop logs, should be used.

Emergency Flow Conveyance

The rights-of-way shall provide sufficient conveyance capacity for the major system flows in the event of the outlet failure or blockage, or if the storm event is greater than the facility's design capacity. Major system flows shall be diverted away from surrounding buildings as much as possible, and the overland flow route should be identified on relevant figures and drawings, with sufficient erosion control specifications if required.

Pipe Loading

Facilities shall be constructed per the standards listed in **Section 1.10.2.3** to ensure structural integrity of the system. Pipe loading calculations shall accompany the Detailed Design submission and be completed per City of Vaughan Engineering Criteria. Selected native backfill may be used above the facility with acceptance from the City and if supported by an opinion from a Geotechnical Engineer. Facility structural design is to be sealed by a Qualified Professional Engineer.

Ponding

The Facility shall provide enough storage volume to contain the runoff volume generated by the 100-year storm without causing surface ponding. For Climate Change consideration, the maximum depth of ponding/flow for the August 19th, 2005, storm event shall not exceed 0.30m above the gutter line of the right-of-way, and the water level shall be contained within the right-of-way.

1.10.2.3 (c) Operations & Maintenance Design Requirements

The facility should be designed to allow for routine maintenance without the need for Confined Space Entry, and to minimize traffic disruptions. As such, the following criteria should be met at the detailed design submission:

- Confined Space Entry only required for infrequent maintenance/rehabilitation (>25-year period) and structural inspections (10-year period).
- The maximum distance between inspection/maintenance ports shall not exceed 60m.
- Inspection ports and maintenance access points should be located to facilitate inspection/maintenance with closure of one lane on multi lane roads.
- Personnel access points shall be provided at the upstream and downstream ends of the facility.
- A personnel access point shall be provided above or adjacent to the outlet structure for the facility.
- The footprint of the facility and associated infrastructure must be fully located on municipally owned land.

The O&M Manual for the facility must identify frequent and infrequent O&M tasks, related costs, and show clean out options that minimize disruption to the ROW. Further requirements and elaboration are provided in **Section 1.10.3**.

1.10.2.3 (d) Design Requirements for SWMF's Located in Parks & Open Space Blocks

Non-Conventional Stormwater Management facilities may be implemented within park blocks or open space blocks to provide conveyance and detention for a site. The proposed facility shall be designed to ensure that all existing City of Vaughan criteria for park grading, servicing, and programming and facility requirements can be met if full parkland dedication is to be achieved for the land above the proposed facility. Standard levels of services for park programming, facilities, amenities, and structures shall not be compromised to accommodate a Non-Conventional SWMF.

1.10.2.3 (e) General

Inlets and Outlets

The proposed on-site storm sewer system will serve as an inlet to the facility. Inlets and catchbasins are to be a minimum of 5 m away from all property lines.

Sizing

The height, length and width of the Facility will be a function of the storage required to meet target discharge rates for the site. The minimum and maximum height of the Facility will be dictated by the product choice. SWMF inverts will be dictated by the requirement for gravity drainage.

Layout & Location

The location of the facility shall be placed so that safe excavation (as per OHSA) is possible without the use of shoring between the facility and any services or property lines when excavation and facility replacement may be required. Park block services shall not cross over the top of the proposed facility. A minimum horizontal clearance between the outside wall of adjacent sewer pipes shall be 800 mm. Minimum clearances between the facility and other services shall be provided in accordance with MECP guidelines. Minimum horizontal and vertical separations between facilities and watermains are established in MECP's Procedure F-6-1.

Additional considerations and consultations shall be required with local service providers to ensure there are no conflicts between other proposed services, utilities, or underground infrastructure.

Consideration to proposed and future park landscaping is required. The Applicant should consult with the Parks Department to determine preferred tree planting locations within the park block and where installation should be avoided. This will allow the development of mature tree canopy within the park, which can be preserved if system excavation is required.

For polymeric (plastic) chamber facilities, facility and park layout shall demonstrate that on-site stockpiling of overlying materials during replacement is possible. Stockpile locations must not interfere with park facilities/features and must be located within open space areas. Topsoil, fill and granular materials shall have separate stockpiles.

The City shall provide the proposed park programming to inform the location of the Non-Conventional SWMF. Park programming shall not be dictated by the design/location of the SWMF. **Table 1-25** outlines various Park Programming options and whether a Non-Conventional SWMF will be permitted underneath. Any park facilities or features not listed below shall be confirmed with the City that a Non-Conventional SWMF can be located underneath. Inspections ports and maintenance access must always be accessible and should not be located underneath any of the Park facilities listed in **Table 1-25.** The facility placement, as well as preliminary access route locations, and approximate locations for maintenance and monitoring ports as determined by minimum spacing criteria, should be reviewed and agreed upon by the City's Parks Department prior to Detailed Design submission. It is noted that outside of the Non-Conventional SWMF area and associated buffers, standard Park's Criteria will still apply.

Table 1-25: Park Facility Acceptance

Park Facilities	**Acceptable Feature above Non-Conventional SWMF**
Playgrounds (Neighbourhood/Urban Park)	Yes
Playgrounds (District/Regional)	No*
Outdoor Fitness	Yes
Water play	No
Seasonal Domes (Slab on Grade)	No
Permanent Domes or field covers	No
Outdoor Swimming Pools	No
Outdoor Ice Rinks and Ice Skating	No
Skateboard and Wheeled Sports	Yes
Sports Fields (baseball diamond, soccer field, cricket pitch, football field, rugby/multiuse field)	Yes
Structures Requiring Deep Footing (e.g., Baseball backstops, football goal posts)	No
Sports Courts (tennis, basketball, bocce, pickleball, volleyball, ball hockey, multiuse court)	No*
Recreational Trails and Pathways	Yes**
Park Buildings (any kind)	No
Picnic Shelters (on ground or concrete slab)	Yes
Shade Structures (on Concrete Slab, cantilevered or standard)	Yes
Off Leash Dog Areas (Primary/Local)	Yes
Irrigation	Yes
Emergency Signage	Yes***
Amenities, Utilities, and Servicing	
Waste Receptacles on Concrete Slab	Yes
Electrical Transformers/Panels	No
Sanitary/Watermain Servicing and unrelated Storm Servicing	No
Typical Lighting	Yes
Lighting Conduits	Yes
Court and Sports Field Lighting	No
Benches/Seating on concrete slab	Yes
Signage	Yes
Retaining Walls	No
Bridge Structures	No

***Facilities require additional design considerations for implementation above Non-Conventional SWMF's. Applicant shall coordinate with City Park's Department to determine feasibility of Non-Conventional SWMF beneath feature.**

****Primary accessible routes and emergency access routes not permitted above SWMF.**

*****Although discouraged, emergency signage placement is subject to approval by Emergency Planning, Fire and Rescue Services staff.**

Grading

Grading over the proposed facility shall meet the City's requirements for Parkland grading, which allow for a minimum 2% and maximum 5% slope. Steeper sloping and/or retaining walls shall not be permitted over the facility, however armour stone seating may be provided over the Non-Conventional SWMF with the height of seating not to exceed 460mm. It is recommended that consultation with the City's Parks Department be undertaken early in the design process to ensure the proposed seating is acceptable.

Facility Depth

The Facility shall have a minimum of 1.8 m depth of cover to top of stone to allow flexibility with potential future Park programming. Maximum depth of cover specifications are dependent on the design of the Non-Conventional SWMF and shall not be exceeded. All access points should not exceed 5 m depth to avoid safety platforms, which may complicate inspection and maintenance procedures.

Facility By-Pass

A by-pass pipe shall be provided to redirect flows around the Facility during major maintenance. Per **Section 1.3.5.6** of the City's Design Criteria, the by-pass shall be designed to convey the peak flow from the 2-year return period storm event and in accordance with the Stormwater Management Planning and Design Manual ("Maintenance By-pass" in Section 4.7 of 2003 edition). Mechanical valves should be avoided as a by-pass option to reduce maintenance requirements and costs. Less maintenance intensive options, such as stop logs, should be used.

Emergency Flow Conveyance

The facility outlet configuration shall be designed with an emergency overflow spillway to allow storm drainage to safely exit the facility if the outlet fails to function, or if the storm event is greater than the Facility 's designed capacity. The spillway and/or emergency outlet shall be sized to safely convey the highest design inflow rate of the Facility, including the August 19th, 2005, storm for Climate Change consideration. The flow should be directed away from adjacent properties, and the overland flow route should be identified on relevant figures and drawings. Sufficient erosion control should be provided if required.

Loading

The facility shall be constructed per the standards listed in **Section 1.10.2.3** to ensure integrity of the system. Maximum depth specifications are product dependent and shall not be exceeded. Facility loading calculations shall accompany the Detailed Design submission and shall assume Canadian Highway Bridge Design Code (CHBDC) CL-625ONT loading. Selected native backfill may be used with acceptance from the City and if supported by an opinion from a Geotechnical Engineer. The facility structural design is to be sealed by a Professional Engineer.

Ponding

No surface ponding shall be permitted within the park. The facility shall provide enough storage required to meet required target discharge rates. The required storage volume for the design storm event shall be fully contained within the facility with no use of surface storage.

1.10.2.3 (f) Operations & Maintenance Design Requirements

The facility should be designed to allow for routine maintenance without the need for Confined Space Entry, and to cause no park use disruptions during routine maintenance and minimize use disruption as much as possible during major rehabilitation and replacement. As such, the following criteria should be met at the detailed design submission:

- Confined Space Entry only required for infrequent/major maintenance (>25-year period) and structural inspections (10-year period).
- The footprint of the facility and associated infrastructure must be setback 5.0 m from property lines and other infrastructure to allow for excavation without the use of shoring.
- Availability for flow by-pass for infrequent/major maintenance must be considered in the design of the facility. Valves are to be avoided to decrease maintenance requirements. Less maintenance intensive options, such as stop logs, are preferred. The maximum distance between access points for maintenance points shall not exceed 60m.
- Maintenance/inspection ports and maintenance holes shall not be located within field of play, or pedestrian pathways through the park.
- Personnel access points shall be provided at the upstream and downstream ends of the facility, as well as above or directly adjacent to the outlet structure of the facility.
- The facility is to be designed to prevent scouring during routine flushing.
- A warning system shall be incorporated when installing the facility to provide notice to future excavators of the facility's location. Requirements include:
    - Tracer wire around the perimeter of the facility.
    - Warning layer of orange delineation material (such as snow fence) over the top of the stone layer of the facility.

The O&M Manual for the facility must identify frequent and infrequent O&M tasks, related costs, and show clean-out options that minimize disruption to the park or open space block. Further requirements and elaboration are provided in **Section 1.10.3**.

1.10.2.3 (g) Access Route Design

The access routes for maintenance of facilities within a park block or open space block are to be considered as part of the overall system. As such, they should conform to the criteria described below. Access route paving will be dependent on the type of maintenance carried out, and type of vehicles used. Should only one access route be provided, the design shall be in accordance with the "Heavy Duty" maintenance access requirements. O&M requirements, as well as replacement and rehabilitation for the access routes should be considered in conjunction with the facility.

<u>"Light Duty" Maintenance Access Routes</u>

- "Light Duty" Access Routes shall be designed as dual-purpose access routes/pedestrian pathways and are for inspection purposes only. Routes will be constructed with either limestone screening with a stabilizing/binder agent (Standard Drawing S-110 and City-Wide Urban Design Guidelines ULA 305) or asphalt paving (Standard Drawing S-111 and Parks Delivery Standard Detail MLA 208).
- Routine Maintenance Access/Inspection Ports should be placed so that they are immediately adjacent to but offset from the pathway. The minimum width of these access routes shall be 4.0m. A turnaround, pathway loop or hammerhead is to be provided for a standard vehicle.
- Maintenance ports/manholes should not be located where overhead obstructions could occur (e.g., overhead wires).
- Sufficient lighting to be provided to ensure adequate illumination for maintenance activities and shall conform to applicable guidelines in **Section 1.8** of the City's Engineering Design Criteria.
- Tree plantings adjacent to the access route shall be offset a minimum of 3.0 m. Additionally, columnar species shall be proposed, to avoid conflict with overhead branches.

"Heavy Duty" Maintenance Access Routes

- Access routes for major rehabilitation or frequent sediment clean out shall be separate from all pedestrian pathways and shall be constructed from concrete.
- Minimum route widths shall be 6.0 m to accommodate large trucks, as determined by the City's Environmental Services department at the detailed review stage. Curves in the road will have a minimum centreline radius of 12.0 m. A turning circle or hammerhead shall be provided for vehicular ingress/egress.
- Access route shall be constructed from concrete.
- Access route should be assessed by a Transportation Engineer to confirm sufficient turning radii at entrances, exits and turning circles within the site.
- The route shall be constructed to be in accordance with Standard Drawing S-111 and Parks Delivery Standard Detail MLA 209.
- The route structure and makeup shall be designed to accommodate the following truck dimensions:
    - Weight: 35,000kg
    - Length: 12.2 m
    - Width: 3.3 m
    - Turning Radius: 15 m
- Sufficient lighting to be provided to ensure adequate illumination for maintenance activities and shall conform to applicable guidelines in Section 1.8 of the City's Engineering Design Criteria.

1.10.2.4 Facility Sizing and Modelling

Facilities will be sized to meet quantity control requirements, per TRCA's SWM Criteria (April 2012 or most recent version). To address climate change controls, the IDF curve from the York University (YUG) rain gauge for the August 19, 2005, storm event shall be used to model ponding limit requirements within rights-of-way. The IDF curve can be found in **Section 1.3.1.16** of the City's Engineering Design Criteria.

Facilities shall be sized to ensure that the largest storage volume required does not exceed 90% of the total volume of the Facility. If Regional Controls are required for the proposed development, the required volume may be detained within a Non-Conventional SWMF, provided sufficient details are included to demonstrate feasibility.

Runoff Coefficients for contributing areas shall be determined per **Section 1.3.1.17** of the City's Engineering Design Criteria. For storms larger than a 5-year return period, runoff coefficients shall be increased per **Section 1.3.1.17** of the City's Engineering Design Criteria.

A computerized hydrologic and hydraulic model shall be developed to calculate major and minor system flows in a dual drainage system analysis for design areas greater than 5 hectares in size. Smaller developments may require such analysis depending on receiving drainage systems (at the discretion of the City). In cases where drainage from the development is to discharge to existing systems, detailed modelling of such downstream systems may be required, at the discretion of the City. The analysis is to be fully documented, prepared, and signed by a Professional Engineer.

When computer modelling is used, the report shall indicate model parameters, assumptions used, outflow hydrographs and hydraulic grade line levels where applicable, flow depths and spreads and any other pertinent information.

Pre-treatment facilities (OGS units, low impact development facilities etc.) for quality control will be sized to meet City of Vaughan and TRCA SWM criteria (80% TSS removal). OGS units shall be designed to treat the incoming

5-year flows and will be credited for 60% TSS removal, provided the units have been sized using ETV Canada PSD.

1.10.2.5 Extended Detention

Extended Detention volume requirements shall be based on the criteria established in the Stormwater Management Planning and Design Manual, the TRCA's Stormwater Management Criteria, or site-specific requirements as established in an approved Master Environmental Servicing Plan, Master Drainage Plan, City-Wide Storm Drainage & Stormwater Management Master Plan or as otherwise established by the City, TRCA or other relevant authorities with jurisdiction. Extended Detention may be provided within the Non-Conventional SWMF after pre-treatment. Minimum orifice sizes as outlined in **Section 1.10.2.3** are applicable.

1.10.2.6 Pre-Treatment Facility Options

A treatment train approach is required to accompany the proposed end-of-pipe Non-Conventional SWMF to meet water quality, and water balance criteria. Pre-treatment will also help reduce peak flows from the development and storage requirements by impacting the overall imperviousness of contributing drainage areas (directly and indirectly connected). It should be noted that erosion control capabilities of each pre-treatment facility should be considered against any site-specific detailed erosion analyses.

The following **Table 1-26** is a list of possible low impact development facilities and manufactured treatment devices assessed for pre-treatment, and what criteria that facility can address (which is dependent on the design of the facility).

Table 1-26: Pre-Treatment Alternatives

Technology/Facility	Examples	Benefit
Separation Manufactured Treatment Devices	ETV-Verified OGS Units	Quality – maximum of 60% TSS removal if sized with Canadian ETV PSD
Infiltration/Filtration	Basins, chambers, trenches, soakaway pits, dry swales, bioswales, grassed/vegetated swales, vegetated filter strips, rain gardens, etc.	Water Balance, Quality (public lands only), Erosion
Exfiltration Trenches/Systems	Perforated pipes, catchbasin exfiltration system	Water Balance, Quality, Erosion
Deep Sump Catchbasins	N/A	Large particle/ debris and garbage removal
Downspout disconnection to Soakaway Pits	N/A	Water Balance, Quantity, Erosion

The following general screening steps should be completed to help select which pre-treatment facility options will be most effective based on-site specific characteristics; however, the ultimate decision of the proposed pre-treatment facility must be acceptable and to the satisfaction of the City.

1. Assess site conditions (hydrogeological, geotechnical, environmental, development regulations).
2. Define design criteria per **Section 1.10.2.3.**
3. Screen pre-treatment options (site constraints, opportunities based on land-use types, performance requirements, O&M requirements)

All pre-treatment facilities should be included in the Operations & Maintenance Manual and Offset Fee calculation.

1.10.2.7 Design Drawings and Details

Submitted drawings shall adhere to **Section 1.1** of the City of Vaughan's Engineering Design Criteria (December 2020, or most recent).

1.10.3 Operations & Maintenance Manual

An Operations & Maintenance (O&M) Manual shall accompany the Detailed Design submission for all proposed facilities included in the SWM solution, which includes the Non-Conventional SWMF and any pre-treatment facilities. The Manual shall be in accordance with guidelines set by MECP's Stormwater Management Planning and Design Manual (2003, or most recent version) and requirements in Schedule E of the CLI-ECA (if applicable). The Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (TRCA, 2016, or most recent version) and other guidance documents from local regulatory agencies can be referenced in the development of the O&M Manual, however CLI-ECA requirements shall remain paramount and take precedence.

The manual shall outline the following:

- Description of types of facilities including function of facility (e.g., quantity, quality etc.), design volumes, discharges, design events etc.
    - Consultation with the City may be required to determine which department is responsible for various maintenance activities, for outline in the O&M document (e.g., Environmental Services or other).
- Maintenance frequency for all facilities and treatment devices included in the SWM solution, based on the sediment loading rate from the contributing drainage area.
- Annual maintenance costs calculated through a detailed breakdown of cost/frequency for relevant inspection, monitoring, and maintenance items.
- Calculation of costs associated with sediment disposal per most current Excess Soil Management Regulations.
- Facility Surface Inspection and Monitoring plan.
- Detailed execution plan for O&M based on maintenance type (frequent versus infrequent) including but not limited to the location of maintenance and monitoring ports and relevant access routes.
- Identification of any required personnel, training, and equipment (including dimensions) for all maintenance activities.

An Offset Fee Calculation is to be provided at the same time as the O&M Manual, which can be included in the manual, or provided as a separate document (refer to **Section 1.10.4** for guidance).

1.10.3.1 Inspection & Monitoring

The O&M manual shall provide sufficient detail on inspection and monitoring requirements, as well as the calculation of associated fees for inspection and monitoring. The cost differential between the fees for inspection and monitoring for the Non-Conventional SWMF compared to the fees for a Conventional SWMF of equal size/function over 50 years will be used in the calculation of the Offset Fee, as the "Inspection & Monitoring Cost" component. Refer to **Section 1.10.4.2** for applicable unit rates.

Inspection

The O&M Manual shall outline the inspection schedule for the proposed facilities, to ensure effective performance, as designed. Discharge from the facility is to be free of floating and settleable solids, and not contain oil or other substance in amounts sufficient to create a visible film, sheen, foam, or discoloration on receiving waters.
Inspection frequency shall be determined by the recommendations from the chosen facility supplier. Within the first two years of post construction, facilities will require inspection after every significant storm to ensure proper

functioning, (typically 4 times a year). After the first two years, the facility should be inspected as per the guidelines of the Non-Conventional SWMF manufacturer but at a minimum of once a year, and after every significant storm to ensure proper functioning, (typically 4 times a year). Standard inspections will determine what maintenance activities are required and should not require Confined Space Entry or CCTV monitoring.
The O&M Manual should provide a template for inspections, which are to be recorded and be available at the Owner's administrative offices. The template should include the following:

- Name of Inspector
- Asset ID of the Works inspected.
- Date and time of inspection
- Observations from inspection including (where applicable):
    - Hydraulic operation of works (e.g., length of occurrence since the last rainfall event, evidence, or occurrence of overflows.
    - Condition of surface vegetation in and around the Works.
    - Occurrence of obstructions at the inlet and outlet of the Works.
    - Evidence of spills and/or grease/oil contamination.
    - Frequency of surface trash build-up.
    - Measurements of sediment accumulation and water levels.

Monitoring

The O&M Manual shall outline a monitoring program of the facility in accordance with the City of Vaughan monitoring requirements, per **Section 1.3.5.20** of the Engineering Design Criteria. At minimum, monitoring will be required for the first two years of operations, and one additional year to be completed by the City, through the monitoring fee collected through the subdivision agreement, for a total of three years of monitoring.
Monitoring Plans shall be in accordance with CLI-ECA requirements (Schedule E) to ensure proper functioning of the facilities from a quantity and quality perspective and inform any corrective measures that may be required prior to assumption. The monitoring plan must be reviewed and approved by the City and at the City's discretion, a third party to verify monitoring plan adequacy. Monitoring Plans shall be kept current following any alterations to the Non-Conventional SWMF and will be available to members of the public upon request.
The Monitoring Plan shall:

- Be carried out by the Landowner, or a delegated third-party Qualified Person, with data recorded in an electronic database.
- Verify the operation performance of the Non-Conventional SWMF is as designed.
- Assess the environmental impact of the Non-Conventional SWMF.
- Identify the works to be monitored (outlets and facilities providing quantity and/or quality control).
- Identify key receivers to be monitored and monitoring locations.
- Consider relevant municipal land use and environmental planning documents.
- Identify rainfall gauges to be used.
- Develop a program that includes:
    - Characterization of water quality and quantity conditions and development of quality and quantity goals.
    - Hydrological, chemical, physical, and biological parameters as appropriate.
    - Water level shall be measured with water level gauge clearly visible to take readings.
    - Monitoring methodology, including frequency and protocols for sampling, analysis, and recording, with consideration of dry and wet weather events and timing of sampling during wet weather events, and date and time of sampling.
- Identify schedule for plan implementation.
- Result in a report with analysis of monitoring information and data, with findings and recommendations.
- Identify adaptive measures based on results of monitoring.

1.10.3.2 Maintenance Cost

Sediment Removal

Sediment removal frequency should be calculated for any component of the treatment train that accumulates sediment. Sediment removal procedure shall be outlined in the O&M Manual. Overall sediment loading rates will be calculated based on the loading rates per impervious area outlined in Section 6.0 of the MECP Stormwater Management Planning and Design Manual, also shown below in **Table 1-27.**

The manual shall provide a detailed execution plan for sediment removal, which considers:

- Sediment removal construction drawings to demonstrate feasibility.
- Frequency of maintenance.
- Identification of access routes and paving requirements (heavy duty vs. light duty).
- Identification of staging locations.
- Sediment removal technique.
- Assessment of restoration requirements.
- Identification of confined space entry requirements (and applicable certifications).
- Equipment requirements.
- Flow diversion strategies.
- Traffic management considerations
- Consideration of impact on park uses.
- Plan for facility entry.
- Identification of Emergency Overland Flow Route

Table 1-27: Sediment Loading

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

***Source: MECP Table 6.3 in MECP Stormwater Management Planning and Design Manual**

Increased Maintenance

A Maintenance Cost Assessment shall be completed for the proposed Non-Conventional SWMF and any proposed pre-treatment measures (e.g., OGS units, LID facilities), which details the increased maintenance costs for the facility over a 50-year period. All unit rates used in the calculation of the Offset Fee shall be subject to annual indexing per Statistics Canada Non-Residential Construction Price Index, beginning from the year of the Non-Conventional SWMF Design Criteria. Adjustments to unit rates may be made by the City through updates of the Design Criteria to maintain accuracy to current typical industry rates.

Items that may need to be considered in the maintenance cost assessment, depending on product choice and placement, are:

- Structural inspection requirements.
- Replacement and maintenance of maintenance access routes in parks.
- ROW reconstruction.
- Restoration and/or replacement of vegetation/trees above and surrounding the facility after major rehabilitation.
- Replacement of components including OGS units, and inlet and outlet structures.
- Ongoing OGS maintenance.
- Flow by-pass contributions for major maintenance/replacement.
- Traffic Management for major maintenance/replacement within ROW's.

- If the City is responsible for implementation of any Park features, structures, facilities, and amenities where a Non-Conventional SWMF is located, the developer shall be responsible for any additional costs caused by the Non-Conventional SWMF.

Maintenance activities for the first 50 years of the proposed facilities, such as debris removal, shall be outlined in the Manual, including frequency for each maintenance activity and associated cost. Required maintenance activities shall be determined through visual surface inspections of all facilities included in the SWM solution. The Manual must consider the following items in the maintenance cost assessment of the proposed facilities, and provide detailed plans where applicable:

- Frequency of maintenance.
- Identification of access routes and paving requirements (heavy duty vs. light duty).
- Identification of stockpiling locations.
- Identification of staging locations.
- Sediment removal technique.
- Assessment of restoration requirements.
- Identification of confined space entry requirements (and applicable certifications).
- Equipment requirements.
- Flow diversion strategies.
- Traffic management considerations
- Consideration of impact on park uses.
- Plan for facility entry.
- Identification of Emergency Overland Flow Route.

Typical maintenance costs for non-conventional facilities are provided in **Table 1-28**:

Table 1-28: Example Maintenance Costs and Frequencies for Non-Conventional SWMF's

Item	Unit/ Frequency	Non-Conventional SWMF Rate
Confined Space Entry Structural Inspection	Every 10 years	$5000/day
Reconstruction of SWMF Inlet/Outlet Components (grates, orifice, weirs, etc.)	Every 50 years	Based on construction cost of inlet/outlet components
Replacement/Maintenance of OGS Components	Every 25 years	Based on construction cost for internal components
Restoration Activities		
Seed and Topsoil	m^2	$7
Grass Sod and Topsoil	m^2	$30
Upland Vegetation	m^2	$5
Trees	each	$550

The maintenance fees for the O&M of a comparative Conventional SWMF shall be calculated assuming a design life of inlet/outlet structures of 50 years. The cost of replacement shall be calculated based on current construction costs. Any other maintenance typically associated with Conventional SWMF's shall also be included in the maintenance cost calculation. **Table 1-29** provides unit costs for typical maintenance activities that can be used in this calculation.

Table 1-29: Example maintenance costs and frequencies for conventional SWMF's

Item	Unit/ Frequency	Conventional SWMF Rate
Standard Maintenance		

Inlet/Outlet Structures	Every 50 years	Based on construction cost
Grass Cutting	Per ha per year	$292
Litter Removal	Per ha per year	$105
Vegetation Maintenance	Per year	$1,000
Tree trimming for overhead clearance of Access Road	Every 3 years	$2,000
Restoration Activities		
Seed and Topsoil	m^2	$7
Grass Sod and Topsoil	m^2	$30
Upland Vegetation	m^2	$5
Trees	each	$550

Items with "Per ha area" listed as their frequency above are for the pond block area. The delta between the total maintenance cost, including sediment removal, over a 50-year period for a Conventional and Non-Conventional SWMF will be used in the calculation of the Offset Fee as the "Maintenance Cost" component. All unit rates used in the calculation of the Offset Fee shall be subject to annual indexing per Statistics Canada Non-Residential Construction Price Index, beginning from the year of the Non-Conventional SWMF Design Criteria.

1.10.4 Financial Requirements

Compensation fees will be calculated and collected by the City after the submission of Detailed Design, prior to assumption. All facilities (quality and quantity) included in the SWM solution to be assumed by the City should be included in the calculation of the fees (pre-treatment and Non-Conventional SWMF).

1.10.4.1 Final Offset Fee

An Offset Fee Calculation is to be provided at the same time as the submission of the Operations & Maintenance Manual at the detailed design stage. It can be included in the manual or provided as a standalone document. The Offset Fee will quantify the operation and maintenance cost differential between the Non-Conventional SWMF (and pre-treatment facilities) and a Conventional SWMF of equal size/function over a period of 50 years.
The Landowner is to provide a 25-year Manufacturer extended warranty for non-conventional SWMF's. Should an extended warranty to the City's satisfaction not be provided, inclusion of a SWMF rehabilitation fee will be added to the total Offset Fee. Rehabilitation of SWMF's is necessary to ensure the structural integrity and longevity of the facility.
The Offset Fee calculation is to use the unit rates for each activity provided in the tables in **Section 1.10.3.2** and **Section 1.10.4.2**, and is to be the summation of:

- Inspection and monitoring costs over the specified period.
- Maintenance costs over the specified period.
    - Increased cost of construction, materials and over the specified period shall be considered in the fee calculation.
    - Any proposed pre-treatment units shall be included in the maintenance cost calculation.
- Inclusion of a SWMF rehabilitation fee should a 25-year extended warranty to the satisfaction of the City Solicitor not be provided for the facility:
    - Concrete rehabilitation of 40% of the facility inner surface area for concrete SWMF's.
    - In the case of infill developments with drainage areas of 2 ha or less which propose concrete superpipes, a replacement/rehabilitation fee is not required regardless of an extended warranty plan. Additional infrastructure such as inlet and outlet structures and components of pre-treatment devices shall still be considered.
- If the City is responsible for implementation of the Park features after assumption, the developer shall be responsible for any additional costs caused by the Non-Conventional SWMF.

All unit rates used in the calculation of the Offset Fee shall be subject to annual indexing per Statistics Canada Non-Residential Construction Price Index, beginning from the year of the Non-Conventional SWMF Design Criteria. Adjustments to unit rates may be made by the City through updates of the Design Criteria to maintain accuracy to current typical industry rates. All calculations must be accompanied by a Sealed Engineering opinion that corroborates the assumed service life of the proposed SWMF.
The Final Offset Fee shall be a requirement of the Subdivision or other Development Related Agreement and paid to the City by the Landowner prior to the registration of the Subdivision or other Development Related Agreement. The fee shall be determined by the following:

$$\text{Final Offset Fee} = \text{Inspection \& Monitoring Costs} + \text{Maintenance Costs Final}$$

Where:
"Inspection & Monitoring Costs" is defined as the differential between the inspection and monitoring costs calculated for a Conventional versus Non-Conventional SWMF, outlined in the O&M Manual. Refer to **Section 1.10.3.1** for a full description of what is involved in these costs. Refer to **Section 1.10.4.2** for estimation methodology.

"Maintenance Costs" is defined as the differential between the costs, including structural inspections, OGS component replacement, sediment removal, and inlet/outlet replacements, for a Conventional versus Non-Conventional SWMF, outlined in the O&M Manual. Refer to **Section 1.10.4.2** for estimation methodology.

1.10.4.2 Final Offset Fee Estimation Methodology

"Inspection & Monitoring Costs"
The unit rates in **Table 1-30** shall be used in the calculation of the inspection costs for the proposed Non-Conventional SWMF and Conventional SWMF of equal size/function.

Table 1-30: Example Inspection Costs

Item	Frequency (years)	Unit	Non-Conventional SWMF Rate	Conventional SWMF Rate
Inspection Activity				
Surface Inspection	1	each	$500	$2000

"Maintenance Costs"
The sediment removal cost for a Non-Conventional SWMF shall be determined using a unit rate of $500/m^3 of sediment. This fee covers all associated restoration, disposal and equipment required for sediment removal.
The comparative maintenance fee for a Conventional SWMF of equal size/function shall be calculated based on a unit rate of $200/m^3 of sediment. The calculation assumes that the sediment loading rate is consistent between the two facilities. For the purposes of the Offset Fee, sediment accumulation will be calculated over a period of 50 years.

Rates were determined through a survey of recent cleanout costs collected from various municipalities in Southern Ontario.

Overall maintenance costs will be highly dependent on the specified product. Maintenance costs shall be calculated over a period of 50 years and shall include general maintenance for the continued operation of the facilities including upstream treatment train approach. An Engineer shall provide recommendations for structural inspection, and replacement of components such as OGS units, inlets and outlets, based on design life. Further details and considerations are provided in **Section 1.10.3.2**.

Rehabilitation of SWMF's may be added to the Offset Fee should a 25-year Manufacturer extended warranty not be provided or accepted by the City. The unit rates in **Table 1-31** shall be used in the calculation of the

Rehabilitation Offset Fee. The warranty must cover any rehabilitation works that will be required over the first 25 years, beginning at the time of Assumption. Suppliers providing a warranty shall be subject to the terms and conditions of a legal agreement provided by the City, and to the satisfaction of the City solicitor.

Table 1-31: Example Additional maintenance cost

Item	Unit/ Frequency	Non-Conventional SWMF Rate
Concrete SWMF Rehabilitation (without extended warranty)	40% of the inner SWMF surface area every 50 years	$2600/m^2 of internal concrete SWMF surface area

Restoration and rehabilitation/replacement costs for the inlet and outlet structures of a Conventional SWMF of equivalent size/function shall be used to calculate the comparative maintenance costs for a Conventional SWMF. Further details and considerations are provided in **Section 1.10.3.2.**

1.10.5 Assumption

Prior to City assumption of the Non-Conventional SWMF's, the following must be provided through a Certificate of Conformance which has been completed by a Qualified Engineer, in addition to any requirements of assumption provided within the subdivision agreement:

1. Proof of structural stability – to be confirmed through CCTV, or other methods to the satisfaction of the City.
2. Proof that the facility is functioning as intended through flow monitoring.
3. Proof the facility is free of sediment and debris – to be confirmed through CCTV, or other methods to the satisfaction of the City.
4. Record drawings sealed by the Engineer of Record, certifying that the construction was completed per the design. Record drawings are to be in accordance with PEO's guidance document on Preparing As-Built and Record Documents, and the City of Vaughan's As-Constructed Document Requirements.
5. If applicable, record of and agreement on any extended warranty for the rehabilitation of SWMF's.
6. Completion of and records for a minimum two-year monitoring and report program to the satisfaction of the City Terms of Reference and CLI-ECA requirements.

Additionally, requirements per the City's Engineering Design Criteria **Section 1.3.5.20** and **Section 1.3.5.21** must be met, where applicable. The following materials required include but are not limited to:

- Annual Sediment Level Monitoring
- Inclusion of:
  - O&M Manual sealed by a qualified P.Eng.
  - SWM Report Sealed by qualified P.Eng.
  - Digital photos of the SWM Facility
  - AutoCAD drawings of facility
  - GIS Shapefiles of facility
  - Monthly Outlet Inspection Records
  - Inlet and Outlet Flow Monitoring records
  - Digital set of approved and the as-constructed technical drawings (sealed by a qualified P.Eng.)

For a comprehensive list, refer to the relevant sections of the City's Engineering Design Criteria, **Section 1.3.5.20** and **Section 1.3.5.21**. Depending on results shown in monitoring data, remedial works may be required to the

satisfaction of the City, which will require at least one additional complete season of monitoring of remedial works. The City will reserve the right to require additional monitoring until the facility is performing to its satisfaction.

It is noted that in a scenario where the developer does not complete the installation of the park features prior to assumption, the applicant shall be required to provide payment for any additional park development expenses that are due to the implementation of the Non-Conventional SWMF. A budget for the development of the park will be provided by the City which will include estimate construction costs, consulting fees, contingency, applicable taxes, and administrative fees. Per Developer Build Park Policy No. 07.2.05, the landowner will prepare detailed construction drawings at the appropriate stages, as well as a detailed cost estimate. Costs that are incurred that are specific to the Non-Conventional SWMF and in excess of the standard park specifications are the landowner's financial responsibility and will be considered separate from standard development charges.

The City may also request any other details and information required by the Director of Development Engineering.

1.10.6 Completion Approval

The following list is an overview of documentation required prior to, and for Completion Approval, which shall be submitted in digital format with the final or as-constructed subdivision submission. Designs are to be in accordance with the requirements per City's Engineering Design Criteria **Section 1.3.5.20** and **Section 1.3.5.21** must be met, where applicable. Each submission shall include the applicant's contact information for comment coordination on the sufficiency of each submission.

1. New Facility Information
    a. Type
    b. Function
    c. General Description
    d. Location Description
    e. Nearest Major Intersection
    f. Municipal Address
    g. Easting
    h. Northing
    i. Access
    j. Driveway (y/n)
    k. Driveway Material
    l. Vehicle Turnaround (y/n)
    m. Gate Present (y/n)
    n. Lock Present (y/n)
    o. Adjacent Land Use (Residential/Commercial/Industrial/Rural)
    p. Land Use above facility (ROW/Park/Open Space)
    q. City Block Number
    r. Comments

2. Drawings (*.TIF)
    a. Storm sewer drainage areas plans (internal and external)
    b. Overland flow drawings
    c. All drawings related to proposed SWM facilities including section & details of facility, inlet/outlet structures, detailed plan views etc.
    d. All major & minor system design sheets

3. SWM Facility Report (PDF)
    a. SWM Facility Design Report
    b. SWM Facility Operations & Maintenance Report

4. Digital Photos of SWM Facility prior to assumption (*.JPG)
    a. All significant components

5. AutoCAD Drawing (*.DWG)
    a. Property lines associated with SWMF area.
    b. Ensure inlets and outlets are labelled.

6. GIS File Geodatabase (ESTRI File Geodatabase compatible with ArcMap 10.2.2)
    a. In NAD83 Zone 17N

7. Environmental Compliance Approval Document (ECA)
    a. Certificate of Approval OR Environmental Compliance Approval for each facility.

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