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# FUNCTIONAL SERVICING / STORMWATER MANAGEMENT REPORT

## Proposed Apartment Buildings

Ida Street, Dundalk
Township of Southgate

January 2025
Rev: September 2026

Prepared For: **Briarwood (Dundalk) Ltd.**

File: **23142**

VALDOR WATER RESOURCES

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# 1.0 INTRODUCTION

Valdor Engineering Inc. has been retained by Briarwood (Dundalk) Ltd. to provide consulting engineering services related to the construction of an apartment building development at a 27.06 Ha property located on the north side of Ida Street, East of Hanburry Street, and west of Eco Parkway in Dundalk, in the Township of Southgate as shown in **Figure 1**.

## 1.1 Existing Conditions

The subject site is currently vacant and is bounded to the north by vacant lands, to the east and west by detached dwellings, and to the south by the road allowance of Ida Street. There are existing watercourses that traverse the subject site that are within Grand River Conservation Authority (GRCA) regulated area. Additionally, there is also a sanitary sewer easement that crosses the subject site.

## 1.2 Proposed Development

The proposed development involves the construction of two apartment buildings containing a total of 240 apartment units with ground surface parking lots. With regards to the unit mix, 172 units will be 2 bedroom apartments and 68 units will be 3 bedroom apartments. The area of the development site is approximately 2.043 Ha. The development includes two driveways from Ida Street which will provide access to parking lots, drop off area and loading areas.

A copy of the Site Plan and Ground Floor Plan for the development is included in **Appendix "A"**. The development statistics are summarized in **Table 1**.

**Table 1. Development Statistics / Equivalent Population**

| **Apartments** | **Population Density** (persons / unit) | **No. of Units** | **Equiv. Population** (persons) |
|---|---|---|---|
| Building A | 2.7 | 120 | 324 |
| Building B | 2.7 | 120 | 324 |
| **Total** | | **240** | **648** |

## 1.3 Purpose of Report

This Functional Servicing and Stormwater Management Report outline the engineering design elements for the proposed development, including water supply, sanitary sewers and storm sewers including stormwater. It has been prepared to address the design criteria of the Township of Southgate in support of a Zoning By-law Amendment application for the subject site. This report was prepared based on a review of the architectural building designs for the proposed development and a review of the detailed topographic survey.

# 2.0 WATER SERVICING

Water is supplied to the residents in the community of Dundalk by a municipal water distribution system which includes three production wells, one on-grade reservoir and one elevated water tower. The existing watermain in the site vicinity includes a 200mm diameter watermain on Ida Street as indicated on **Figure 2**. The following is a summary of the proposed water servicing for the site:

## 2.1 Domestic Demand

The average domestic water demand for the proposed development was calculated using the Township of Southgate engineering design standards which include the following parameters:

| | |
|---|---|
| Residential Average Day Demand: | 450 L/person/day |
| Maximum Day Factor: | 2.50 |
| Peak Hour Factor: | 3.75 |
| Min Hour Factor | 0.45 |

Based on the above, the development will have a domestic water demand as summarized in **Table 2**. A detailed tabulation of the domestic water demand calculation is included in **Table B1** of **Appendix "B"**.

**Table 2. Water Demand**

| | Equivalent Population (Persons) | Average Day Demand (L/min) | Max Day Demand (L/min) | Peak Hour (L/min) | Min Hour (L/min) | Fire Flow (L/min) | Max Day Demand + Fire Flow (L/min) |
|---|---|---|---|---|---|---|---|
| Building A | 324 | 101.3 | 253.1 | 379.7 | 45.6 | 19,000 | |
| Building B | 324 | 101.3 | 253.1 | 379.7 | 45.6 | 19,000 | |
| **Total** | **648** | **202.5** | **506.3** | **759.4** | **91.1** | **19,000** | **19,506** |

With regards to capacity in the Dundalk water system, based on the 2026 Reserve Capacity Calculations prepared by the Township's consultant (Triton Engineering Services Limited, June 3, 2026), the current system has an available capacity of 485 ERUs (Equivalent Residential Units). The subject development is comprised of 240 apartment and based on 0.70 ERUs per apartment unit, a total of 168 ERUs of water allocation are required for the subject development.

As indicated in the 2026 Reserve Capacity Calculations there are several development applications within the community of Dundalk that are at various stages of approval, some of which have been inactive, which total approximately 1,900 units. Allocation is granted once a development has advanced to the point where planning and engineering approvals are sufficiently advanced. It is noted that the Township will be initiating a Municipal Class

EA for the expansion of the Dundalk water system. On this basis, it is expected that there will be sufficient capacity available for the subject development. A copy of the 2026 Reserve Capacity Calculations is included in **Appendix "B"**.

### 2.2 Water Service Connection

The development will be serviced by one connection to the existing 200mm diameter Ida Street watermain. The water site servicing will consist of a 200mm watermain with a domestic and fire line connection to each building.

Each building will have a water meter and backflow prevention device which will be located in the meter room. The configuration of the site watermain as well as the location of the water meters is illustrated in **Figure 2**.

### 2.3 Fire Protection

The fire flow required for the proposed buildings was calculated using the criteria indicated in the *Water Supply for Public Fire Protection Manual*, 2020, by the Fire Underwriters Survey (FUS). Appropriate reductions and increases have been applied to the equation such as coefficient for wood frame construction, a reduction for low-hazard occupancies, an adjustment for sprinkler protection system, and an increase due to neighbouring building proximity.

Based on the calculation, each building of the proposed development requires 19,000 L/min. The detailed fire flow calculations are provided in **Table B2-1** and **Table B2-2,** which are included in **Appendix "B"**. In accordance with the Township standards, this flow must be available at the nearest hydrant with a minimum pressure of 140 KPa.

In accordance with the OBC the principal entrance of each building must be within 90m of a fire hydrant. The existing municipal fire hydrant at the frontage of the site will be supplemented with three private site fire hydrants to provide sufficient coverage.

The fire department connection for each building will be located within 45m of the proposed private site fire hydrant as required by the OBC. The locations of the existing and proposed fire hydrants are illustrated in **Figure 2**.

## 3.0 WASTEWATER SERVICING

The community of Dundalk is serviced by the Dundalk Wastewater Treatment Facility (WWTF) which is located in the southwest area of the community. There are no municipal sanitary sewers in the vicinity of the subject site along Ida Street. However, there is a 600mm diameter sanitary sewer located within an easement that traverses the site east of the development area as indicated on **Figure 3**.

The following is a summary of the wastewater servicing analysis for the subject site.

## 3.1 Wastewater Loading

The wastewater loading has been calculated using the Township of Southgate engineering design standards which include the following parameters:

Domestic Flow: Q = 350 L/person/day

Extraneous Flow: *I* = 0.15 L/s/Ha (Infiltration)

Peaking Factor: $K_H = 1 + \frac{14}{4 + \sqrt{P}}$

Where: $K_H$ = Harmon Peaking Factor (Min 2.0, Max 4.0)
$P$ = Population in thousands

Design Flow, Q = $Q \times K_H + I$

The wastewater loading is summarized in **Table 3**. The detailed calculation for the wastewater loading is included in **Table C1** which is contained in **Appendix “”C”**.

**Table 3. Wastewater Loading Summary**

| | Area (Ha) | Population (Persons) | Average Daily Flow (L/s) | Harmon Peaking Factor | Peak Daily Flow (L/s) | Infiltration Rate (L/s) | Total Flow (L/s) |
|---|---|---|---|---|---|---|---|
| Building A | | 324 | 1.31 | 4.00 | 5.25 | | 5.25 |
| Building B | | 324 | 1.31 | 4.00 | 5.25 | | 5.25 |
| Infiltration | 2.043 | | | | | 0.31 | 0.31 |
| **Total** | **2.043** | **648** | **2.63** | | **10.50** | **0.31** | **10.81** |

With regards to capacity in the Dundalk Wastewater Treatment Facility (WWTF), based on the 2026 Reserve Capacity Calculations prepared by the Township’s consultant (Triton Engineering Services Limited, June 3, 2026), the current system has an available capacity of 262 ERUs (Equivalent Residential Units). The subject development is comprised of 240 apartment and based on 0.70 ERUs per apartment unit, a total of 168 ERUs of water allocation are required for the subject development.

As indicated in the 2026 Reserve Capacity Calculations there are several development applications within the community of Dundalk that are at various stages of approval, some of which have been inactive, which total approximately 1,900 units. Allocation is granted once a development has advanced to the point where planning and engineering approvals are sufficiently advanced. It is noted that the Township will be tendering the WWTF expansion project in late 2026. On this basis, it is expected that there will be sufficient capacity available for the subject development. A copy of the 2026 Reserve Capacity Calculations is included in **Appendix “B”**.

### 3.2 Sanitary Service Connection

Given the distance between the development site and the existing 600mm diameter sanitary sewer in the easement to northeast is approximately 286.8m, and the existing sanitary sewer in the easement is only approximately 1.4m deep, draining the wastewater from the site by gravity is not feasible. Therefore, a 150mm diameter sanitary force main is proposed from the pump station located at the southeast corner of the development site to the existing 600mm diameter sanitary sewer in the easement.

A site sanitary sewer will collect flow from each building and convey it to the proposed pump station. The configuration of the site sanitary sewer as well as the location of the pump station and forcemain is illustrated in **Figure 3**.

## 4.0 STORM DRAINAGE & STORMWATER MANAGEMENT

The subject site is located within the tributary of the Grand River Watershed. The Grand River starts in the Dufferin Highlands and flows south about 310 km to Lake Erie. The main watershed along Grand River has a drainage area of 5,263 $km^2$. The subject site is located within the regulated area of the Grand River Conservation Authority. A plan of the watershed as well as the regulation mapping is included in **Appendix "D"**.

In accordance with the municipal standards, the storm drainage and stormwater management system for the subject site is to include the following:

- Stormwater quantity control is to be provided to restrict post-development flows to pre-development rates for the 2- to 100-year storm events
- Stormwater quality control is to be provided for "Enhanced" protection (Level 1 treatment).

The following is a summary of the storm drainage and stormwater management system for the site:

### 4.1 Quantity Control

Stormwater quantity control is typically implemented to minimize the potential for downstream flooding, stream bank erosion and overflows of infrastructure. The impact of the proposed development has been analyzed as follows:

#### 4.1.1 Pre-Development Flow

The pre-development surfaces consist primarily of a vegetated field. The pre-development surface condition is illustrated in **Figure 4.**

As per the Town's request, the drainage system has been designed using Visual Otthymo based on the Environment Canada intensity duration frequency (IDF) data for the subject site included in **Appendix "D"**.

Based on the modelling results, the 2- to 100-year pre-development peak flows are summarized in the first row of **Table 4** (detailed results are provided in **Table E1**, contained in **Appendix "E"**).

**Table 4: Storm Drainage Peak Flows**

| Condition | Area (Ha) | Peak Flows (L/s) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2-Year | 5-Year | 10-Year | 25-Year | 50-Year | 100-Year |
| **Pre-Development** | 2.043 | 19 | 40 | 57 | 82 | 102 | 124 |
| **Post-Development Unmitigated** | 2.043 | 325 | 437 | 512 | 605 | 674 | 744 |
| **Post-Development Mitigated** | **2.043** | **5** | **32** | **47** | **64** | **93** | **116** |

### 4.1.2 Post-Development Flow: Uncontrolled

Based on a review of the architect's site plan, the post-development drainage areas are illustrated in **Figure 5**. An area with landscape features is proposed along the north, east and west limits of the development site. The stormwater runoff from this area will not be directed to the on-site orifices given the grading constraints.

The allowable release rates for the 2- to 100-year storm events are summarized in the third row of **Table 4**. The uncontrolled flow calculations are provided in **Table E2-B** in **Appendix "E"**.

### 4.1.3 Post-Development Flow: Unmitigated

The surfaces under the post-development condition are comprised of landscaped areas, roof area as well as driveway parking lot and walkway pavements. Based on these surfaces, the proposed development is more impervious than the existing site condition.

Based on area of the proposed surfaces, the post-development hydrological condition was calculated assuming no mitigation measures will be implemented. The unmitigated 2- to 100-year peak pre-development flow rates are summarized in the second row of **Table 4**. A comparison of the rates in the first and second rows of **Table 4** indicates that the un-mitigated post-development flows will be greater than the existing flow rates. Based on the above, mitigation measures are necessary.

### 4.1.4 Post-Development Flow: Mitigated

Given that the level of imperviousness is expected to increase, on-site detention will be required to reduce post-development peak flows to pre-development rates.

In order to achieve the stormwater management required on-site, the following quantity control measures are proposed. Based on a review of the landscape architect's site plan it was determined that underground detention be implemented in the form of a modular detention tank (GreenStorm Tank) as well as the site storm sewers. A surface detention area at the south-east end of the site is also proposed. Discharge will be controlled using a control structure with an orifice and weir downstream of the storage provided.

The stormwater quantity control was modelled using Visual Otthymo. Through an iterative assessment of various orifice sizes, underground storage configurations and high water levels, a detention system was developed.

As indicated in **Section 4.1.3** of this report, the lower area along the north, east and west limits of the site will drain uncontrolled. Adequate overcontrol is provided for the rest of the site such that the overall flow targets are not being exceeded.

Based on the modelling, the post-development mitigated peak flows are summarized in the third row of **Table 4**. A comparison of the flows in the first and third rows of **Table 4** indicates that the mitigated post-development peak flows have been reduced to less than the corresponding pre-development rates. Based on the above, and using an orifice diameter of 190 mm in combination with a 0.30 m wide by 0.10 m high weir, a total 100-year storage volume of 704.03 $m^3$ is provided. This will be provided through the underground SWM detention tank, storm sewer pipes, and the surface detention area. The SWM detention tank will be in the form of modular storage system comprised of polypropylene top, bottom and side panels and PVC columns, all of which are assembled on site to create the storage chamber. These modular units, which have a 95% void ratio, are marketed as GreenStorm Tank. The individual GreenStorm tank units have a modular size of 0.80 m long x 0.80 m wide with a height of 0.66 m.

The orifice, weir and storage calculations are provided in **Table E.5**, which are included in **Appendix "E"**. The location of the detention tank is provided in **FSP-1**.

## 4.2 Quality Control

Based on the Stormwater Management Planning & Design Manual prepared by the Ministry of the Environment (March 2003), various levels of treatment are defined with the goal to maintain or enhance existing aquatic habitat based on the total suspended solids (TSS) removal efficiency.

Based on the municipal criteria for the area, storm water quality control for the subject site is to be designed to achieve "Enhanced" protection level (Level 1 treatment) which provides 80% TSS removal. An industrial setting parking lots can generate motor vehicle

related contaminants such as spills of oil, fuel and lubricants and sediment accumulation. In order to provide stormwater quality control for the subject site, a Stormceptor EFO8 oil/grit separator (OGS) will achieve a TSS removal of 86%. The sizing report and a typical detail form the manufacture are included in **Appendix "F"**. The location of the proposed OGS is indicated in **FSP-1**.

## 4.3 Low Impact Development (LID)

The subject is located within an area designated as a Significant Groundwater Recharge Area, as such, Low-Impact Development (LID) will be required to enhance the stormwater quality control in addition to the proposed OGS.

Low Impact Development (LID) measures such as infiltration trenches, bio-retention swales, and permeable pavers are implemented as source and conveyance stormwater management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roofs, roads, parking areas, and the storm drainage system, as well as the promotion of infiltration on each development or redevelopment site.

The benefits from LID stormwater management practices are generally focused on the more frequent storm events (5 mm rainfall events) of lower volumes as opposed to the less frequent storm events (e.g. 100 year storm) with higher volumes. It is also recognized that the forms of LID which promote infiltration or filtration through a granular medium also provide thermal mitigation for storm runoff. LID measures can be implemented to varying degrees based upon the available area, the proposed land use, the development form and the soil infiltration capacity.

Based on a review of the hydrogeological assessment completed by Soil Engineers Ltd. dated September 2026, the groundwater level is high across the subject site. LID in the form of two infiltration trenches is proposed to capture an equivalent of 10 mm event of clean roof water from the north and south building. Since the water entering the infiltration trenches will be clean, a clearance of 0.5 m will be maintained from the groundwater level to the bottom of the infiltration trenches. The dimensions and locations of the infiltration trenches are provided on Drawing **FSP-1**. A total annual infiltration volume of 1,486 $m^3$ will be provided. Please refer to **Tables G.1-5** in **Appendix "G"** for detailed calculations.

## 4.4 Wetland Water Balance

A total existing wetland drainage area to 8.89 ha, consisting of mainly pasture and woodland. A runoff volume of 29,786 $m^3$ was calculated based on average monthly precipitation and temperature data obtained from Environment Canada for Port Law Ontario Station.

In the post-development condition, the same drainage area to the wetland remains. The runoff increased to 28,957 $m^3$ (112.4% of the existing runoff) due to the increase of impervious area. Please refer to **Tables G.7-10** in **Appendix "G"** for detailed calculations.

## 4.5 Storm Drainage

The main features of the storm drainage system include surface drainage, roof drainage and foundation drainage as follows:

### 4.5.1 Minor System

In accordance with the municipal standards, the development will be serviced with a minor storm sewer system that has been designed to convey runoff from the 5-year storm event. In this regard the on-site storm sewer will convey the flows to the stormwater detention system after which it will discharge to the watercourse located to the east of the development site via an outfall headwall with erosion protection. The storm drainage system is illustrated in **Figure 6**. A preliminary Storm Sewer Design Sheet is included in **Appendix "D"**.

### 4.5.2 Major System

The major system will generally be comprised of an overland flow route along the driveways and parking lots which will convey rainfall events up to and including the 100 year storm to the on-site detention system. In the event of rainfall in excess of the 100 year storm, the overland flow route will convey flow towards the watercourse located east side of the development site. The overland flow route is indicated on the **Functional Grading Plan** (Dwg FGP-1).

### 4.5.3 Roof Drainage

A storm service connection will be provided to each building in order to collect roof drainage. Roof drainage will be directed to an infiltration trench via a diversion manhole such that excess water will over flow to the site storm sewer system.

### 4.5.4 Foundation Drainage

Given that both buildings are slab-on-grade design, there is no basement and therefore no weeping tile. Based on the foregoing, there will be no groundwater discharge.

### 4.5.5 Flood Plain

A Flood Plain Analysis Report was prepared by Valdor Engineering Inc. to delineate the existing flood plain associated with the watercourse that drains in a southerly direction through the property. Based on the results of the hydrologic and hydraulic investigations completed for existing conditions, the proposed development will be located outside of the floodplain. The existing floodline is indicated on the **Functional Grading Plan** (Dwg FGP-1). Please refer to *Floodplain Analysis for Proposed Development – Ida Street* completed by Valdor Engineering Inc. dated September 2026 for more information.

### 4.6 SWM Inspection & Maintenance

The proposed stormwater management system requires regular inspection and maintenance to ensure the infrastructure function as designed. The suggested inspection and maintenance procedures are as follows:

| | |
|---|---|
| Orifices: | Inspect orifices periodically. Ensure orifice devices clear of blockage and keep the area around the head walls clear. |
| Detention Tank: | Inspect the tank regularly to ensure that there is no debris in the tank and to ensure that the access ports are unobstructed. |
| Oil/Grit Separator: | Inspect and maintain the unit in accordance with the manufacturer's recommendations. |

Maintenance should be performed immediately if an abnormality is observed such as slow drain down time for the detention area.

## 5.0 EROSION & SEDIMENT CONTROL DURING CONSTRUCTION

Construction activity, especially operations involving the handling of earthen material, dramatically increases the availability of particulate matter for erosion and transport by surface drainage. In order to mitigate the adverse environmental impacts caused by the release of silt-laden stormwater runoff into receiving watercourses, measures for erosion and sediment control (ESC) are required for construction sites.
The impact of construction on the environment is recognized by the Greater Golden Horseshoe Area Conservation Authorities. In December 2006 they released their document titled "Erosion & Sediment Control Guidelines for Urban Construction". This document provides guidance for the preparation of effective erosion and sediment control plans.

Control measures must be selected that are appropriate for the erosion potential of the site and it is important that they be implemented and modified on a staged basis to reflect the site activities. Furthermore, their effectiveness decreases with sediment loading and therefore inspection and maintenance is required. The selection, implementation, inspection and maintenance of the control features are summarized as follows:

### 5.1 Control Measures

On relatively small sites, measures for erosion and sediment control typically include the use of silt fencing and sediment traps. The following is a description of the sediment controls to be implemented on the subject site:

- **Silt Fences** are to be installed adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as at the bases of topsoil stockpiles.
- **Mud Mat** is to be installed at the construction entrance prior to commencing earthworks to minimize the tracking of mud onto municipal roads.

- **Sediment Traps** are to be installed at all catchbasin and area drain locations once the storm sewer system has been constructed to prevent silt laden runoff from entering the municipal storm sewer system.

## 5.2 Construction Sequencing

The following is the scheduling of construction activities with respect to sediment controls:

1. Install all silt fences prior to any other activities on the site.
2. Construct mud mat.
3. Strip topsoil and dispose of off site.
4. Cut / fill to the pre-grade elevations including stormwater detention area.
5. Install the site services.
6. Upon completion of the site services, the outlet for the storm detention area is to be protected with a rock check dam.
7. Construct the building and parking lot.
8. Restore / re-vegetate all disturbed areas final landscape and paving materials.
9. Once the surfaces are stabilized the stormwater detention area is to be cleaned of any silt and debris.
10. Upon stabilization of all disturbed areas, remove sediment controls.

## 5.3 ESC Inspection & Maintenance

In order to ensure that the erosion and sediment control measures operate effectively, they are to be regularly monitored and they will require periodic cleaning (e.g., removal of accumulated silt), maintenance and/or re-construction.

Inspections of all of the erosion and sediment controls on the construction site should be undertaken with the following frequency:

- On a weekly basis
- After every rainfall event
- After significant snow melt events
- Prior to forecasted rainfall events

If damaged control measures are found they should be repaired and/or replaced within 48 hours. Site inspection staff and construction managers should refer to the Erosion and Sediment Control Inspection Guide (2008) prepared by the Greater Golden Horseshoe Area Conservation Authorities. This Inspection Guide provides information related to the inspection reporting, problem response and proper installation techniques.

# 6.0 CONCLUSIONS

Based on the discussions contained herein, the proposed building additions can be adequately serviced with full municipal services (watermain, sanitary and storm) in accordance with the standards of the Township of Southgate as follows:

**Water Servicing**

- The proposed development will be serviced by one connection to the existing 200mm diameter Ida Street watermain. The water site servicing will consist of a 200mm watermain with a domestic and fire line connection to each building.
- Each building will have a water meter and backflow prevention device which will be located in the meter room.
- Fire protection will be provided by the existing municipal fire hydrant along Ida Street and supplemented by three private site fire hydrants.
- The total water requirement including fire flow and the max hour demand for the proposed development is 19,506 L/min.

**Wastewater Servicing**

- The subject site Given there is no sanitary sewer along Ida Street in the vicinity of the subject site, the wastewater from the proposed building will discharge to the existing 600mm diameter sanitary sewer in the easement across the subject property to the east of the development limit via a 150mm diameter force main with a sanitary pump station located at the southeast corner of the development limit.
- The total wastewater flow from the subject development was calculated to be 10.81 L/s.

**Storm Drainage**

- The subject site will be serviced by a minor storm sewer system that will discharge the controlled stormwater runoff to the watercourse located to the east of the development site via an outfall headwall with erosion protection.
- An overland flow route will be provided within the subject site to direct runoff, in excess of the 100 year storm event. In this regard, the proposed site grades have been designed to ensure that flows in excess of the 100 year storm will be directed towards the watercourse on the east side of the development site.
- Given that both buildings are slab-on-grade design, there is no basement and therefore no weeping tile. Based on the foregoing, there will be no groundwater discharge.
- A Flood Plain Analysis Report was prepared by Valdor Engineering Inc. to delineate the existing flood plain associated with the watercourse that drains in a southerly direction through the property. The proposed development will be located outside of the floodplain.

**Stormwater Management**

- The subject site will have a combination of surface stormwater detention system, storage volume within the pipes, and underground storage tanks to control the post-development peak flows to pre-development rates. With an orifice diameter of 190 mm in combination with a 0.30 m wide by 0.10 m high weir, a total 100-year storage required volume of 645 $m^3$ will be achieved with a provided volume of 704 $m^3$.

- "Enhanced" Level 1 treatment of stormwater achieving at least 80% TSS removal rate will be achieved by the OGS.
- A wetland water balance assessment was completed in order to demonstrate that the proposed drainage to the wetland will maintain same annual runoff as the existing wetlands.
- LID in the form of two infiltration trenches is proposed to capture an equivalent of 10 mm event of clean roof water from the north and south building. A total annual infiltration volume of 1,486 $m^3$ will be provided.

**Erosion & Sediment Controls**

- Erosion and sediment control measures are to be implemented during construction to prevent silt laden runoff downstream in accordance with the Erosion & Sediment Control Guidelines for Urban Construction (December 2006).

# 7.0 REFERENCES & BIBLIOGRAPHY


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- Ministry of Environment, **Stormwater Management Planning & Design Manual**, March 2003.
- TRCA & CVC, **Low Impact Development Stormwater Management Planning & Design Guide**, Version 1.0, 2010
- Greater Golden Horseshoe Area Conservation Authorities, **Erosion & Sediment Control Guidelines for Urban Construction**, December 2006.
- Hydrogeological Assessment, **Soil Engineers Ltd.**, September 18, 2026.
- Floodplain Analysis Report, **Valdor Engineering Inc.**, September 2026.


Respectfully submitted,

**VALDOR ENGINEERING INC.**




**David Giugovaz**, P.Eng.
Senior Project Manager

905-264-0054 x 224
dgiugovaz@valdor-engineering.com

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LEGEND

DEVELOPMENT SITE

SUBJECT SITE

# PROPOSED CONDOMINIUM APARTMENTS

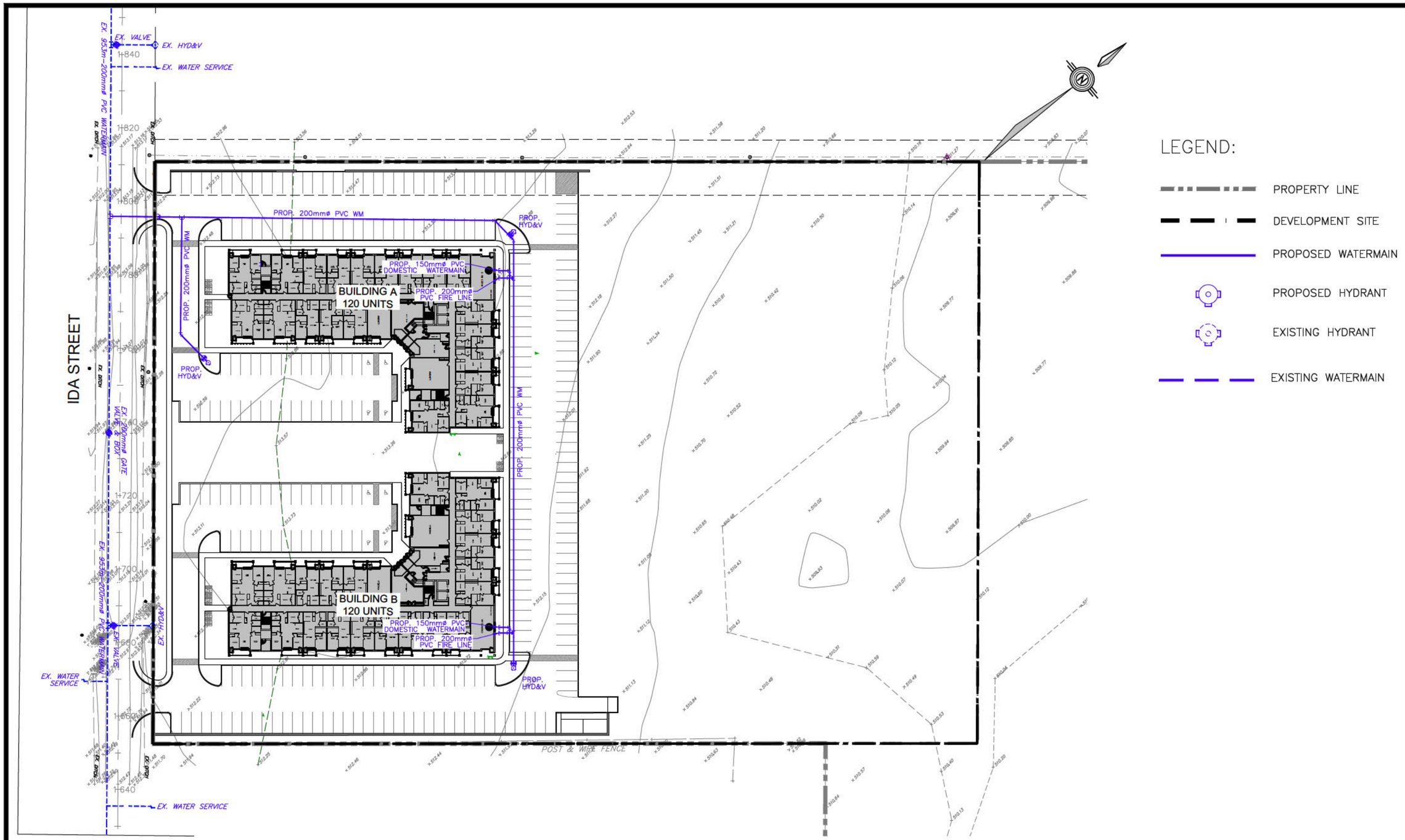
IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE

## PROPOSED SITE LOCATION

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
571 Chrislea Road, Unit 4, 2nd Floor, Woodbridge, Ontario, L4L 8A2
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| | | | | | |
|---|---|---|---|---|---|
| SCALE | N.T.S. | CKD. BY | D.G | DWG. | FIGURE 1 |
| DATE | SEPTEMBER 2026 | DRAWN BY | D.Z. | PROJECT | 23142 |

S:\Projects\2023\23142\Drawings\Working\Figures_23142.dwg, FIG-1_Site Loc., 2026-09-24 3:55:48 PM, amdekerracher, DWG To PDF.pc3, ANSI full bleed A (8.50 x 11.00 Inches), 1:25.4




# PROPOSED CONDOMINIUM APARTMENTS

IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE

## WATERMAIN SERVICING

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
571 Chrislea Road, Unit 4, 2nd Floor, Woodbridge, Ontario, L4L 8A2
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| | | | | | |
|---|---|---|---|---|---|
| DATE: | SEPTEMBER 2026 | DRAWN BY: | R.P. | PROJECT: | 23142 |
| SCALE: | N.T.S. | CKD. BT: | D.G. | DWG.: | FIGURE 2 |

S:\Projects\2023\23142\Drawings\Working\Figures_23142.dwg, FIG-2_WM, 2026-09-24 4:12:01 PM, amckeracher, DWG To PDF.pc3, ANSI full bleed B (11.00 x 17.00 Inches), 1:25.4

LEGEND:

- PROPERTY LINE
- DEVELOPMENT SITE
- PROPOSED SANITARY
- MANHOLE
- EXISTING SANITARY

IDA STREET

BUILDING A
120 UNITS

BUILDING B
120 UNITS

PROP. 5.8m-200mmØ PVC SAN @1.0%

PROP. INV. 511.28
(FOR BUILDING A)

SAN.MH3A
TOP: 513.66
SW INV. 511.22
SE INV. 511.14

PROP. 83.5m - 200mmØ PVC SAN @ 1.0%

SAN.MH2A
TOP: 513.14
SW INV. 510.30
NW INV. 510.25
E INV. 510.22

PROP. 18.7m-200mmØ PVC SAN @1.0%

PROP. 13.1m-200mmØ PVC SAN @1.0%

SANITARY PUMP STATION
TOP: 512.20
NW INV. 509.82

PROP. INV. 510.36
(FOR BUILDING B)

PROP. 5.8m-200mmØ PVC SAN @1.0%

SAN.MH1A
TOP: 513.02
NW INV. 510.03
NE INV. 509.95

PROP. 389.7m - 150mmØ SANITARY FORCEMAIN

EX.SAN.MH.9
NW.508.91
SE.508.89

Ex.92.66m - 600mmØ CONC. SAN. @ 0.22%

EX.SAN.MH.8
NW.508.65
SE.508.67

EX. SANITARY EASEMENT

EX. SANITARY EASEMENT

Ex.102.72m - 600mmØ CONC. SAN. @ 0.22%

EX.SAN.MH.7
NW.508.49
SE.508.46

PROP. INV. 508.90

Ex.104.55m - 600mmØ CONC. SAN. @ 0.22%

EX.SAN.MH.6
NW.508.32
SE.508.29

DENSE WOODED AREA

# PROPOSED CONDOMINIUM APARTMENTS

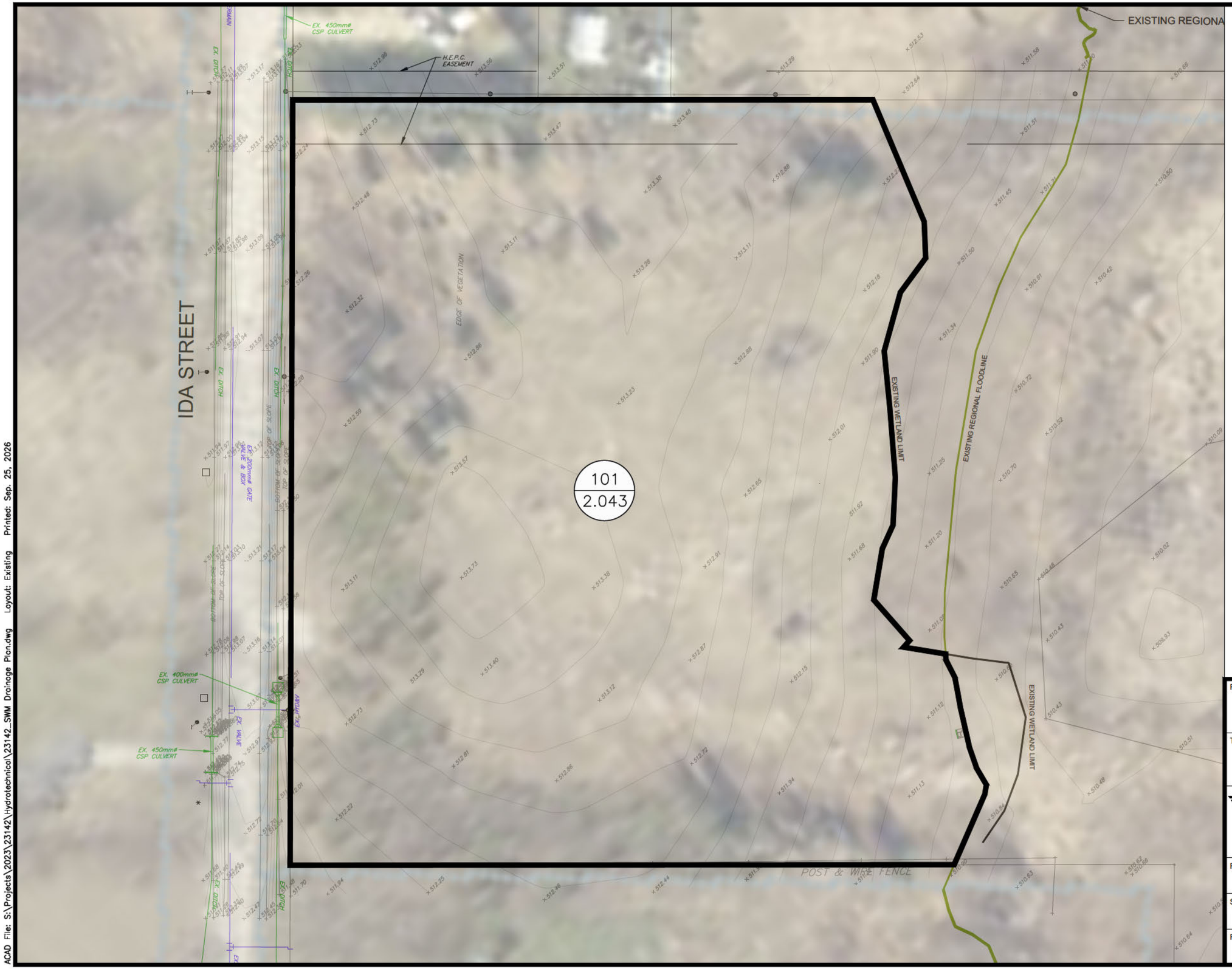
IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE

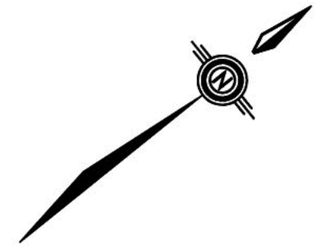
## SANITARY SERVICING

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
571 Chrislea Road, Unit 4, 2nd Floor, Woodbridge, Ontario, L4L 8A2
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| | | | | | |
|---|---|---|---|---|---|
| DATE: | SEPTEMBER 2026 | DRAWN BY: | R.P. | PROJECT: | 23142 |
| SCALE: | N.T.S. | CKD. BT: | D.G. | DWG.: | FIGURE 3 |

S:\Projects\2023\23142\Drawings\Working\Figures_23142.dwg, FIG-3_SAN, 2026-09-25 9:41:23 AM, amdkeradher, DWG To PDF.pc3, ANSI full bleed B (11.00 x 17.00 Inches), 1:25.4



## LEGEND

101 — CATCHMENT ID
10.00 — AREA (HA)

DRAINAGE BOUNDARY

OVERLAND FLOW

PROJECT
**PROPOSED CONDOMINIUM APARTMENTS**
**IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE**

TITLE
# SWM DRAINAGE PLAN PRE-DEVELOPMENT

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
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E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| PREPARED BY | CHECKED BY |
|---|---|
| P.Y. | D.G. |
| SCALE | DATE |
| 1:750 | SEP. 2026 |
| PROJECT | |
| 23142 | **FIGURE 4** |

ACAD File: S:\Projects\2023\23142\Hydrotechnical\23142_SWM Drainage Plan.dwg Layout: Existing Printed: Sep. 25, 2026
S:\Projects\2023\23142\Hydrotechnical\23142_SWM Drainage Plan.dwg, Existing, 2026-09-25 10:53:39 AM, amckeracher, DWG To PDF.pc3, ANSI full bleed B (17.00 x 11.00 Inches), 1:25.4

IDA STREET

EX. 450mmø CSP CULVERT

H.E.P.C. EASEMENT

PROPOSED PARKING LOT

BUILDING A
120 UNITS
FFE: 514.15

LANDSCAPE

PROPOSED PARKING LOT

CONTROLLED AREA
201
1.714

PROPOSED PARKING LOT

BUILDING B
120 UNITS
FFE: 513.85

PROPOSED PARKING LOT

LOADING BAY STAGING AREA

GARBAGE ROOM

EXISTING WETLAND LIMIT

UNCONTROLLED AREA
202
0.329

EXISTING WETLAND LIMIT

POST & WIRE FENCE

EX. 400mmø CSP CULVERT

EX. 450mmø CSP CULVERT

## LEGEND

101 — CATCHMENT ID
10.00 — AREA (HA)

DRAINAGE BOUNDARY

OVERLAND FLOW

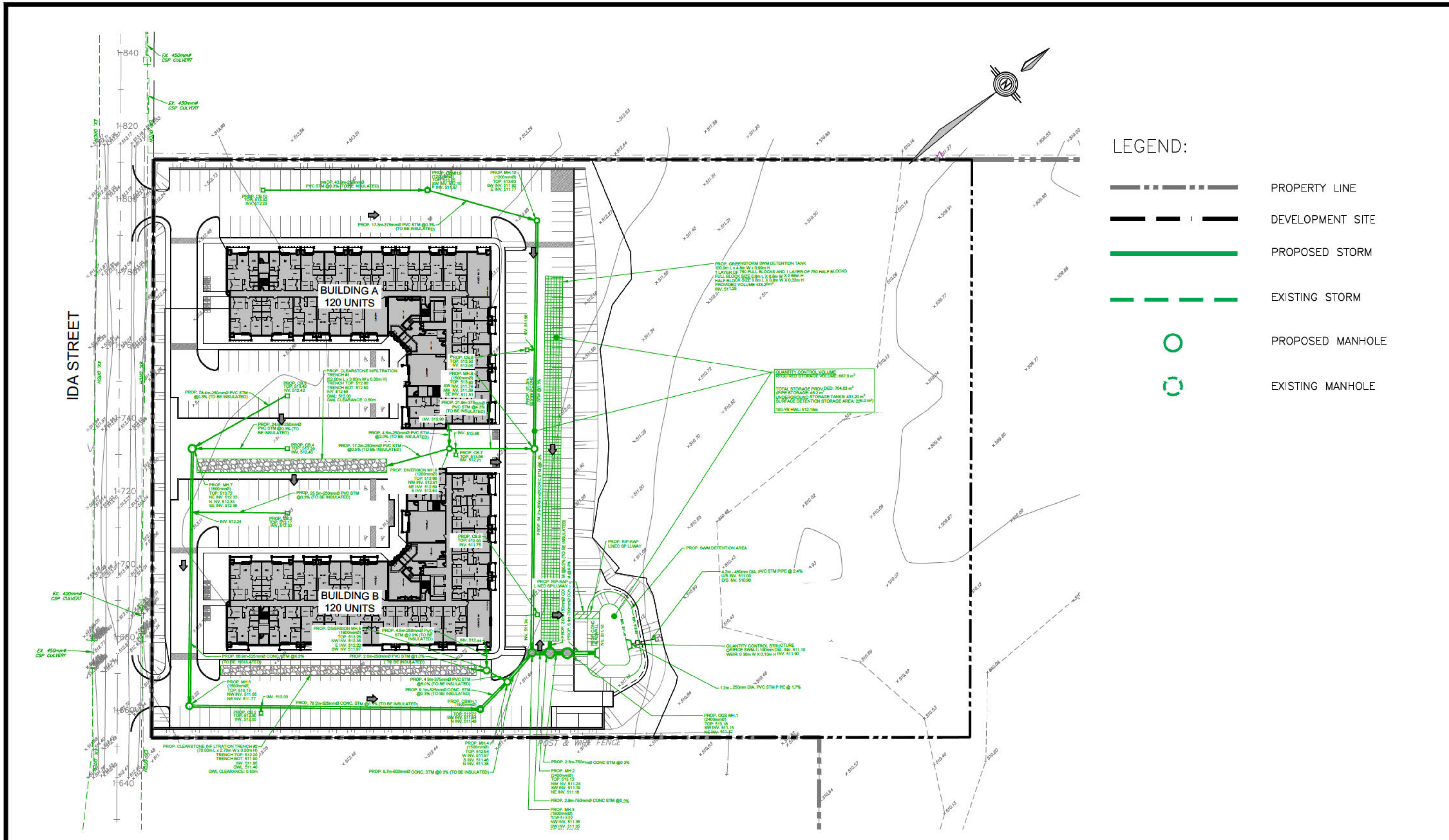
PROJECT
**PROPOSED CONDOMINIUM APARTMENTS**
**IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE**

TITLE
# SWM DRAINAGE PLAN POST-DEVELOPMENT

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
571 Chrislea Road, Unit 4, 2nd Floor Vaughan, Ontario, L4L 8A2
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| PREPARED BY | CHECKED BY |
|---|---|
| P.Y. | D.G. |
| SCALE | DATE |
| 1:750 | SEP. 2026 |
| PROJECT | |
| 23142 | **FIGURE 5** |

ACAD File: S:\Projects\2023\23142\Hydrotechnical\23142_SWM Drainage Plan.dwg, Proposed, 2026-09-25 10:53:04 AM, amckeracher, DWG To PDF.pc3, ANSI full bleed B (17.00 x 11.00 Inches), 1:25.4
Printed: Sep. 25, 2026 Layout: Proposed S:\Projects\2023\23142\Hydrotechnical\23142_SWM Drainage Plan.dwg




# PROPOSED CONDOMINIUM APARTMENTS

IDA STREET, DUNDALK, TOWNSHIP OF SOUTHGATE

## STORM SERVICING

VALDOR ENGINEERING INC.
Consulting Engineers - Project Managers
571 Chrislea Road, Unit 4, 2nd Floor, Woodbridge, Ontario, L4L 8A2
TEL (905)264-0054, FAX (905)264-0069
E-MAIL: info@valdor-engineering.com
www.valdor-engineering.com

| | | | | | |
|---|---|---|---|---|---|
| DATE: | SEPTEMBER 2026 | DRAWN BY: | R.P. | PROJECT: | 23142 |
| SCALE: | N.T.S. | CKD. BT: | D.G. | DWG.: | FIGURE 6 |

S:\Projects\2023\23142\Drawings\Working\Figures_23142.dwg, FIG-6_STM, 2026-09-25 9:41:53 AM, amckeracher, DWG To PDF.pc3, ANSI full bleed B (11.00 x 17.00 Inches), 1:25.4

# APPENDIX "A"

Architectural Site Plan & Equivalent Population Calculation

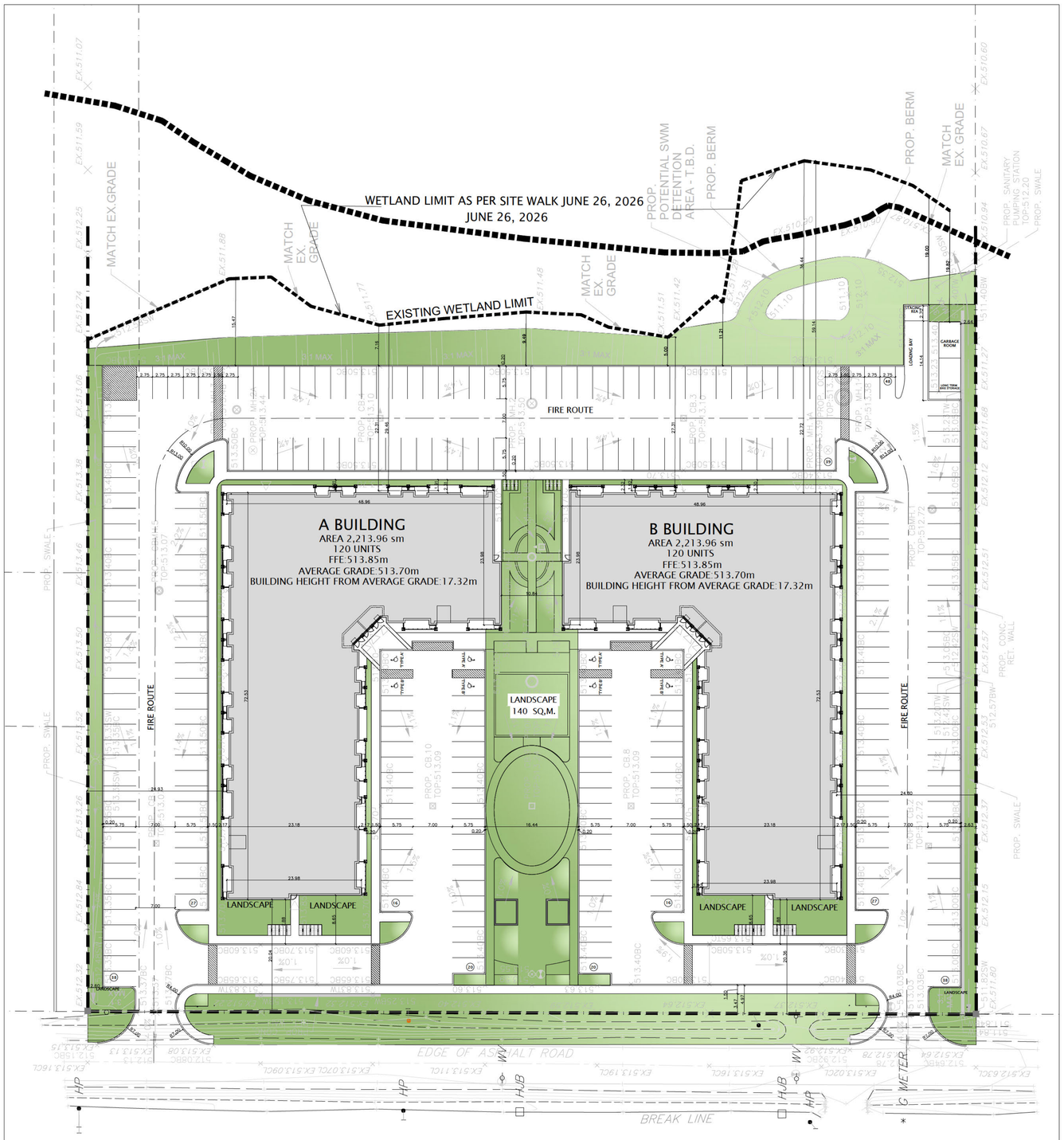
**VALDOR ENGINEERING INC.**
571 Chrislea Road, Unit 4, 2nd floor, Woodbridge, ON L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

**TABLE: A1**

# EQUIVALENT POPULATION

Project Name: **Ida Street, Dundalk, Township of Southgate**
File: 23142
Date: September 2026

| Condo Apartments | Criteria | Residential Units | Equivalent Population |
|---|---|---|---|
| Building 'A' | 2.7 persons per unit | 120 | 324 |
| Building 'B' | 2.7 persons per unit | 120 | 324 |
| **Total:** | | **240** | **648** |




PROPOSED DEVELOPMENT DATA

OBC: 3.2.2.45 group C, up to 5 storeys, Sprinklered

Building A– 5 Storey Apartment Building,
Building A– 120 units
Building Height from Average Grade 17.32m

Building B– 5 Storey Apartment Building
Building B– 120 units
Building Height from Average Grade 17.32m

| SITE AREA | |
|---|---|
| NORTH SITE AREA | 206,085.79 m2 |
| RAIL EASEMENT SITE AREA | 5,291.57 m2 |
| SOUTH SITE AREA | 64,472.77 m2 |
| GRAND TOTAL SITE AREA | 275,856.9 m2<br>2,969,299 sq.ft. |
| DENSITY | 8.70 units per hectare |
| ZONING | R4 |

| LOT COVERAGE AND SETBACKS FOR THE WHOLE DEVELOPMENT | |
|---|---|
| LOT COVERAGE (BUILDING AREA) | 4,427.92 sm |
| LOT COVERAGE (GARBAGE ROOM) | 48.82 sm |
| PAVED SURFACE(ROAD) | 8,811.16 sm |
| PROPOSED LANDSCAPE AREA (NEW)<br>PROPOSED DEVELOPMENT AREA<br>(PLANTING, LAWN, WALKWAYS ETC.) | 6,343.29 sm |

| | |
|---|---|
| FRONT YARD SET BACK(SOUTH SIDE) | 20.36m |
| SIDE YARD SET BACK (EAST SIDE) | 24.80m |
| SIDE YARD SET BACK (WEST SIDE) | 24.93m |
| REAR YARD SET BACK (NORTH SIDE) | 130.90m |

WETLAND LIMIT AS PER SITE WALK JUNE 26, 2026
REAR YARD SET BACK 27.31m

GROSS FLOOR AREA

| | |
|---|---|
| A– Apartment Building | 11,041.28sm (118,847.3sf) |
| B– Apartment Building | 11,041.28sm (118,847.3sf) |
| TOTAL G.F.A | 22,082.56sm (237,694.7sf) |

BUILDING AREAS

| BUILDING –A– | |
|---|---|
| MAIN FLOOR AREA | 2,213.96 m2 |
| 2ND FLOOR AREA | 2,206.83 m2 |
| 3RD FLOOR AREA | 2,206.83 m2 |
| 4TH FLOOR AREA | 2,206.83 m2 |
| 5TH FLOOR AREA | 2,206.83 m2 |
| GFA–TOTAL AREA PER BUILDING | 11,041.28 m2 |

| BUILDING –B– | |
|---|---|
| MAIN FLOOR AREA | 2,213.96 m2 |
| 2ND FLOOR AREA | 2,206.83 m2 |
| 3RD FLOOR AREA | 2,206.83 m2 |
| 4TH FLOOR AREA | 2,206.83 m2 |
| 5TH FLOOR AREA | 2,206.83 m2 |
| GFA–TOTAL AREA PER BUILDING | 11,041.28 m2 |

GFA–GRAND TOTAL AREA 22,082.56sm (237,694.7sf)

AMENITY AREA
with–in the buildings

| | |
|---|---|
| A– Apartment Building | 273.55sm (2,944.46sf) |
| B– Apartment Building | 273.55sm (2,944.46sf) |
| | 547.10sm (5,888.93sf) |

outside of the buildings( balconies and patios)

| | |
|---|---|
| A– Apartment Building | 750.54 sm (8,127.18sf) |
| B– Apartment Building | 750.54 sm (8,127.18sf) |
| | 1,510.08 sm (16,254.37sf) |
| OUT DOOR PARK | 140.00sm (1,506.95.46sf) |

UNIT COUNT

| | |
|---|---|
| A– Apartment Building | 120 UNITS |
| B– Apartment Building | 120 UNITS |
| Total | 240 UNITS |

RENTAL UNITS

| BUILDING A | | BUILDING B | | | |
|---|---|---|---|---|---|
| 2 BED | 86 | 2 BED | 86 | TOTAL | 172 |
| 3 BED | 34 | 3 BED | 34 | TOTAL | 68 |
| TOTAL | 120 | TOTAL | 120 | TOTAL | 240 |

GRAND TOTAL UNITS 240

UNIT AREAS

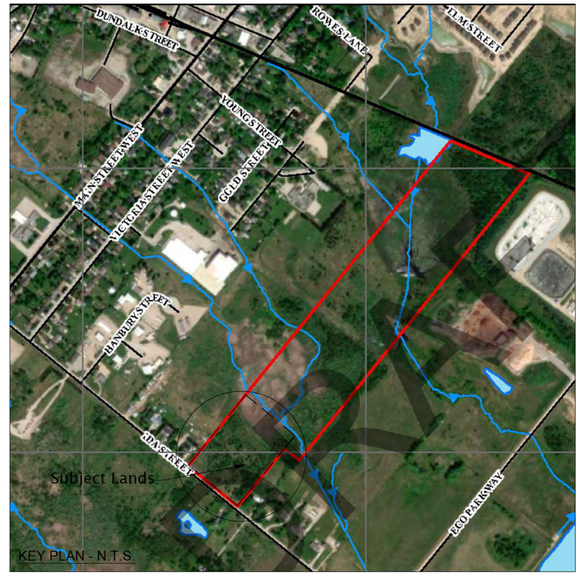
| | | | |
|---|---|---|---|
| A | 3–bed | 87.13sm | 937.86sf |
| B | 2–bed | 65.61sm | 706.22sf |
| C | 2–bed | 78.69sm | 846.69sf |

REQUIRED SURFACE PARKING

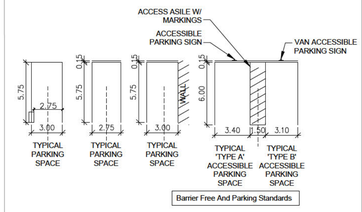
| | |
|---|---|
| PARKING STALLS 1.0 PER APARTMENT UNIT | 240 |
| PARKING STALLS VISITOR 0.2 PER TOTAL UNITS (240) | 48 |
| SURFACE PARKING SPACES REQUIRED | 288 |
| SURFACE PARKING SPACES PROVIDED | 289 |

TOWNSHIP OF SOUTHGATE
ZONING BY–LAW
5.10 Parking Spaces for Handicapped
is in excess of 20 parking spaces, 1 space of the first 20 spaces required and
1 space out of each additional 100 spaces or portion thereof shall be provided near and accessible to the point of entrance to the building and clearly marked for the parking of the vehicles used by the disabled person or persons.

| | |
|---|---|
| PARKING STALLS REQUIRED | 6 |
| PARKING STALLS PROVIDED | 8 |




NOTE:
ALL LANDSCAP NG IMAGES ARE FOR REFERENCE ONLY, SEE LANDSCAPE ARCHITECTS DWGS.
ALL SITE GRADES PROPOSED ON THIS AND FOLLOWINGS DWGS ARE SUBJECT TO CIVIL DWGS



Barrier Free And Parking Standards

| No. | Description | Date | Rev. |
|---|---|---|---|
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT. 29, 2026 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG. 21, 2026 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW (sidewalk connection) | Dec 09, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | OCT 22, 2024 | |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Sept 30, 2024 | |

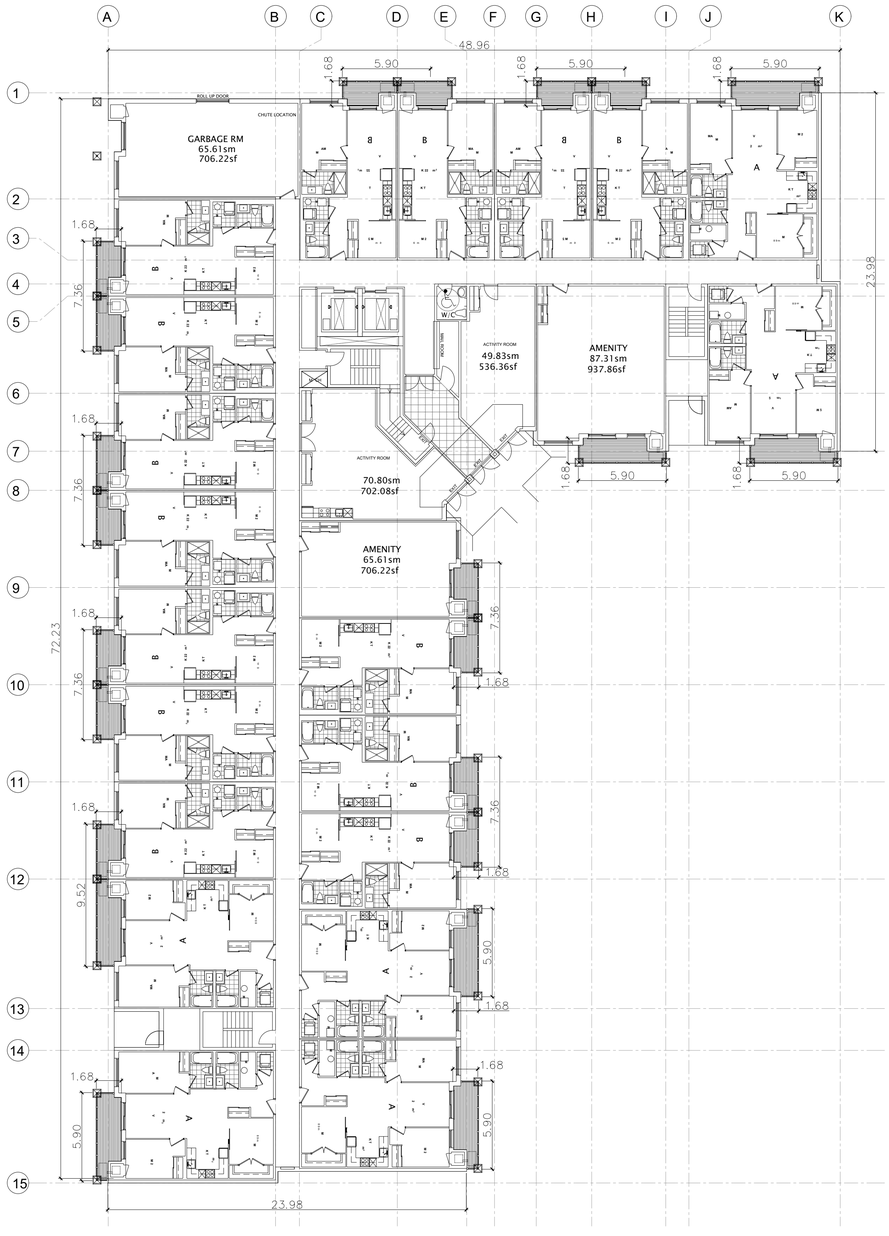
CLIENT:

DUNDALK CONCEPT — ELEVATION: — Drawing No. A-101

FLOOD PLAIN SITE PLAN — DATE ISSUED: JUNE 27,2024

PROJECT #: 2024-25 — MARKETING NAME: - — SCALE: 1:400 — MUNICIPALITY:

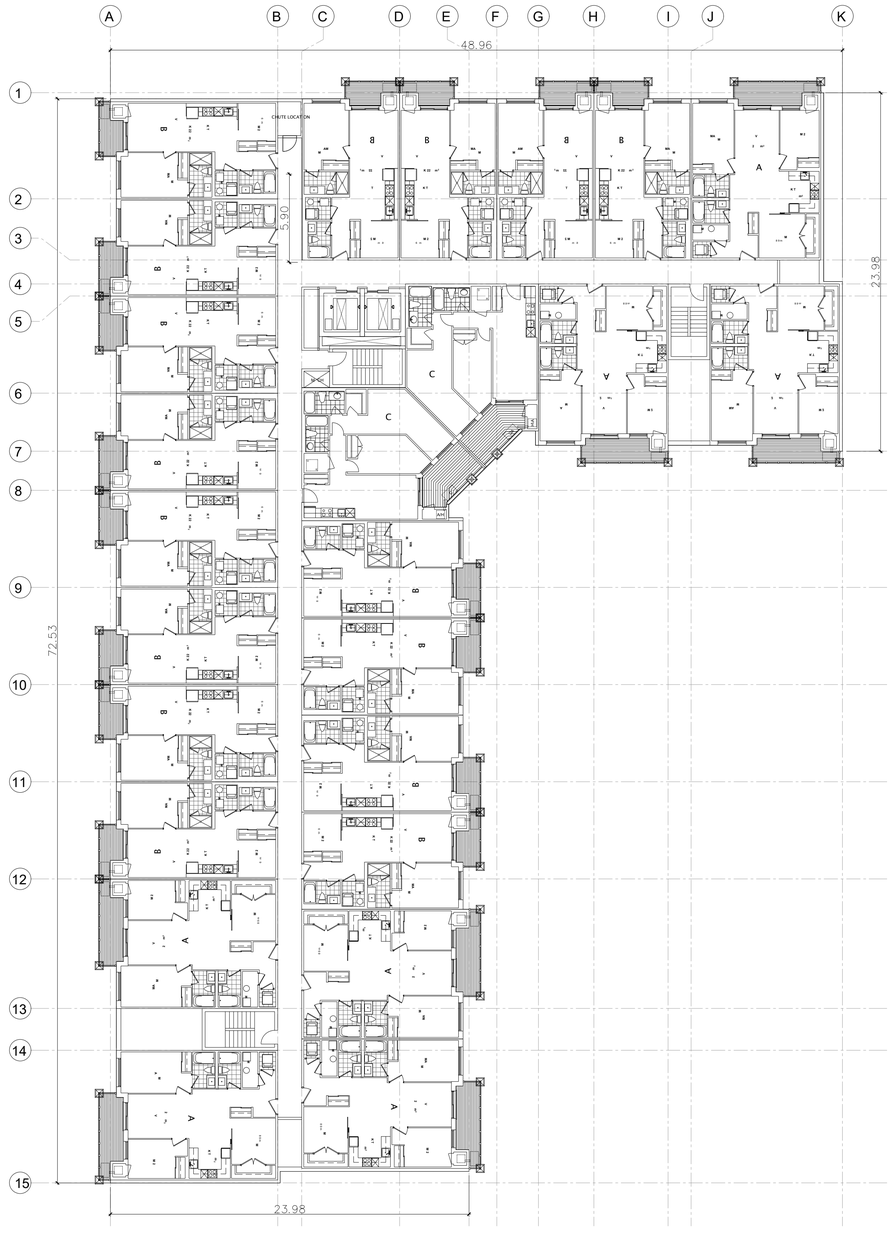
S&C ARCHITECTS INC.
T:(416)848–0991 F:(416)860–6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE SUITE 10
AJAX, ONTARIO L1S 6L3




# GRND FLOOR PLAN

AREA 2,213.96 sm

| | |
|---|---|
| 2 BED | 14 |
| 3 BED | 6 |
| TOTAL | 20 |




# TYPICAL
# 2ND - 5TH FLOOR PLAN

AREA 2,206.83 sm

| | |
|---|---|
| 2 BED | 18 |
| 3 BED | 7 |
| TOTAL | 25 |

| No. | Description | Date | Rev. |
|---|---|---|---|
| 9 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT 29, 2026 | |
| 8 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG 21, 2026 | |
| 7 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Dec 20, 2024 | |
| 6 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Oct 22, 2024 | |
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Aug 08, 2024 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 16, 2024 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 11, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 27, 2024 | SA |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 12, 2024 | SA |

CLIENT

DUNDALK CONCEPT

ELEVATION:

Drawing No. A-102

APPLICABLE TO BOTH BUILD NGS
MAIN-5TH FLOOR PLANS

DATE ISSUED: JUNE 27,2024

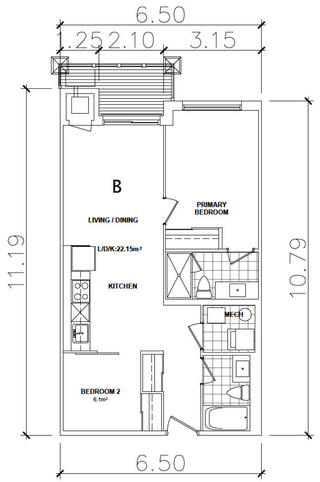
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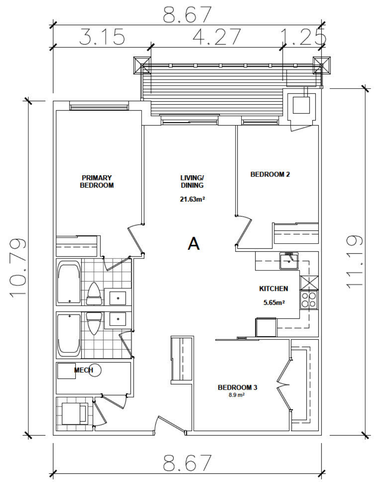
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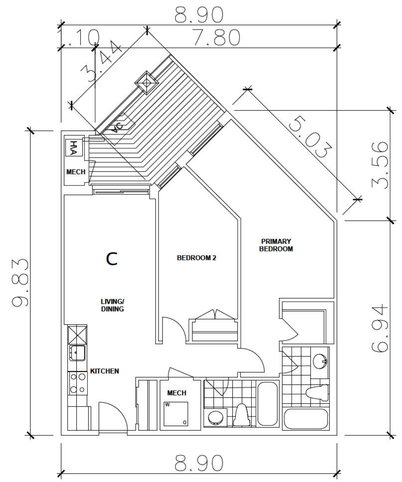
S&C ARCHITECTS INC.
T: (416)848-0991 F: (416)860-6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE, SUITE 10
AJAX, ONTARIO L1S 6L3




B
2-bed
65.61sm
706.22sf




A
3-bed
87.13sm
937.86sf




C
2-bed
78.66sm
846.69sf

# UNIT FLOOR PLANS

| No. | Description | Date | Rev. |
|---|---|---|---|
| 9 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT. 29, 2025 | |
| 8 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG. 21, 2025 | |
| 7 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Dec. 20, 2024 | |
| 6 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Oct. 22, 2024 | |
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Aug. 08, 2024 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 16, 2024 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 11, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 27, 2024 | SA |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 02, 2024 | SA |

CLIENT:

DUNDALK CONCEPT

ELEVATION:

Drawing No.
A-103

UNIT
FLOOR PLANS

DATE ISSUED
JUNE 27,2024

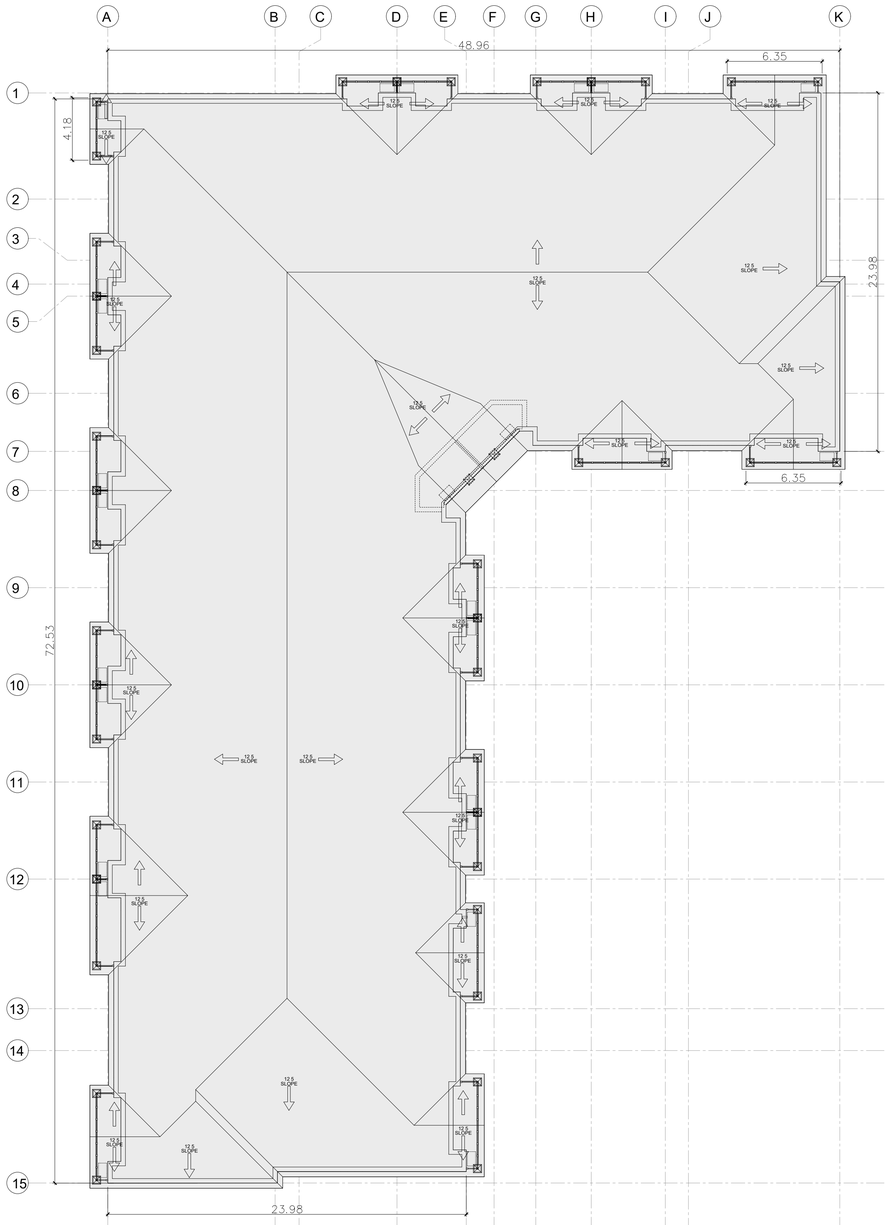
PROJECT #:
2024-25

MARKET RE MARK
-

SCALE:
1:100

MUN CAPACITY:

S&C ARCHITECTS INC.
T: (416)848-0991 F: (416)860-6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE, SUITE 10
AJAX, ONTARIO L1S 6L3




SCALE: 1:200

| No. | Description | Date | Rev. |
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| 8 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT 29, 2026 | |
| 7 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG 21, 2026 | |
| 6 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Oct 22, 2024 | |
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Aug 08, 2024 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 16, 2024 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 11, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 27, 2024 | SA |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 12, 2024 | SA |

CLIENT:

DUNDALK CONCEPT

ELEVATION:

Drawing No. A-104

APPLICABLE TO BOTH BU LDINGS
ROOF PLANS

DATE ISSUED: JUNE 27,2024

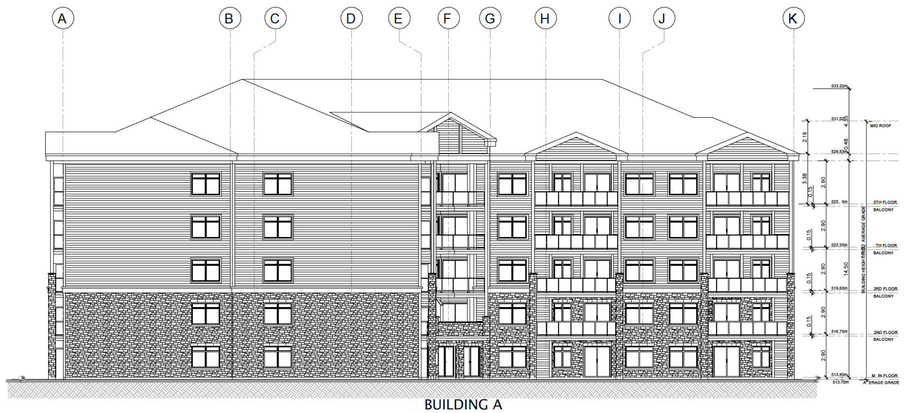
PROJECT #: 2024-25

MARKET RD NAME: -

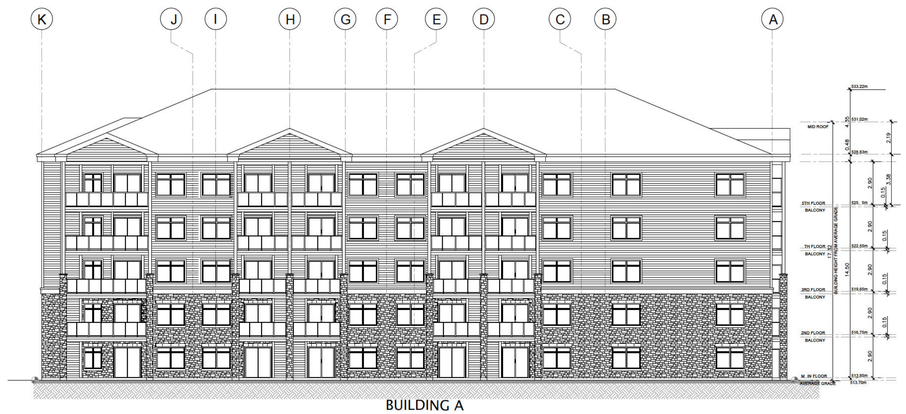
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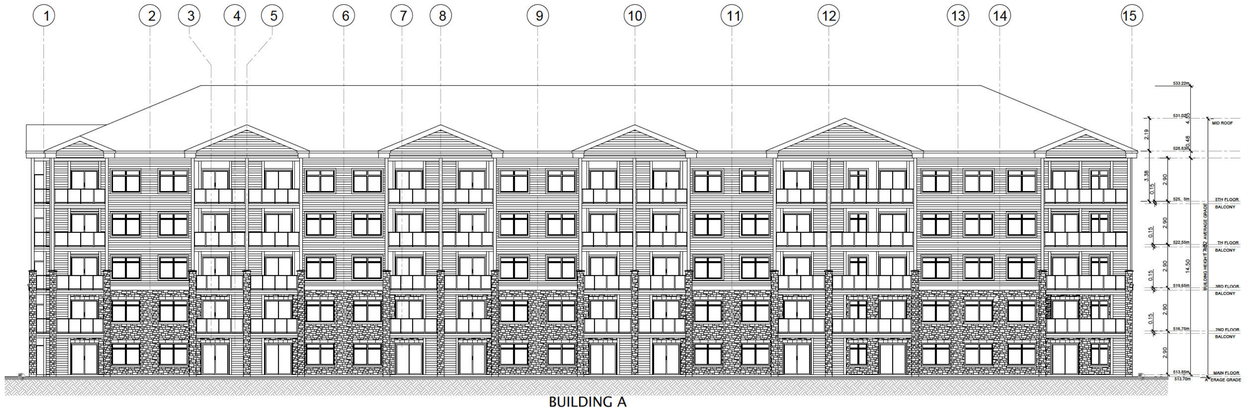
S&C ARCHITECTS INC.
T: (416)848-0991 F: (416)860-6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE, SUITE 10
AJAX, ONTARIO L1S 6L3



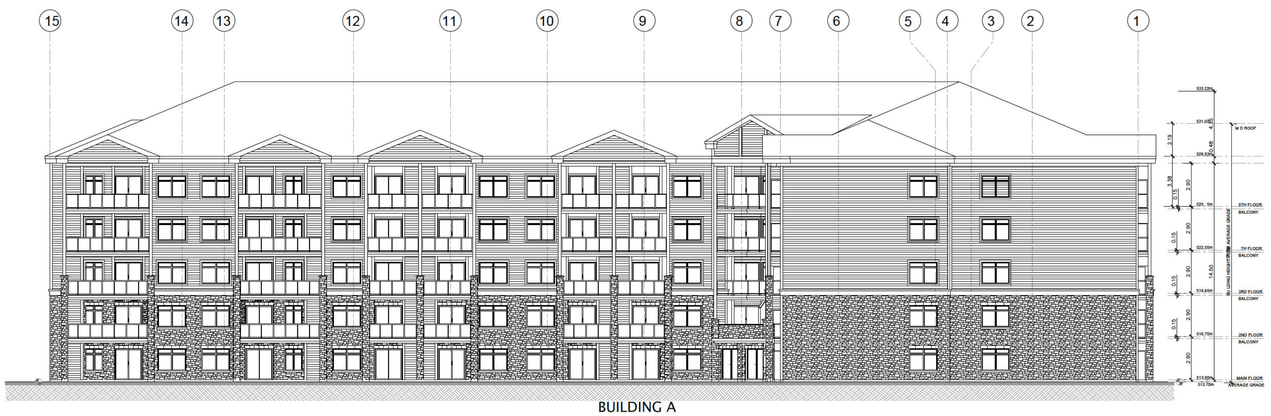

BUILDING A
SOUTH ELEVATION




BUILDING A
NORTH ELEVATION




BUILDING A
WEST ELEVATION




BUILDING A
EAST ELEVATION

NOTE:
SEE SPEC FOR EACH BUILDINGS ASSIGNED
COLOURS AND STONE WORK.
LOCATIONS OF MATERIALS WILL REMAIN CONSTANT WITH EACH BUILDING.
ALL GLAZING TO BE CLEAR AT RAILINGS.

ALL GRADES ARE TO CONFORM TO CIVIL ENG DWGS.

SEE COLOUR ELEVATIONS
A-110a

| No. | Description | Date | Rev. |
|---|---|---|---|
| 8 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT. 29, 2025 | |
| 7 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG. 21, 2025 | |
| 6 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Oct 22, 2024 | |
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Aug 08, 2024 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 16, 2024 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 11, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 27, 2024 | SA |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 07, 2024 | SA |

CLIENT:

DUNDALK CONCEPT

ELEVATION: Drawing No. A-105

BUILDING "A" ELEVATIONS

DATE ISSUED: JUNE 27,2024

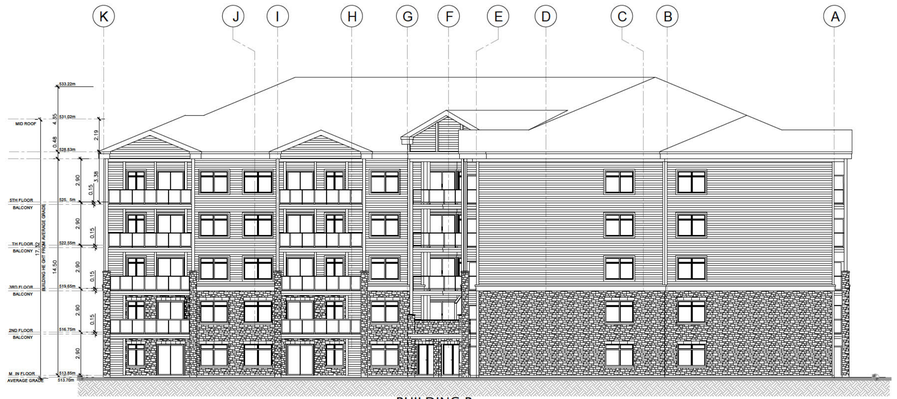
PROJECT #: 2024-25

MARKETING NAME: -

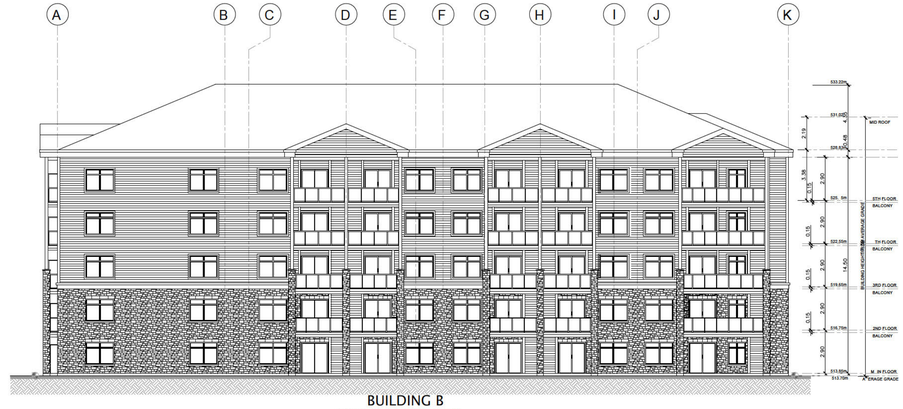
SCALE: 1:150

MUNICIPALITY:

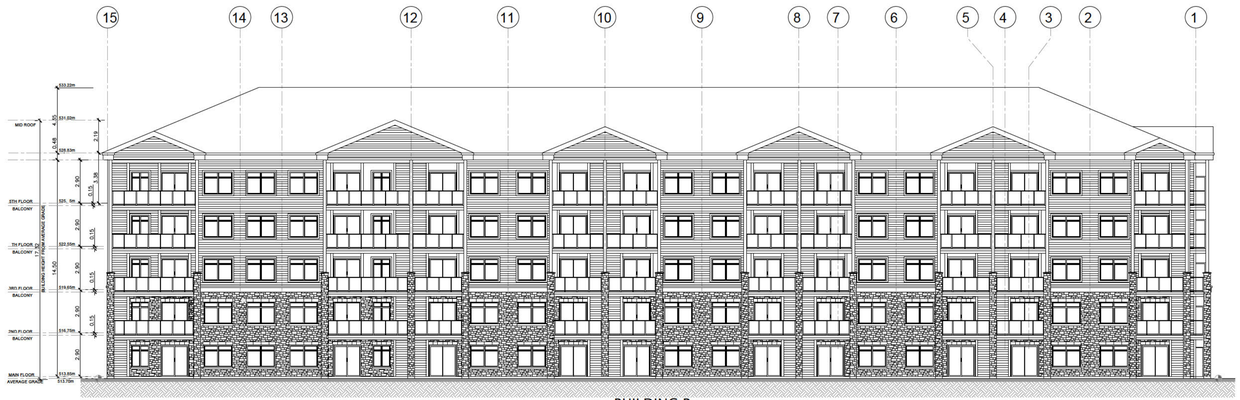
S&C ARCHITECTS INC.
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BUILDING B
SOUTH ELEVATION




BUILDING B
NORTH ELEVATION




BUILDING B
EAST ELEVATION




BUILDING B
WEST ELEVATION

NOTE:
SEE SPEC FOR EACH BUILDINGS ASSIGNED
COLOURS AND STONE WORK.
LOCATIONS OF MATERIALS WILL REMAIN CONSTANT WITH EACH BUILDING.
ALL GLAZING TO BE CLEAR AT RAILINGS.

ALL GRADES ARE TO CONFORM TO CIVIL ENG DWGS.

SEE COLOUR ELEVATIONS
A-110a

| No. | Description | Date | Rev. |
|---|---|---|---|
| 8 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | SEPT. 29, 2025 | |
| 7 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | AUG. 21, 2025 | |
| 6 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Oct. 22, 2024 | |
| 5 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | Aug. 08, 2024 | |
| 4 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 16, 2024 | |
| 3 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | July 11, 2024 | |
| 2 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 27, 2024 | SA |
| 1 | ISSUED FOR CLIENT AND CONSULTANT REVIEW | June 12, 2024 | SA |

CLIENT:

DUNDALK CONCEPT

BU LDING "B" ELEVATIONS

ELEVATION: Drawing No. A-106

DATE ISSUED: JUNE 27,2024

PROJECT #: 2024-25

MARKETING NAME: -

SCALE: 1:150

MUNICIPALITY:

S&C ARCHITECTS INC.
T: (416)848-0991 F: (416)860-6101
INFO@SCARCHITECTS.CA
60 RANDALL DRIVE SUITE 10
AJAX, ONTARIO L1S 6L3

# APPENDIX “B”

Water Servicing

**VALDOR ENGINEERING INC.**
571 Chrislea Road, Unit 4, 2nd floor, Woodbridge, ON L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

**TABLE: B1**

# WATER DEMAND CALCULATION

Project Name: **Ida Street, Dundalk, Township of Southgate**

File: 23142

Date: September 2026

Demand Critera:

| | Base Demand | | Peaking Factors | |
|---|---|---|---|---|
| Domestic Flows | 450 | L/capita/day | Max Day | 2.5 |
| | | | Peak Hour | 3.75 |
| | | | Min Hour | 0.45 |

| | Equivalent Population | Average Day (L/day) | Average Day (L/min) | Max Day (L/min) | Peak Hour (L/min) | Min Hour (L/min) |
|---|---|---|---|---|---|---|
| Building 'A' | 324.0 | 145,800.0 | 101.3 | 253.1 | 379.7 | 45.6 |
| Building 'B' | 324.0 | 145,800.0 | 101.3 | 253.1 | 379.7 | 45.6 |
| **Total** | **648** | **291,600.0** | **202.5** | **506.3** | **759.4** | **91.1** |

**VALDOR ENGINEERING INC.**
571 Chrislea Road, Unit 4, 2nd floor, Woodbridge, ON L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

**Table B2-1**

# REQUIRED FIRE FLOW CALCULATION

In accordance to Water Supply for Public Fire Protection, Fire Underwriters Survey 2020

Project Name: **Ida Street, Dundalk, Township of Southgate**
File: 23142
Date: Septmber 2026

Notes: Building 'A' - 5 Storeys

**Type of Construction -** Wood Frame Construction

$C =$ 1.5

For a building classified with a Construction Coefficient from 1.0 to 1.5, the total effective area shall be the total area of all floor areas (assuming vertical openings and exterior vertical communications are properly protected):

| Floor | Area (sq.m) | % | |
|---|---|---|---|
| | 2,214 | 100% | (Main Floor) |
| | 2,207 | 100% | (2nd Floor) |
| | 2,207 | 100% | (3rd Floor) |
| | 2,207 | 100% | (4th Floor) |
| | 2,207 | 100% | (5th Floor) |
| $A =$ | 11,041 | sq.m | |

$F = 220\ C\ \sqrt{A}$

$F =$ 34,676 L/min

$F =$ 35,000 (to nearest 1,000 Lmin)

**Occupancy Factor**

| | | Charge |
|---|---|---|
| Type: | Residential | -15% |
| | $f_1 =$ | -15% |

$F' = F \times (1+f_1)$

$F' =$ 29,750 L/min

**Sprinkler Credit**

| | | Charge |
|---|---|---|
| NFPA 13 Sprinkler Standard: | YES | -30% |
| Standard Water Supply: | YES | -10% |
| Fully Supervised System: | YES | -10% |
| Total Charge to Fire Flow: | $f_2 =$ | -50% |

**Exposure Factor**

| | | Charge | |
|---|---|---|---|
| North Side - Distance to Building (m): | >30m | 0% | |
| East Side - Distance to Building (m): | 10.1 to 20m | 0% | |
| South Side - Distance to Building (m): | >30m | 15% | |
| West Side - Distance to Building (m): | >30m | 0% | |
| | $f_3 =$ | 15% | (maximum of 75%) |

$F'' = F' + F' \times f_2 + F' \times f_3$

$F'' =$ 19,338 L/min

**REQUIRED FIRE FLOW**

$F'' =$ **19,000** **L/min** (to nearest 1,000 L/min)

**VALDOR ENGINEERING INC.**
571 Chrislea Road, Unit 4, 2nd floor, Woodbridge, ON L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

**Table B2-2**

# REQUIRED FIRE FLOW CALCULATION

In accordance to Water Supply for Public Fire Protection, Fire Underwriters Survey 2020

Project Name: **Ida Street, Dundalk, Township of Southgate**
File: 23142
Date: Septmber 2026

Notes: Building 'B' - 5 Storeys

**Type of Construction -** Wood Frame Construction

$C =$ 1.5

For a building classified with a Construction Coefficient from 1.0 to 1.5, the total effective area shall be the total area of all floor areas (assuming vertical openings and exterior vertical communications are properly protected):

| Floor | Area (sq.m) | % | |
|---|---|---|---|
| | 2,214 | 100% | (Main Floor) |
| | 2,207 | 100% | (2nd Floor) |
| | 2,207 | 100% | (3rd Floor) |
| | 2,207 | 100% | (4th Floor) |
| | 2,207 | 100% | (5th Floor) |
| $A =$ | 11,041 | sq.m | |

$$F = 220\,C\,\sqrt{A}$$

$F =$ 34,676 L/min

$F =$ 35,000 (to nearest 1,000 Lmin)

**Occupancy Factor**

| | | Charge |
|---|---|---|
| Type: | Residential | -15% |
| $f_1 =$ | | -15% |

$$F' = F \times (1+f_1)$$

$F' =$ 29,750 L/min

**Sprinkler Credit**

| | | Charge |
|---|---|---|
| NFPA 13 Sprinkler Standard: | YES | -30% |
| Standard Water Supply: | YES | -10% |
| Fully Supervised System: | YES | -10% |
| Total Charge to Fire Flow: $f_2 =$ | | -50% |

**Exposure Factor**

| | | Charge | |
|---|---|---|---|
| North Side - Distance to Building (m): | >30m | 0% | |
| East Side - Distance to Building (m): | >30m | 0% | |
| South Side - Distance to Building (m): | >30m | 0% | |
| West Side - Distance to Building (m): | 10.1 to 20m | 15% | |
| $f_3 =$ | | 15% | (maximum of 75%) |

$$F'' = F' + F' \times f_2 + F' \times f_3$$

$F'' =$ 19,338 L/min

**REQUIRED FIRE FLOW**

$F'' =$ **19,000** **L/min** (to nearest 1,000 L/min)

TRITON ENGINEERING SERVICES LIMITED
Consulting Engineers

105 Queen Street West, Unit 14
Fergus
Ontario N1M 1S6
Tel: (519) 843-3920
Fax: (519) 843-1943
Email: info@tritoneng.on.ca

ORANGEVILLE • FERGUS • HARRISTON

June 3, 2026

Township of Southgate
185667 Grey Road 9
Dundalk, Ontario
N0C 1B0

ATTENTION: Cory Henry,
Supervisor of Water & Roads

RE: Township of Southgate
Dundalk Water Supply and
Wastewater Treatment Facility
2026 Reserve Capacity Calculations
Our File: A4160 R04

Dear Sir:

The attached tables outline the 2026 reserve capacity calculations for the water supply and sewage treatment systems in Dundalk. The reserve capacities have been calculated in accordance with Ministry of Environment and Conservation and Parks (MECP) guidelines. **25** new equivalent residential units were occupied within the municipal systems of Dundalk in 2025.

Table 3 provides a summary of the upcoming developments in Dundalk. The Township has committed 830 Equivalent Residential Units (ERUs) to the water system and 607 ERUs to the sanitary system. A portion of these ERUs had been occupied in previous years, with a further 25 water and sanitary ERUs occupied in 2025. This leaves 485 ERUs for the water system and 262 ERUs for the sanitary system that are committed but not yet complete or occupied.

Additionally, within Table 3, the *Unallocated Developments* noted further outlines the various potential developments that are being considered for future development; however they have not been allocated (committed) reserve capacity. There are an additional 1,945 potential ERUs applicable to the water system and 1,911 potential ERUs applicable to the sanitary system being considered for development, as *Unallocated Development.*

**Water System:**

The three (3) year average maximum day demand of the water system increased from 1,371$m^3$/d to **1,659$m^3$/d** over the past year. The 2026 uncommitted reserve capacity of the water system is **615 ERU**. This is based on the Townships' amount of water taking permitted by the Permit to

Take Water and committed developments as outlined in Table 3. The Permit to Take Water, indicates an allowable water taking of 2,817$m^3$/day.

The Dundalk water system is a single pressure zone watermain distribution network that includes one elevated water tower, one on-grade reservoir, three supply wells with associated necessary reservoirs required to achieve chlorine contact time for treatment. The current storage volume requirement for the serviced population is **1,688$m^3$** which is well below the system storage volume currently available of 5,360$m^3$. Note: This current volume includes the reservoir at D3 (1,365$m^3$) but does not include storage available at D4 and D5 as they are required to achieve the chlorine treatment.

The storage volume required to support the committed developments noted in Table 3 indicates that the existing available storage is expected to be sufficient to service the committed developments.

Refer to Table 1.0 and Table 1.1 for additional information.

**Wastewater Treatment Facility:**

Table 2 summarizes the wastewater treatment reserve capacity calculations for 2026. The three-year annual average day flow increased from 1,215 $m^3$/d to **1,329$m^3$/d**. The 2026 Uncommitted Reserve Capacity for the sewage treatment facility has decreased from 429 ERUs to **346** new development ERUs.

The Dundalk Wastewater Treatment Facility expansion project is currently in the detailed design stage and is expected to increase the sewage treatment capacity to 3,025$m^3$/day. The expectation is that this project will begin construction within 2026.

Refer to Table 2 for additional information regarding sewage treatment system reserve capacity calculations. Given the current system conditions and recent high-flow events, it is also our understanding that the MECP is not supportive of allocating additional development capacity until the wastewater treatment facility expansion is underway. As construction is anticipated to be completed within approximately one year, development allocated in 2026 may still allow sufficient time for the expansion works to proceed before those allocations translate into full servicing demand.

**Extraneous Flow:**

In conjunction with the reserve capacity calculations, we have completed a high-level assessment of the extraneous flows within the Dundalk sewage collection system. This assessment compares the precipitation, temperature, average day demand of water and the average day sewage flow measured at the WWTP on a monthly and yearly basis. The results indicate that the extraneous flows over and above the expected amount within a typical system is, on average, 126$m^3$/day, which equates to an estimated **153** new development ERUs. See Table 4 summary.

The results indicate that the system appears to be subject to notable extraneous flow during the winter and spring, with the most significant relationship observed between the wastewater flows and temperature increase in the late winter and spring. This is indicative of a system that may be subject to groundwater infiltration as groundwater levels increase with rain and snow melts.

Additionally, the facility experienced significant flow events during the spring of 2026, which further highlights the impact of inflow and infiltration (I&I) on the wastewater system. The Township has undertaken multiple studies of the collection system and, in 2026, completed CCTV investigations that identified several deficiencies contributing to extraneous flows. It is recommended that the Township implement a targeted I&I reduction program to address these issues. While the planned wastewater treatment facility expansion is expected to increase treatment capacity, it will not address capacity limitations within the collection system. Without corresponding collection system improvements, there remains a risk of surcharging and basement backups during prolonged wet weather and spring melt conditions.

**Recommendation:**

Following Council's review and adoption of the attached report, we would recommend that a copy of the report be forwarded to the MECP District Office in Owen Sound and the Grey County Planning Department. We trust you will find the enclosed to be in order.

Should you have any questions, please do not hesitate to contact this office.

Respectfully,
Triton Engineering Services Limited



Dustin Lyttle, P. Eng.

cc: Jim Ellis – Chief Administrative Officer, Township of Southgate
Phil Schram - Chief Building Official, Township of Southgate

**TABLE 1**
**TOWNSHIP OF SOUTHGATE**
**2026 RESERVE CAPACITY**
**DUNDALK WATER SYSTEM**

| | DESCRIPTION | 2025 |
|---|---|---|
| 1 | Available Capacity[1] | 2,817 |
| 2 | Max Day Demand 3-yr average ($m^3/d$)[2] | 1,659 |
| 3 | Reserve Capacity ($m^3/d$)<br>(1) - (2) | 1,158 |
| 4 | Service Connections[3] | 1,633 |
| 5 | Persons Per Existing Residential Unit<br>(2021 Census Data) | 2.66 |
| 6 | Population Served<br>(4) x (5) | 4,344 |
| 7 | Maximum Day Per Capita Demand ($m^3/d$)<br>(2) ÷ (6) | 0.382 |
| 8 | Additional Population that can be Served<br>(3) ÷ (7) | 3,033 |
| 9 | Person Per New Equivalent Residential Unit<br>(Draft 2024 DC Growth Forcast) | 2.758 |
| 10 | Additional ERUs that can be served.<br>(8) ÷ (9) | 1,100 |
| 11 | Committed Development ERUs (Table 3) | 485 |
| **12** | **Uncommitted Reserve Capacity (ERUs)<br>(10) - (11)** | **615** |

[1] Available Capacity is based on lesser of Firm Capacity or Permit to Take Water. Firm capacity is 2,819$m^3$/day, PTTW is 2,817$m^3$/d. Well Production is 4,780$m^3$/day.

[2] Average of the maximum day demands from 2023, 2024 and 2025 (1,421, 1,576 and 1,979* $m^3$/d respectively). Maximum day demands have been adjusted to account for high demands during various infrastructure works or watermain breaks.

[3] Service connections as reported in the "2025 Water Report".

**TABLE 1.1**
**TOWNSHIP OF SOUTHGATE**
**2026 RESERVE CAPACITY**
**DUNDALK WATER TOWER ASSESSMENT**

| | DESCRIPTION | 2025 |
|---|---|---|
| 1 | Existing System Storage ($m^3$)[1] | 5,360 |
| 2 | Three-Year Max Day Demand ($m^3$/d) (Table 1) | 1,659 |
| 3 | Storage Required ($m^3$) (as per MECP Guidelines) | 1,688 |
| **4** | **Existing Surplus Storage Available ($m^3$)** | **3,671** |
| 5 | Committed Equivalent Residential Units (Table 3) | 485 |
| 6 | Storage Required to Service Committed Developments ($m^3$) | 2,028 |
| **7** | **Additional Storage Available ($m^3$) (1) - (6)** | **3,332** |

[1] Total System Storage includes D3 (1,365$m^3$) and The New Tower (3,995$m^3$). Storage within D4 and D5 are not counted as they are for chlorine contact time.

**TABLE 2**
**TOWNSHIP OF SOUTHGATE**
**2026 RESERVE CAPACITY**
**DUNDALK WASTEWATER TREATMENT FACILITY**

| | DESCRIPTION | 2025 |
|---|---|---|
| 1 | Design Capacity of Sewage Treatment Facility ($m^3$/d) | 1,832 |
| 2 | Average Day Flow[1] ($m^3$/d)<br>(Average of 2022, 2023 and 2024 Average Day Flows) | 1,329 |
| 3 | Reserve Capacity ($m^3$/d)<br>(1) - (2) | 503 |
| 4 | Average New Development per Capita Flow[2] ($m^3$/day) | 0.300 |
| 5 | Additional Population that can be Served<br>(3) ÷ (4) | 1,677 |
| 6 | Person Per Equivalent Residential Unit<br>(Draft 2024 DC Growth Forcast) | 2.758 |
| 7 | ERU Flow Rate ($m^3$/d)<br>(4) x (6) | 0.827 |
| 8 | Additional ERUs that can be Served<br>(5) ÷ (6) | 608 |
| 9 | Committed Development ERUs (Table 3) | 262 |
| **10** | **Uncommitted Reserve Capacity (ERUs)<br>(7) - (8)** | **346** |

[1] Average of the average day flows in 2023, 2024 and 2025 (1,237, 1,419 and 1,331$m^3$/day respectively).

[2] As determined by new development flow analysis supported by flow monitoring program.

**TABLE 3**
**TOWNSHIP OF SOUTHGATE**
**2026 RESERVE CAPACITY**
**SUMMARY OF DUNDALK DEVELOPMENTS**

| | TOTAL UNITS | | OCCUPIED IN 2025 | | REMAING UNITS AT END OF 2025 | |
|---|---|---|---|---|---|---|
| **ALLOCATED DEVELOPMENTS** | **WATER** | **SANITARY** | **WATER** | **SANITARY** | **WATER** | **SANITARY** |
| White Rose (Phase 3)[1] | 30 | 30 | 0 | 0 | 30 | 30 |
| Flato East (7,8 & 10) | 188 | 188 | 25 | 25 | 15 | 15 |
| Flato East (Phase 11) | 197 | 197 | 0 | 0 | 197 | 197 |
| Glenelg (Phase 1) | 183 | 183 | 0 | 0 | 11 | 11 |
| Southgate Renewables[4] | 227 | 4 | 0 | 0 | 227 | 4 |
| ANNUAL INFILL LOTS[3] | 5 | 5 | 0 | 0 | 5 | 5 |
| **SUB-TOTAL** | **830** | **607** | **25** | **25** | **485** | **262** |
| **TOTAL COMMITTED UNITS** | | | | | **485** | **262** |

| | TOTAL UNITS | | |
|---|---|---|---|
| **UNALLOCATED DEVELOPMENT** | **WATER** | **SANITARY** | |
| White Rose (Phase 3)[1] | 47 | 47 | |
| Edgewood Greens (Phase 9) | 47 | 47 | |
| Glenelg (Phase 2A) | 41 | 41 | |
| Braemore Subdivision | 66 | 66 | |
| Glenelg (Phase 3) | 400 | 400 | |
| Glenelg (School Block)[5] | 124 | 90 | |
| Dundalk North West (MZO 161/22) | 416 | 416 | |
| Ida Subdivision (MZO 165/22) | 321 | 321 | |
| Eco Park Subdivision (MZO 162/22) | 483 | 483 | |
| **SUB-TOTAL** | **1,945** | **1,911** | |

[1] Partial allocation (30 of 77) of White Rose (Phase 3). 47 remain unallocated.

[2] Apartment units based on assumption that each unit is 0.7 ERU.

[3] 5 ERUs designated annually for residential infill Lots.

[4] Southgate Renewable is expected to use 227 ERUs of Water Servicing (temporarily until the connection the Dundalk WWTF is complete)

[5] Glenelg (School Block) is expected to use 124 ERUs of Water Servicing and 90 ERUs of Sanitary Servicing.

**TABLE 4**
**TOWNSHIP OF SOUTHGATE**
**2026 RESERVE CAPACITY**
**DUNDALK EXTRANEOUS FLOWS**

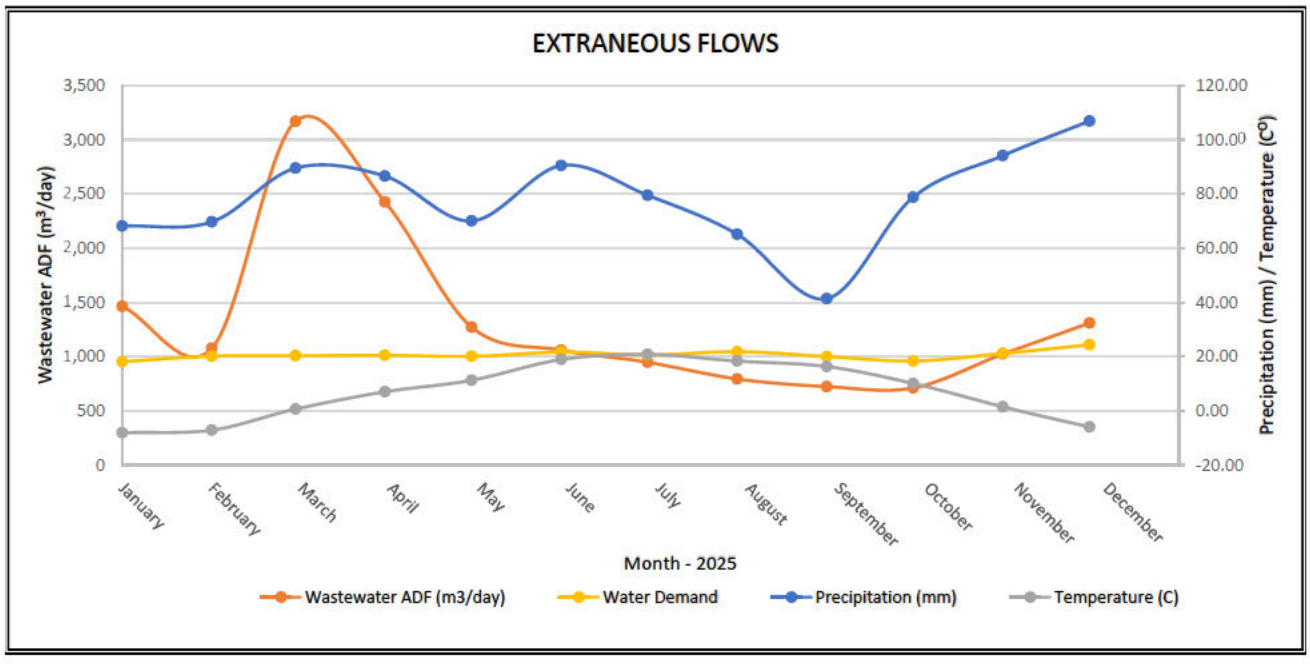
| MONTH | PRECIPITATION (mm)[4] | AMBIENT TEMP. (C°)[4] | WASTEWATER ADF ($m^3$/day) | WATER ADD ($m^3$/day) | EXTRANEOUS FLOW ($m^3$/day)[1] |
|---|---|---|---|---|---|
| January-2025 | 68.10 | -8.04 | 1,463 | 954 | 509 |
| February-2025 | 69.70 | -7.09 | 1,078 | 1,005 | 73 |
| March-2025 | 89.50 | 0.70 | 3,168 | 1,009 | 2,159 |
| April-2025 | 86.50 | 7.10 | 2,426 | 1,012 | 1,414 |
| May-2025 | 70.00 | 11.31 | 1,272 | 1,003 | 269 |
| June-2025 | 90.40 | 18.93 | 1,060 | 1,042 | 18 |
| July-2025 | 79.50 | 20.80 | 949 | 1,015 | 0 |
| August-2025 | 65.10 | 18.39 | 794 | 1,046 | 0 |
| September-2025 | 41.40 | 16.32 | 724 | 1,000 | 0 |
| October-2025 | 78.80 | 10.07 | 711 | 960 | 0 |
| November-2025 | 94.10 | 1.49 | 1,023 | 1,029 | 0 |
| December-2025 | 106.80 | -5.96 | 1,309 | 1,109 | 200 |
| **AVERAGE** | | | **1,331** | **1,015** | **387** |
| **REASONABLE EXTRANEOUS FLOW BASED ON POPULATION - TABLE 1.0 ($m^3$/day)[2]** | | | | | **261** |
| **EXTRANEOUS FLOW OVER AND ABOVE REASONABLE AMOUNT ($m^3$/day)** | | | | | **126** |
| **EQUIVALENT RESIDENTIAL UNITS USED BY EXTRANEOUS FLOWS (ERU)[3]** | | | | | **153** |

[1] Wastewater ADF minus the Water ADD, used to determine Wastewater Flow over and above expected.

[2] Expected infiltration based 60 Litres per person per day allowable infiltration (modified historic MOE Standard).

[3] Based on New Development Equivalent Residential Unit Sanitary Flow Rate.

[4] Data as available for the nearest Weather Station (Environment Canada - Daily Data Report Mount Forest).



# APPENDIX “C”

Wastewater Servicing

**VALDOR ENGINEERING INC.**
571 Chrislea Road, Unit 4, 2nd Floor, Vaughan, ON L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com
www.valdor-engineering.com

**TABLE: C1**

# Wastewater Loading Calculation

Project Name: Ida Street, Dundalk, Township of Southgate
File: 23142
Date: September 2026

**Criteria:**

**Design Parameters**

Avg. Flow Rate (Residential): 350 L/person/day

Infiltration Rate: 0.15 L/s/ha

Residential Peaking Factor: 1 + (14 / (4+(P/1000)^0.5)) where P is population in thousands

Peaking Factor to be Min 2.0, Max 4.0

| Proposed Residential Development | Site Area (ha.) | Equivalent Population | Average Flow (L/s) | Peaking Factor | Peak Flow (L/s) | Infiltration (L/s) | Total Peak Flow (L/s) |
|---|---|---|---|---|---|---|---|
| Building A | | 324 | 1.31 | 4.00 | 5.25 | | 5.25 |
| Building B | | 324 | 1.31 | 4.00 | 5.25 | | 5.25 |
| Infiltration | 2.043 | | | | | 0.31 | 0.31 |
| **TOTAL** | **2.043** | **648** | **2.63** | | **10.50** | **0.31** | **10.81** |

# APPENDIX “D”

Watershed Map, Regulation Mapping, IDF Data & Storm Design Sheet

# The Grand River Watershed

ONTARIO, CANADA




SUBJECT SITE

535 m
1760 ft
Dundalk
COUNTY OF GREY
DUFFERIN COUNTY
Luther Lake
Damascus Reservoir
Grand River
Arthur
Grand Valley
Waldemar
COUNTY OF PERTH
Drayton
COUNTY OF WELLINGTON
Conestogo Lake
Conestogo River
Woolwich Reservoir
Elora
Fergus
Lake Belwood
REGIONAL MUNICIPALITY OF WATERLOO
Elmira
St. Clements
Heidelberg
St. Jacobs
Nith River
Laurel Reservoir
St. Agatha
WATERLOO
GUELPH
Guelph Lake
Eramosa River
Rockwood
New Hamburg
Baden
KITCHENER
New Dundee
Plattsville
Speed River
CAMBRIDGE
Mill Ck.
Shade`s Reservoir
COUNTY OF OXFORD
REGIONAL MUNICIPALITY OF HALTON
Ayr
Grand River
Paris
CITY OF HAMILTON
Whitemans Ck.
Fairchild Ck.
BRANTFORD
Lake Ontario
COUNTY OF BRANT
NORFOLK COUNTY
SIX NATIONS OF THE GRAND RIVER
Big Ck.
Boston Ck.
McKenzie Ck.
Caledonia
MISSISSAUGAS OF THE NEW CREDIT
Cayuga
HALDIMAND COUNTY
Grand River
Dunnville
Lake Erie
Port Maitland
175 m
574 ft
N

Grand River Conservation Authority

**Transportation**

- Major Highway
- Secondary Highway
- Major Road

**Boundaries**

- Grand River Watershed Boundary
- County/Regional Municipality Boundary

**Scale:**

5 2,5 0 5 10 km

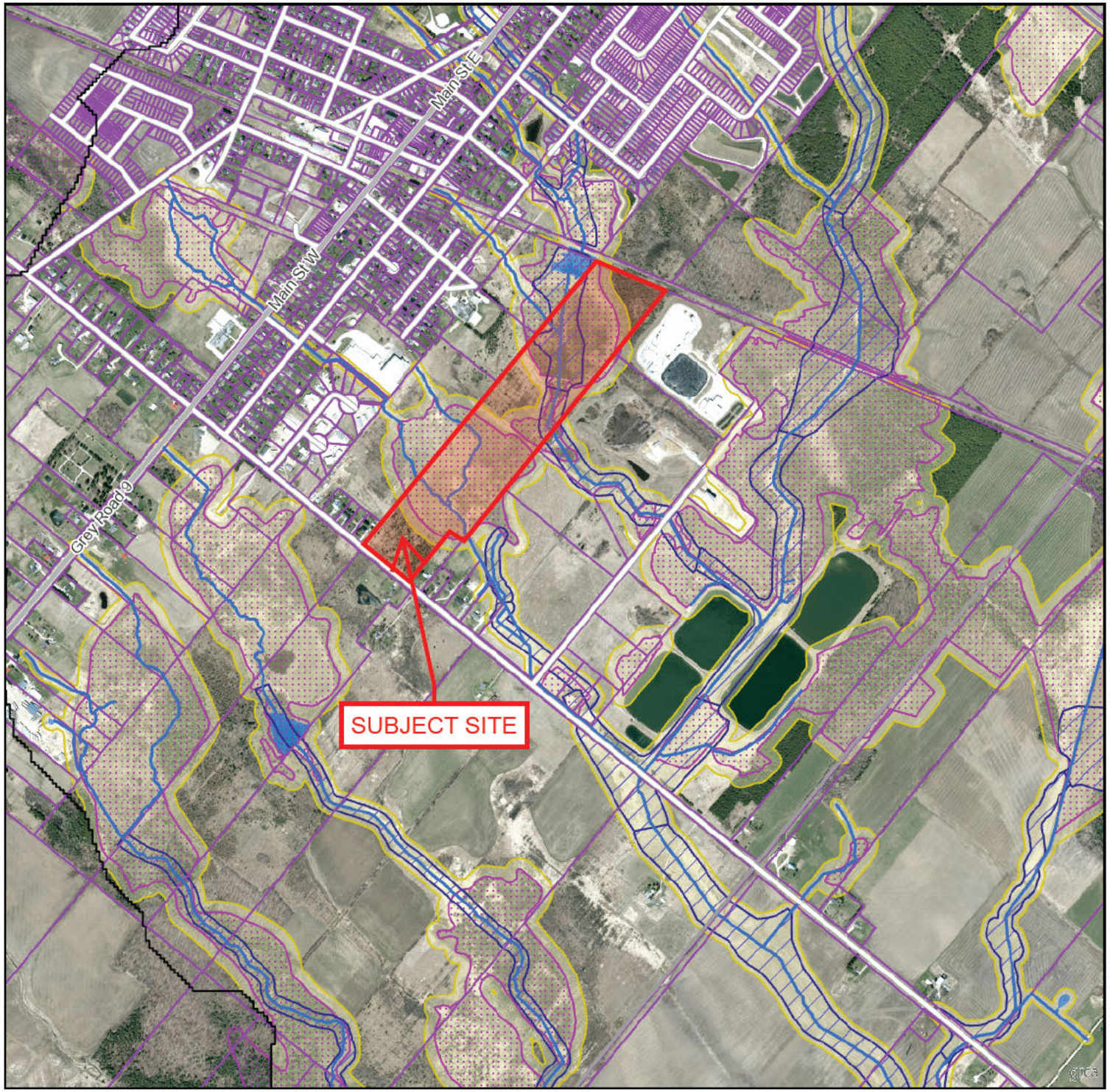
**Drainage**

- River/Stream
- Lake/Reservoir

**Other areas**

- City/Town
- Conservation Lands

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Data: © Copyright 2000. Government of Canada with permission from Natural Resources Canada. Portions of this map are produced under license from Her Majesty the Queen in Right of Canada with permission from Natural Resources Canada.




Grand River Conservation Authority

Date: Dec 11, 2024

## GRCA Web-GIS

Legend

- Regulation Limit (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
- Floodplain - Special Policy Area (GRCA)
- Slope Erosion (GRCA)
  - Steep
  - Oversteep
  - Toe
- Slope Valley (GRCA)
  - Steep
  - Oversteep
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

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Disclaimer: This map is for illustrative purposes only. Information contained herein is not a substitute for professional review or a site survey and is subject to change without notice. The Grand River Conservation Authority takes no responsibility for, nor guarantees, the accuracy of the information contained on this map. Any interpretations or conclusions drawn from this map are the sole responsibility of the user.
The source for each data layer is shown in parentheses in the map legend. See Sources and Citations for details.

Scale 1:15,558

NAD83 UTM zone 17 (EPSG:26917)

Map Centre (X,Y): 548991.70, 4889664.33 | Map Link

This map is not to be used for navigation | 2020 Ortho (ON)

Ontario IDF CURVE LOOKUP

## Active coordinate

44° 9' 45" N, 80° 23' 45" W (44.162500,-80.395833)

Retrieved: Mon, 18 Nov 2024 19:36:16 GMT



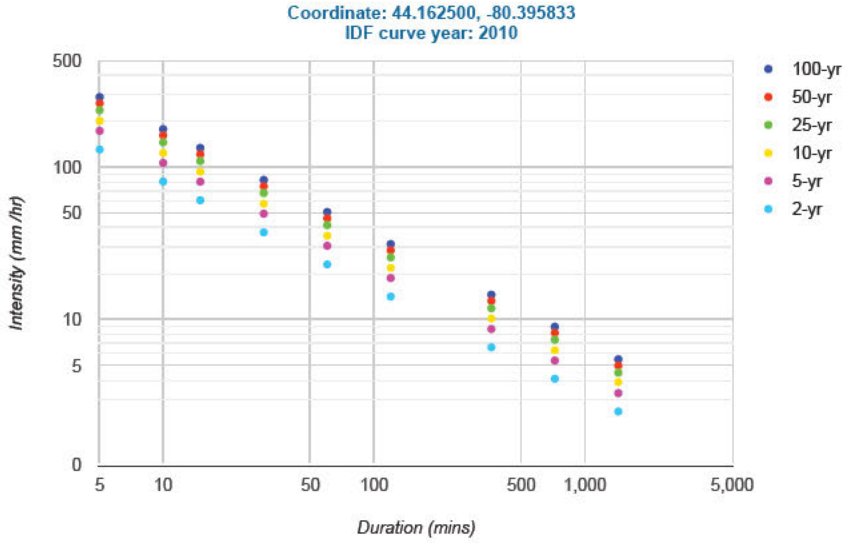

### Location summary

These are the locations in the selection.

**IDF Curve:** 44° 9' 45" N, 80° 23' 45" W (44.162500,-80.395833)

### Results

An IDF curve was found.



### Coefficient summary

**IDF Curve:** 44° 9' 45" N, 80° 23' 45" W (44.162500,-80.395833)

Retrieved: Mon, 18 Nov 2024 19:36:16 GMT

**Data year:** 2010
**IDF curve year:** 2010

| Return period | 2-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
|---|---|---|---|---|---|---|
| **A** | 23.1 | 30.6 | 35.6 | 41.8 | 46.4 | 51.0 |
| **B** | -0.699 | -0.699 | -0.699 | -0.699 | -0.699 | -0.699 |

### Statistics

#### Rainfall intensity (mm $hr^{-1}$)

| Duration | 5-min | 10-min | 15-min | 30-min | 1-hr | 2-hr | 6-hr | 12-hr | 24-hr |
|---|---|---|---|---|---|---|---|---|---|
| **2-yr** | 131.2 | 80.8 | 60.9 | 37.5 | 23.1 | 14.2 | 6.6 | 4.1 | 2.5 |
| **5-yr** | 173.8 | 107.1 | 80.6 | 49.7 | 30.6 | 18.8 | 8.7 | 5.4 | 3.3 |
| **10-yr** | 202.2 | 124.6 | 93.8 | 57.8 | 35.6 | 21.9 | 10.2 | 6.3 | 3.9 |
| **25-yr** | 237.4 | 146.3 | 110.2 | 67.9 | 41.8 | 25.7 | 11.9 | 7.4 | 4.5 |
| **50-yr** | 263.6 | 162.3 | 122.3 | 75.3 | 46.4 | 28.6 | 13.3 | 8.2 | 5.0 |
| **100-yr** | 289.7 | 178.4 | 134.4 | 82.8 | 51.0 | 31.4 | 14.6 | 9.0 | 5.5 |

#### Rainfall depth (mm)

| Duration | 5-min | 10-min | 15-min | 30-min | 1-hr | 2-hr | 6-hr | 12-hr | 24-hr |
|---|---|---|---|---|---|---|---|---|---|
| **2-yr** | 10.9 | 13.5 | 15.2 | 18.8 | 23.1 | 28.5 | 39.6 | 48.8 | 60.1 |
| **5-yr** | 14.5 | 17.8 | 20.2 | 24.8 | 30.6 | 37.7 | 52.5 | 64.6 | 79.6 |
| **10-yr** | 16.9 | 20.8 | 23.5 | 28.9 | 35.6 | 43.9 | 61.0 | 75.2 | 92.7 |
| **25-yr** | 19.8 | 24.4 | 27.5 | 33.9 | 41.8 | 51.5 | 71.7 | 88.3 | 108.8 |
| **50-yr** | 22.0 | 27.1 | 30.6 | 37.7 | 46.4 | 57.2 | 79.6 | 98.0 | 120.8 |
| **100-yr** | 24.1 | 29.7 | 33.6 | 41.4 | 51.0 | 62.8 | 87.5 | 107.7 | 132.7 |

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C

VALDOR ENGINEERING INC.
571 Chrislea Road, Unit 4, 2nd Floor, Woodbridge, Ontario, L4L 8A2
Tel: 905-264-0054 Fax: 905-264-0069 info@valdor-engineering.com

**Township of Southgate**
**Engineering and Public Works Department**
STORM SEWER DESIGN SHEET

**Project Name: Ida Street, Dundalk**
**Project No: 23142**

5 year IDF Curve: I=535.36 x (T)^(-0.699)

Design: A.McKeracher, B.Eng.
Checked: D. Giugovaz, P.Eng
Approved: D. Giugovaz, P.Eng
Date: September 2026

| Street | FROM MH | TO MH | A (ha) | R | A x R | Accum. A x R | Tc (min) | 5 Year I (mm/hr) | 5yr Design Flow Qd ($m^3/s$) | Size of Pipe (mm) | Grade (%) | Nominal Capacity Qc ($m^3/s$) | Full Flow Velocity (m/s) | Length (m) | Time in Sect. (min) | Total Time (min) | Qd / Qc | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subject Site | MH.8 | MH.3 | 0.718 | 0.90 | 0.646 | 0.646 | 10.0 | 107.1 | 0.19 | 600 | 0.30 | 0.336 | 1.20 | 54.4 | 0.754 | 10.8 | 57% | |
| Subject Site | MH.4 | MH.3 | 0.939 | 0.90 | 0.845 | 0.845 | 10.0 | 107.1 | 0.25 | 600 | 0.30 | 0.336 | 1.20 | 8.9 | 0.123 | 10.1 | 75% | |
| Subject Site | MH.3 | MH.2 | 0.000 | 0.00 | 0.000 | 1.491 | 10.8 | 101.8 | 0.42 | 750 | 0.30 | 0.610 | 1.39 | 2.9 | 0.035 | 10.8 | 69% | |
| Subject Site | MH.2 | OGS.MH.1 | 0.000 | 0.00 | 0.000 | 1.491 | 10.8 | 101.5 | 0.42 | 750 | 0.30 | 0.610 | 1.39 | 2.3 | 0.027 | 10.8 | 69% | |
| Subject Site | OGS.MH.1 | HEADWALL | 0.000 | 0.00 | 0.000 | 1.491 | 10.8 | 101.3 | 0.42 | 750 | 0.30 | 0.610 | 1.39 | 6.4 | 0.076 | 10.9 | 69% | |

| No. | REVISION | DATE | AUTH |
|---|---|---|---|
| | | | |

STORM SEWER DESIGN SHEET

SCALE: N.T.S. DATE: September 2026
DRAWN BY: A.M DWG. No. 1

# APPENDIX “E”

Stormwater Quantity Control Calculations

VALDOR

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026

**Table E.1: Summary of VO Model Parameters**
**Pre-Development Conditions**

| Catchment ID | Area (ha) | VO5 Routine | TIMP | XIMP | CN II | IA (mm) | Tpeak (hr) |
|---|---|---|---|---|---|---|---|
| 101 | 2.043 | NasHyd | - | - | 65 | 7.4 | 0.20 |
| **Total** | **2.043** | | | | | | |

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026

**Table E.2: Summary of VO Model Parameters**
**Post-Development Conditions**

| Catchment ID | Area (ha) | VO5 Routine | TIMP | XIMP | CN II | IA (mm) | Tpeak (hr) |
|---|---|---|---|---|---|---|---|
| 201 | 0.074 | NashHyd | - | - | 39 | 5.0 | 0.17 |
| 202 | 1.805 | StandHyd | 0.82 | 0.82 | 39 | 5.0 | - |
| 203 | 0.164 | NashHyd | - | - | 39 | 5.0 | 0.17 |
| **Total** | **2.043** | | | | | | |

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026

**Table E.3: Calculation of CN Values, Initial Abstractions and Runoff Coefficients**

| *Subcatchment* | Area (ha) | Land Use and Land Cover | | CN II | Area Weighted CN II | IA (mm) | Area Weighted IA (mm) | C-Value | Area Weighted C-Value |
|---|---|---|---|---|---|---|---|---|---|
| | | Type | Area (ha) | | | | | | |
| *101* | 2.043 | Row Crops (HSG 'A') | 1.739 | 72 | **65** | 7 | **7.4** | 0.22 | **0.20** |
| | | Forest (HSG 'A') | 0.304 | 25 | | 10 | | 0.08 | |

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026

**Table E.4: SWM Analysis - Calculation of Time to Peak**

| Subcatchment | A Area (ha) | C Runoff Coefficient (Area Weighted) | L (m) Catchment Length | Highest Elevation (m) | Lowest Elevation (m) | S (%) Catchment Slope | [1,2]$T_c$ Method | $T_c$ (min) | [3]Adjusted $T_c$ (min) | [1,2]$T_p$ (hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 2.043 | 0.20 | 70.0 | 513.73 | 511.94 | 2.56 | Airport | 18.0 | 18.0 | 0.20 |
| 201 | 0.074 | 0.25 | 30.0 | 513.25 | 512.24 | 3.37 | Airport | 10.2 | 15.0 | 0.17 |
| 203 | 0.164 | 0.25 | 15.0 | 511.13 | 510.84 | 1.93 | Airport | 8.6 | 15.0 | 0.17 |

**Notes:**

1) $T_p$ calculation for catchments with C < 0.40 is based on the Airport Formula: $T_c = 3.26 \times (1.1 - C) \times L^{0.5} / S_w^{0.33}$

2) $T_p$ calculation for catchments with C > 0.40 is based on the Bransby-Williams Formula: $T_c = (0.057)(L) / (S_w)^{0.2} (A)^{0.1}$

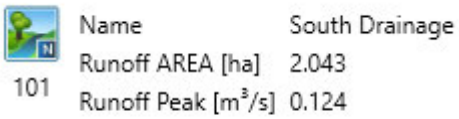
$$T_P = 0.67 T_c$$

3) For the pre-development condition, a minimum time of concentration of 15 mins (Adjusted $T_c$) is to be used in the modelling.

**VALDOR ENGINEERING INC.**
Project: Dundalk
File: 23142
Date: September 2026

**Table E.5: Stage-Storage-Discharge Table**

| Stage Storage Curve | | | | | | | | Outlet Structure | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (m) | Sec Area ($m^2$) | Avg Area ($m^2$) | Sec Volume ($m^3$) | Cumulative Volume ($m^3$) | Storage Tank | Pipe | Total Volume ($m^3$) | | Stage Active (m) | [1]Discharge $m^3/s$ Orifice #1 | Orifice #2 (Weir Flow) | Orifice #2 (Orifice Flow) | Total Flow | **Comments:** |
| | | | | | | | | Invert Elevation (m) | | 511.10 | 511.90 | 511.90 | | |
| | | | | | | | | Diameter (mm)/Length (m) | | 190 | 0.300 | 0.30 | | |
| | | | | | | | | Height (m) | | - | 0.100 | 0.10 | | |
| | | | | | | | | Orifice Area ($m^2$) | | 0.0284 | | 0.0300 | | |
| | | | | | | | | | | | | | | Weir Equation: $Q=1.837xLxH^{1.5}$ |
| **Underground Storage Tanks + Pipes + Surface Detention Area** | | | | | | | | | | | | | | |
| **511.10** | **114** | **-** | **-** | **0** | 0 | | 0 | | 0.00 | 0.000 | | | **0.000** | |
| 511.20 | 130 | 122 | 12 | 12 | 433 | | 445 | | 0.10 | 0.005 | | | **0.005** | |
| 511.30 | 147 | 139 | 14 | 26 | 433 | | 459 | | 0.20 | 0.024 | | | **0.024** | |
| 511.40 | 164 | 155 | 16 | 42 | 433 | | 475 | | 0.30 | 0.034 | | | **0.034** | |
| 511.50 | 180 | 172 | 17 | 59 | 433 | | 492 | | 0.40 | 0.042 | | | **0.042** | |
| 511.60 | 197 | 188 | 19 | 78 | 433 | | 511 | | 0.50 | 0.048 | | | **0.048** | |
| 511.70 | 213 | 205 | 21 | 98 | 433 | | 531 | | 0.60 | 0.054 | | | **0.054** | |
| 511.80 | 230 | 222 | 22 | 120 | 433 | | 554 | | 0.70 | 0.059 | | | **0.059** | |
| 511.90 | 247 | 238 | 24 | 144 | 433 | | 577 | | 0.80 | 0.063 | 0.000 | | **0.063** | |
| 512.00 | 263 | 255 | 25 | 170 | 433 | | 603 | | 0.90 | 0.068 | 0.016 | | **0.083** | |
| 512.10 | 280 | 272 | 27 | 197 | 433 | | 630 | | 1.00 | 0.072 | | 0.036 | **0.107** | |
| **512.20** | **297** | **288** | **29** | **226** | 433 | 45 | 704.03 | | 1.10 | 0.076 | | 0.044 | **0.119** | |




**VO Model Schematic – Pre-Development Storm Drainage**

```
================================================================================
==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
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  Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\31741832-9db9-47aa-accc-967b3228f147\scenar


DATE: 09-17-2026                          TIME: 03:48:45

USER:



COMMENTS: _____________________________________________________________

--------------------------------------------------------------------------------
--------------
  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_002yr     **
  ************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 404.147
| Ptotal= 32.13 mm |                           B=   0.000
--------------------                           C=   0.699
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    3.76 |  0.83   80.82 |   1.67    5.83 |  2.50    3.63
                0.17    4.42 |  1.00   17.11 |   1.83    5.15 |  2.67    3.39
                0.33    5.48 |  1.17   10.79 |   2.00    4.63 |  2.83    3.20
                0.50    7.50 |  1.33    8.23 |   2.17    4.23 |
                0.67   13.95 |  1.50    6.78 |   2.33    3.90 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area    (ha)=   2.04   Curve Number    (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.40   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

                NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                  ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    3.76 | 0.833   13.95 | 1.583    6.78 |  2.33    4.23
                0.167    3.76 | 0.917   80.82 | 1.667    6.78 |  2.42    3.90
                0.250    4.42 | 1.000   80.82 | 1.750    5.83 |  2.50    3.90
                0.333    4.42 | 1.083   17.11 | 1.833    5.83 |  2.58    3.63
                0.417    5.48 | 1.167   17.11 | 1.917    5.15 |  2.67    3.63
                0.500    5.48 | 1.250   10.79 | 2.000    5.15 |  2.75    3.39
                0.583    7.50 | 1.333   10.79 | 2.083    4.63 |  2.83    3.39
                0.667    7.50 | 1.417    8.23 | 2.167    4.63 |  2.92    3.20
                0.750   13.95 | 1.500    8.23 | 2.250    4.23 |  3.00    3.20

     Unit Hyd Qpeak  (cms)=   0.390

     PEAK FLOW       (cms)=   0.019 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   3.780
     TOTAL RAINFALL   (mm)=  32.132
     RUNOFF COEFFICIENT   =   0.118

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
================================================================================
==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\d8d70b41-16a2-4c21-89c2-1e9c26ad780c\scenar
  Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\d8d70b41-16a2-4c21-89c2-1e9c26ad780c\scenar


DATE: 09-17-2026                          TIME: 03:48:45

USER:



COMMENTS: _____________________________________________________________

--------------------------------------------------------------------------------
--------------
  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_005yr     **
  ************************************************
```

```
-------------------
| CHICAGO STORM     |
| Ptotal= 42.56 mm  |
-------------------
```

IDF curve parameters: A= 535.364
B= 0.000
C= 0.699
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.00 | 4.98 | 0.83 | 107.07 | 1.67 | 7.72 | 2.50 | 4.80 |
| 0.17 | 5.86 | 1.00 | 22.67 | 1.83 | 6.82 | 2.67 | 4.50 |
| 0.33 | 7.26 | 1.17 | 14.30 | 2.00 | 6.14 | 2.83 | 4.24 |
| 0.50 | 9.93 | 1.33 | 10.90 | 2.17 | 5.60 | | |
| 0.67 | 18.47 | 1.50 | 8.98 | 2.33 | 5.16 | | |

```
-------------------
| CALIB             |
| NASHYD  (  0101)  |
|ID= 1 DT= 5.0 min  |
-------------------
```

Area (ha)= 2.04 Curve Number (CN)= 65.0
Ia (mm)= 7.40 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 4.98 | 0.833 | 18.47 | 1.583 | 8.98 | 2.33 | 5.60 |
| 0.167 | 4.98 | 0.917 | 107.07 | 1.667 | 8.98 | 2.42 | 5.16 |
| 0.250 | 5.86 | 1.000 | 107.07 | 1.750 | 7.72 | 2.50 | 5.16 |
| 0.333 | 5.86 | 1.083 | 22.67 | 1.833 | 7.72 | 2.58 | 4.80 |
| 0.417 | 7.26 | 1.167 | 22.67 | 1.917 | 6.82 | 2.67 | 4.80 |
| 0.500 | 7.26 | 1.250 | 14.30 | 2.000 | 6.82 | 2.75 | 4.50 |
| 0.583 | 9.93 | 1.333 | 14.30 | 2.083 | 6.14 | 2.83 | 4.50 |
| 0.667 | 9.93 | 1.417 | 10.90 | 2.167 | 6.14 | 2.92 | 4.24 |
| 0.750 | 18.47 | 1.500 | 10.90 | 2.250 | 5.60 | 3.00 | 4.24 |

Unit Hyd Qpeak (cms)= 0.390

PEAK FLOW (cms)= 0.040 (i)
TIME TO PEAK (hrs)= 1.167
RUNOFF VOLUME (mm)= 7.178
TOTAL RAINFALL (mm)= 42.565
RUNOFF COEFFICIENT = 0.169

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
V V I SSSSS U U A L (v 6.2.2019)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTTT TTTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO
```

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
Output filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-605764144db8\23279ec8-18cc-471e-a983-f00b2bc0a0cf\scenar
Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-605764144db8\23279ec8-18cc-471e-a983-f00b2bc0a0cf\scenar

DATE: 09-17-2026 TIME: 03:48:45

USER:

COMMENTS: _____

**********
** SIMULATION : Dundalk_Chicago_3hr_010yr **
**********

```
-------------------
| CHICAGO STORM     |
| Ptotal= 49.52 mm  |
-------------------
```

IDF curve parameters: A= 622.842
B= 0.000
C= 0.699
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.00 | 5.79 | 0.83 | 124.56 | 1.67 | 8.98 | 2.50 | 5.59 |
| 0.17 | 6.82 | 1.00 | 26.38 | 1.83 | 7.93 | 2.67 | 5.23 |
| 0.33 | 8.45 | 1.17 | 16.63 | 2.00 | 7.14 | 2.83 | 4.93 |
| 0.50 | 11.56 | 1.33 | 12.68 | 2.17 | 6.51 | | |
| 0.67 | 21.49 | 1.50 | 10.45 | 2.33 | 6.01 | | |

```
-------------------
| CALIB             |
| NASHYD  (  0101)  |
|ID= 1 DT= 5.0 min  |
-------------------
```

Area (ha)= 2.04 Curve Number (CN)= 65.0
Ia (mm)= 7.40 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.20

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 5.79 | 0.833 | 21.49 | 1.583 | 10.45 | 2.33 | 6.51 |
| 0.167 | 5.79 | 0.917 | 124.56 | 1.667 | 10.45 | 2.42 | 6.01 |
| 0.250 | 6.82 | 1.000 | 124.56 | 1.750 | 8.98 | 2.50 | 6.01 |
| 0.333 | 6.82 | 1.083 | 26.38 | 1.833 | 8.98 | 2.58 | 5.59 |
| 0.417 | 8.45 | 1.167 | 26.38 | 1.917 | 7.93 | 2.67 | 5.59 |
| 0.500 | 8.45 | 1.250 | 16.63 | 2.000 | 7.93 | 2.75 | 5.23 |
| 0.583 | 11.56 | 1.333 | 16.63 | 2.083 | 7.14 | 2.83 | 5.23 |
| 0.667 | 11.56 | 1.417 | 12.68 | 2.167 | 7.14 | 2.92 | 4.93 |
| 0.750 | 21.49 | 1.500 | 12.68 | 2.250 | 6.51 | 3.00 | 4.93 |

Unit Hyd Qpeak (cms)= 0.390

```
     PEAK FLOW       (cms)=   0.057 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   9.898
     TOTAL RAINFALL   (mm)=  49.520
     RUNOFF COEFFICIENT   =   0.200

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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================================================================================
==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
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  Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\e91ba374-4bcf-4211-b8e1-b296338abdb1\scenar


DATE: 09-17-2026                          TIME: 03:48:45

USER:


COMMENTS: ____________________________________________________________


--------------------------------------------------------------------------------
--------------
  ***********************************************
  ** SIMULATION : Dundalk_Chicago_3hr_025yr     **
  ***********************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 731.314
| Ptotal= 58.14 mm |                           B=   0.000
--------------------                           C=   0.699
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    = 10.00 min
                        Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    6.80 |  0.83  146.25 |   1.67   10.54 |  2.50    6.56
                0.17    8.01 |  1.00   30.97 |   1.83    9.31 |  2.67    6.14
                0.33    9.92 |  1.17   19.53 |   2.00    8.38 |  2.83    5.79
                0.50   13.57 |  1.33   14.89 |   2.17    7.65 |
                0.67   25.24 |  1.50   12.27 |   2.33    7.05 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0101)|   Area     (ha)=   2.04   Curve Number    (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   7.40   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083   6.80 | 0.833   25.24 | 1.583   12.27 |  2.33    7.65
                0.167   6.80 | 0.917  146.25 | 1.667   12.27 |  2.42    7.05
                0.250   8.01 | 1.000  146.25 | 1.750   10.54 |  2.50    7.05
                0.333   8.01 | 1.083   30.97 | 1.833   10.54 |  2.58    6.56
                0.417   9.92 | 1.167   30.97 | 1.917    9.31 |  2.67    6.56
                0.500   9.92 | 1.250   19.53 | 2.000    9.31 |  2.75    6.14
                0.583  13.57 | 1.333   19.53 | 2.083    8.38 |  2.83    6.14
                0.667  13.57 | 1.417   14.89 | 2.167    8.38 |  2.92    5.79
                0.750  25.24 | 1.500   14.89 | 2.250    7.65 |  3.00    5.79

     Unit Hyd Qpeak  (cms)=   0.390

     PEAK FLOW       (cms)=   0.082 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  13.706
     TOTAL RAINFALL   (mm)=  58.144
     RUNOFF COEFFICIENT   =   0.236

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\e7e13933-ff7d-4c82-bad5-de54be2b72a4\scenar
  Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\e7e13933-ff7d-4c82-bad5-de54be2b72a4\scenar


DATE: 09-17-2026                          TIME: 03:48:45

USER:


COMMENTS: ____________________________________________________________
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```
 ********************************************
 ** SIMULATION : Dundalk_Chicago_3hr_050yr     **
 ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 811.794
| Ptotal= 64.54 mm |                          B=   0.000
--------------------                          C=   0.699
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

              TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
               hrs   mm/hr  |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
              0.00    7.55  |  0.83  162.35  |   1.67   11.70  |  2.50    7.28
              0.17    8.89  |  1.00   34.38  |   1.83   10.34  |  2.67    6.82
              0.33   11.01  |  1.17   21.68  |   2.00    9.30  |  2.83    6.42
              0.50   15.06  |  1.33   16.53  |   2.17    8.49  |
              0.67   28.01  |  1.50   13.62  |   2.33    7.83  |

--------------------
| CALIB            |
| NASHYD  (  0101) |   Area    (ha)=   2.04   Curve Number    (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.40   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
                hrs   mm/hr  |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
              0.083    7.55  | 0.833   28.01  |  1.583   13.62  |  2.33    8.49
              0.167    7.55  | 0.917  162.35  |  1.667   13.62  |  2.42    7.83
              0.250    8.89  | 1.000  162.35  |  1.750   11.70  |  2.50    7.83
              0.333    8.89  | 1.083   34.38  |  1.833   11.70  |  2.58    7.28
              0.417   11.01  | 1.167   34.38  |  1.917   10.34  |  2.67    7.28
              0.500   11.01  | 1.250   21.68  |  2.000   10.34  |  2.75    6.82
              0.583   15.06  | 1.333   21.68  |  2.083    9.30  |  2.83    6.82
              0.667   15.06  | 1.417   16.53  |  2.167    9.30  |  2.92    6.42
              0.750   28.01  | 1.500   16.53  |  2.250    8.49  |  3.00    6.42

     Unit Hyd Qpeak  (cms)=   0.390

     PEAK FLOW       (cms)=   0.102 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  16.807
     TOTAL RAINFALL   (mm)=  64.542
     RUNOFF COEFFICIENT   =   0.260

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

================================================================================
================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

          OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
         O   O    T      T    H   H   Y Y   MM MM  O   O
         O   O    T      T    H   H    Y    M M M  O   O
          OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\9ab499a7-eff8-45e0-953d-981ef7077608\scenar
  Summary filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
605764144db8\9ab499a7-eff8-45e0-953d-981ef7077608\scenar

DATE: 09-17-2026                          TIME: 03:48:45

USER:


COMMENTS: _____

 ********************************************
 ** SIMULATION : Dundalk_Chicago_3hr_100yr     **
 ********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 892.273
| Ptotal= 70.94 mm |                          B=   0.000
--------------------                          C=   0.699
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

              TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
               hrs   mm/hr  |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
              0.00    8.30  |  0.83  178.44  |   1.67   12.86  |  2.50    8.00
              0.17    9.77  |  1.00   37.79  |   1.83   11.36  |  2.67    7.50
              0.33   12.10  |  1.17   23.83  |   2.00   10.23  |  2.83    7.06
              0.50   16.55  |  1.33   18.17  |   2.17    9.33  |
              0.67   30.79  |  1.50   14.97  |   2.33    8.61  |

--------------------
| CALIB            |
| NASHYD  (  0101) |   Area    (ha)=   2.04   Curve Number    (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.40   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.20

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
                hrs   mm/hr  |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
              0.083    8.30  | 0.833   30.79  |  1.583   14.97  |  2.33    9.33
              0.167    8.30  | 0.917  178.44  |  1.667   14.97  |  2.42    8.61
              0.250    9.77  | 1.000  178.44  |  1.750   12.86  |  2.50    8.61
              0.333    9.77  | 1.083   37.79  |  1.833   12.86  |  2.58    8.00
```

```
              0.417   12.10 | 1.167   37.79 | 1.917   11.36 |  2.67    8.00
              0.500   12.10 | 1.250   23.83 | 2.000   11.36 |  2.75    7.50
              0.583   16.55 | 1.333   23.83 | 2.083   10.23 |  2.83    7.50
              0.667   16.55 | 1.417   18.17 | 2.167   10.23 |  2.92    7.06
              0.750   30.79 | 1.500   18.17 | 2.250    9.33 |  3.00    7.06

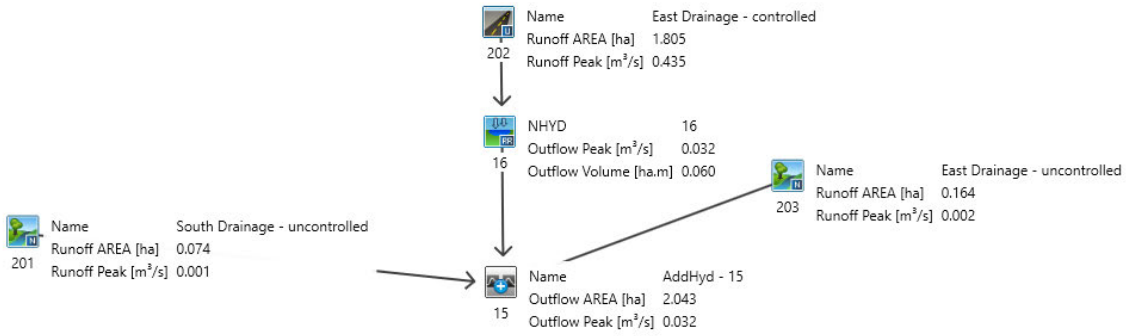
     Unit Hyd Qpeak  (cms)=   0.390

     PEAK FLOW       (cms)=   0.124 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=  20.117
     TOTAL RAINFALL   (mm)=  70.941
     RUNOFF COEFFICIENT   =   0.284

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------

 FINISH
================================================================================================
==============
```




**VO Model Schematic – Post-Development Storm Drainage**

```
================================================================================
==============
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U A   A  L
         VV     I    SSSSS  UUUUU A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\pyung\AppData\Local\Civica\VH5\59240a7b-1b4a-45f6-9044-
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DATE: 09-17-2026                          TIME: 03:50:20

USER:


COMMENTS: _____________________________________________________________

--------------------------------------------------------------------------------------------
--------------
  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_002yr     **
  ************************************************

-------------------
| CHICAGO STORM   |    IDF curve parameters: A= 404.147
| Ptotal= 32.13 mm |                          B=   0.000
-------------------                          C=   0.699
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN | TIME    RAIN |'  TIME    RAIN | TIME    RAIN
                 hrs   mm/hr |  hrs   mm/hr |'   hrs   mm/hr |  hrs   mm/hr
                0.00    3.76 | 0.83   80.82 |  1.67    5.83 | 2.50    3.63
                0.17    4.42 | 1.00   17.11 |  1.83    5.15 | 2.67    3.39
                0.33    5.48 | 1.17   10.79 |  2.00    4.63 | 2.83    3.20
                0.50    7.50 | 1.33    8.23 |  2.17    4.23 |
                0.67   13.95 | 1.50    6.78 |  2.33    3.90 |


--------------------------------------------------------------------------------
-------------------
| CALIB           |
| NASHYD  (  0201)|   Area     (ha)=   0.07   Curve Number    (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                  ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN | TIME    RAIN |'  TIME    RAIN | TIME    RAIN
                 hrs   mm/hr |  hrs   mm/hr |'   hrs   mm/hr |  hrs   mm/hr
               0.083    3.76 | 0.833   13.95 | 1.583    6.78 | 2.33    4.23
               0.167    3.76 | 0.917   80.82 | 1.667    6.78 | 2.42    3.90
               0.250    4.42 | 1.000   80.82 | 1.750    5.83 | 2.50    3.90
               0.333    4.42 | 1.083   17.11 | 1.833    5.83 | 2.58    3.63
               0.417    5.48 | 1.167   17.11 | 1.917    5.15 | 2.67    3.63
               0.500    5.48 | 1.250   10.79 | 2.000    5.15 | 2.75    3.39
               0.583    7.50 | 1.333   10.79 | 2.083    4.63 | 2.83    3.39
               0.667    7.50 | 1.417    8.23 | 2.167    4.63 | 2.92    3.20
               0.750   13.95 | 1.500    8.23 | 2.250    4.23 | 3.00    3.20

     Unit Hyd Qpeak  (cms)=   0.017

     PEAK FLOW       (cms)=   0.000 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   1.721
     TOTAL RAINFALL   (mm)=  32.132
     RUNOFF COEFFICIENT   =   0.054

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| CALIB           |
| NASHYD  (  0203)|   Area     (ha)=   0.16   Curve Number    (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                  ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN | TIME    RAIN |'  TIME    RAIN | TIME    RAIN
                 hrs   mm/hr |  hrs   mm/hr |'   hrs   mm/hr |  hrs   mm/hr
               0.083    3.76 | 0.833   13.95 | 1.583    6.78 | 2.33    4.23
               0.167    3.76 | 0.917   80.82 | 1.667    6.78 | 2.42    3.90
               0.250    4.42 | 1.000   80.82 | 1.750    5.83 | 2.50    3.90
               0.333    4.42 | 1.083   17.11 | 1.833    5.83 | 2.58    3.63
               0.417    5.48 | 1.167   17.11 | 1.917    5.15 | 2.67    3.63
               0.500    5.48 | 1.250   10.79 | 2.000    5.15 | 2.75    3.39
               0.583    7.50 | 1.333   10.79 | 2.083    4.63 | 2.83    3.39
               0.667    7.50 | 1.417    8.23 | 2.167    4.63 | 2.92    3.20
               0.750   13.95 | 1.500    8.23 | 2.250    4.23 | 3.00    3.20

     Unit Hyd Qpeak  (cms)=   0.037

     PEAK FLOW       (cms)=   0.001 (i)
     TIME TO PEAK    (hrs)=   1.167
     RUNOFF VOLUME    (mm)=   1.725
     TOTAL RAINFALL   (mm)=  32.132
     RUNOFF COEFFICIENT   =   0.054

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| CALIB           |
| STANDHYD (  0202)|   Area     (ha)=   1.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  82.00   Dir. Conn.(%)=  82.00
-------------------

                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.48          0.32
     Dep. Storage     (mm)=        1.00          5.00
     Average Slope     (%)=        1.00          2.00
     Length            (m)=      109.70         40.00
     Mannings n           =       0.013         0.250
```

```
        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    3.76 | 0.833   13.95 | 1.583    6.78 |  2.33    4.23
               0.167    3.76 | 0.917   80.82 | 1.667    6.78 |  2.42    3.90
               0.250    4.42 | 1.000   80.82 | 1.750    5.83 |  2.50    3.90
               0.333    4.42 | 1.083   17.11 | 1.833    5.83 |  2.58    3.63
               0.417    5.48 | 1.167   17.11 | 1.917    5.15 |  2.67    3.63
               0.500    5.48 | 1.250   10.79 | 2.000    5.15 |  2.75    3.39
               0.583    7.50 | 1.333   10.79 | 2.083    4.63 |  2.83    3.39
               0.667    7.50 | 1.417    8.23 | 2.167    4.63 |  2.92    3.20
               0.750   13.95 | 1.500    8.23 | 2.250    4.23 |  3.00    3.20

    Max.Eff.Inten.(mm/hr)=      80.82         2.98
                over (min)       5.00        10.00
    Storage Coeff.  (min)=       2.94 (ii)    7.13 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=       0.28         0.14
                                                    *TOTALS*
    PEAK FLOW       (cms)=       0.32         0.00          0.324 (iii)
    TIME TO PEAK    (hrs)=       1.00         1.08           1.00
    RUNOFF VOLUME    (mm)=      31.13         1.73          25.84
    TOTAL RAINFALL   (mm)=      32.13        32.13          32.13
    RUNOFF COEFFICIENT   =       0.97         0.05           0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN*  =  39.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| RESERVOIR(  0016)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
-------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                          0.0000     0.0000    |    0.0535     0.0531
                          0.0053     0.0445    |    0.0586     0.0554
                          0.0244     0.0459    |    0.0633     0.0577
                          0.0341     0.0475    |    0.0835     0.0603
                          0.0416     0.0492    |    0.1073     0.0630
                          0.0480     0.0511    |    0.1192     0.0702

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0202)    1.805     0.324      1.00      25.84
   OUTFLOW: ID= 1 (  0016)    1.805     0.005      3.08      24.66

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  1.58
                  TIME SHIFT OF PEAK FLOW         (min)=125.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0431

--------------------------------------------------------------------------------

-------------------
| ADD HYD  (  0015)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)     (cms)    (hrs)     (mm)
       ID1= 1 (  0016):      1.81    0.005     3.08    24.66
     + ID2= 2 (  0201):      0.07    0.000     1.17     1.72
       ================================================
       ID = 3 (  0015):      1.88    0.005     3.00    23.75

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

-------------------
| ADD HYD  (  0015)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)     (cms)    (hrs)     (mm)
       ID1= 3 (  0015):      1.88    0.005     3.00    23.75
     + ID2= 2 (  0203):      0.16    0.001     1.17     1.73
       ================================================
       ID = 1 (  0015):      2.04    0.005     3.00    21.99

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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      V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


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DATE: 09-17-2026                          TIME: 03:50:20

USER:



COMMENTS: _____

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  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_005yr     **
  ************************************************

-------------------
| CHICAGO STORM    |     IDF curve parameters: A= 535.364
| Ptotal= 42.56 mm |                           B=   0.000
-------------------                           C=   0.699
                          used in:   INTENSITY =  A / (t + B)^C

                          Duration of storm  =  3.00 hrs
                          Storm time step    = 10.00 min
                          Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    4.98 |  0.83  107.07 |  1.67    7.72 |  2.50    4.80
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.17 | 5.86 | 1.00 | 22.67 | 1.83 | 6.82 | 2.67 | 4.50 |
| 0.33 | 7.26 | 1.17 | 14.30 | 2.00 | 6.14 | 2.83 | 4.24 |
| 0.50 | 9.93 | 1.33 | 10.90 | 2.17 | 5.60 | | |
| 0.67 | 18.47 | 1.50 | 8.98 | 2.33 | 5.16 | | |

CALIB NASHYD ( 0201) ID= 1 DT= 5.0 min | Area (ha)= 0.07 Curve Number (CN)= 39.0 | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00 | U.H. Tp(hrs)= 0.17

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 4.98 | 0.833 | 18.47 | 1.583 | 8.98 | 2.33 | 5.60 |
| 0.167 | 4.98 | 0.917 | 107.07 | 1.667 | 8.98 | 2.42 | 5.16 |
| 0.250 | 5.86 | 1.000 | 107.07 | 1.750 | 7.72 | 2.50 | 5.16 |
| 0.333 | 5.86 | 1.083 | 22.67 | 1.833 | 7.72 | 2.58 | 4.80 |
| 0.417 | 7.26 | 1.167 | 22.67 | 1.917 | 6.82 | 2.67 | 4.80 |
| 0.500 | 7.26 | 1.250 | 14.30 | 2.000 | 6.82 | 2.75 | 4.50 |
| 0.583 | 9.93 | 1.333 | 14.30 | 2.083 | 6.14 | 2.83 | 4.50 |
| 0.667 | 9.93 | 1.417 | 10.90 | 2.167 | 6.14 | 2.92 | 4.24 |
| 0.750 | 18.47 | 1.500 | 10.90 | 2.250 | 5.60 | 3.00 | 4.24 |

Unit Hyd Qpeak (cms)= 0.017

PEAK FLOW (cms)= 0.001 (i)
TIME TO PEAK (hrs)= 1.167
RUNOFF VOLUME (mm)= 3.227
TOTAL RAINFALL (mm)= 42.565
RUNOFF COEFFICIENT = 0.076

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD ( 0203) ID= 1 DT= 5.0 min | Area (ha)= 0.16 Curve Number (CN)= 39.0 | Ia (mm)= 5.00 # of Linear Res.(N)= 3.00 | U.H. Tp(hrs)= 0.17

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 4.98 | 0.833 | 18.47 | 1.583 | 8.98 | 2.33 | 5.60 |
| 0.167 | 4.98 | 0.917 | 107.07 | 1.667 | 8.98 | 2.42 | 5.16 |
| 0.250 | 5.86 | 1.000 | 107.07 | 1.750 | 7.72 | 2.50 | 5.16 |
| 0.333 | 5.86 | 1.083 | 22.67 | 1.833 | 7.72 | 2.58 | 4.80 |
| 0.417 | 7.26 | 1.167 | 22.67 | 1.917 | 6.82 | 2.67 | 4.80 |
| 0.500 | 7.26 | 1.250 | 14.30 | 2.000 | 6.82 | 2.75 | 4.50 |
| 0.583 | 9.93 | 1.333 | 14.30 | 2.083 | 6.14 | 2.83 | 4.50 |
| 0.667 | 9.93 | 1.417 | 10.90 | 2.167 | 6.14 | 2.92 | 4.24 |
| 0.750 | 18.47 | 1.500 | 10.90 | 2.250 | 5.60 | 3.00 | 4.24 |

Unit Hyd Qpeak (cms)= 0.037

PEAK FLOW (cms)= 0.002 (i)
TIME TO PEAK (hrs)= 1.167
RUNOFF VOLUME (mm)= 3.231
TOTAL RAINFALL (mm)= 42.565
RUNOFF COEFFICIENT = 0.076

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD ( 0202) ID= 1 DT= 5.0 min | Area (ha)= 1.81 | Total Imp(%)= 82.00 Dir. Conn.(%)= 82.00

| | | IMPERVIOUS | PERVIOUS (i) |
|---|---|---|---|
| Surface Area | (ha)= | 1.48 | 0.32 |
| Dep. Storage | (mm)= | 1.00 | 5.00 |
| Average Slope | (%)= | 1.00 | 2.00 |
| Length | (m)= | 109.70 | 40.00 |
| Mannings n | = | 0.013 | 0.250 |

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 4.98 | 0.833 | 18.47 | 1.583 | 8.98 | 2.33 | 5.60 |
| 0.167 | 4.98 | 0.917 | 107.07 | 1.667 | 8.98 | 2.42 | 5.16 |
| 0.250 | 5.86 | 1.000 | 107.07 | 1.750 | 7.72 | 2.50 | 5.16 |
| 0.333 | 5.86 | 1.083 | 22.67 | 1.833 | 7.72 | 2.58 | 4.80 |
| 0.417 | 7.26 | 1.167 | 22.67 | 1.917 | 6.82 | 2.67 | 4.80 |
| 0.500 | 7.26 | 1.250 | 14.30 | 2.000 | 6.82 | 2.75 | 4.50 |
| 0.583 | 9.93 | 1.333 | 14.30 | 2.083 | 6.14 | 2.83 | 4.50 |
| 0.667 | 9.93 | 1.417 | 10.90 | 2.167 | 6.14 | 2.92 | 4.24 |
| 0.750 | 18.47 | 1.500 | 10.90 | 2.250 | 5.60 | 3.00 | 4.24 |

| | | | | |
|---|---|---|---|---|
| Max.Eff.Inten.(mm/hr)= | 107.07 | 5.98 | | |
| over (min) | 5.00 | 10.00 | | |
| Storage Coeff. (min)= | 2.63 (ii) | 6.37 (ii) | | |
| Unit Hyd. Tpeak (min)= | 5.00 | 10.00 | | |
| Unit Hyd. peak (cms)= | 0.29 | 0.15 | | |
| | | | *TOTALS* | |
| PEAK FLOW (cms)= | 0.43 | 0.00 | 0.435 (iii) | |
| TIME TO PEAK (hrs)= | 1.00 | 1.08 | 1.00 | |
| RUNOFF VOLUME (mm)= | 41.56 | 3.25 | 34.67 | |
| TOTAL RAINFALL (mm)= | 42.56 | 42.56 | 42.56 | |
| RUNOFF COEFFICIENT = | 0.98 | 0.08 | 0.81 | |

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 39.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR( 0016) IN= 2---> OUT= 1 | DT= 5.0 min | OVERFLOW IS OFF

| OUTFLOW (cms) | STORAGE (ha.m.) | OUTFLOW (cms) | STORAGE (ha.m.) |
|---|---|---|---|
| 0.0000 | 0.0000 | 0.0535 | 0.0531 |
| 0.0053 | 0.0445 | 0.0586 | 0.0554 |
| 0.0244 | 0.0459 | 0.0633 | 0.0577 |
| 0.0341 | 0.0475 | 0.0835 | 0.0603 |
| 0.0416 | 0.0492 | 0.1073 | 0.0630 |
| 0.0480 | 0.0511 | 0.1192 | 0.0702 |

| | AREA (ha) | QPEAK (cms) | TPEAK (hrs) | R.V. (mm) |
|---|---|---|---|---|
| INFLOW : ID= 2 ( 0202) | 1.805 | 0.435 | 1.00 | 34.67 |
| OUTFLOW: ID= 1 ( 0016) | 1.805 | 0.032 | 1.83 | 33.48 |

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.26

```
                TIME SHIFT OF PEAK FLOW         (min)= 50.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.0471

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0015)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)      (mm)
       ID1= 1 (  0016):     1.81   0.032     1.83    33.48
     + ID2= 2 (  0201):     0.07   0.001     1.17     3.23
       ================================================
       ID = 3 (  0015):     1.88   0.032     1.83    32.29

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0015)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)      (mm)
       ID1= 3 (  0015):     1.88   0.032     1.83    32.29
     + ID2= 2 (  0203):     0.16   0.002     1.17     3.23
       ================================================
       ID = 1 (  0015):     2.04   0.032     1.83    29.96

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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================================================================================
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      V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M M M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                ***** D E T A I L E D   O U T P U T *****


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DATE: 09-17-2026                          TIME: 03:50:20

USER:


COMMENTS: _____________________________________________________

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  ***********************************************
  ** SIMULATION : Dundalk_Chicago_3hr_010yr     **
  ***********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 622.842
| Ptotal= 49.52 mm |                          B=   0.000
--------------------                          C=   0.699
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

              TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.00    5.79 |  0.83  124.56 |'  1.67    8.98 |  2.50    5.59
              0.17    6.82 |  1.00   26.38 |'  1.83    7.93 |  2.67    5.23
              0.33    8.45 |  1.17   16.63 |'  2.00    7.14 |  2.83    4.93
              0.50   11.56 |  1.33   12.68 |'  2.17    6.51 |
              0.67   21.49 |  1.50   10.45 |'  2.33    6.01 |

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0201)|   Area    (ha)=   0.07   Curve Number   (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
              TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
             0.083    5.79 | 0.833   21.49 | 1.583   10.45 |  2.33    6.51
             0.167    5.79 | 0.917  124.56 | 1.667   10.45 |  2.42    6.01
             0.250    6.82 | 1.000  124.56 | 1.750    8.98 |  2.50    6.01
             0.333    6.82 | 1.083   26.38 | 1.833    8.98 |  2.58    5.59
             0.417    8.45 | 1.167   26.38 | 1.917    7.93 |  2.67    5.59
             0.500    8.45 | 1.250   16.63 | 2.000    7.93 |  2.75    5.23
             0.583   11.56 | 1.333   16.63 | 2.083    7.14 |  2.83    5.23
             0.667   11.56 | 1.417   12.68 | 2.167    7.14 |  2.92    4.93
             0.750   21.49 | 1.500   12.68 | 2.250    6.51 |  3.00    4.93

    Unit Hyd Qpeak  (cms)=   0.017

    PEAK FLOW       (cms)=   0.001 (i)
    TIME TO PEAK    (hrs)=   1.083
    RUNOFF VOLUME    (mm)=   4.462
    TOTAL RAINFALL   (mm)=  49.520
    RUNOFF COEFFICIENT   =   0.090

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0203)|   Area    (ha)=   0.16   Curve Number   (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
              TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
             0.083    5.79 | 0.833   21.49 | 1.583   10.45 |  2.33    6.51
             0.167    5.79 | 0.917  124.56 | 1.667   10.45 |  2.42    6.01
             0.250    6.82 | 1.000  124.56 | 1.750    8.98 |  2.50    6.01
             0.333    6.82 | 1.083   26.38 | 1.833    8.98 |  2.58    5.59
```

```
              0.417    8.45 | 1.167   26.38 | 1.917    7.93 |  2.67    5.59
              0.500    8.45 | 1.250   16.63 | 2.000    7.93 |  2.75    5.23
              0.583   11.56 | 1.333   16.63 | 2.083    7.14 |  2.83    5.23
              0.667   11.56 | 1.417   12.68 | 2.167    7.14 |  2.92    4.93
              0.750   21.49 | 1.500   12.68 | 2.250    6.51 |  3.00    4.93

     Unit Hyd Qpeak  (cms)=   0.037

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=   1.083
     RUNOFF VOLUME    (mm)=   4.467
     TOTAL RAINFALL   (mm)=  49.520
     RUNOFF COEFFICIENT   =   0.090

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0202)|   Area    (ha)=   1.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  82.00   Dir. Conn.(%)=  82.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=     1.48          0.32
     Dep. Storage     (mm)=     1.00          5.00
     Average Slope     (%)=     1.00          2.00
     Length            (m)=   109.70         40.00
     Mannings n           =    0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                        ---- TRANSFORMED HYETOGRAPH ----
               TIME     RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs    mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083     5.79 | 0.833   21.49 | 1.583   10.45 |  2.33    6.51
              0.167     5.79 | 0.917  124.56 | 1.667   10.45 |  2.42    6.01
              0.250     6.82 | 1.000  124.56 | 1.750    8.98 |  2.50    6.01
              0.333     6.82 | 1.083   26.38 | 1.833    8.98 |  2.58    5.59
              0.417     8.45 | 1.167   26.38 | 1.917    7.93 |  2.67    5.59
              0.500     8.45 | 1.250   16.63 | 2.000    7.93 |  2.75    5.23
              0.583    11.56 | 1.333   16.63 | 2.083    7.14 |  2.83    5.23
              0.667    11.56 | 1.417   12.68 | 2.167    7.14 |  2.92    4.93
              0.750    21.49 | 1.500   12.68 | 2.250    6.51 |  3.00    4.93

     Max.Eff.Inten.(mm/hr)=    124.56          8.49
               over (min)         5.00         10.00
     Storage Coeff.  (min)=     2.47 (ii)     6.00 (ii)
     Unit Hyd. Tpeak (min)=     5.00         10.00
     Unit Hyd. peak  (cms)=     0.29          0.15
                                                    *TOTALS*
     PEAK FLOW       (cms)=     0.50          0.01          0.509 (iii)
     TIME TO PEAK    (hrs)=     1.00          1.08           1.00
     RUNOFF VOLUME    (mm)=    48.52          4.49          40.59
     TOTAL RAINFALL   (mm)=    49.52         49.52          49.52
     RUNOFF COEFFICIENT   =     0.98          0.09           0.82

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  39.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0016)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |   0.0535     0.0531
                          0.0053      0.0445   |   0.0586     0.0554
                          0.0244      0.0459   |   0.0633     0.0577
                          0.0341      0.0475   |   0.0835     0.0603
                          0.0416      0.0492   |   0.1073     0.0630
                          0.0480      0.0511   |   0.1192     0.0702

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0202)    1.805     0.509     1.00       40.59
   OUTFLOW: ID= 1 (  0016)    1.805     0.046     1.58       39.41

                PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.03
                TIME SHIFT OF PEAK FLOW          (min)= 35.00
                MAXIMUM  STORAGE   USED        (ha.m.)=  0.0505

-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0015)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0016):      1.81    0.046     1.58    39.41
     + ID2= 2 (  0201):      0.07    0.001     1.08     4.46
       ================================================
       ID = 3 (  0015):      1.88    0.046     1.58    38.04

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0015)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0015):      1.88    0.046     1.58    38.04
     + ID2= 2 (  0203):      0.16    0.002     1.08     4.47
       ================================================
       ID = 1 (  0015):      2.04    0.047     1.58    35.34

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
================================================================================
==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****

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```

DATE: 09-17-2026 TIME: 03:50:20

USER:

COMMENTS: _____

**********
** SIMULATION : Dundalk_Chicago_3hr_025yr **
**********

| CHICAGO STORM | Ptotal= 58.14 mm |

IDF curve parameters: A= 731.314
B= 0.000
C= 0.699
used in: INTENSITY = A / (t + B)^C

Duration of storm = 3.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.00 | 6.80 | 0.83 | 146.25 | 1.67 | 10.54 | 2.50 | 6.56 |
| 0.17 | 8.01 | 1.00 | 30.97 | 1.83 | 9.31 | 2.67 | 6.14 |
| 0.33 | 9.92 | 1.17 | 19.53 | 2.00 | 8.38 | 2.83 | 5.79 |
| 0.50 | 13.57 | 1.33 | 14.89 | 2.17 | 7.65 | | |
| 0.67 | 25.24 | 1.50 | 12.27 | 2.33 | 7.05 | | |

| CALIB | NASHYD ( 0201) | ID= 1 DT= 5.0 min |

Area (ha)= 0.07 Curve Number (CN)= 39.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.17

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 6.80 | 0.833 | 25.24 | 1.583 | 12.27 | 2.33 | 7.65 |
| 0.167 | 6.80 | 0.917 | 146.25 | 1.667 | 12.27 | 2.42 | 7.05 |
| 0.250 | 8.01 | 1.000 | 146.25 | 1.750 | 10.54 | 2.50 | 7.05 |
| 0.333 | 8.01 | 1.083 | 30.97 | 1.833 | 10.54 | 2.58 | 6.56 |
| 0.417 | 9.92 | 1.167 | 30.97 | 1.917 | 9.31 | 2.67 | 6.56 |
| 0.500 | 9.92 | 1.250 | 19.53 | 2.000 | 9.31 | 2.75 | 6.14 |
| 0.583 | 13.57 | 1.333 | 19.53 | 2.083 | 8.38 | 2.83 | 6.14 |
| 0.667 | 13.57 | 1.417 | 14.89 | 2.167 | 8.38 | 2.92 | 5.79 |
| 0.750 | 25.24 | 1.500 | 14.89 | 2.250 | 7.65 | 3.00 | 5.79 |

Unit Hyd Qpeak (cms)= 0.017

PEAK FLOW (cms)= 0.001 (i)
TIME TO PEAK (hrs)= 1.083
RUNOFF VOLUME (mm)= 6.242
TOTAL RAINFALL (mm)= 58.144
RUNOFF COEFFICIENT = 0.107

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB | NASHYD ( 0203) | ID= 1 DT= 5.0 min |

Area (ha)= 0.16 Curve Number (CN)= 39.0
Ia (mm)= 5.00 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= 0.17

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 6.80 | 0.833 | 25.24 | 1.583 | 12.27 | 2.33 | 7.65 |
| 0.167 | 6.80 | 0.917 | 146.25 | 1.667 | 12.27 | 2.42 | 7.05 |
| 0.250 | 8.01 | 1.000 | 146.25 | 1.750 | 10.54 | 2.50 | 7.05 |
| 0.333 | 8.01 | 1.083 | 30.97 | 1.833 | 10.54 | 2.58 | 6.56 |
| 0.417 | 9.92 | 1.167 | 30.97 | 1.917 | 9.31 | 2.67 | 6.56 |
| 0.500 | 9.92 | 1.250 | 19.53 | 2.000 | 9.31 | 2.75 | 6.14 |
| 0.583 | 13.57 | 1.333 | 19.53 | 2.083 | 8.38 | 2.83 | 6.14 |
| 0.667 | 13.57 | 1.417 | 14.89 | 2.167 | 8.38 | 2.92 | 5.79 |
| 0.750 | 25.24 | 1.500 | 14.89 | 2.250 | 7.65 | 3.00 | 5.79 |

Unit Hyd Qpeak (cms)= 0.037

PEAK FLOW (cms)= 0.003 (i)
TIME TO PEAK (hrs)= 1.083
RUNOFF VOLUME (mm)= 6.246
TOTAL RAINFALL (mm)= 58.144
RUNOFF COEFFICIENT = 0.107

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB | STANDHYD ( 0202) | ID= 1 DT= 5.0 min |

Area (ha)= 1.81
Total Imp(%)= 82.00 Dir. Conn.(%)= 82.00

| | | IMPERVIOUS | PERVIOUS (i) |
|---|---|---|---|
| Surface Area | (ha)= | 1.48 | 0.32 |
| Dep. Storage | (mm)= | 1.00 | 5.00 |
| Average Slope | (%)= | 1.00 | 2.00 |
| Length | (m)= | 109.70 | 40.00 |
| Mannings n | = | 0.013 | 0.250 |

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 6.80 | 0.833 | 25.24 | 1.583 | 12.27 | 2.33 | 7.65 |
| 0.167 | 6.80 | 0.917 | 146.25 | 1.667 | 12.27 | 2.42 | 7.05 |
| 0.250 | 8.01 | 1.000 | 146.25 | 1.750 | 10.54 | 2.50 | 7.05 |
| 0.333 | 8.01 | 1.083 | 30.97 | 1.833 | 10.54 | 2.58 | 6.56 |
| 0.417 | 9.92 | 1.167 | 30.97 | 1.917 | 9.31 | 2.67 | 6.56 |
| 0.500 | 9.92 | 1.250 | 19.53 | 2.000 | 9.31 | 2.75 | 6.14 |
| 0.583 | 13.57 | 1.333 | 19.53 | 2.083 | 8.38 | 2.83 | 6.14 |
| 0.667 | 13.57 | 1.417 | 14.89 | 2.167 | 8.38 | 2.92 | 5.79 |
| 0.750 | 25.24 | 1.500 | 14.89 | 2.250 | 7.65 | 3.00 | 5.79 |

| | | | | *TOTALS* |
|---|---|---|---|---|
| Max.Eff.Inten. | (mm/hr)= | 146.25 | 12.14 | |
| | over (min) | 5.00 | 10.00 | |
| Storage Coeff. | (min)= | 2.32 (ii) | 5.62 (ii) | |
| Unit Hyd. Tpeak | (min)= | 5.00 | 10.00 | |
| Unit Hyd. peak | (cms)= | 0.30 | 0.15 | |
| PEAK FLOW | (cms)= | 0.59 | 0.01 | 0.601 (iii) |
| TIME TO PEAK | (hrs)= | 1.00 | 1.08 | 1.00 |
| RUNOFF VOLUME | (mm)= | 57.14 | 6.27 | 47.98 |
| TOTAL RAINFALL | (mm)= | 58.14 | 58.14 | 58.14 |
| RUNOFF COEFFICIENT | = | 0.98 | 0.11 | 0.83 |

| CALIB |

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  39.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| RESERVOIR(  0016)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
-------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                          0.0000      0.0000   |    0.0535      0.0531
                          0.0053      0.0445   |    0.0586      0.0554
                          0.0244      0.0459   |    0.0633      0.0577
                          0.0341      0.0475   |    0.0835      0.0603
                          0.0416      0.0492   |    0.1073      0.0630
                          0.0480      0.0511   |    0.1192      0.0702

                              AREA     QPEAK     TPEAK       R.V.
                              (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0202)    1.805     0.601      1.00      47.98
   OUTFLOW: ID= 1 (  0016)    1.805     0.061      1.50      46.80

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 10.19
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0567

--------------------------------------------------------------------------------

-------------------
| ADD HYD  (  0015)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0016):      1.81    0.061     1.50    46.80
     + ID2= 2 (  0201):      0.07    0.001     1.08     6.24
       ==========================================
       ID = 3 (  0015):      1.88    0.062     1.50    45.21

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

-------------------
| ADD HYD  (  0015)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
-------------------           (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0015):      1.88    0.062     1.50    45.21
     + ID2= 2 (  0203):      0.16    0.003     1.08     6.25
       ==========================================
       ID = 1 (  0015):      2.04    0.064     1.42    42.08

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
================================================================================
===============

      V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                    *****  D E T A I L E D   O U T P U T *****

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DATE: 09-17-2026                          TIME: 03:50:20

USER:


COMMENTS: _____________________________________________________

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  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_050yr     **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 811.794
| Ptotal= 64.54 mm |                          B=   0.000
--------------------                          C=   0.699
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  3.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
          0.00    7.55 |  0.83  162.35 |   1.67   11.70 |  2.50    7.28
          0.17    8.89 |  1.00   34.38 |   1.83   10.34 |  2.67    6.82
          0.33   11.01 |  1.17   21.68 |   2.00    9.30 |  2.83    6.42
          0.50   15.06 |  1.33   16.53 |   2.17    8.49 |
          0.67   28.01 |  1.50   13.62 |   2.33    7.83 |

--------------------------------------------------------------------------------
-------------------
| CALIB            |
| NASHYD   (  0201)|   Area     (ha)=   0.07   Curve Number    (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
         0.083    7.55 | 0.833   28.01 | 1.583   13.62 |  2.33    8.49
         0.167    7.55 | 0.917  162.35 | 1.667   13.62 |  2.42    7.83
         0.250    8.89 | 1.000  162.35 | 1.750   11.70 |  2.50    7.83
         0.333    8.89 | 1.083   34.38 | 1.833   11.70 |  2.58    7.28
         0.417   11.01 | 1.167   34.38 | 1.917   10.34 |  2.67    7.28
         0.500   11.01 | 1.250   21.68 | 2.000   10.34 |  2.75    6.82
         0.583   15.06 | 1.333   21.68 | 2.083    9.30 |  2.83    6.82
         0.667   15.06 | 1.417   16.53 | 2.167    9.30 |  2.92    6.42
         0.750   28.01 | 1.500   16.53 | 2.250    8.49 |  3.00    6.42
```

```
     Unit Hyd Qpeak  (cms)=   0.017

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=   1.083
     RUNOFF VOLUME    (mm)=   7.726
     TOTAL RAINFALL   (mm)=  64.542
     RUNOFF COEFFICIENT   =   0.120

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

---

| CALIB | | | | | |
|---|---|---|---|---|---|
| NASHYD ( 0203) | Area (ha)= | 0.16 | Curve Number (CN)= | 39.0 | |
| ID= 1 DT= 5.0 min | Ia (mm)= | 5.00 | # of Linear Res.(N)= | 3.00 | |
| | U.H. Tp(hrs)= | 0.17 | | | |

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 7.55 | 0.833 | 28.01 | 1.583 | 13.62 | 2.33 | 8.49 |
| 0.167 | 7.55 | 0.917 | 162.35 | 1.667 | 13.62 | 2.42 | 7.83 |
| 0.250 | 8.89 | 1.000 | 162.35 | 1.750 | 11.70 | 2.50 | 7.83 |
| 0.333 | 8.89 | 1.083 | 34.38 | 1.833 | 11.70 | 2.58 | 7.28 |
| 0.417 | 11.01 | 1.167 | 34.38 | 1.917 | 10.34 | 2.67 | 7.28 |
| 0.500 | 11.01 | 1.250 | 21.68 | 2.000 | 10.34 | 2.75 | 6.82 |
| 0.583 | 15.06 | 1.333 | 21.68 | 2.083 | 9.30 | 2.83 | 6.82 |
| 0.667 | 15.06 | 1.417 | 16.53 | 2.167 | 9.30 | 2.92 | 6.42 |
| 0.750 | 28.01 | 1.500 | 16.53 | 2.250 | 8.49 | 3.00 | 6.42 |

```
     Unit Hyd Qpeak  (cms)=   0.037

     PEAK FLOW       (cms)=   0.004 (i)
     TIME TO PEAK    (hrs)=   1.083
     RUNOFF VOLUME    (mm)=   7.730
     TOTAL RAINFALL   (mm)=  64.542
     RUNOFF COEFFICIENT   =   0.120

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

---

| CALIB | | | | | |
|---|---|---|---|---|---|
| STANDHYD ( 0202) | Area (ha)= | 1.81 | | | |
| ID= 1 DT= 5.0 min | Total Imp(%)= | 82.00 | Dir. Conn.(%)= | 82.00 | |

| | | IMPERVIOUS | PERVIOUS (i) |
|---|---|---|---|
| Surface Area | (ha)= | 1.48 | 0.32 |
| Dep. Storage | (mm)= | 1.00 | 5.00 |
| Average Slope | (%)= | 1.00 | 2.00 |
| Length | (m)= | 109.70 | 40.00 |
| Mannings n | = | 0.013 | 0.250 |

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

| TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr | TIME hrs | RAIN mm/hr |
|---|---|---|---|---|---|---|---|
| 0.083 | 7.55 | 0.833 | 28.01 | 1.583 | 13.62 | 2.33 | 8.49 |
| 0.167 | 7.55 | 0.917 | 162.35 | 1.667 | 13.62 | 2.42 | 7.83 |
| 0.250 | 8.89 | 1.000 | 162.35 | 1.750 | 11.70 | 2.50 | 7.83 |
| 0.333 | 8.89 | 1.083 | 34.38 | 1.833 | 11.70 | 2.58 | 7.28 |
| 0.417 | 11.01 | 1.167 | 34.38 | 1.917 | 10.34 | 2.67 | 7.28 |
| 0.500 | 11.01 | 1.250 | 21.68 | 2.000 | 10.34 | 2.75 | 6.82 |
| 0.583 | 15.06 | 1.333 | 21.68 | 2.083 | 9.30 | 2.83 | 6.82 |
| 0.667 | 15.06 | 1.417 | 16.53 | 2.167 | 9.30 | 2.92 | 6.42 |
| 0.750 | 28.01 | 1.500 | 16.53 | 2.250 | 8.49 | 3.00 | 6.42 |

| | | | | |
|---|---|---|---|---|
| Max.Eff.Inten.(mm/hr)= | 162.35 | 15.23 | | |
| over (min) | 5.00 | 10.00 | | |
| Storage Coeff. (min)= | 2.22 (ii) | 5.39 (ii) | | |
| Unit Hyd. Tpeak (min)= | 5.00 | 10.00 | | |
| Unit Hyd. peak (cms)= | 0.30 | 0.16 | | |
| | | | | *TOTALS* |
| PEAK FLOW (cms)= | 0.66 | 0.01 | | 0.670 (iii) |
| TIME TO PEAK (hrs)= | 1.00 | 1.08 | | 1.00 |
| RUNOFF VOLUME (mm)= | 63.54 | 7.76 | | 53.50 |
| TOTAL RAINFALL (mm)= | 64.54 | 64.54 | | 64.54 |
| RUNOFF COEFFICIENT = | 0.98 | 0.12 | | 0.83 |

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =  39.0     Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

---

| RESERVOIR( 0016) | OVERFLOW IS OFF | | | |
|---|---|---|---|---|
| IN= 2---> OUT= 1 | | | | |
| DT= 5.0 min | OUTFLOW (cms) | STORAGE (ha.m.) | OUTFLOW (cms) | STORAGE (ha.m.) |
| | 0.0000 | 0.0000 | 0.0535 | 0.0531 |
| | 0.0053 | 0.0445 | 0.0586 | 0.0554 |
| | 0.0244 | 0.0459 | 0.0633 | 0.0577 |
| | 0.0341 | 0.0475 | 0.0835 | 0.0603 |
| | 0.0416 | 0.0492 | 0.1073 | 0.0630 |
| | 0.0480 | 0.0511 | 0.1192 | 0.0702 |

| | AREA (ha) | QPEAK (cms) | TPEAK (hrs) | R.V. (mm) |
|---|---|---|---|---|
| INFLOW : ID= 2 ( 0202) | 1.805 | 0.670 | 1.00 | 53.50 |
| OUTFLOW: ID= 1 ( 0016) | 1.805 | 0.089 | 1.33 | 52.32 |

```
     PEAK   FLOW   REDUCTION [Qout/Qin](%)= 13.27
     TIME SHIFT OF PEAK FLOW          (min)= 20.00
     MAXIMUM  STORAGE   USED       (ha.m.)=  0.0610
```

---

ADD HYD ( 0015)

1 + 2 = 3

| | | AREA (ha) | QPEAK (cms) | TPEAK (hrs) | R.V. (mm) |
|---|---|---|---|---|---|
| ID1= 1 ( 0016): | | 1.81 | 0.089 | 1.33 | 52.32 |
| + ID2= 2 ( 0201): | | 0.07 | 0.002 | 1.08 | 7.73 |
| ID = 3 ( 0015): | | 1.88 | 0.090 | 1.33 | 50.56 |

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---

ADD HYD ( 0015)

3 + 2 = 1

| | | AREA (ha) | QPEAK (cms) | TPEAK (hrs) | R.V. (mm) |
|---|---|---|---|---|---|
| ID1= 3 ( 0015): | | 1.88 | 0.090 | 1.33 | 50.56 |
| + ID2= 2 ( 0203): | | 0.16 | 0.004 | 1.08 | 7.73 |
| ID = 1 ( 0015): | | 2.04 | 0.093 | 1.33 | 47.12 |

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---

```
================================================================================
==============

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U A   A  L
         VV     I    SSSSS  UUUUU A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


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DATE: 09-17-2026                          TIME: 03:50:20

USER:


COMMENTS: _____________________________________________________________

--------------------------------------------------------------------------------------------------
--------------
  ************************************************
  ** SIMULATION : Dundalk_Chicago_3hr_100yr     **
  ************************************************

-------------------
| CHICAGO STORM   |     IDF curve parameters: A= 892.273
| Ptotal= 70.94 mm|                           B=   0.000
-------------------                           C=   0.699
                      used in:   INTENSITY =  A / (t + B)^C

                      Duration of storm  =  3.00 hrs
                      Storm time step    = 10.00 min
                      Time to peak ratio =  0.33

                TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
                 hrs    mm/hr |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
                0.00     8.30 |  0.83  178.44  |   1.67   12.86  |  2.50    8.00
                0.17     9.77 |  1.00   37.79  |   1.83   11.36  |  2.67    7.50
                0.33    12.10 |  1.17   23.83  |   2.00   10.23  |  2.83    7.06
                0.50    16.55 |  1.33   18.17  |   2.17    9.33  |
                0.67    30.79 |  1.50   14.97  |   2.33    8.61  |


--------------------------------------------------------------------------------
-------------------
| CALIB             |
| NASHYD   (  0201) |   Area     (ha)=   0.07   Curve Number    (CN)= 39.0
|ID= 1 DT= 5.0 min  |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                  ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
                 hrs    mm/hr |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
               0.083     8.30 | 0.833   30.79  | 1.583   14.97  |  2.33    9.33
               0.167     8.30 | 0.917  178.44  | 1.667   14.97  |  2.42    8.61
               0.250     9.77 | 1.000  178.44  | 1.750   12.86  |  2.50    8.61
               0.333     9.77 | 1.083   37.79  | 1.833   12.86  |  2.58    8.00
               0.417    12.10 | 1.167   37.79  | 1.917   11.36  |  2.67    8.00
               0.500    12.10 | 1.250   23.83  | 2.000   11.36  |  2.75    7.50
               0.583    16.55 | 1.333   23.83  | 2.083   10.23  |  2.83    7.50
               0.667    16.55 | 1.417   18.17  | 2.167   10.23  |  2.92    7.06
               0.750    30.79 | 1.500   18.17  | 2.250    9.33  |  3.00    7.06

     Unit Hyd Qpeak  (cms)=   0.017

     PEAK FLOW       (cms)=   0.002 (i)
     TIME TO PEAK    (hrs)=   1.083
     RUNOFF VOLUME    (mm)=   9.345
     TOTAL RAINFALL   (mm)=  70.941
     RUNOFF COEFFICIENT   =   0.132

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| CALIB             |
| NASHYD   (  0203) |   Area     (ha)=   0.16   Curve Number    (CN)= 39.0
|ID= 1 DT= 5.0 min  |   Ia       (mm)=   5.00   # of Linear Res.(N)= 3.00
-------------------   U.H. Tp(hrs)=   0.17

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                                  ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN  |  TIME    RAIN  |'  TIME    RAIN  |  TIME    RAIN
                 hrs    mm/hr |   hrs   mm/hr  |'   hrs   mm/hr  |   hrs   mm/hr
               0.083     8.30 | 0.833   30.79  | 1.583   14.97  |  2.33    9.33
               0.167     8.30 | 0.917  178.44  | 1.667   14.97  |  2.42    8.61
               0.250     9.77 | 1.000  178.44  | 1.750   12.86  |  2.50    8.61
               0.333     9.77 | 1.083   37.79  | 1.833   12.86  |  2.58    8.00
               0.417    12.10 | 1.167   37.79  | 1.917   11.36  |  2.67    8.00
               0.500    12.10 | 1.250   23.83  | 2.000   11.36  |  2.75    7.50
               0.583    16.55 | 1.333   23.83  | 2.083   10.23  |  2.83    7.50
               0.667    16.55 | 1.417   18.17  | 2.167   10.23  |  2.92    7.06
               0.750    30.79 | 1.500   18.17  | 2.250    9.33  |  3.00    7.06

     Unit Hyd Qpeak  (cms)=   0.037

     PEAK FLOW       (cms)=   0.005 (i)
     TIME TO PEAK    (hrs)=   1.083
     RUNOFF VOLUME    (mm)=   9.350
     TOTAL RAINFALL   (mm)=  70.941
     RUNOFF COEFFICIENT   =   0.132

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
-------------------
| CALIB             |
| STANDHYD (  0202) |   Area     (ha)=   1.81
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  82.00   Dir. Conn.(%)=  82.00
-------------------

                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.48          0.32
     Dep. Storage     (mm)=        1.00          5.00
     Average Slope     (%)=        1.00          2.00
     Length            (m)=      109.70         40.00
     Mannings n           =       0.013         0.250
```

```
        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    8.30 | 0.833   30.79 | 1.583   14.97 | 2.33    9.33
               0.167    8.30 | 0.917  178.44 | 1.667   14.97 | 2.42    8.61
               0.250    9.77 | 1.000  178.44 | 1.750   12.86 | 2.50    8.61
               0.333    9.77 | 1.083   37.79 | 1.833   12.86 | 2.58    8.00
               0.417   12.10 | 1.167   37.79 | 1.917   11.36 | 2.67    8.00
               0.500   12.10 | 1.250   23.83 | 2.000   11.36 | 2.75    7.50
               0.583   16.55 | 1.333   23.83 | 2.083   10.23 | 2.83    7.50
               0.667   16.55 | 1.417   18.17 | 2.167   10.23 | 2.92    7.06
               0.750   30.79 | 1.500   18.17 | 2.250    9.33 | 3.00    7.06

    Max.Eff.Inten.(mm/hr)=     178.44        18.64
                 over (min)       5.00        10.00
    Storage Coeff.  (min)=       2.14 (ii)    5.19 (ii)
    Unit Hyd. Tpeak (min)=       5.00        10.00
    Unit Hyd. peak  (cms)=       0.31         0.16
                                                        *TOTALS*
    PEAK FLOW       (cms)=       0.73         0.01          0.739 (iii)
    TIME TO PEAK    (hrs)=       1.00         1.08           1.00
    RUNOFF VOLUME    (mm)=      69.94         9.39          59.04
    TOTAL RAINFALL   (mm)=      70.94        70.94          70.94
    RUNOFF COEFFICIENT   =       0.99         0.13           0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  39.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0016)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |   (cms)     (ha.m.)
                           0.0000      0.0000   |    0.0535      0.0531
                           0.0053      0.0445   |    0.0586      0.0554
                           0.0244      0.0459   |    0.0633      0.0577
                           0.0341      0.0475   |    0.0835      0.0603
                           0.0416      0.0492   |    0.1073      0.0630
                           0.0480      0.0511   |    0.1192      0.0702

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0202)     1.805     0.739      1.00       59.04
   OUTFLOW: ID= 1 (  0016)     1.805     0.110      1.25       57.86

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 14.85
                  TIME SHIFT OF PEAK FLOW          (min)= 15.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0645

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0015)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)     (cms)    (hrs)     (mm)
       ID1= 1 (  0016):      1.81    0.110     1.25     57.86
     + ID2= 2 (  0201):      0.07    0.002     1.08      9.35
       ==========================================================
       ID = 3 (  0015):      1.88    0.112     1.25     55.95

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

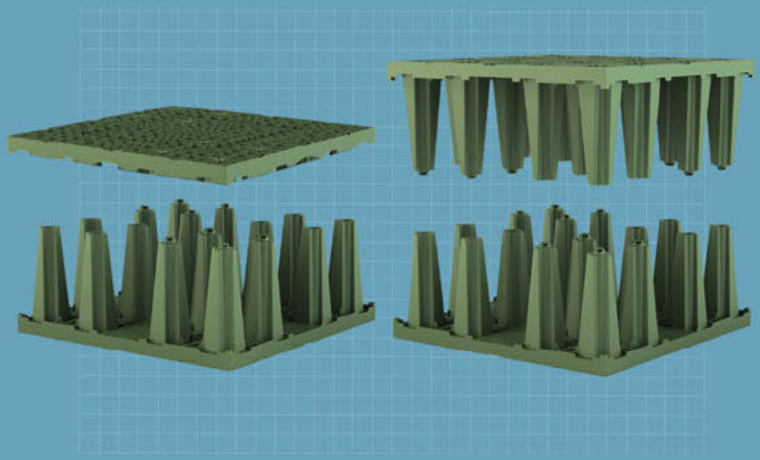
--------------------
| ADD HYD  (  0015)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)     (cms)    (hrs)     (mm)
       ID1= 3 (  0015):      1.88    0.112     1.25     55.95
     + ID2= 2 (  0203):      0.16    0.005     1.08      9.35
       ==========================================================
       ID = 1 (  0015):      2.04    0.116     1.25     52.21

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

 FINISH
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STORMCON

**STORMWATER MANAGEMENT**
**STORMWATER STORAGE**



# GREENSTORM ST
# GREENSTORM ST-B

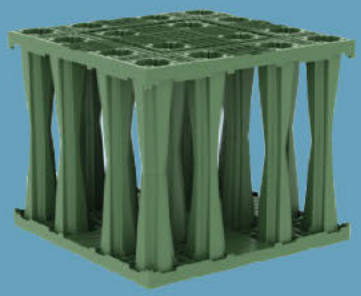
UNDERGROUND STORAGE INFILTRATION MODULES

www.stormcon.ca

STORMCON

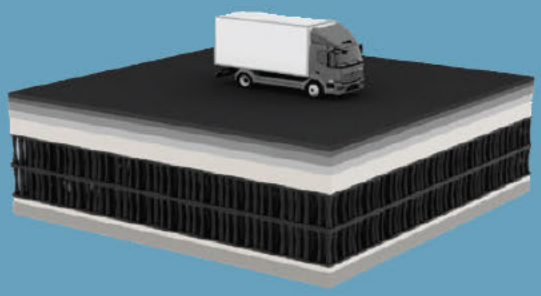
# GREENSTORM ST* SYSTEM

Certifcation CSTB









**EXTREMELY HIGH VOLUME** **VERY EASY TO INSTALL** **100% INSPECTABLE**

NB

In what follows, an illustrative explanation of the GreenStorm system will be given by means of the green module. All properties and advantages also apply to the GreenStorm ST-B system. The systems have been optimised for different installation situations.

In the following, please be sure to pay attention to these signs:

Statements marked with this sign apply to both GreenStorm ST and GreenStorm ST-B.

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# STORING STORMWATER WITH STORAGE/ INFILTRATION SYSTEMS

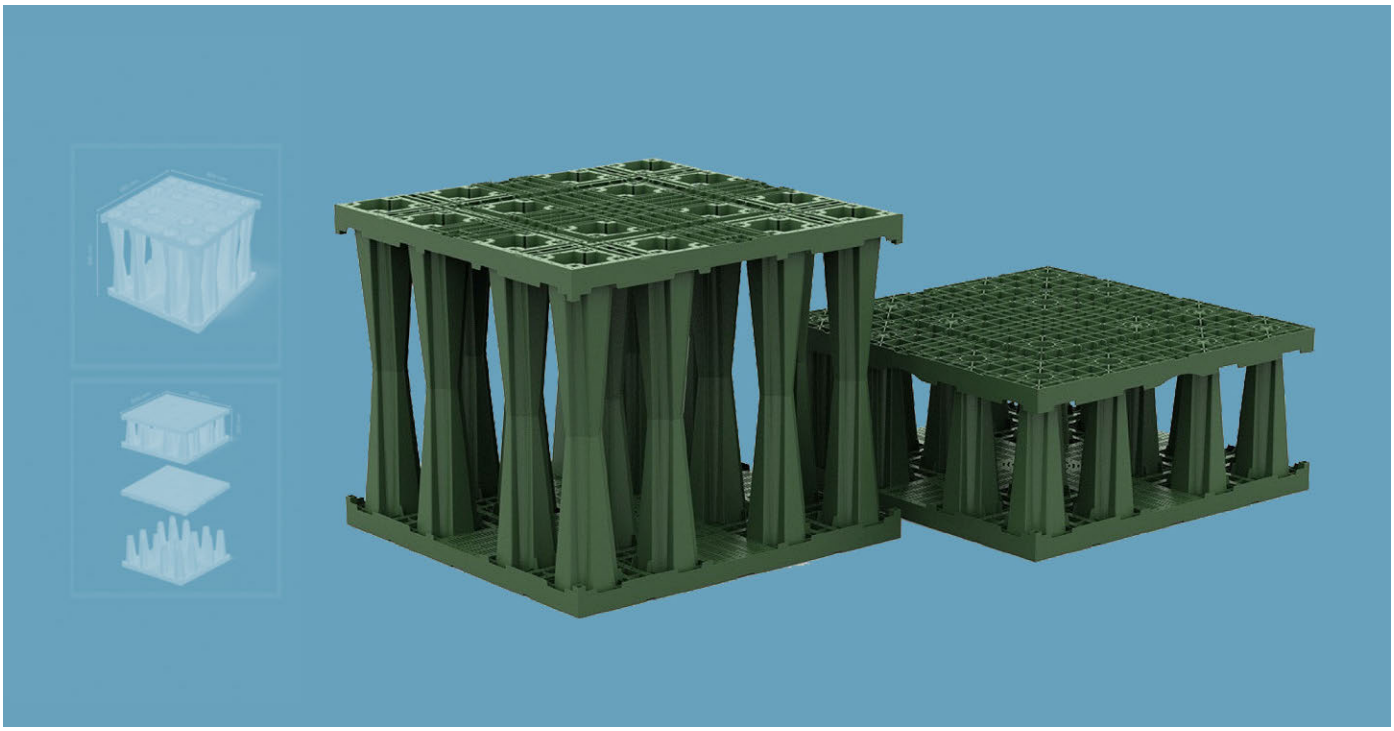
## Basic element for underground water storage facilities

GreenStorm ST* are plastic tanks to be installed underground (storage/ infiltration modules) in which water is collected and stored. Storage/infiltration systems temporarily collect stormwater and discharge it later. In addition to infiltration using underdrained swale systems, pipe swales, and gravel swales common in the past, increasingly more storage/infiltration systems are being built today.

The storage space of the storage/ infiltration system consists of numerous GreenStorm ST* modules which can be combined three - dimensionally to form large systems.

The advantage of this method is that the void ratio is up to three times larger in these infiltration systems than in gravel swales which saves space and excavation work.

GreenStorm ST* is a modular system which is characterised by high flexibility, rapid installation and a high level of user-friendliness.



# APPLICATION – INFILTRATION

## Stormwater infiltration – giving back to nature

Large amounts of stormwater can reduce the performance of wastewater treatment systems. Infiltrating unpolluted stormwater nearby has therefore several advantages.

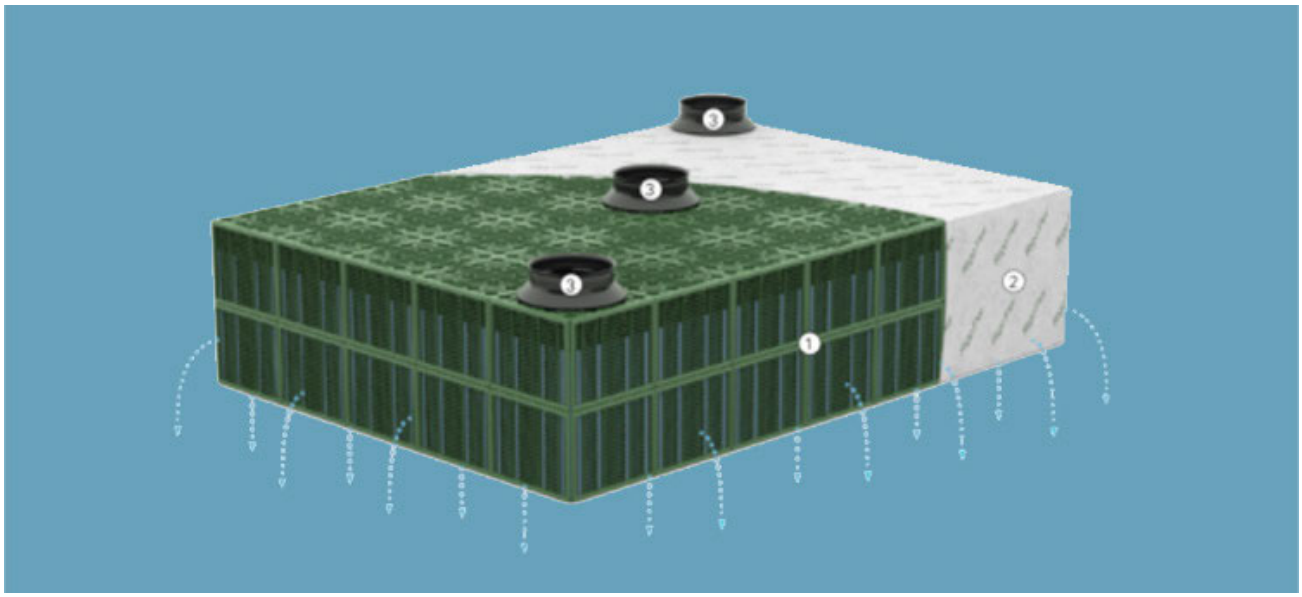
A constant growth in built-up areas and increase in impervious surfaces prevent natural infiltration of stormwater into the soil. Special infiltration systems are used in order to discharge it to the water cycle. In addition to infiltration using pipe swales, increasingly more storage/infiltration systems are being built.

The advantage of this method is that the storage volume of the infiltration system is increased, and space and excavation are saved as compared to gravel swales.

Stormwater is thus returned to the natural water cycle and can contribute to producing new groundwater. Infiltration systems are subject to very high requirements. Consequently, they have become an important component of urban drainage.

Storage/infiltration systems considerably increase the underground storage volume. High-performance storage/infiltration systems can be installed even in confined space.

In particular in urban construction no additional space is required and precious building ground is saved.



1 GreenStorm ST* storage/infiltration module 2 Geotextile 3 QuadrControl ST system shaft

# APPLICATION – RETENTION

## Retaining stormwater – instead of flooding

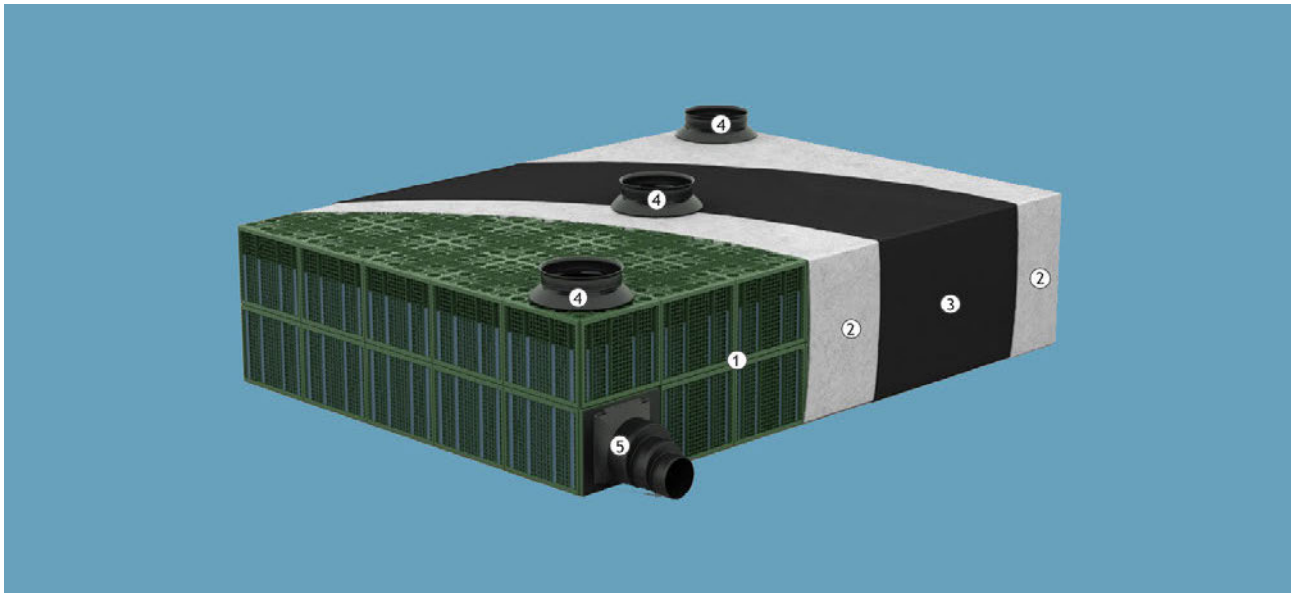
If subsoil conditions are unfavourable to infiltration, the goal is to retain the stormwater and ensure a retarded, timelagged discharge. Exposure to impulsive stress can be eliminated or reduced in sewer networks, wastewater treatment systems and waterbodies.

Stormwater retention systems retard the infiltration of stormwater. They are comprised of a watertight retaining element, an inlet and a vortex outlet.

The stormwater distributes evenly in the system where it can be stored and is then discharged in a controlled manner through throttle shafts. If infiltration must be avoided or to prevent unintended discharge of groundwater or strata water (e.g., in case of contaminated soil), it is necessary to waterproof the retention system.

Stormwater runoff from impervious surfaces that cannot infiltrate naturally leads to peak loads in sewer systems.

Stormwater retention facilities collect stormwater in an underground storage tank and discharge it in a retarded manner but continuously. Their very short construction times make storage/ infiltration systems an inexpensive alternative to conventional retention facilities such as retention channels or underground concrete tanks.




1 GreenStorm ST* storage/infiltration module 2 Geotextile 3 Impermeable membrane
4 QuadroControl ST system shaft 5 Adapter

# APPLICATION – HARVESTING / FIRE WATER STORAGE

## Retaining stormwater – instead of flooding

Water – particularly drinking water – is a priceless resource which should be treated responsibly and used sparingly. It is therefore wise to collect, store and use stormwater if the water must not necessarily be suitable for drinking purposes, instead of allowing the water to infiltrate into the soil unused or diverting it into the sewer system.

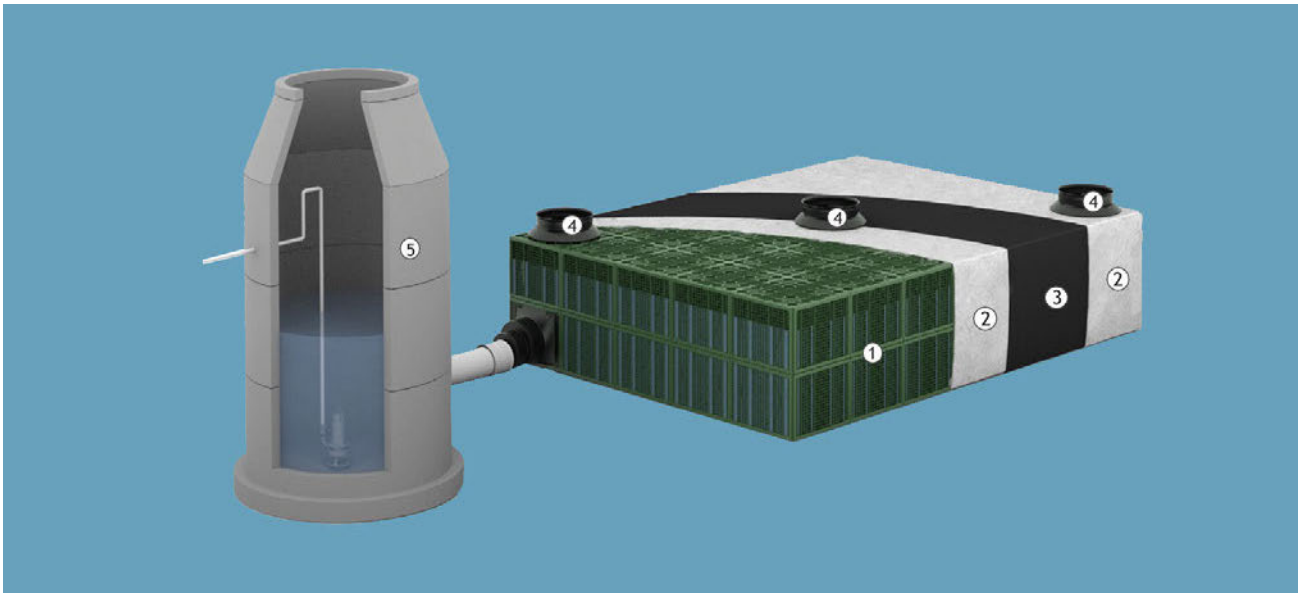
There are many examples: irrigation for greens, car wash, use in toilets, etc.

Water is diverted into a waterproof storage/ infiltration system and can be supplied for use via a pumping system

The use of the GreenStorm inspect system allows for finding solutions that fit project-specific requirements – even under the most difficult conditions such as very tight space, narrow conditions, low cover, high groundwater level, etc.

Stormwater harvesting systems provide waterfor different domestic and industrial water uses. They comprise a watertight retaining element, an inlet with upstream stormwater treatment system, a pump shaft and a system control.

Using GreenStorm ST* for fire water storage also saves water, since system checks can be made in a filled state and water does not have to be pumped out as is the case with conventional concrete tanks.




1 GreenStorm ST* storage/infiltration module 2 Geotextile 3 Impermeable membrane
4 QuadroControl ST system shaft 5 Adapter

# APPLICATION – MODULAR DESIGN

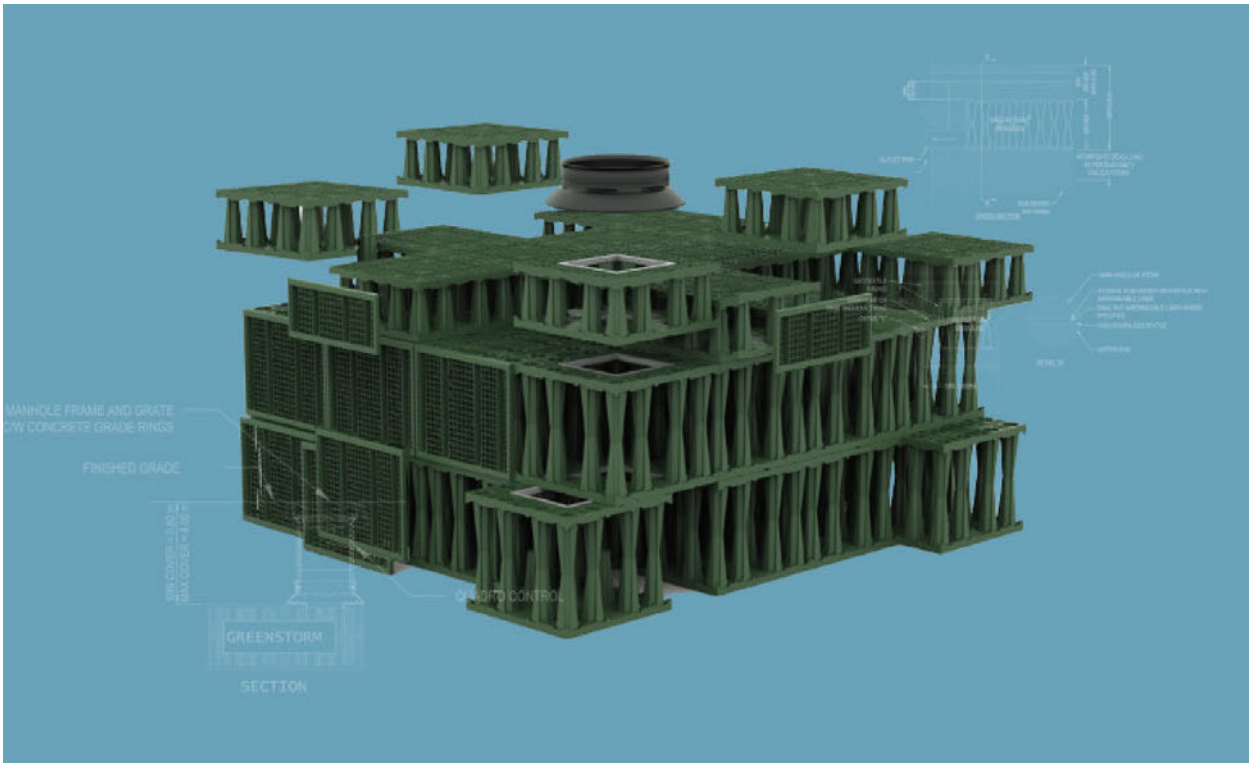
## Individual system geometries due to modular design

Sizes (length and width) of GreenStorm Storage/infiltration systems can be freely designed with hardly any limitations. The 31.4961 in cellular block type structure can easily be adapted to fit nearly any layout.

With heights of 25.9843 in (full block) and 350 mm (half block), systems can be built in various sizes to accommodate any single or multi-layer combination. Therefore, the system can very easily be adapted to on-site requirements.

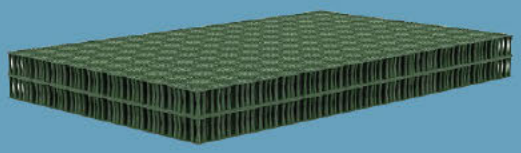
Under high groundwater conditions or low permeability of backfill soil, for example, rather shallow depth systems are to be preferred.

For soils with good permeability, however, high and compact systems are favourable and may be built accordingly. The maximum space available is used.

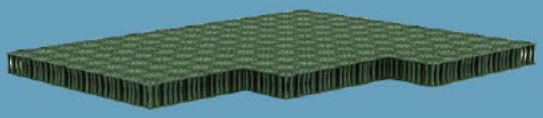



*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

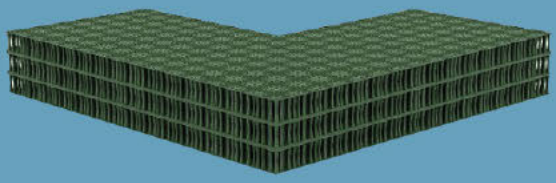
## POSSIBLE SYSTEM GEOMETRIES



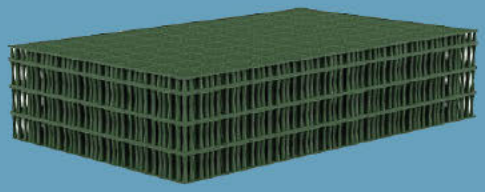
GreenStorm ST*
2 Layer



GreenStorm ST*
1 Layer



GreenStorm ST*
3 Layer



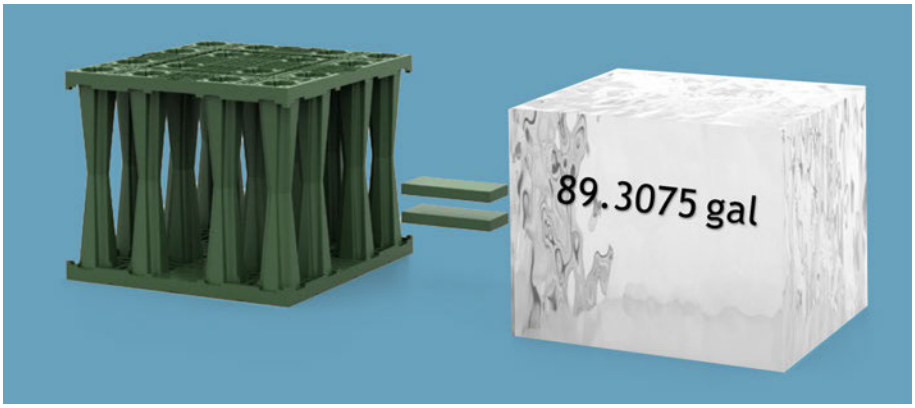
GreenStorm ST*
3 1/2 Layer

# STORAGE VOLUME

## Extremely high volume

The GreenStorm ST* full block provides a storage volume of 89.3075 gallons with a gross volume of 92.827 gallons. With a storage volume of more than 96 %, it stores three times as much water as gravel swales.

The half block has a height of 13.7795 in and is used if shallow systems are required, e.g, in case of high groundwater levels. With a gross volume of 49.2731 gallons, it offers a storage volume of 46.6335 gallons.

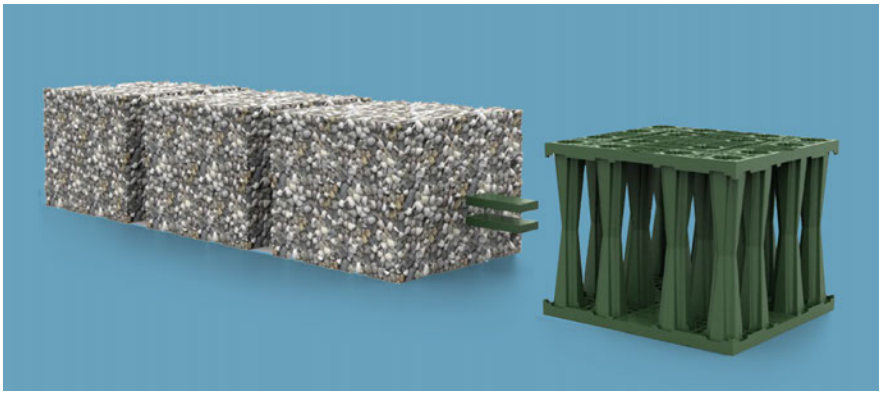



Pipe and gravel swales only use approx. 30 % of their volume to store water. Therefore, three times the required water storage volume must be provided by excavation.

This requires lots of space which is frequently not available in urban areas. GreenStorm ST* storage/infiltration systems save an enormous amount of space and excavation work.

Thus, subsoil storage spaces for stormwater can be built in a very efficient and cost-saving way.

Storage/infiltration systems considerably increase the storage space. High- performance storage/infiltration systems can be installed even in confined space.



*GreenStorm ST/STB underground infitration/storage modules *Rigofill ST RigofillST-B

# INSTALLATION

## Easy construction site handling

### REQUIRES LITTLE SPACE FOR STORAGE.

The storage/infiltration modules are delivered in compact, stacked units with 17 modules per pallet. The easy stackability of the GreenStorm ST* and ST-B modules allows them to be stored even in confined construction space, even outside the excavation pit. This facilitates installation, since no additional storage space must be provided in the excavation pit. Installation is neither impeded nor constrained.



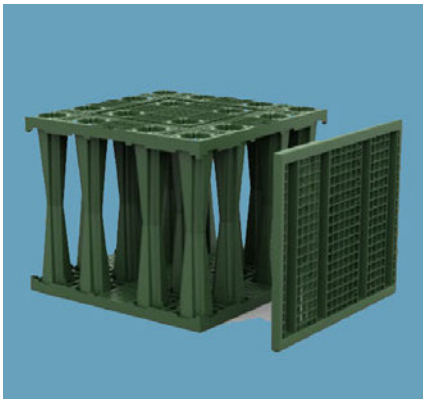
### PRE-ASSEMBLY

Depending on the requirements, GreenStorm ST and GreenStorm ST*-B modules can be pre-assembled in no time at all, both outside and inside the excavation pit with just one easy move. Easy high tensile strength snap connections allow for combining two half elements to create a reliable unit in only a short period of time. This can easily be done by one person alone without requiring any additional tools. The moveable parts of the snap connection are recessed and thus protected from damage.



### EASY ASSEMBLY

There is no need to adhere to any complex installation pattern – the pre-assembled modules or half blocks can just as well be connected to create a single unit. The low weight allows this to be done by one person only. Connectors establish firm connections between the individual modules. The surface can be accessed immediately without any risk of accidents, since the hole size of the columns is dimensioned respectively (< 3.93701 in).
Thus, no additional covers of column holes are required.





UP TO **88%**
The storage/infiltration modstorage space saved as compared to unstackable storage/infiltration modules

*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

# INSPECTION

## CCTV inspection even when filled

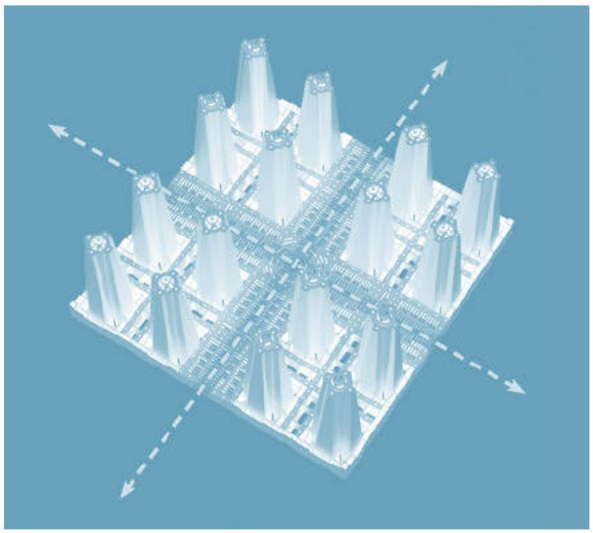
Storage/infiltration systems are durable structures for urban drainage; they must work reliably for decades. Durability and reliability are essential requirements. The best way to inspect the state of a system using state-of-the-art technology is CCTV inspection. Thus, a storage/infiltration system can be inspected excellently – for final acceptance or later. This provides safety for authorities, engineers, construction companies, customers, and operators.

## Cross-shaped inspection tunnel

GreenStorm ST* modules have a cross-shaped tunnel which makes the storage/ infiltration system camera-accessible and flushable in two axes and thus in four dimensions.The special and open design of the inspection tunnel allows for an unobstructed view of the entire interior and not only the inspection tunnel.

For example, the statically relevant load-bearing elements, the condition of the geotextile and the entire soil area can be viewed. GreenStorm ST* and GreenStorm ST*-B thus provide excellent options to control the "inner life" of a storage/ infiltration system at any time.

The ideal, level and vibration-free running surface and the slim column structure allow for an unobstructed view of the entire module volume. The Quadro Control ST shaft for GreenStorm ST*, which can be integrated, allows for easy access of the automotive dolly for both professional final acceptance inspection and flushing technology.



**100 %**
**INSPECTABLE**

# INSPECTION

## Recommended camera equipment

A standard sewer camera is sufficient for camera inspection. A rotatable and height-adjustable camera head allows for an optimal view of the lateral soil area, a controllable carriage ensures a centred positioning, and high- performance optics together with lighting allow for a perfect picture.




## Recommended: tender invitation for final acceptance inspection

Final acceptance of sewers using camera inspection has long since become a matter of course in sewer construction.
Also in the construction of storage/ infiltration systems, the final acceptance inspection is important! Planning engineers should absolutely include this in their tender documents.



## Certified CCTV accessibility

GreenStorm ST* has been designed for the use of modern CCTV inspection technology. The inspectability of the GreenStorm ST* and QuadroControl ST system unit has been tested and confirmed by leading manufacturers of pipe CCTV inspection technology.

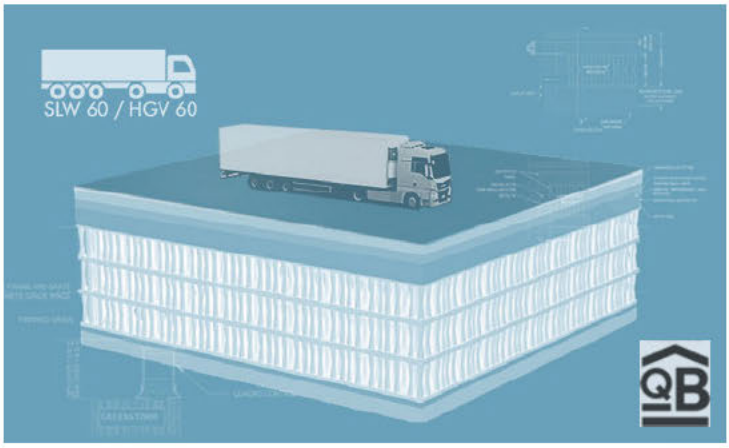


# LOADING

## Heavy traffic

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against impacting soil and traffic loads.

GreenStorm ST* storage/ infiltration sys- tems are extremely strong and have been designed with various applications in mind: While GreenStorm ST* has been designed in particular for traffic loads of up to 13 tons axle load.




## High resistance

When installed under traffic areas, relevant national guidelines must be observed.
To build the planum for the road construction, an upper levelling layer must be provided.

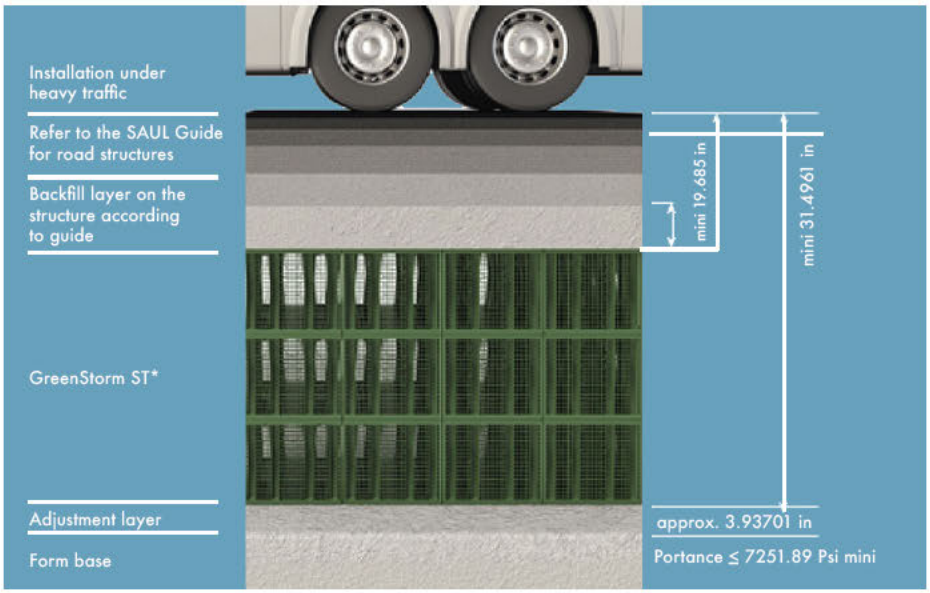
It should preferably be built as a gravel sub-base with a thickness of at least 13.7795 in, other materials usually result in larger covers.

Generally, a uniform modulus of deformation EV2 ≥ 45 MN/m² must be proven on the planum.

## Installation under traffic area

The subsoil structures must have sufficient load-carrying capacity against impacting soil and traffic loads to ensure reliable stability.

This is why GreenStorm ST* is suitable for traffic loads of up to 15 tons axle load (20 tons possible, please refer to our technical department).





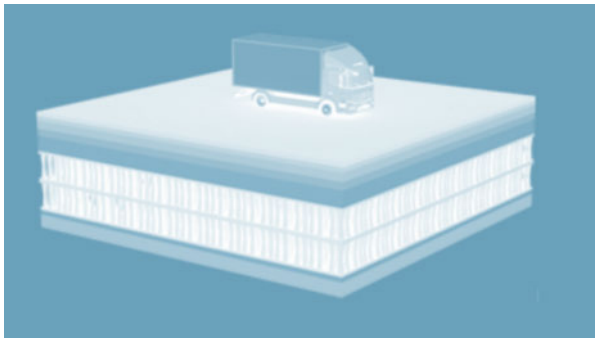

With conventional installation parameters*, depths of cover of DC 157.48 in and soil depths DSof 236.22 in are possible for infiltration systems. A project-specific stability analysis can be prepared by STORMCON.

*specific weight of soil 18 kN/m3 Mean soil temperature max. 73.4°F, 236.22 in. soil depth, = 0.3, 4-layer

# LOADING

## Light traffic, green spaces

The special material composition of GreenStorm ST-B* makes it ideal for surfaces with less traffic such as sports fields or green spaces. STORMCON storage/ infiltration systems have been designed for a minimum lifetime of 50 years.



## Installation under traffic areas

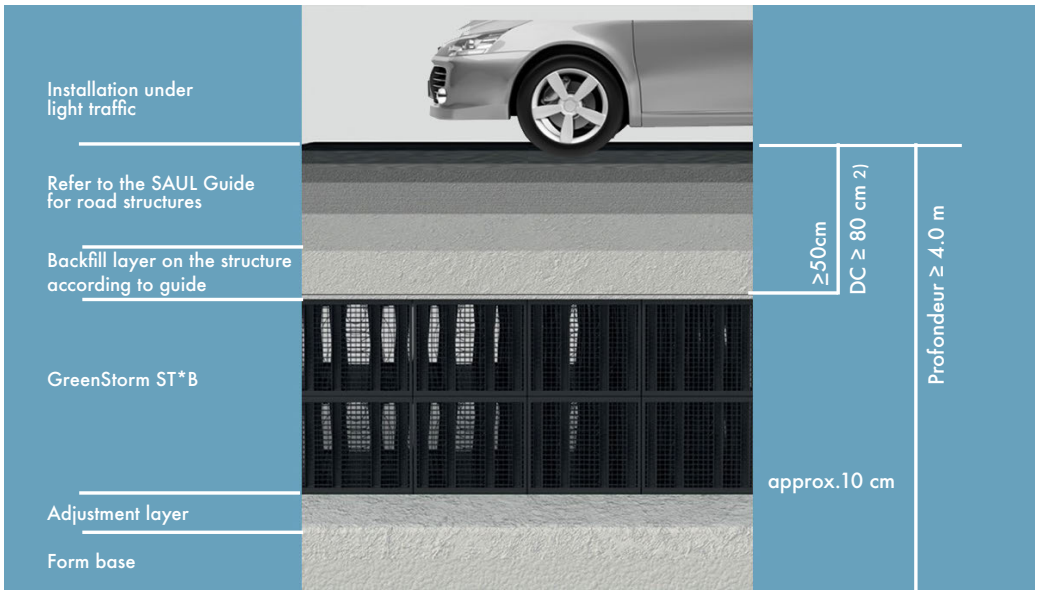
When installed under traffic areas, relevant national guidelines must be observed.
To build the planum for the road construction, an upper levelling layer must be provided.

It should preferably be built as a gravel sub-base with a thickness of at least 13.7795 in, other materials usually result in larger covers.

Generally, a uniform modulus of deformation EV2 ≥ 45 MN/m² must be proven on the planum.

## Standard installation under a traffic area

The GreenStorm ST-B* storage/infiltration module is suitable for traffic loads of up to 10 tons axle load and therefore also suitable for the construction of systems under parks, greens and car parks.



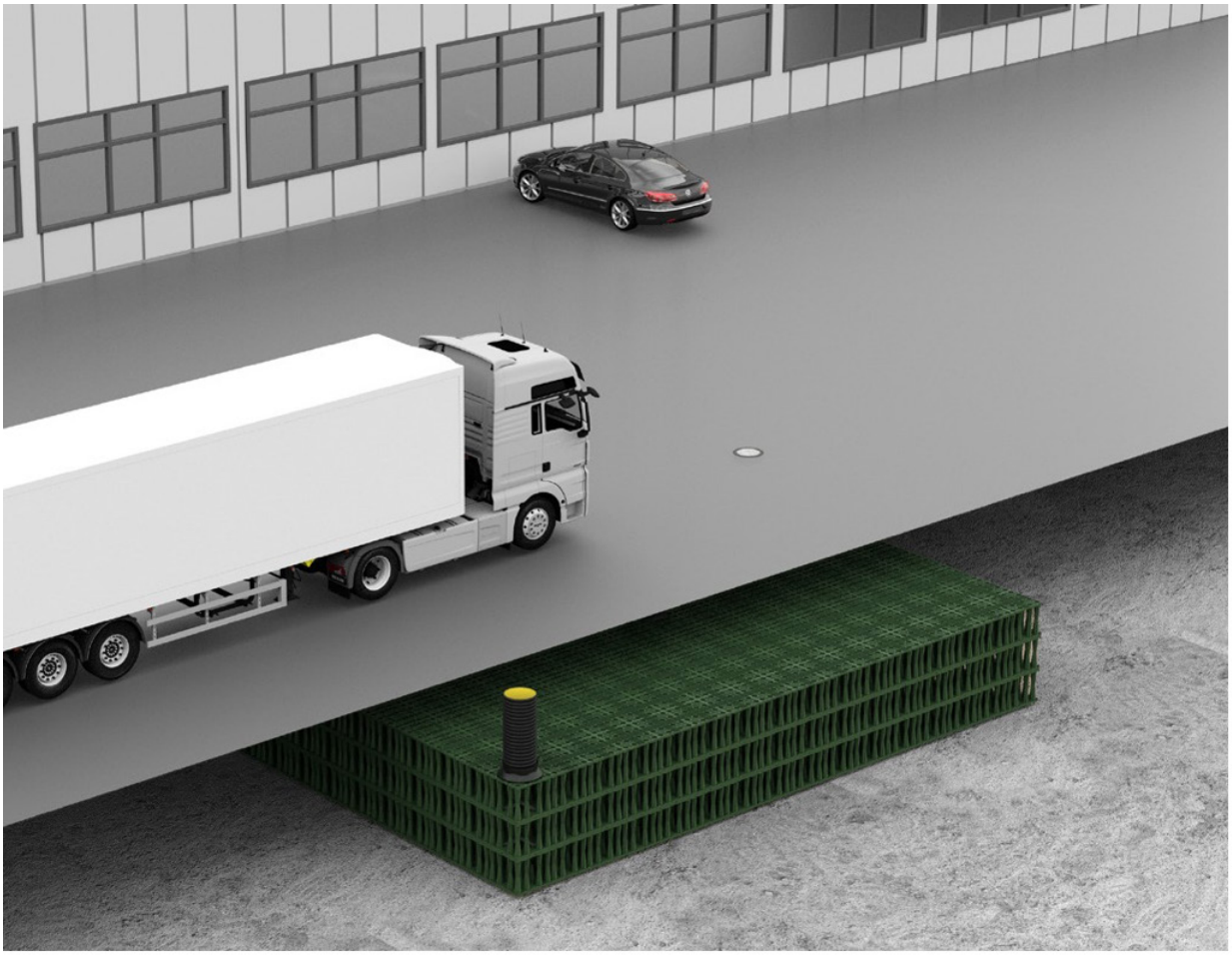

With conventional installation parameters*, depths of cover up to 2.5 m and soil depths up to 4m are possible for infiltration systems. A project-specific stability analysiscan be prepared by STORMCON.

*Light traffic, specific weight of soil 18 kN/m3 Mean soil temperature max. 23 °C, = 0.3

*GreenStorm ST/STB underground infitration/storage modules *Rigofill ST RigofillST-B

# LOADING

## Heavy traffic example GreenStorm ST*

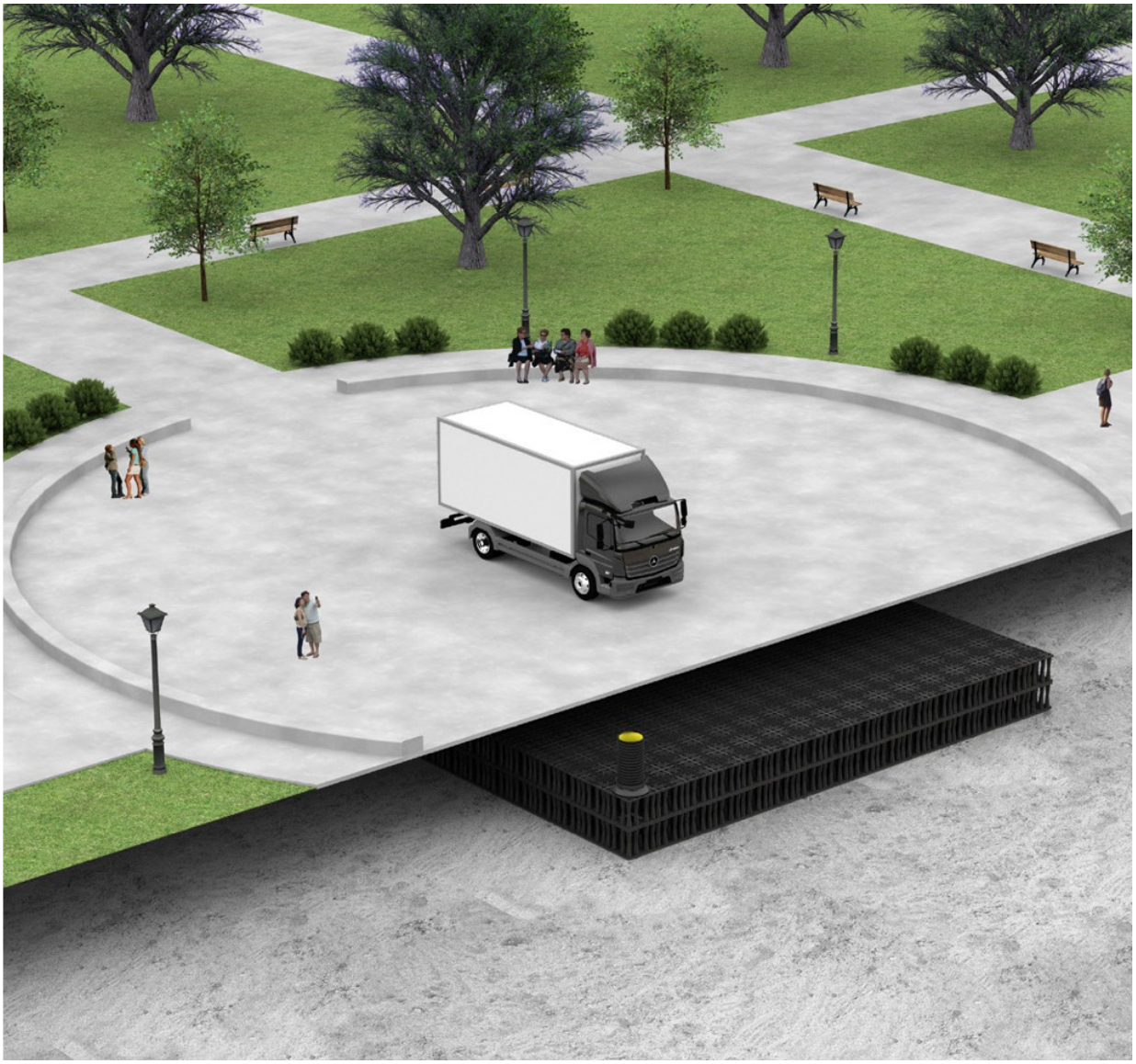




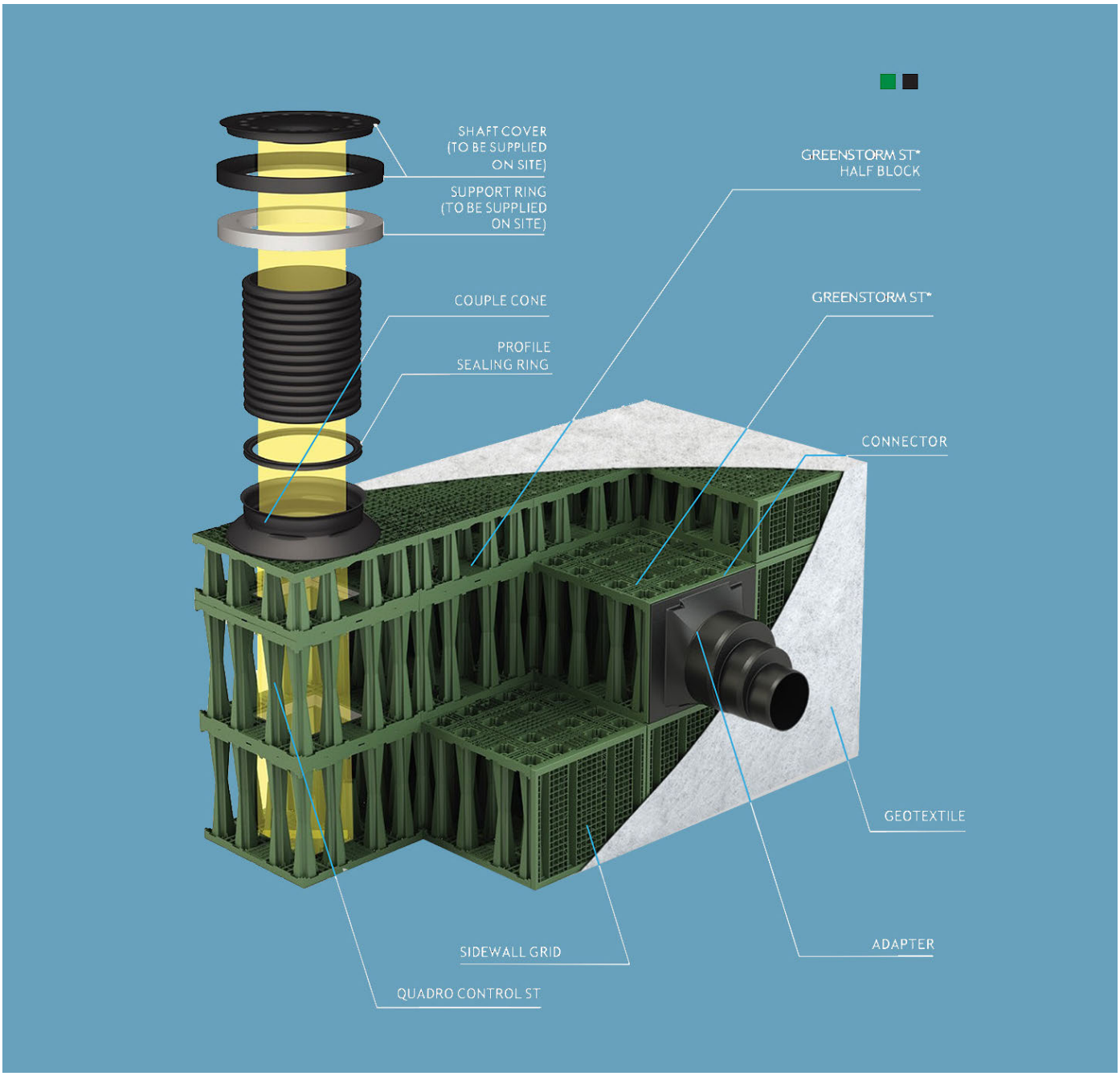
*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

# LOADING

## Light traffic example GreenStorm ST*



# Quadro® Control ST – system shaft




*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

# INTEGRATED INSPECTION SHAFTS

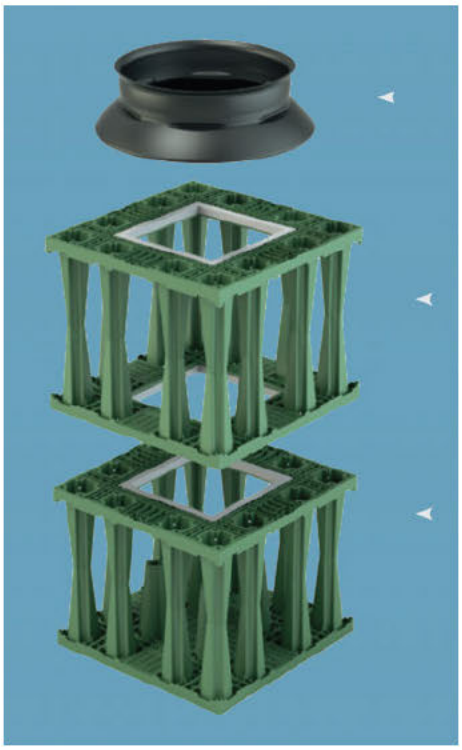
Quadro® Control ST is a polypropylene inspection shaft which can be integrated in the storage/infiltration system.

It is square with a base of 800 x 800 mm and can be used in any position of the layout.

Its height results from the number of layers of the connected storage/ infiltration system. The shaft allows for comfortable access to the inspection tunnel from aboveground. High-performance inspection and flushing equipment can easily be inserted into the inspection

tunnel. The shaft is integrated in the storage/infiltration system and grows layer by layer as construction progresses. QuadroControl ST is delivered with all required components and will be assembled on site.

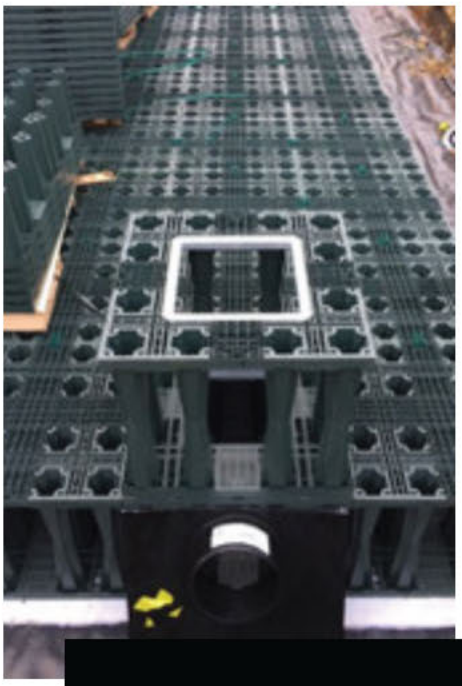
## Structure

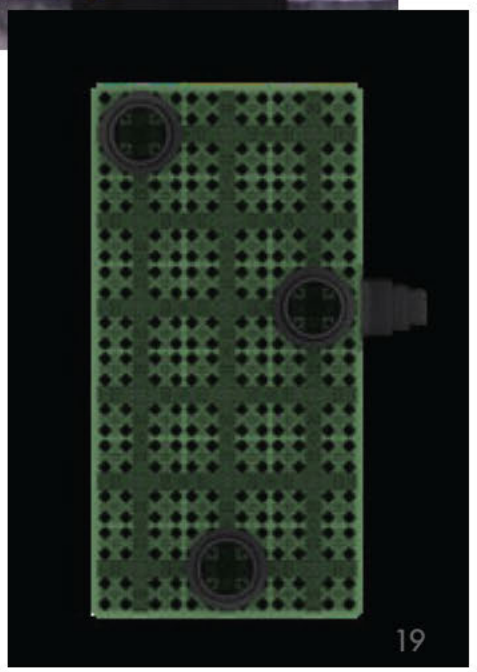


The shaft cone is the transition to the extension pipe. The length of the extension pipe is chosen depending on the installation depth.

The shaft is integrated in the storage/ infiltration system and grows layer by layer as construction progresses.

The shaft components are stackable and delivery includes the cone with all required components as shaft package.





## Arrangement of inspection shafts

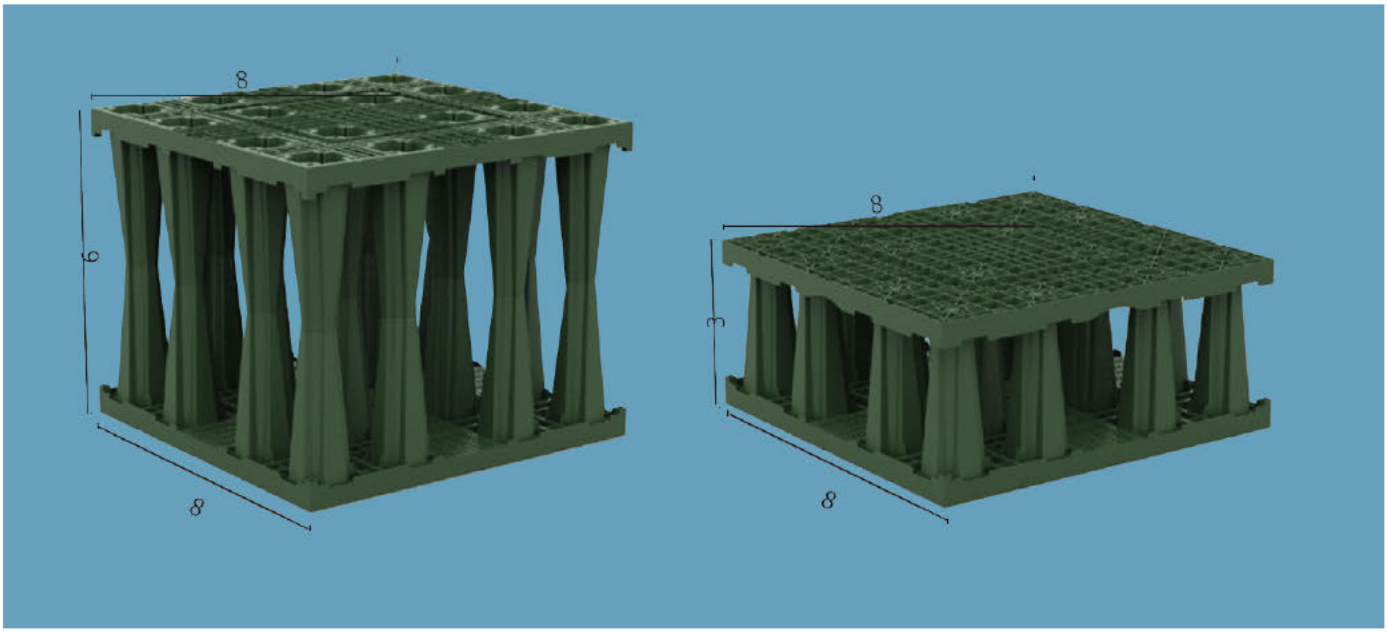
Number of and position in the system are above all determined by the size of the system, access, pipe connections and design of the outdoor facilities.

In order to ensure that flushing of the complete system is possible, each module should comprise at least one inspection shaft. In addition, the shafts should be positioned such that the shaft covers do not interfere with the design of the outdoor facilities, but can easily be accessed by vehicles for maintenance purposes.

Adjacent shafts should be staggered in the layout.

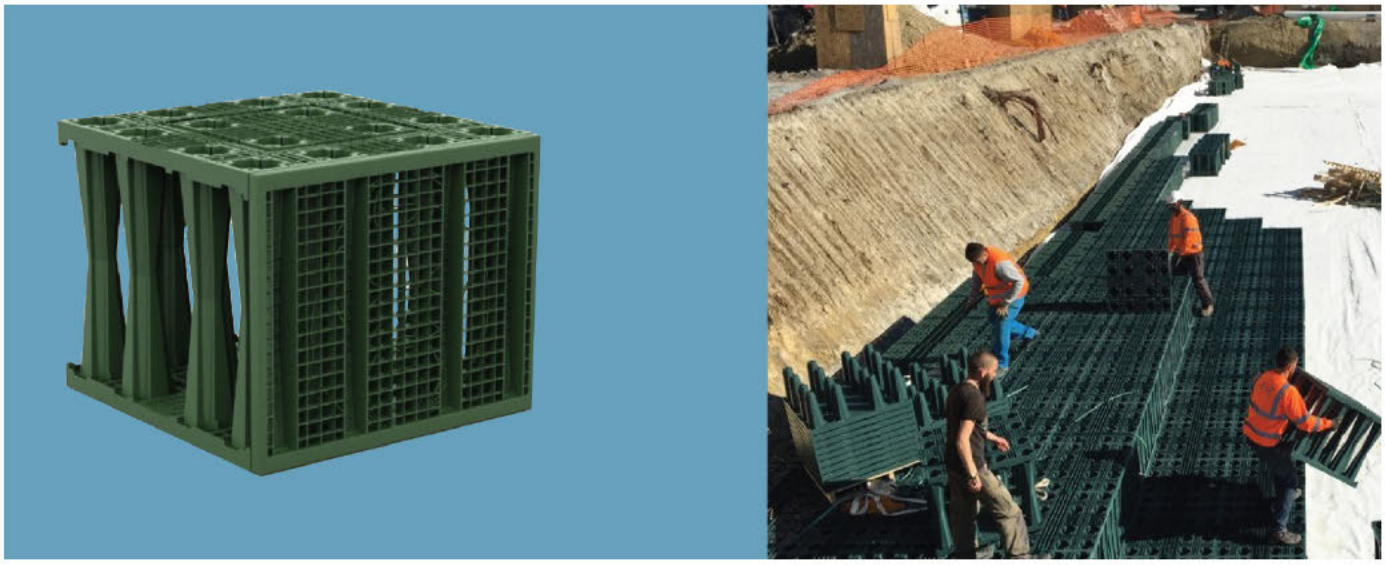
*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

## DESIGN-RELEVANT DIMENSIONS




## Sidewall grid connection options

Full block connection options
Dia 100 mm, 135 mm, 150 mm, 200 mm,
250 mm, 300 mm, 375 mm et 450 mm



This allows all available nominal diameters to be realised both at the top and the bottom of the module.

*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

## SIDEWALL GRID CONNECTION OPTIONS

Sidewall grid connection options

Half block connection options
Dia 100 mm, 135 mm, 150 mm,
200 mm et 250 mm



The side plates can be drilled to the height and desired position within the frame.

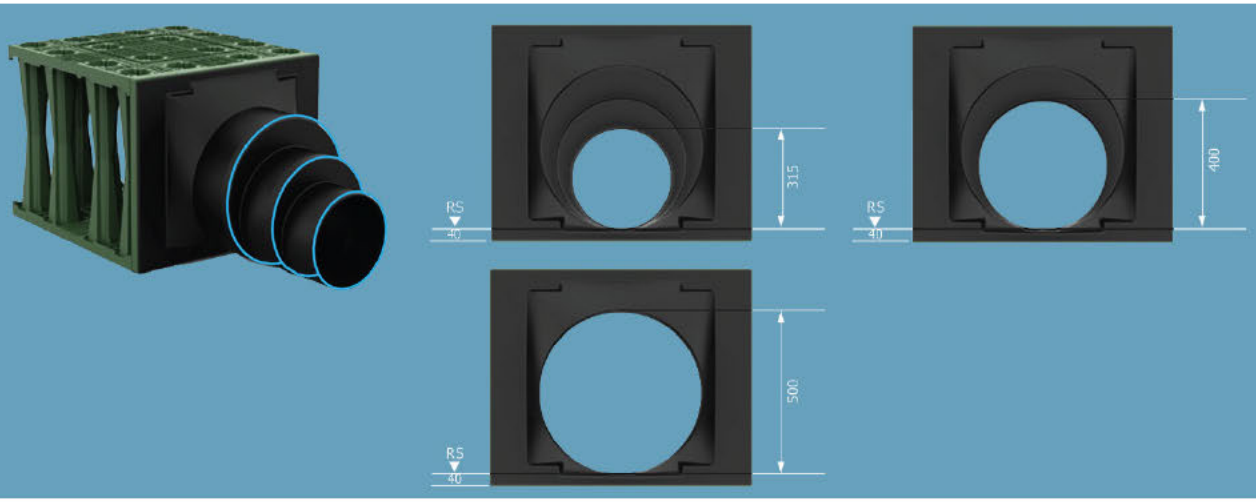


## ADAPTER CONNECTION OPTIONS

Connections:
Dia 300 mm, 450 mm
et 525 mm

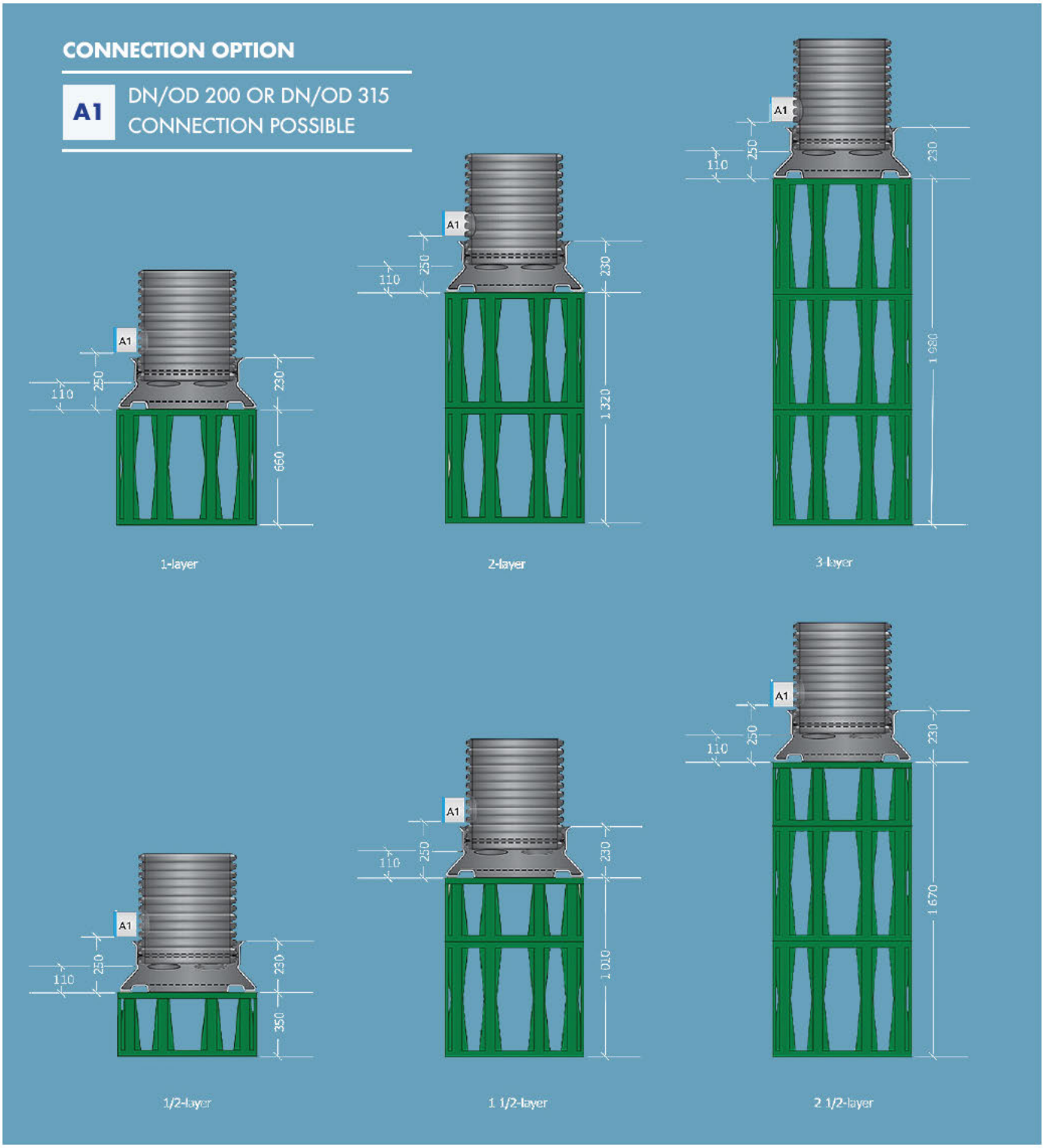
Outside diameter 315 mm for a pipe diameter 300 mm PVC

Outside diameter 400 mm for a pipe diameter 450 mm PVC. A flexible sleeve off center is required.




Outside diameter 500 mm for a pipe of diameter 525 mm.
A flexible sleeve off center is required

# DIMENSIONS OF QUADRO® CONTROL ST



# SHAFT DESIGN OF QUADRO® CONTROL ST

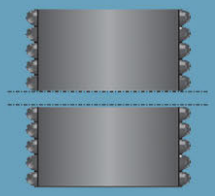
## Structure of inspection shaft



Class B or D
shaft cover acc. to DIN EN 124,
CW 610



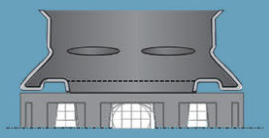
Support ring acc. to DIN 4034,
$D_1$ = 625 mm

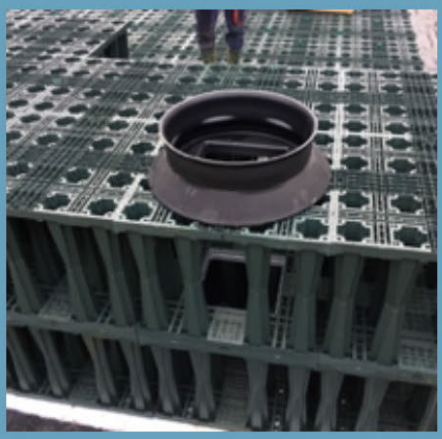


Extension pipe
$D_O$ 600

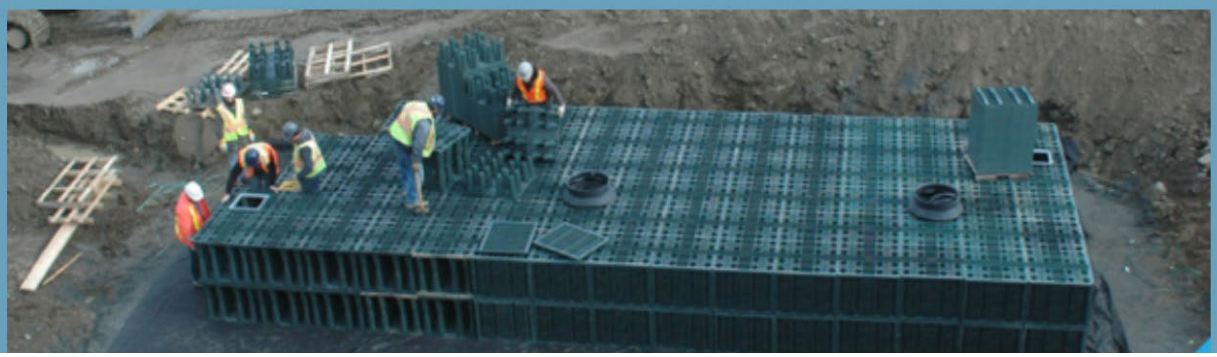


Sealing ring









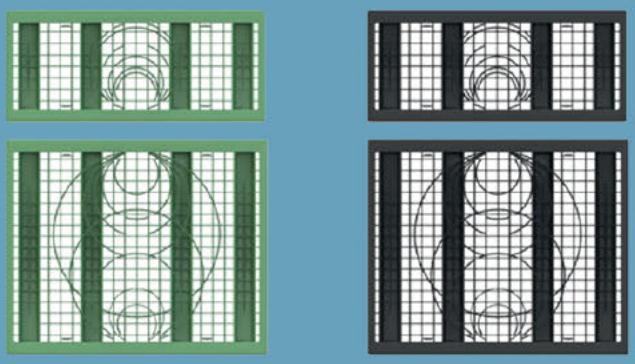
## Sidewall grid

The sidewall grids serve as external boundary.

They can be assembled easily using snap connections. The predefined position of the connections at the sidewall grids guarantees that the connections of inlet pipe and outlet pipe and the tunnel are same level. The sidewall grids can be assembled easily also outside the excavation pit.

The sidewall grid for the full block and Quadro® Control ST and Quadro® Control ST-B has a size of W x D x H = 800 x 30 x 660 mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160,
200, 225, 250, 315, 400 and 500.

The sidewall grid for the half block or the half-layer shaft has a size of W x D x H = 800 x 30 x 350 mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160, 200, 225 and 250. In storage/ infiltration designs with inside corners, shortened sidewall grids are used at one side.



Different connection heights (regardless of the nominal diameter) are required above the bottom depending on the number of floors:

| ST | ST-B | Number of floors | Connection height |
|---|---|---|---|
| ● | ● | 0.5-layer | 40 mm |
| ● | ● | 1-layer | 40 mm |
| ● | ● | 1.5-layer | 700 mm |
| ● | ● | 2-layer | 700 mm |
| ● | ● | 2.5-layer | 1 360 mm |
| ● | ● | 3-layer | 1 360 mm |

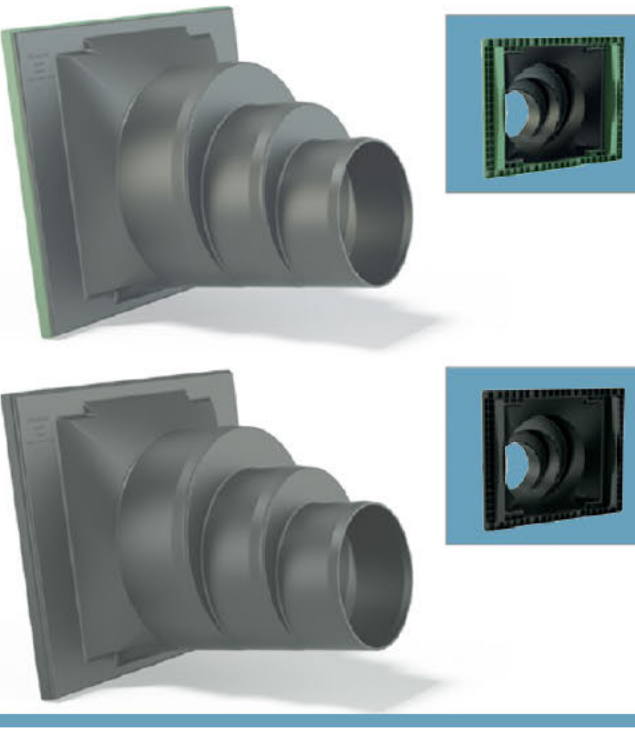
## Adapter

The adapter for GreenStorm ST* and GreenStorm ST-B* has a length of 800 mm and a height of 660 mm and serves as an inlet and outlet connection.

It provides an inlet connection with an optimised flow design with diffusor effect for solid wall pipes DN 315, 400 and 500. It can be connected to GreenStorm ST* and GreenStorm ST-B* easily and quickly thanks to the snap connection.

The predefined position of the snap connection at the module guarantees that inlet pipe and outlet pipe and tunnel connect same level.

The adapter ensures a connection with the same crown, as it is installed turned by 180°.



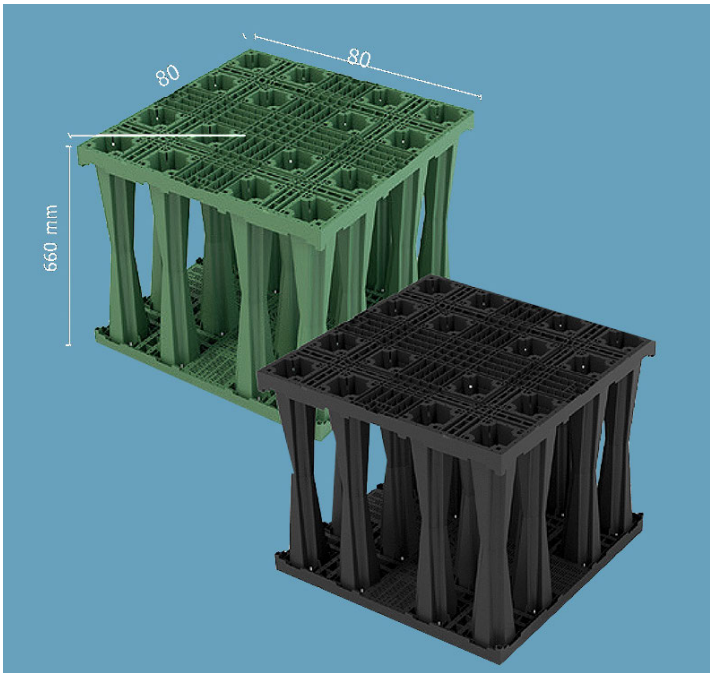
STORMCON

# GREENSTORM ST* AND ST-B* – HALF BLOCK

## GreenStorm ST* and GreenStorm ST-B* are highly durable and hard-wearing storage/infiltration module with a base of 800 x 800 mm and a height of 660 mm full blocks.

The polypropylene full block consists of two half elements to be installed on site and has a void ratio of more than 96 %. Water can flow through the module three-dimensionally almost without any obstacles. GreenStorm ST* and GreenStorm ST-B* allows for virtually any size and geometry of the systems.

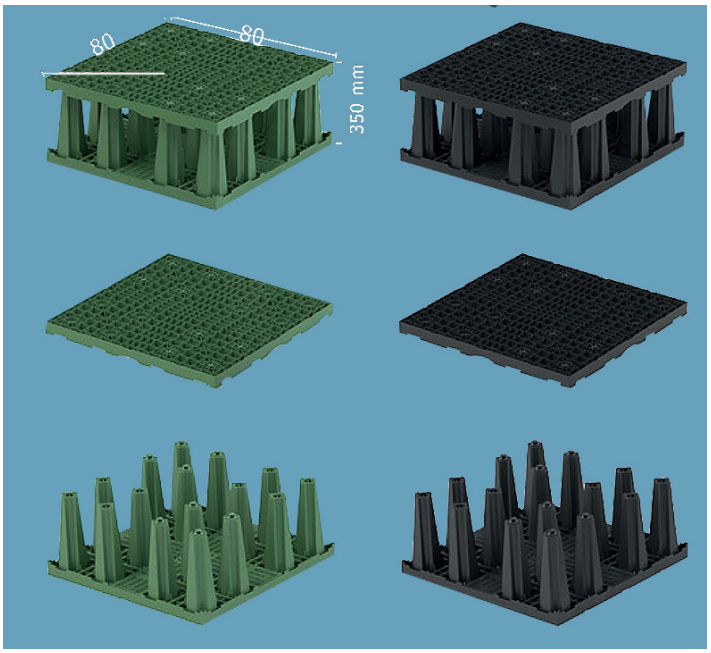
The cross-shaped inspection tunnel in the storage/ infiltration modules has been designed for the use of automotive dollies. This allows the effective drainage surface and the entire system volume with all statically relevant bearing-type fixtures to be inspected.




## The GreenStorm ST* and GreenStorm ST-B* half block have a base of 800 x 800 mm and a height of 350 mm

It consists of only one half element which must be assembled with a roof slab on site. This roof slab is only required for the half block. The GreenStorm ST* and GreenStorm ST-B* half block are used in particular for systems with shallow installation depths, e.g, in case of high groundwater levels.

Systems in various heights can be realised in 35cm steps and adjusted to almost any layout in combination with the full block.



STORMCON

# NOTES

# APPENDIX “F”

Stormwater Quality Control Calculations

## Imbrium® Systems
## ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/21/2026

| | |
|---|---|
| Province: | Ontario |
| City: | Southgate |
| Nearest Rainfall Station: | BARRIE-ORO |
| Climate Station Id: | 6117700 |
| Years of Rainfall Data: | 14 |

| | |
|---|---|
| Site Name: | |

| | |
|---|---|
| Drainage Area (ha): | 1.804 |
| % Imperviousness: | 82.00 |

Runoff Coefficient 'c': 0.79

| | |
|---|---|
| Particle Size Distribution: | Fine |
| Target TSS Removal (%): | 80.0 |

| | |
|---|---|
| Required Water Quality Runoff Volume Capture (%): | 90.00 |
| Estimated Water Quality Flow Rate (L/s): | 46.56 |
| Oil / Fuel Spill Risk Site? | Yes |
| Upstream Flow Control? | No |
| Peak Conveyance (maximum) Flow Rate (L/s): | |
| Influent TSS Concentration (mg/L): | 200 |
| Estimated Average Annual Sediment Load (kg/yr): | 1626 |
| Estimated Average Annual Sediment Volume (L/yr): | 1322 |

| | |
|---|---|
| Project Name: | Dundalk |
| Project Number: | 23142 |
| Designer Name: | Phoebe Yung |
| Designer Company: | Valdor |
| Designer Email: | pyung@valdor-engineering.com |
| Designer Phone: | 905-264-0054 |
| EOR Name: | |
| EOR Company: | |
| EOR Email: | |
| EOR Phone: | |

**Net Annual Sediment (TSS) Load Reduction Sizing Summary**

| Stormceptor Model | TSS Removal Provided (%) |
|---|---|
| EFO4 | 65 |
| EFO5 | 73 |
| EFO6 | 79 |
| EFO8 | 86 |
| EFO10 | 91 |
| EFO12 | 94 |

**Recommended Stormceptor EFO Model: EFO8**

**Estimated Net Annual Sediment (TSS) Load Reduction (%): 86**

**Water Quality Runoff Volume Capture (%): > 90**

imbrium

## THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

## PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

## PARTICLE SIZE DISTRIBUTION (PSD)

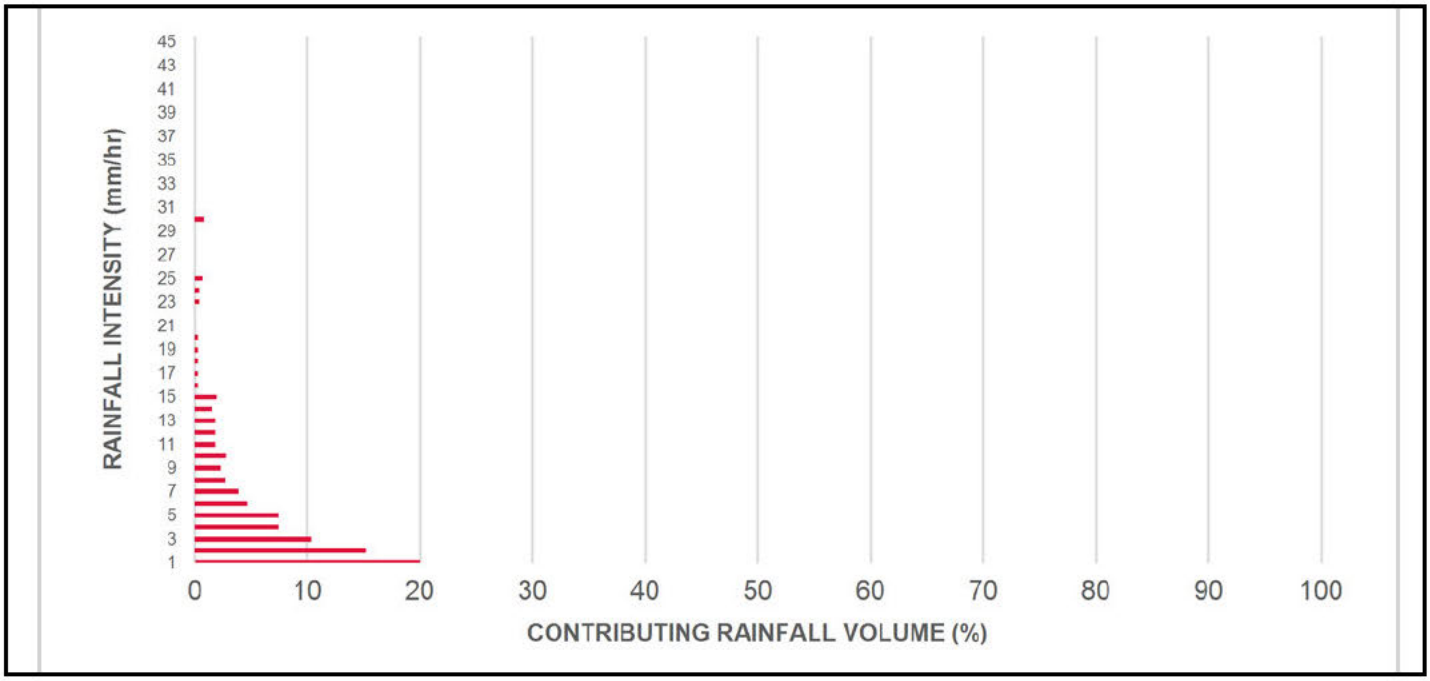
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

| Particle Size (µm) | Percent Less Than | Particle Size Fraction (µm) | Percent |
|---|---|---|---|
| 1000 | 100 | 500-1000 | 5 |
| 500 | 95 | 250-500 | 5 |
| 250 | 90 | 150-250 | 15 |
| 150 | 75 | 100-150 | 15 |
| 100 | 60 | 75-100 | 10 |
| 75 | 50 | 50-75 | 5 |
| 50 | 45 | 20-50 | 10 |
| 20 | 35 | 8-20 | 15 |
| 8 | 20 | 5-8 | 10 |
| 5 | 10 | 2-5 | 5 |
| 2 | 5 | <2 | 5 |

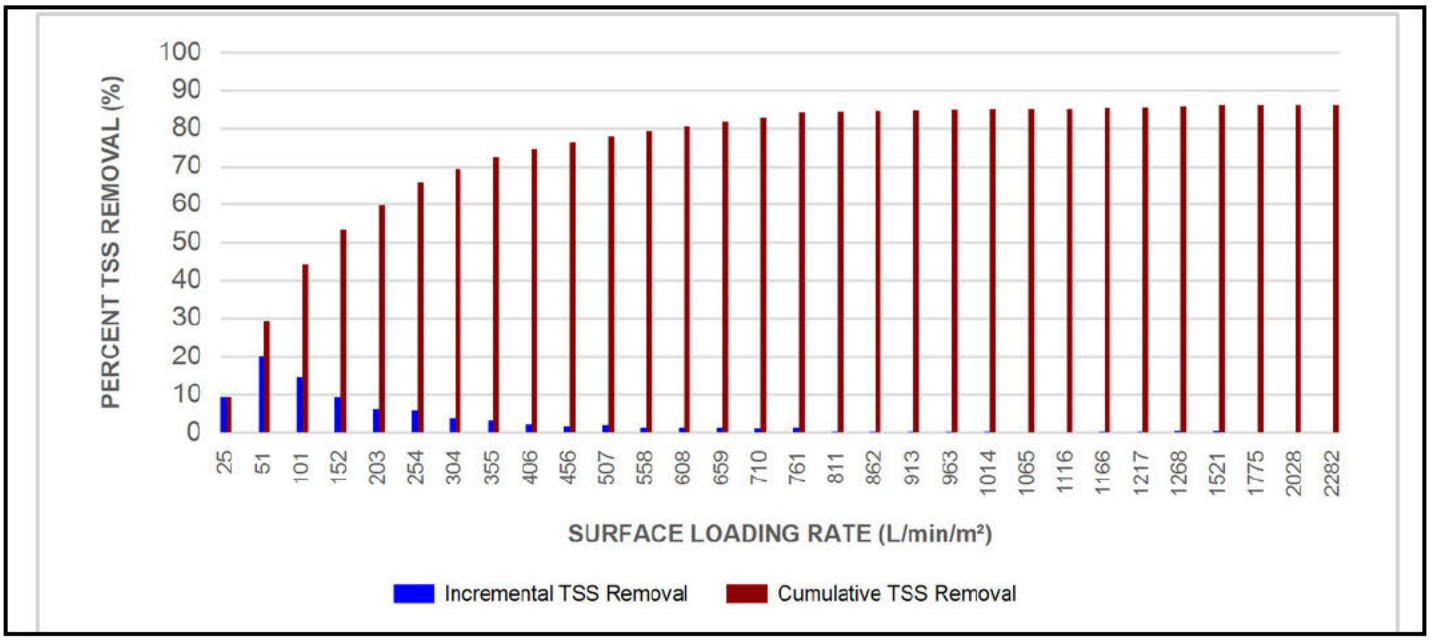
| Rainfall Intensity (mm / hr) | Percent Rainfall Volume (%) | Cumulative Rainfall Volume (%) | Flow Rate (L/s) | Flow Rate (L/min) | Surface Loading Rate (L/min/m²) | Removal Efficiency (%) | Incremental Removal (%) | Cumulative Removal (%) |
|---|---|---|---|---|---|---|---|---|
| 0.50 | 9.4 | 9.4 | 1.99 | 119.0 | 25.0 | 100 | 9.4 | 9.4 |
| 1.00 | 20.0 | 29.4 | 3.97 | 238.0 | 51.0 | 100 | 20.0 | 29.4 |
| 2.00 | 15.3 | 44.7 | 7.94 | 477.0 | 101.0 | 96 | 14.7 | 44.1 |
| 3.00 | 10.4 | 55.1 | 11.92 | 715.0 | 152.0 | 89 | 9.3 | 53.4 |
| 4.00 | 7.5 | 62.6 | 15.89 | 953.0 | 203.0 | 83 | 6.3 | 59.6 |
| 5.00 | 7.5 | 70.1 | 19.86 | 1192.0 | 254.0 | 81 | 6.1 | 65.7 |
| 6.00 | 4.7 | 74.9 | 23.83 | 1430.0 | 304.0 | 78 | 3.7 | 69.4 |
| 7.00 | 4.0 | 78.8 | 27.80 | 1668.0 | 355.0 | 76 | 3.0 | 72.4 |
| 8.00 | 2.7 | 81.6 | 31.78 | 1907.0 | 406.0 | 74 | 2.0 | 74.5 |
| 9.00 | 2.3 | 83.9 | 35.75 | 2145.0 | 456.0 | 72 | 1.7 | 76.1 |
| 10.00 | 2.8 | 86.6 | 39.72 | 2383.0 | 507.0 | 69 | 1.9 | 78.0 |
| 11.00 | 1.9 | 88.6 | 43.69 | 2622.0 | 558.0 | 67 | 1.3 | 79.3 |
| 12.00 | 1.9 | 90.5 | 47.66 | 2860.0 | 608.0 | 65 | 1.3 | 80.6 |
| 13.00 | 1.9 | 92.4 | 51.64 | 3098.0 | 659.0 | 64 | 1.2 | 81.8 |
| 14.00 | 1.6 | 94.0 | 55.61 | 3336.0 | 710.0 | 64 | 1.0 | 82.8 |
| 15.00 | 2.0 | 96.0 | 59.58 | 3575.0 | 761.0 | 63 | 1.2 | 84.1 |
| 16.00 | 0.3 | 96.3 | 63.55 | 3813.0 | 811.0 | 63 | 0.2 | 84.2 |
| 17.00 | 0.3 | 96.6 | 67.52 | 4051.0 | 862.0 | 63 | 0.2 | 84.4 |
| 18.00 | 0.3 | 96.9 | 71.50 | 4290.0 | 913.0 | 62 | 0.2 | 84.6 |
| 19.00 | 0.3 | 97.2 | 75.47 | 4528.0 | 963.0 | 62 | 0.2 | 84.8 |
| 20.00 | 0.3 | 97.5 | 79.44 | 4766.0 | 1014.0 | 61 | 0.2 | 85.0 |
| 21.00 | 0.0 | 97.5 | 83.41 | 5005.0 | 1065.0 | 60 | 0.0 | 85.0 |
| 22.00 | 0.0 | 97.5 | 87.38 | 5243.0 | 1116.0 | 59 | 0.0 | 85.0 |
| 23.00 | 0.4 | 97.9 | 91.36 | 5481.0 | 1166.0 | 58 | 0.2 | 85.2 |
| 24.00 | 0.4 | 98.3 | 95.33 | 5720.0 | 1217.0 | 57 | 0.2 | 85.4 |
| 25.00 | 0.8 | 99.1 | 99.30 | 5958.0 | 1268.0 | 56 | 0.5 | 85.9 |
| 30.00 | 0.9 | 100.0 | 119.16 | 7150.0 | 1521.0 | 48 | 0.4 | 86.3 |
| 35.00 | 0.0 | 100.0 | 139.02 | 8341.0 | 1775.0 | 41 | 0.0 | 86.3 |
| 40.00 | 0.0 | 100.0 | 158.88 | 9533.0 | 2028.0 | 36 | 0.0 | 86.3 |
| 45.00 | 0.0 | 100.0 | 178.74 | 10724.0 | 2282.0 | 32 | 0.0 | 86.3 |
| **Estimated Net Annual Sediment (TSS) Load Reduction =** | | | | | | | | **86 %** |

*Climate Station ID*: 6117700 *Years of Rainfall Data*: 14

## RAINFALL DATA FROM BARRIE-ORO RAINFALL STATION




## INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



**Maximum Pipe Diameter / Peak Conveyance**

| Stormceptor EF / EFO | Model Diameter | | Min Angle Inlet / Outlet Pipes | Max Inlet Pipe Diameter | | Max Outlet Pipe Diameter | | Peak Conveyance Flow Rate | |
|---|---|---|---|---|---|---|---|---|---|
| | (m) | (ft) | | (mm) | (in) | (mm) | (in) | (L/s) | (cfs) |
| EF4 / EFO4 | 1.2 | 4 | 90 | 609 | 24 | 609 | 24 | 425 | 15 |
| EF5 / EFO5 | 1.5 | 5 | 90 | 762 | 30 | 762 | 30 | 710 | 25 |
| EF6 / EFO6 | 1.8 | 6 | 90 | 914 | 36 | 914 | 36 | 990 | 35 |
| EF8 / EFO8 | 2.4 | 8 | 90 | 1219 | 48 | 1219 | 48 | 1700 | 60 |
| EF10 / EFO10 | 3.0 | 10 | 90 | 1828 | 72 | 1828 | 72 | 2830 | 100 |
| EF12 / EFO12 | 3.6 | 12 | 90 | 1828 | 72 | 1828 | 72 | 2830 | 100 |

## SCOUR PREVENTION AND ONLINE CONFIGURATION

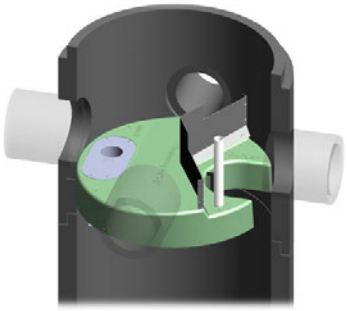
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

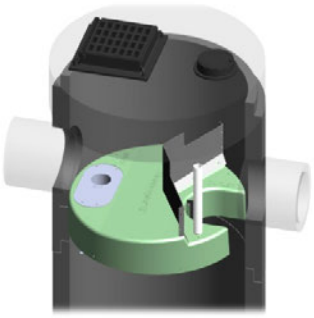
## DESIGN FLEXIBILITY

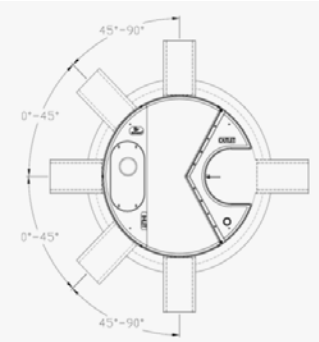
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

## OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.








**INLET-TO-OUTLET DROP**

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

**HEAD LOSS**

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

**Pollutant Capacity**

| Stormceptor EF / EFO | Model Diameter | | Depth (Outlet Pipe Invert to Sump Floor) | | Oil Volume | | Recommended Sediment Maintenance Depth * | | Maximum Sediment Volume * | | Maximum Sediment Mass ** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (m) | (ft) | (m) | (ft) | (L) | (Gal) | (mm) | (in) | (L) | ($ft^3$) | (kg) | (lb) |
| EF4 / EFO4 | 1.2 | 4 | 1.52 | 5.0 | 265 | 70 | 203 | 8 | 1190 | 42 | 1904 | 5250 |
| EF5 / EFO5 | 1.5 | 5 | 1.62 | 5.3 | 420 | 111 | 305 | 10 | 2124 | 75 | 2612 | 5758 |
| EF6 / EFO6 | 1.8 | 6 | 1.93 | 6.3 | 610 | 160 | 305 | 12 | 3470 | 123 | 5552 | 15375 |
| EF8 / EFO8 | 2.4 | 8 | 2.59 | 8.5 | 1070 | 280 | 610 | 24 | 8780 | 310 | 14048 | 38750 |
| EF10 / EFO10 | 3.0 | 10 | 3.25 | 10.7 | 1670 | 440 | 610 | 24 | 17790 | 628 | 28464 | 78500 |
| EF12 / EFO12 | 3.6 | 12 | 3.89 | 12.8 | 2475 | 655 | 610 | 24 | 31220 | 1103 | 49952 | 137875 |

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/$ft^3$ )

| Feature | Benefit | Feature Appeals To |
|---|---|---|
| Patent-pending enhanced flow treatment and scour prevention technology | Superior, verified third-party performance | Regulator, Specifying & Design Engineer |
| Third-party verified light liquid capture and retention for EFO version | Proven performance for fuel/oil hotspot locations | Regulator, Specifying & Design Engineer, Site Owner |
| Functions as bend, junction or inlet structure | Design flexibility | Specifying & Design Engineer |
| Minimal drop between inlet and outlet | Site installation ease | Contractor |
| Large diameter outlet riser for inspection and maintenance | Easy maintenance access from grade | Maintenance Contractor & Site Owner |

**STANDARD STORMCEPTOR EF/EFO DRAWINGS**

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

**STANDARD STORMCEPTOR EF/EFO SPECIFICATION**

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

# STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREAMENT DEVICE

## PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

## PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

| | | |
|---|---|---|
| 2.1.1 | 4 ft (1219 mm) Diameter OGS Units: | 1.19 $m^3$ sediment / 265 L oil |
| | 5 ft (1524 mm) Diameter OGS Units: | 1.95 $m^3$ sediment / 420 L oil |
| | 6 ft (1829 mm) Diameter OGS Units: | 3.48 $m^3$ sediment / 609 L oil |
| | 8 ft (2438 mm) Diameter OGS Units: | 8.78 $m^3$ sediment / 1,071 L oil |
| | 10 ft (3048 mm) Diameter OGS Units: | 17.78 $m^3$ sediment / 1,673 L oil |
| | 12 ft (3657 mm) Diameter OGS Units: | 31.23 $m^3$ sediment / 2,476 L oil |

## PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/$m^2$ to 1400 L/min/$m^2$, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/$m^2$ and 1400 L/min/$m^2$ shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/$m^2$ shall be assumed to be identical to the sediment removal efficiency at 40 L/min/$m^2$. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/$m^2$.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/$m^2$ shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/$m^2$, and shall be calculated using a simple proportioning formula, with 1400 L/min/$m^2$ in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/$m^2$.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/$m^2$.

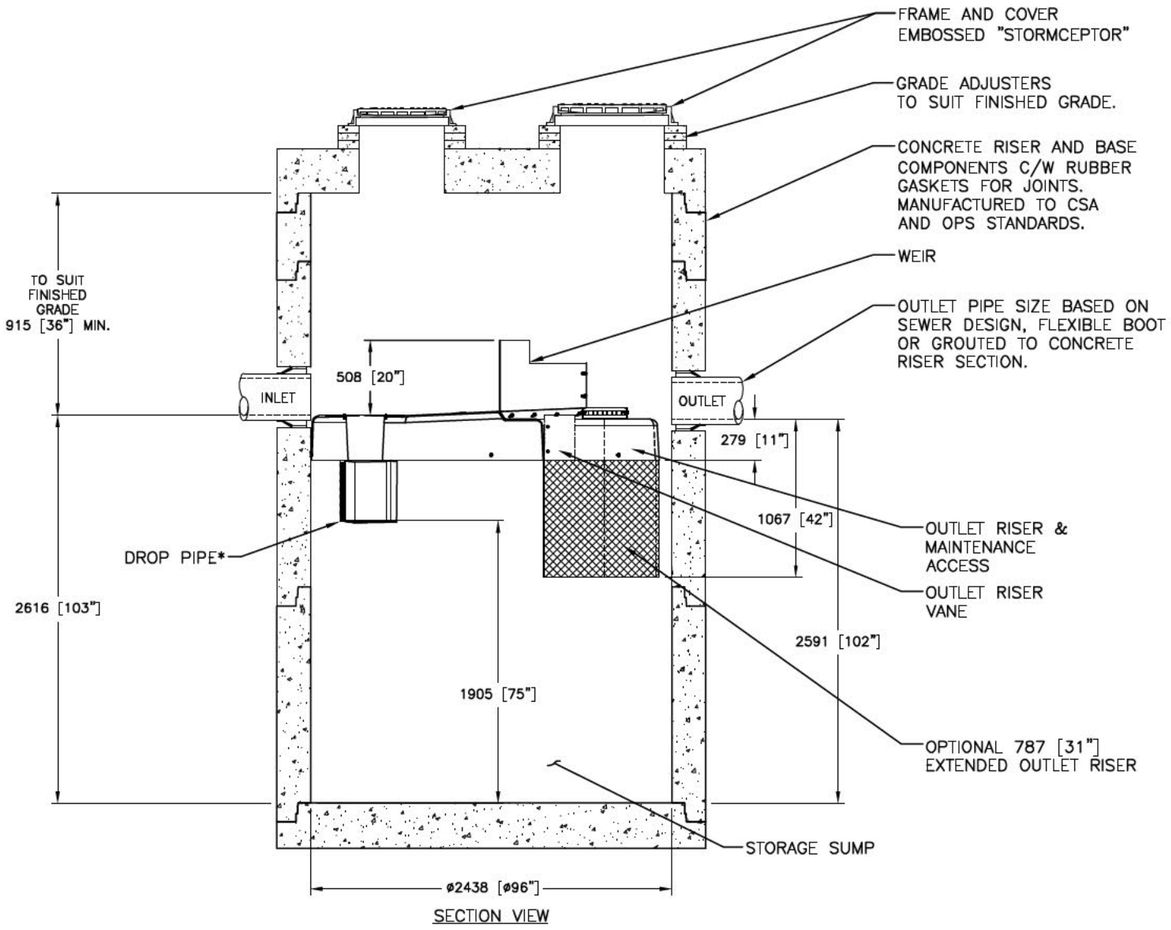
3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid

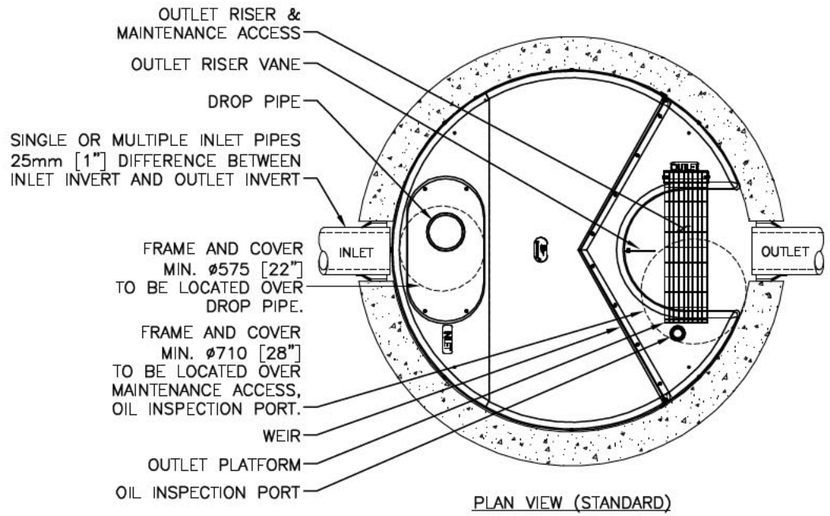
Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/$m^2$ to 2600 L/min/$m^2$) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

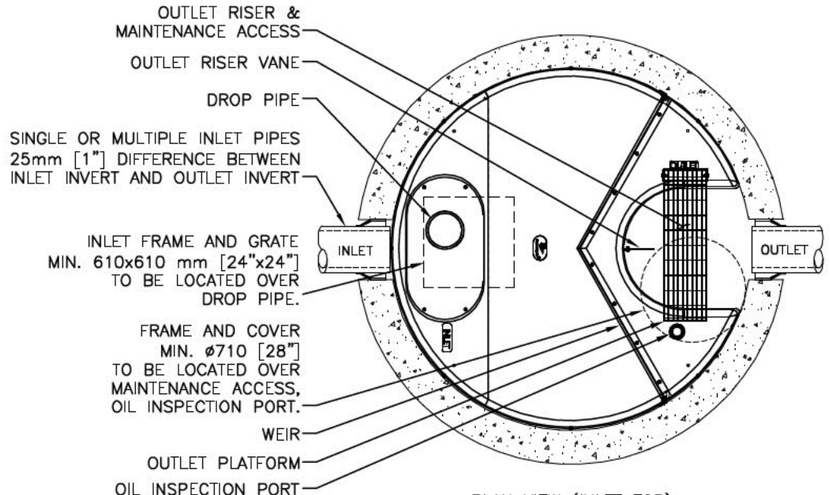
# DRAWING NOT TO BE USED FOR CONSTRUCTION




SECTION VIEW




PLAN VIEW (STANDARD)




PLAN VIEW (INLET TOP)

**GENERAL NOTES:**

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m$^2$ (27.9 gpm/ft$^2$) FOR STORMCEPTOR EF8 AND 535 L/min/m$^2$ (13.1 gpm/ft$^2$) FOR STORMCEPTOR EFO8 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

**INSTALLATION NOTES**

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

# STANDARD DETAIL
# NOT FOR CONSTRUCTION

## SITE SPECIFIC DATA REQUIREMENTS

| | | | | | |
|---|---|---|---|---|---|
| STORMCEPTOR MODEL | EFO8 | | | | |
| STRUCTURE ID | | | | | * |
| HYDROCARBON STORAGE REQ'D (L) | | | | | * |
| WATER QUALITY FLOW RATE (L/s) | | | | | * |
| PEAK FLOW RATE (L/s) | | | | | * |
| RETURN PERIOD OF PEAK FLOW (yrs) | | | | | * |
| DRAINAGE AREA (HA) | | | | | * |
| DRAINAGE AREA IMPERVIOUSNESS (%) | | | | | * |
| PIPE DATA: | I.E. | MAT'L | DIA | SLOPE % | HGL |
| INLET #1 | * | * | * | * | * |
| INLET #2 | * | * | * | * | * |
| OUTLET | * | * | * | * | * |

* PER ENGINEER OF RECORD

The design and information shown on this drawing is provided as a service to the client, engineer and contractor by Imbrium Systems (Imbrium), Imbrium makes no representation or warranties of any kind whatsoever regarding the contents of this drawing, for any part thereof, and Imbrium specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. No part of this drawing shall be reproduced, distributed or transmitted in any form or by any means, electronic or mechanical, or stored in a database or retrieval system, for any purpose without the prior written consent of Imbrium. Failure to comply with this restriction may result in a violation of copyright law and may subject the violator to legal action. Use of the information contained in this drawing is done at the user's own risk and Imbrium expressly disclaims any liability or responsibility for such use.

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| MARK | DATE | REVISION DESCRIPTION | BY |
|---|---|---|---|
| 1 | 6/8/18 | OUTLET PLATFORM | JSK |
| 0 | 5/26/17 | INITIAL RELEASE | JSK |

Stormceptor® EF

SCALE = NTS


imbrium
407 FAIRVIEW DRIVE, WHITBY, ON L1N 9N9
TF 800.565.6801 CA 416.665.6600 INTL +1-416.665.6600


DATE: 10/13/2017

| DESIGNED: | DRAWN: |
|---|---|
| JSK | JSK |
| CHECKED: | APPROVED: |
| BSF | * |
| PROJECT No.: | SEQUENCE No.: |
| EFO8 | * |

SHEET: 1 OF 1


I:\IMBRIUM\PRODUCTS\STORMCEPTOR EFHO DRAWINGS & DETAILS\STANDARD DETAILS\EFO8-STANDARD DETAILS_DWG 4/12/2019 11:57 AM

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

# VERIFICATION STATEMENT

## GLOBE Performance Solutions

Verifies the performance of

## Stormceptor® EF4 and EFO4 Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

In accordance with

## ISO 14034:2016

**Environmental management —**
**Environmental technology verification (ETV)**

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 10, 2017
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

# Technology description and application

The Stormceptor® EF4 and EFO4 are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO4 is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

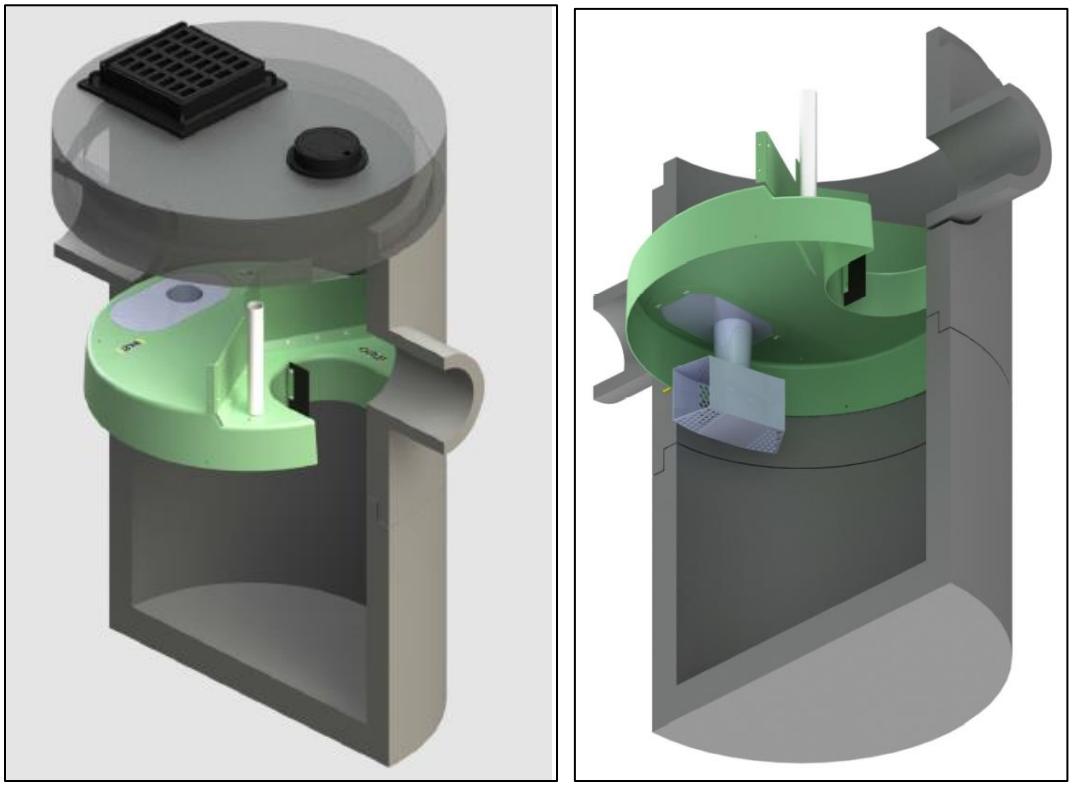


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m$^2$ (27.9 gal/min/ft$^2$) and 535 L/min/m$^2$ (13.1 gal/min/ft$^2$) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of

additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

# Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® OGS device, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

# Performance claim(s)

Capture test [a]:

During the capture test, the Stormceptor® EF OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m$^2$, respectively.

Stormceptor® EFO, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 42, 40, and 34 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m$^2$, respectively.

Scour test [a]:

During the scour test, the Stormceptor® EF and Stormceptor® EFO OGS devices, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m$^2$, respectively.

Light liquid re-entrainment test [a]:

During the light liquid re-entrainment test, the Stormceptor® EFO OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m$^2$.

[a] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

# Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition.

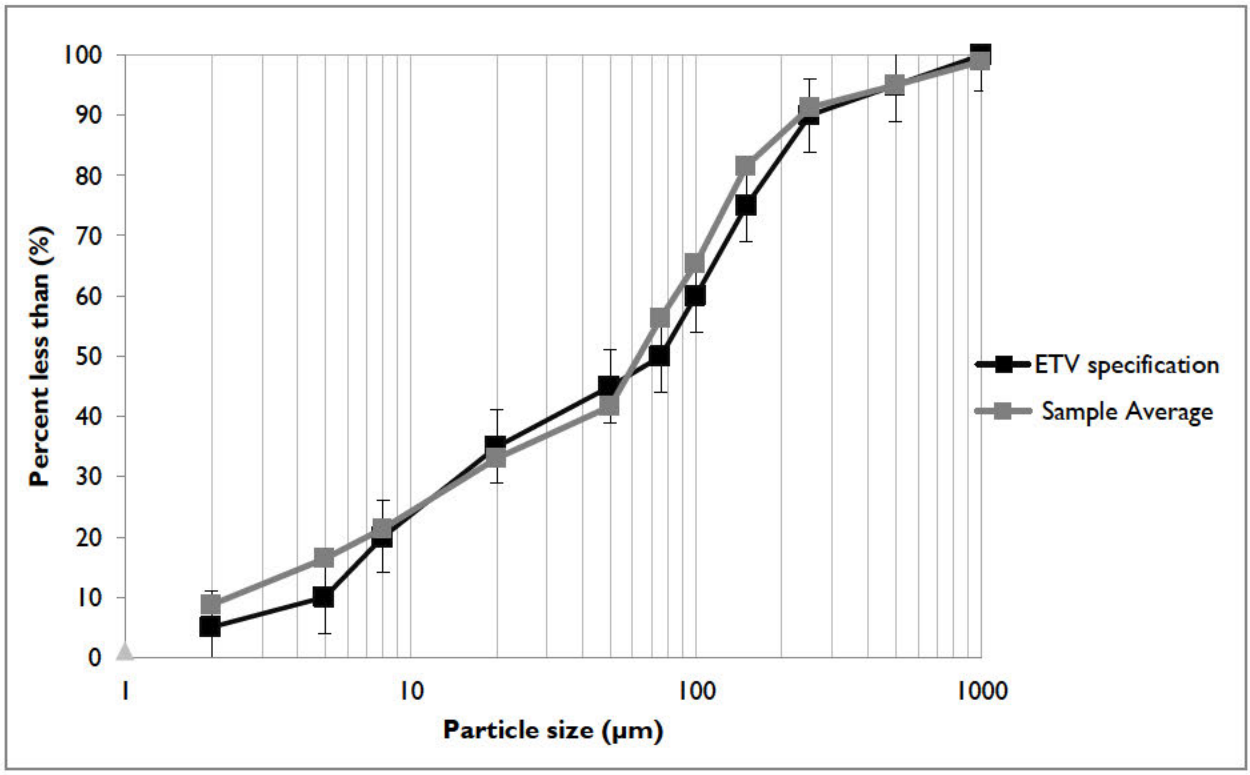



Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m$^2$ (13.1 gpm/ft$^2$), sediment capture tests at surface loading rates from 40 to 400 L/min/m$^2$ were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m$^2$ were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory

analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the EF4 at specified surface loading rates

| Particle size fraction (µm) | Surface loading rate (L/min/m²) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 40 | 80 | 200 | 400 | 600 | 1000 | 1400 |
| >500 | 90 | 58 | 58 | 100* | 86 | 72 | 100* |
| 250 - 500 | 100* | 100* | 100 | 100* | 100* | 100* | 100* |
| 150 - 250 | 90 | 82 | 26 | 100* | 100* | 67 | 90 |
| 105 - 150 | 100* | 100* | 100* | 100* | 100* | 100* | 100 |
| 75 - 105 | 100* | 92 | 74 | 82 | 77 | 68 | 76 |
| 53 - 75 | Undefined [a] | 56 | 100* | 72 | 69 | 50 | 80 |
| 20 - 53 | 54 | 100* | 54 | 33 | 36 | 40 | 31 |
| 8 - 20 | 67 | 52 | 25 | 21 | 17 | 20 | 20 |
| 5 – 8 | 33 | 29 | 11 | 12 | 9 | 7 | 19 |
| <5 | 13 | 0 | 0 | 0 | 0 | 0 | 4 |
| **All particle sizes by mass balance** | **70.4** | **63.8** | **53.9** | **47.5** | **46.0** | **43.7** | **49.0** |

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m²

| Particle size fraction (µm) | Surface loading rate (L/min/m²) | | |
|---|---|---|---|
| | 600 | 1000 | 1400 |
| >500 | 89 | 83 | 100* |
| 250 - 500 | 90 | 100* | 92 |
| 150 - 250 | 90 | 67 | 100* |
| 105 - 150 | 85 | 92 | 77 |
| 75 - 105 | 80 | 71 | 65 |
| 53 - 75 | 60 | 31 | 36 |
| 20 - 53 | 33 | 43 | 23 |
| 8 - 20 | 17 | 23 | 15 |
| 5 – 8 | 10 | 3 | 3 |
| <5 | 0 | 0 | 0 |
| **All particle sizes by mass balance** | **41.7** | **39.7** | **34.2** |

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m².

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

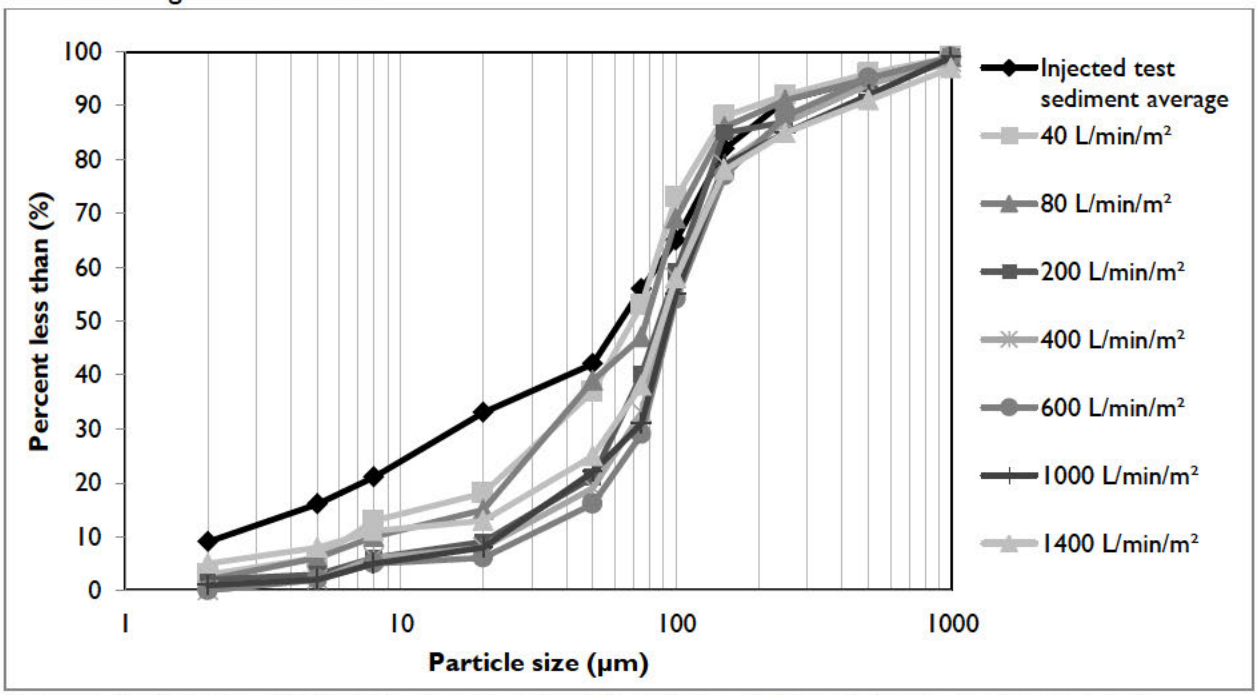



Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

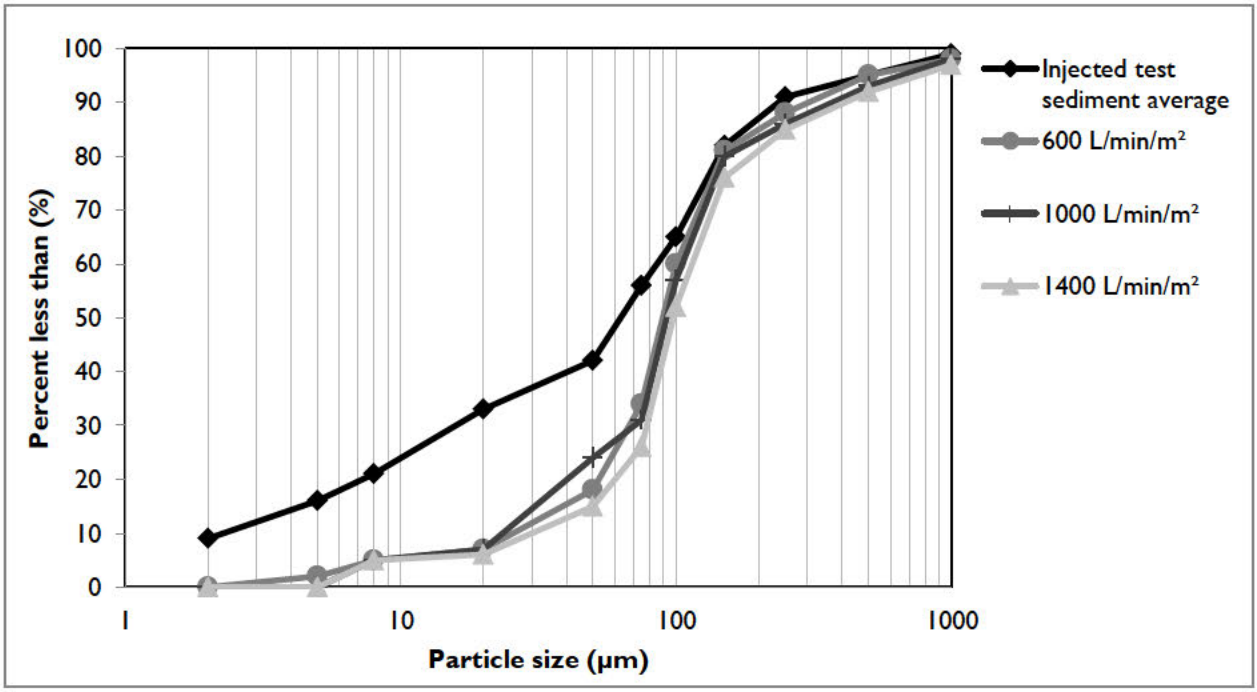



Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into

the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m$^2$ sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m$^2$, potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

| Run | Surface loading rate (L/min/m$^2$) | Run time (min) | Background sample concentration (mg/L) | Adjusted effluent suspended sediment concentration (mg/L) [a] | Average (mg/L) |
|---|---|---|---|---|---|
| 1 | 200 | 1:00 | <RDL | 11.9 | 4.6 |
| | | 2:00 | | 7.0 | |
| | | 3:00 | | 4.4 | |
| | | 4:00 | | 2.2 | |
| | | 5:00 | | 1.0 | |
| | | 6:00 | | 1.2 | |
| 2 | 800 | 7:00 | <RDL | 1.1 | 0.7 |
| | | 8:00 | | 0.9 | |
| | | 9:00 | | 0.6 | |
| | | 10:00 | | 1.4 | |
| | | 11:00 | | 0.1 | |
| | | 12:00 | | 0 | |
| 3 | 1400 | 13:00 | <RDL | 0 | 0 |
| | | 14:00 | | 0.1 | |
| | | 15:00 | | 0 | |
| | | 16:00 | | 0 | |
| | | 17:00 | | 0 | |
| | | 18:00 | | 0 | |
| 4 | 2000 | 19:00 | 1.2 | 0.2 | 0.2 |
| | | 20:00 | | 0 | |
| | | 21:00 | | 0 | |
| | | 22:00 | | 0.7 | |
| | | 23:00 | | 0 | |

| | | | | | |
|---|---|---|---|---|---|
| | | 24:00 | | 0.4 | |
| 5 | 2600 | 25:00 | 1.6 | 0.3 | 0.4 |
| | | 26:00 | | 0.4 | |
| | | 27:00 | | 0.7 | |
| | | 28:00 | | 0.4 | |
| | | 29:00 | | 0.2 | |
| | | 30:00 | | 0.4 | |

[a] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m$^2$) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m$^2$). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

| Surface Loading Rate (L/min/m2) | Time Stamp | Amount of Beads Re-entrained | | | |
|---|---|---|---|---|---|
| | | Mass (g) | Volume (L)[a] | % of Pre-loaded Mass Re-entrained | % of Pre-loaded Mass Retained |
| 200 | 62 | 0 | 0 | 0.00 | 100 |
| 800 | 247 | 168.45 | 0.3 | 0.52 | 99.48 |
| 1400 | 432 | 51.88 | 0.09 | 0.16 | 99.83 |
| 2000 | 617 | 55.54 | 0.1 | 0.17 | 99.84 |
| 2600 | 802 | 19.73 | 0.035 | 0.06 | 99.94 |
| Total Re-entrained | | 295.60 | 0.525 | 0.91 | -- |
| Total Retained | | 32403 | 57.78 | -- | 99.09 |
| Total Loaded | | 32699 | 58.3 | -- | -- |

[a] Determined from bead bulk density of 0.56074 g/cm$^3$

# Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. During the capture test, the 40 L/min/m$^2$ and 80 L/min/m$^2$ surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was

continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m$^2$) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m$^2$ run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m$^2$ for the Stormceptor® EF4 and 1000 and 1400 L/min/m$^2$ for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

# Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

# What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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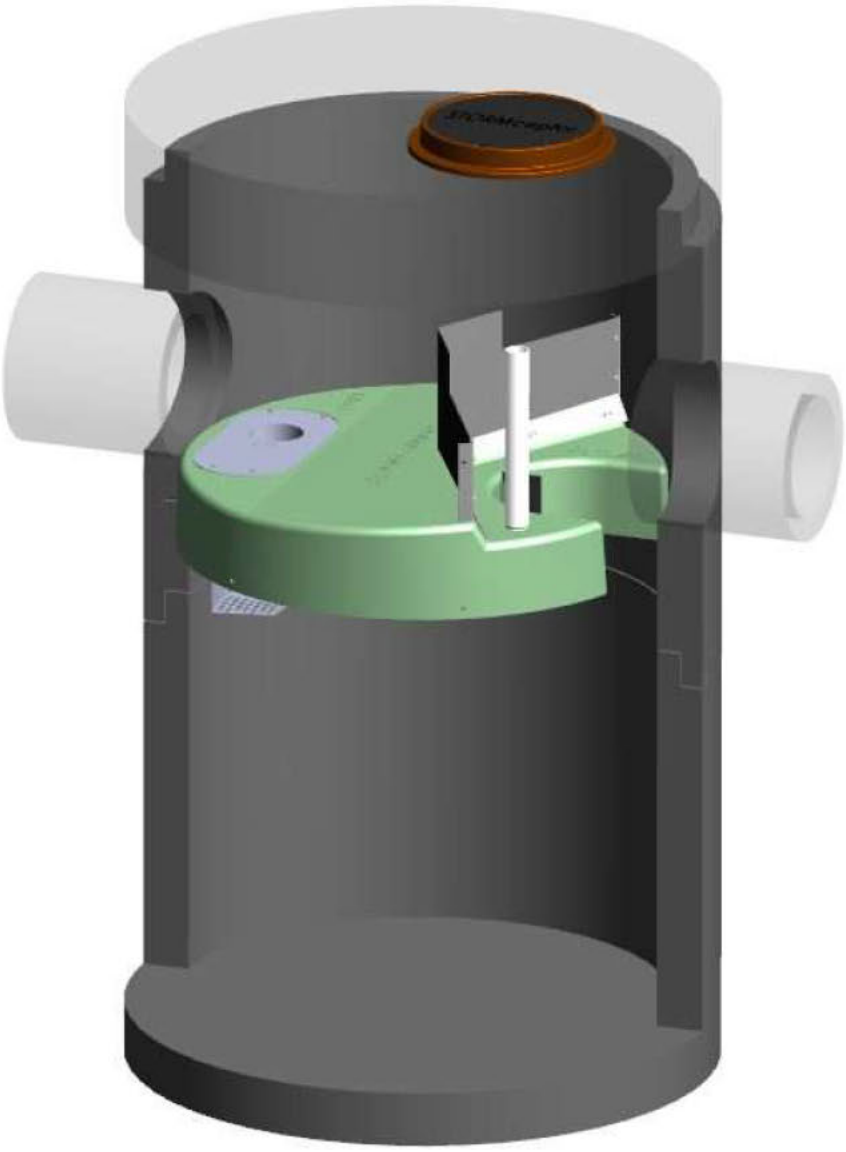
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**Limitation of verification**
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

# Stormceptor® EF

# Owner's Manual



*Stormceptor is protected by one or more of the following patents:*

Canadian Patent No. 2,137,942
Canadian Patent No. 2,180,305
Canadian Patent No. 2,327,768
Canadian Patent No. 2,694,159
Canadian Patent No. 2,697,287
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 729,096
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Japanese Patent No. 5,997,750
Japanese Patent No. 5,555,160
Korean Patent No. 0519212
Korean Patent No. 1451593
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Patent pending

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**4 - Stormceptor EF Identification**

**5 - Stormceptor EF Inspection & Maintenance**

**6 – Stormceptor Contacts**

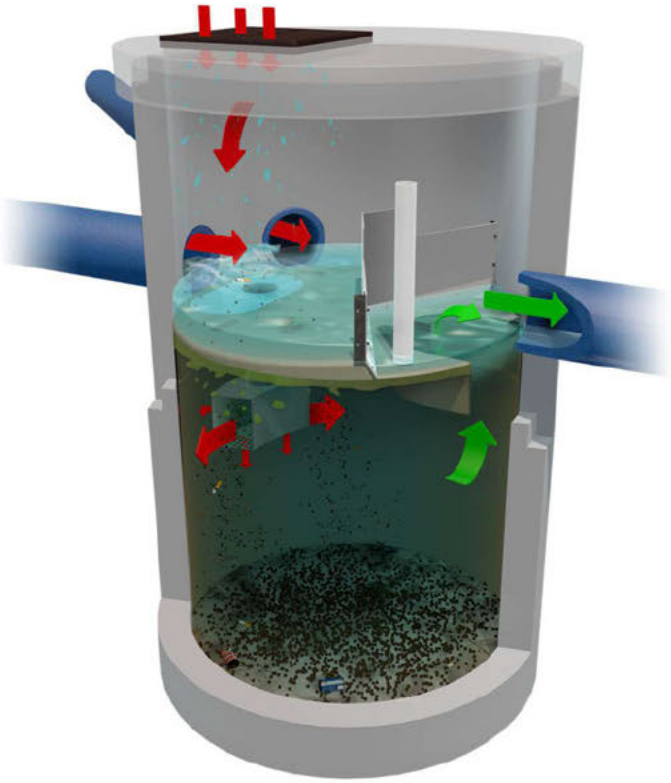
## OVERVIEW

**Stormceptor® EF** is a continuation and evolution of the most globally recognized oil grit separator (OGS) stormwater treatment technology - ***Stormceptor®***. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at flow rates higher than the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention platform ensures sediment is retained during all rainfall events.

Stormceptor EF offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe, multiple inlet pipes, and/or from the surface through an inlet grate. Stormceptor EF can also serve as a junction structure, accommodate a 90-degree inlet to outlet bend angle, and be modified to ensure performance in submerged conditions. With its scour prevention and internal bypass, Stormceptor EF can be installed online, eliminating the need for costly additional bypass structures.

## OPERATION

- Stormwater enters the Stormceptor upper chamber through the inlet pipe(s) or a surface inlet grate. A specially designed insert reduces the influent velocity by creating a pond upstream of the insert's weir. Sediment particles immediately begin to settle. Swirling flow sweeps water, sediment, and floatables across the sloped surface of the insert to the inlet opening of the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone.
- Influent exits the cone into the drop pipe duct. The duct has two large rectangular outlet openings as well as perforations in the backside and floor of the duct. Influent is diffused through these various opening in multiple directions and at low velocity into the lower chamber.
- Free oils and other floatables rise up within the channel surrounding the central riser pipe and are trapped beneath the insert, while sediment settles to the sump. Pollutants are retained for later removal during maintenance cleaning.
- Treated effluent enters the outlet riser, moves upward, and discharges to the top side of the insert downstream of the weir, where it flows out the outlet pipe.
- During intense storm events with very high influent flow rates, the pond height on the upstream side of the weir may exceed the height of the weir, and the excess flow passes over the top of the weir to the downstream side of the insert, and exits through the outlet pipe. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, the pond separates sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate.
- Stormceptor EF's patent-pending enhanced flow and scour prevention technology ensures pollutants are captured and retained, allowing excess flows to bypass during infrequent, high intensity storms.



## COMPONENTS

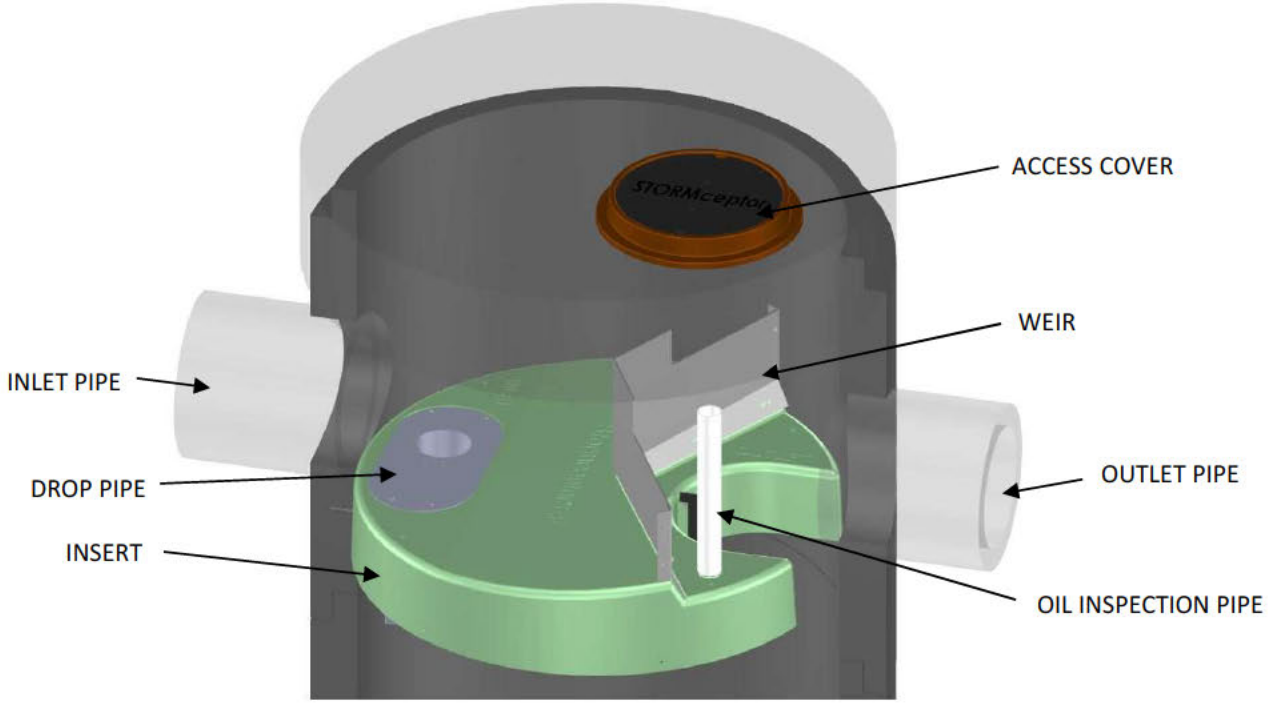



**Figure 1**

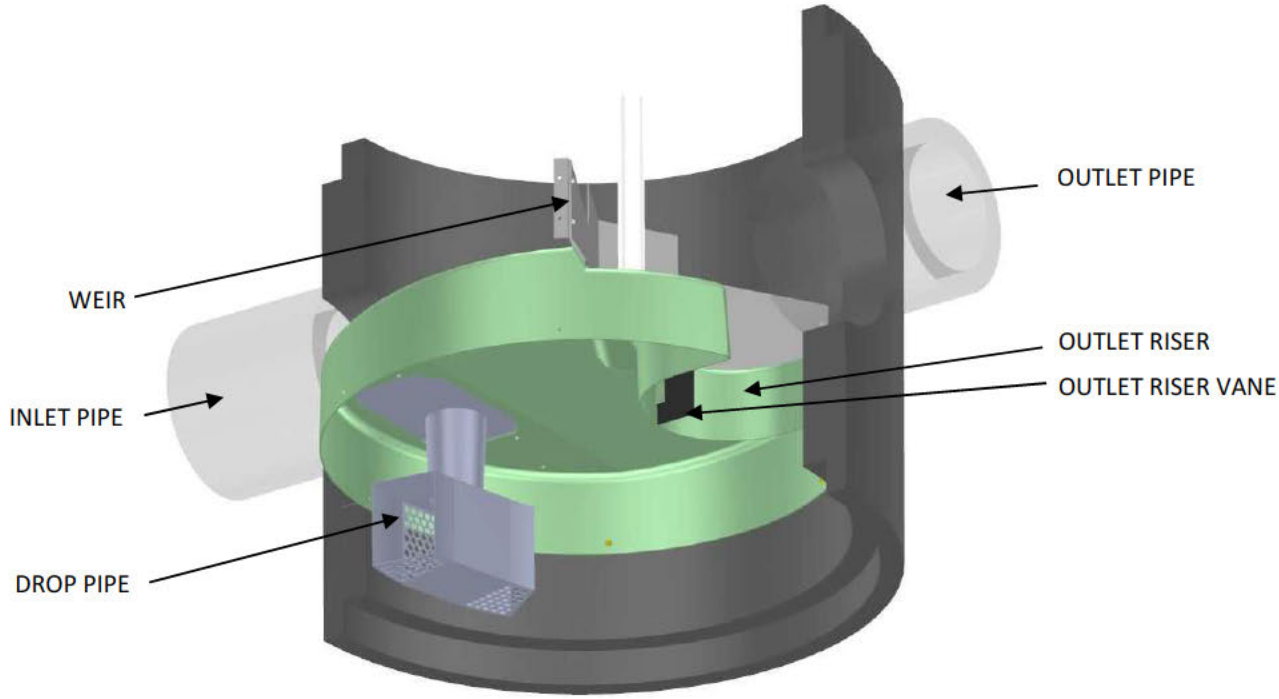



**Figure 2**

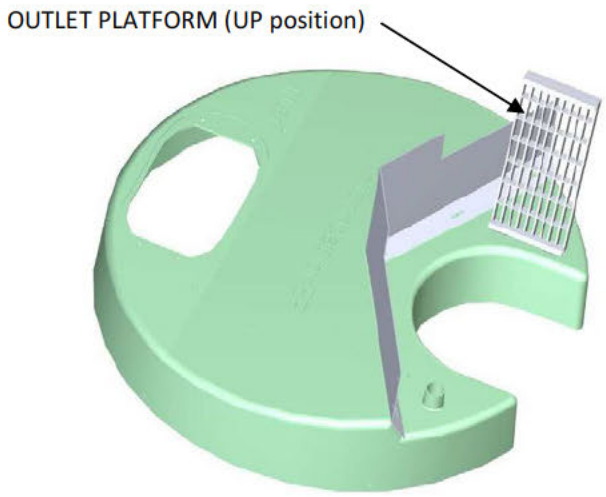



**Figure 3A**

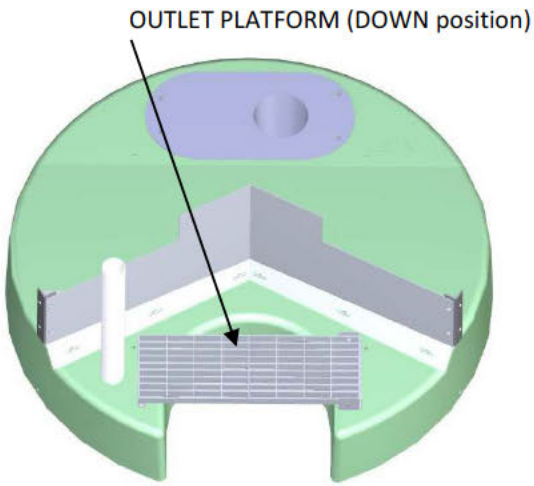



**Figure 3B**

- **Insert** – separates vessel into upper and lower chambers, and provides double-wall containment of hydrocarbons
- **Weir** – creates stormwater ponding and driving head on top side of insert
- **Drop pipe** – conveys stormwater and pollutants into the lower chamber
- **Outlet riser** – conveys treated stormwater from the lower chamber to the outlet pipe, and provides primary inspection and maintenance access into the lower chamber
- **Outlet riser vane** – prevents formation of a vortex in the outlet riser during high flow rate conditions
- **Outlet platform (optional)** – safety platform in the event of manned entry into the unit
- **Oil inspection pipe** – primary access for measuring oil depth

# PRODUCT DETAILS

## METRIC DIMENSIONS AND CAPACITIES

**Table 1**

| Stormceptor Model | Inside Diameter (m) | Minimum Surface to Outlet Invert Depth (mm) | Depth Below Outlet Pipe Invert (mm) | Wet Volume (L) | Sediment Capacity [1] ($m^3$) | Hydrocarbon Storage Capacity [2] (L) | Maximum Flow Rate into Lower Chamber [3] (L/s) | Peak Conveyance Flow Rate [4] (L/s) |
|---|---|---|---|---|---|---|---|---|
| EF4 / EFO4 | 1.22 | 915 | 1524 | 1780 | 1.19 | 265 | 22.1 / 10.4 | 425 |
| EF6 / EFO6 | 1.83 | 915 | 1930 | 5070 | 3.47 | 610 | 49.6 / 23.4 | 990 |
| EF8 / EFO8 | 2.44 | 1219 | 2591 | 12090 | 8.78 | 1070 | 88.3 / 41.6 | 1700 |
| EF10 / EFO10 | 3.05 | 1219 | 3251 | 23700 | 17.79 | 1670 | 138 / 65 | 2830 |
| EF12 / EFO12 | 3.66 | 1524 | 3886 | 40800 | 31.22 | 2475 | 198.7 / 93.7 | 2830 |

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 1135 L/min/$m^2$.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 535 L/min/$m^2$.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 1.5 m/s.

## U.S. DIMENSIONS AND CAPACITIES

**Table 2**

| Stormceptor Model | Inside Diameter (ft) | Minimum Surface to Outlet Invert Depth (in) | Depth Below Outlet Pipe Invert (in) | Wet Volume (gal) | Sediment Capacity [1] ($ft^3$) | Hydrocarbon Storage Capacity [2] (gal) | Maximum Flow Rate into Lower Chamber [3] (cfs) | Peak Conveyance Flow Rate [4] (cfs) |
|---|---|---|---|---|---|---|---|---|
| EF4 / EFO4 | 4 | 36 | 60 | 471 | 42 | 70 | 0.78 / 0.37 | 15 |
| EF6 / EFO6 | 6 | 36 | 76 | 1339 | 123 | 160 | 1.75 / 0.83 | 35 |
| EF8 / EFO8 | 8 | 48 | 102 | 3194 | 310 | 280 | 3.12 / 1.47 | 60 |
| EF10 / EFO10 | 10 | 48 | 128 | 6261 | 628 | 440 | 4.87 / 2.30 | 100 |
| EF12 / EFO12 | 12 | 60 | 153 | 10779 | 1103 | 655 | 7.02 / 3.31 | 100 |

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 27.9 gpm/$ft^2$.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 13.1 gpm/$ft^2$.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 5 fps.

## IDENTIFICATION

Each Stormceptor EF/EFO unit is easily identifiable by the trade name ***Stormceptor®*** embossed on the access cover at grade as shown in **Figure 3**. The tradename ***Stormceptor®*** is also embossed on the top of the insert upstream of the weir as shown in **Figure 3**.

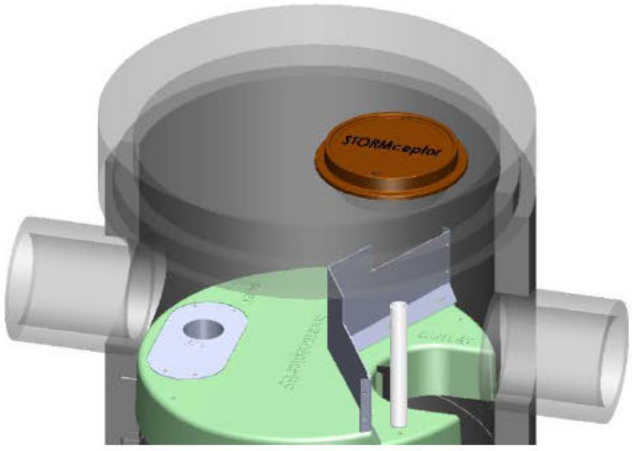



**Figure 4**

The specific Stormceptor EF/EFO model number is identified on the top of the aluminum Drop Pipe as shown in **Figure 4**. The unit serial number is identified on the top of the insert upstream of the weir as shown in **Figure 4**.

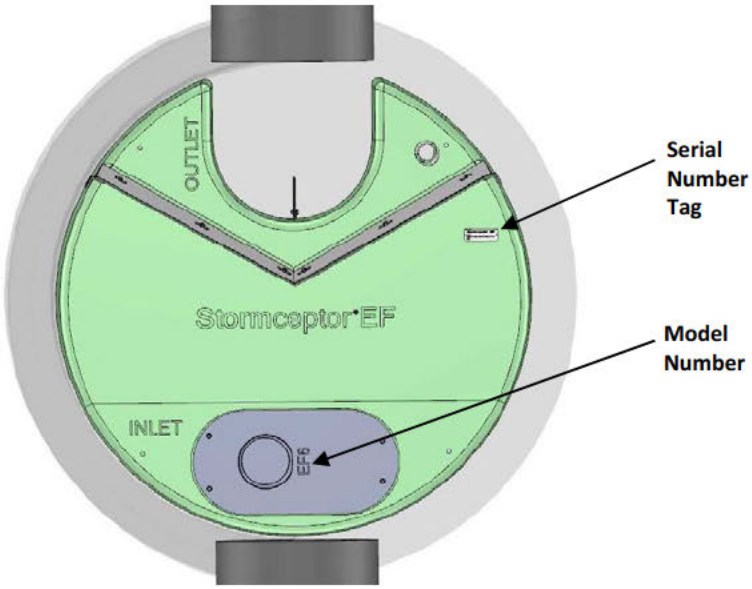



**Figure 5**

## INSPECTION AND MAINTENANCE

It is very important to perform regular inspection and maintenance. Regular inspection and maintenance ensures maximum operation efficiency, keeps maintenance costs low, and provides continued of natural waterways.

**Quick Reference**

- Typical inspection and maintenance is performed from grade
- Remove manhole **cover(s)** or **inlet grate** to access insert and lower chamber
  NOTE: EF4/EFO4 requires the removal of a **flow deflector** beneath inlet grate
- Use Sludge Judge® or similar sediment probe to check sediment depth through the **outlet riser**
- Oil dipstick can be inserted through the **oil inspection pipe**
- Visually inspect the **insert** for debris, remove debris if present
- Visually inspect the **drop pipe** opening for blockage, remove blockage if present
- Visually inspect **insert** and **weir** for damage, schedule repair if needed
- Insert vacuum hose and jetting wand through the outlet riser and extract sediment and floatables
- Replace flow deflector (EF4/EFO4), inlet grate, and cover(s)
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

***When is inspection needed?***

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess pollutant accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

***What equipment is typically required for inspection?***

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

***When is maintenance cleaning needed?***

- If the post-construction inspection indicates presence of construction sediment of a depth greater than a few inches, maintenance is recommended at that time.
- For optimum performance and normal operation the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, see **Table 3**.
- Maintain immediately after an oil, fuel, or other chemical spill.

**Table 3**

| **Recommended Sediment Depths for Maintenance Service*** | |
|---|---|
| MODEL | Sediment Depth (in/mm) |
| EF4 / EFO4 | 8 / 203 |
| EF6 / EFO6 | 12 /305 |
| EF8 / EFO8 | 24 / 610 |
| EF10 / EFO10 | 24 / 610 |
| EF12 / EFO12 | 24 / 610 |

* Based on a minimum distance of 40 inches (1,016 mm) from bottom of outlet riser to top of sediment bed

The frequency of inspection and maintenance may need to be adjusted based on site conditions to ensure the unit is operating and performing as intended. Maintenance costs will vary based on the size of the unit, site conditions, local requirements, disposal costs, and transportation distance.

***What equipment is typically required for maintenance?***

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required (adhere to all OSHA / CCOSH standards)

***What conditions can compromise Stormceptor performance?***

- Presence of construction sediment and debris in the unit prior to activation
- Excessive sediment depth beyond the recommended maintenance depth
- Oil spill in excess of the oil storage capacity
- Clogging or restriction of the drop pipe inlet opening with debris
- Downstream blockage that results in a backwater condition

## Maintenance Procedures

- Maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is maintained from grade through a standard surface manhole access cover or inlet grate.
- In the case of submerged or tailwater conditions, extra measures are likely required, such as plugging the inlet and outlet pipes prior to conducting maintenance.
- Inspection and maintenance of upstream catch basins and other stormwater conveyance structures is also recommended to extend the time between future maintenance cycles.

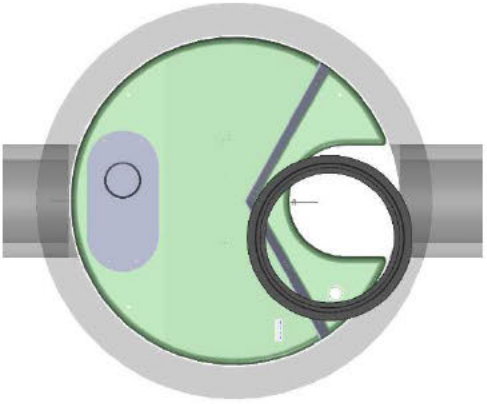


**Figure 6**

- Sediment depth inspections are performed through the **Outlet Riser** and oil presence can be determined through the **Oil Inspection Pipe**.
- Oil presence and sediment depth are determined by inserting a Sludge Judge® or measuring stick to quantify the pollutant depths.

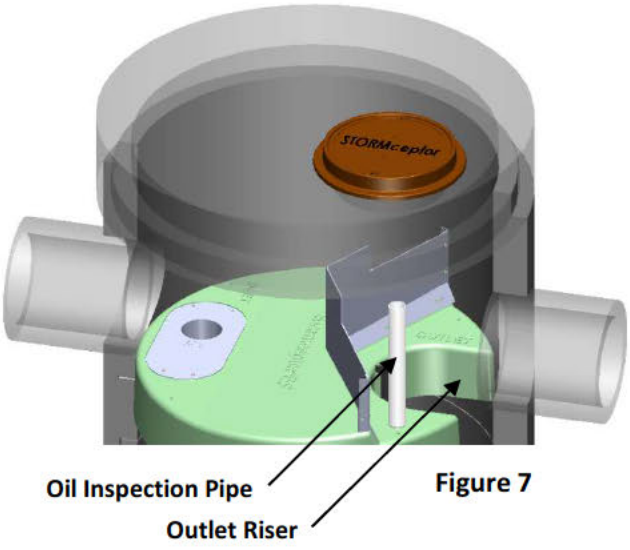



**Figure 7**




**Figure 8**

- Visually inspect the insert, weir, and drop pipe inlet opening to ensure there is no damage or blockage.
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

- When maintenance is required, a standard vacuum truck is used to remove the pollutants from the lower chamber of the unit through the **Outlet Riser**.



**Figure 9**

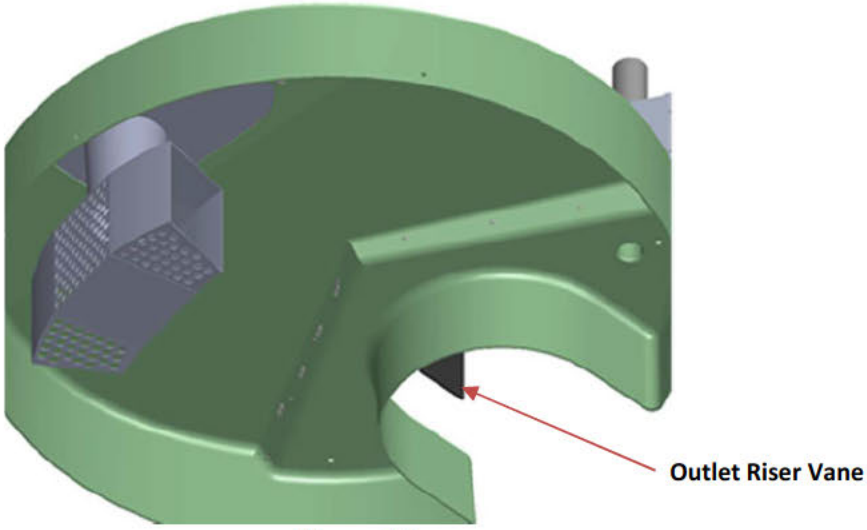
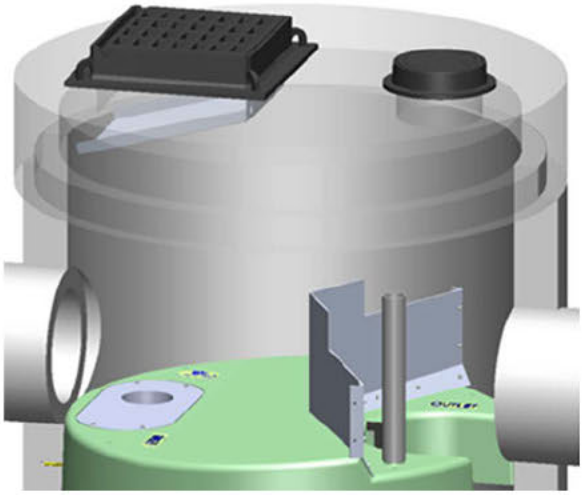



**Figure 10**

NOTE: The Outlet Riser Vane is durable and flexible and designed to allow maintenance activities with minimal, if any, interference.

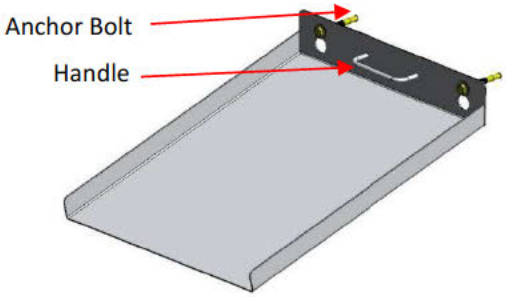
## Removable Flow Deflector

- Top grated inlets for the Stormceptor EF4/EFO4 model requires a removable flow deflector staged underneath a 24-inch x 24-inch (600 mm x 600 mm) square inlet grate to direct flow towards the inlet side of the insert, and avoid flow and pollutants from entering the outlet side of the insert from grade. The EF6/EFO6 and larger models do not require the flow deflector.



**How to Remove:**

1. Loosen anchor bolts
2. Pull up and out using the handle




Removable Flow Deflector

**Figure 11**

## Hydrocarbon Spills

Stormceptor is often installed on high pollutant load hotspot sites with vehicular traffic where hydrocarbon spill potential exists. Should a spill occur, or presence of oil be identified within a Stormceptor EF/EFO, it should be cleaned immediately by a licensed liquid waste hauler.

### Disposal

Maintenance providers are to follow all federal, state/ provincial, and local requirements for disposal of material.

### Oil Sheens

When oil is present in stormwater runoff, a sheen may be noticeable at the Stormceptor outlet. An oil rainbow or sheen can be noticeable at very low oil concentrations (< 10 mg/L). Despite the appearance of a sheen, Stormceptor EF/EFO may still be functioning as intended.

### Oil Level Alarm

To mitigate spill liability with 24/7 detection, an electronic monitoring system can be employed to trigger a visual and audible alarm when a pre-set level of oil is captured within the lower chamber or when an oil spill occurs. The oil level alarm is available as an optional feature to include with Stormceptor EF/EFO as shown in **Figure 11**. For additional details about the Oil Level Alarm please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-systems.

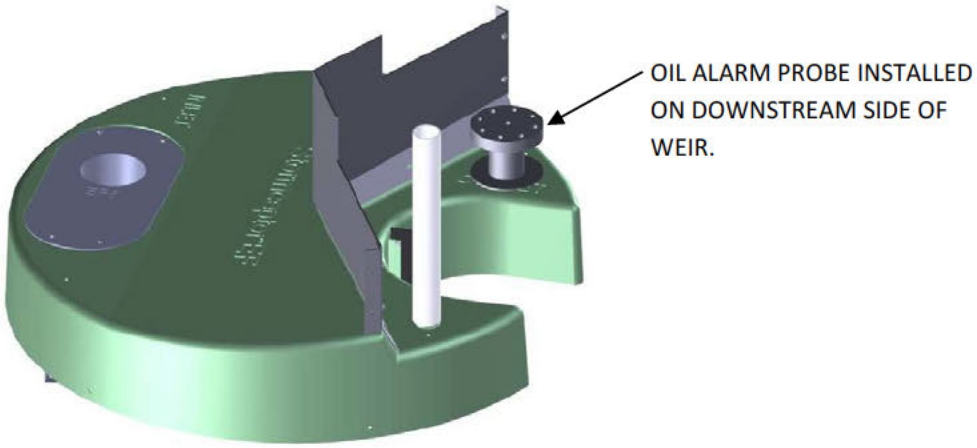



**Figure 12**

## Replacement Parts

Stormceptor has no moving parts to wear out. Therefore inspection and maintenance activities are generally focused on pollutant removal. Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. However, if replacement parts are necessary, they may be purchased by contacting your local Stormceptor representative.

## Stormceptor Inspection and Maintenance Log

Stormceptor Model No: _____

Serial Number: _____

Installation Date: _____

Location Description of Unit: _____

Recommended Sediment Maintenance Depth: _____

| DATE | SEDIMENT DEPTH (inch or mm) | OIL DEPTH (inch or mm) | SERVICE REQUIRED (Yes / No) | MAINTENANCE PERFORMED | MAINTENANCE PROVIDER | COMMENTS |
|---|---|---|---|---|---|---|
| | | | | | | |
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Other Comments:

# Contact Information

Questions regarding Stormceptor EF/EFO can be addressed by contacting your local Stormceptor representative or by visiting our website at **www.stormceptor.com**.

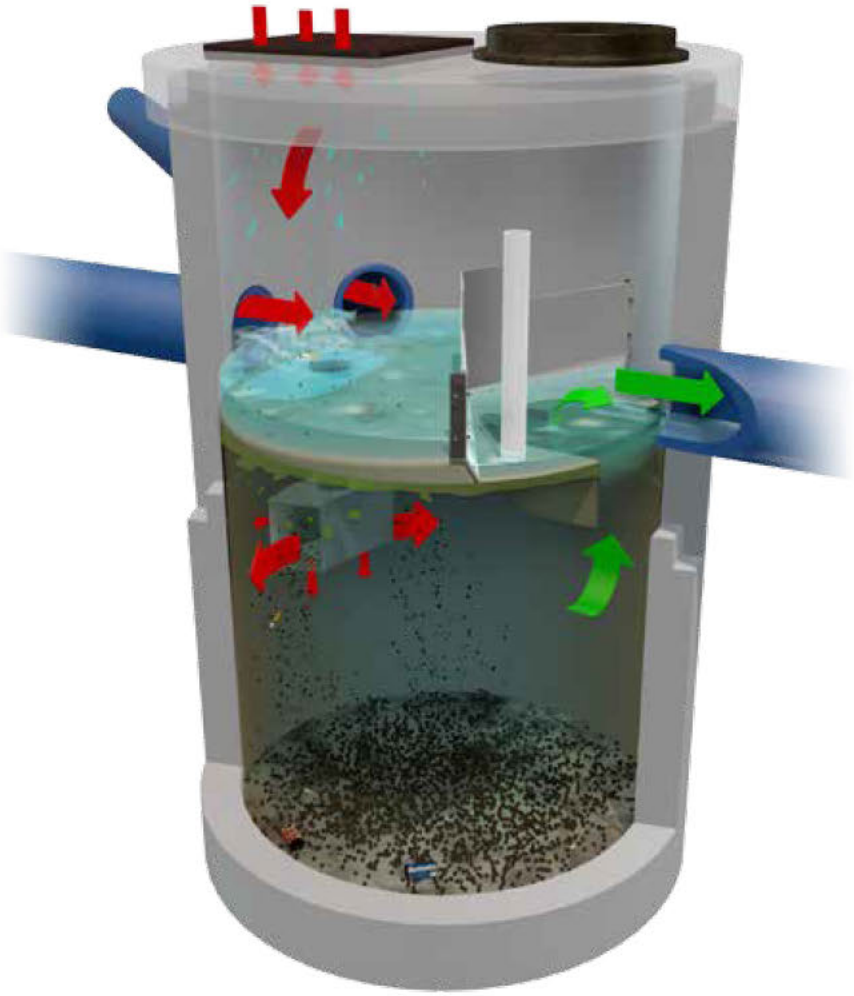
**Imbrium Systems Inc. & Imbrium Systems LLC**

| | |
|---|---|
| Canada | 1-416-960-9900 / 1-800-565-4801 |
| United States | 1-301-279-8827 / 1-888-279-8826 |
| International | +1-416-960-9900 / +1-301-279-8827 |

www.imbriumsystems.com
www.stormceptor.com
info@imbriumsystems.com

# Stormceptor® EF

# Technical Manual



imbrium®

## OVERVIEW

**Stormceptor® EF** is a continuation and evolution of the most globally recognized oil-grit separator (OGS) stormwater treatment technology - ***Stormceptor®***. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil-grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at higher flow rates as compared to the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention technology and internal bypass ensures sediment is retained during all rainfall events..

Stormceptor EF offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe, multiple inlet pipes, and/or from the surface through an inlet grate. Stormceptor EF can also serve as a junction structure, accommodate a 90-degree inlet to outlet bend angle, and be modified to ensure performance in submerged conditions. With its scour prevention technology and internal bypass, Stormceptor EF can be installed online, eliminating the need for costly additional bypass structures.

## OPERATION

- Stormwater enters the Stormceptor upper chamber through the inlet pipe(s) or a surface inlet grate. A specially designed insert reduces the influent velocity by creating a pond upstream of the insert's weir. Sediment particles immediately begin to settle. Swirling flow sweeps water, sediment, and floatables across the sloped surface of the insert to the inlet opening of the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone.
- Influent exits the cone into the drop pipe duct. The duct has two large rectangular outlet openings as well as perforations in the backside and floor of the duct. Influent is diffused through these various opening in multiple directions and at low velocity into the lower chamber.
- Free oils and other floatables rise up and are trapped beneath the insert, while sediment settles to the sump. Pollutants are retained for later removal during maintenance cleaning.
- Treated effluent enters the outlet riser, moves upward, and discharges to the top side of the insert downstream of the weir, where it flows out the outlet pipe.
- During intense storm events with very high influent flow rates, the pond height on the upstream side of the weir may exceed the height of the weir, and the excess flow passes over the top of the weir to the downstream side of the insert, and exits through the outlet pipe. This internal bypass feature allows for online installation, avoiding the cost of additional bypass structures. During bypass, the pond separates sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate.
- Stormceptor EF's patent-pending enhanced flow and scour prevention technology ensures pollutants are captured and retained, allowing excess flows to bypass during infrequent, high intensity storms.
- **Refer to components identified in Figures 1 and 2 to understand the Stormceptor EF operation.**

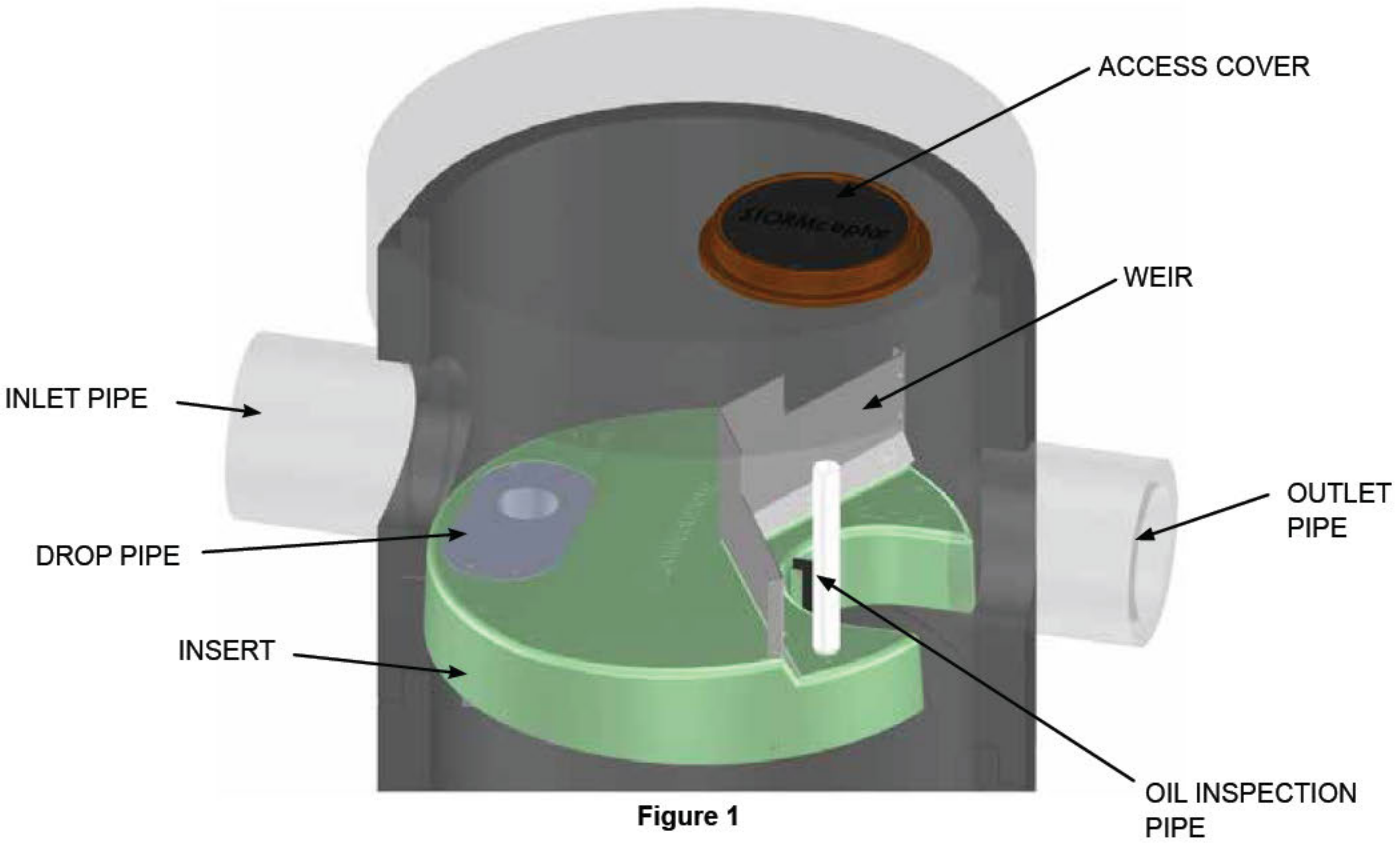



**Figure 1**

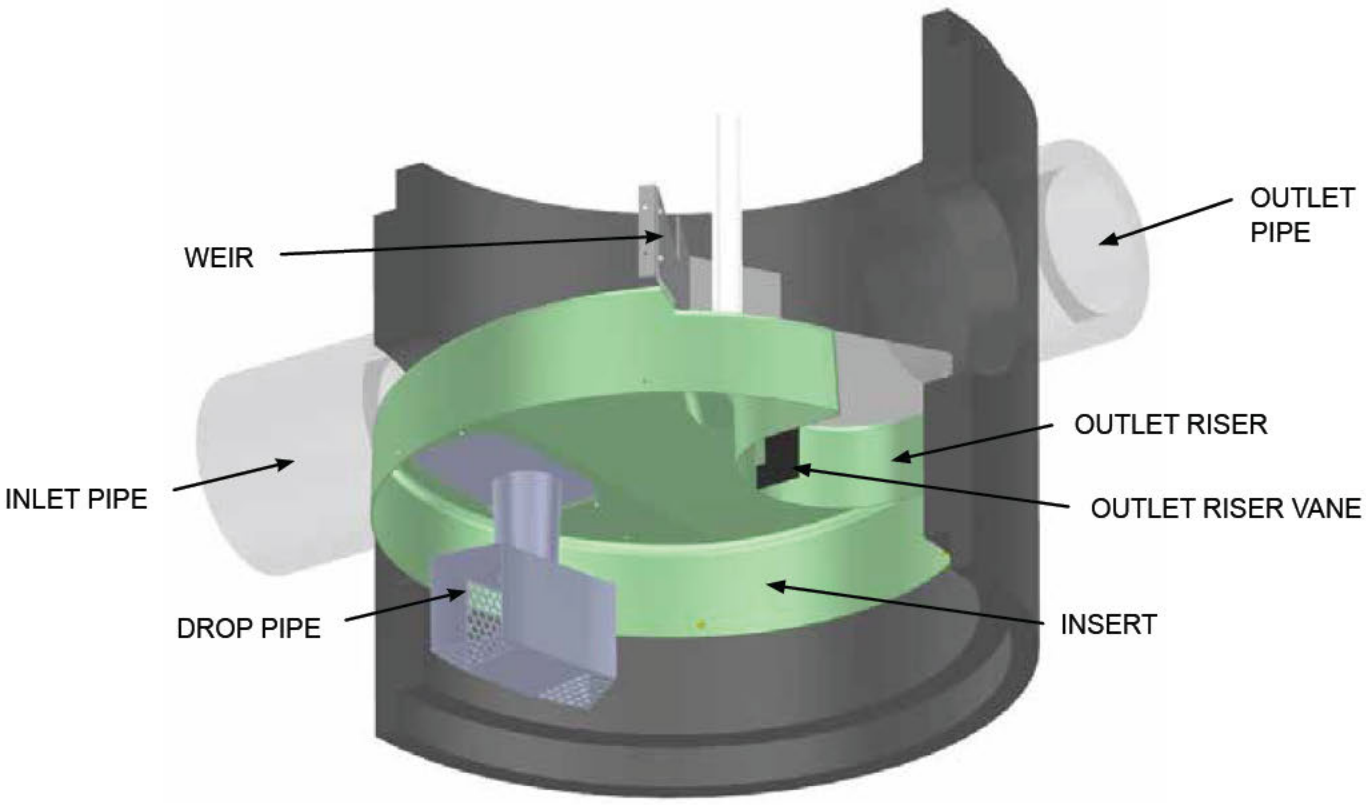



**Figure 2**

## FEATURES AND BENEFITS

| FEATURE | BENEFITS |
|---|---|
| Patent-pending enhanced flow, TSS treatment technology | Superior, verified third-party performance |
| Scour prevention with an internal bypass | Validated online installation and cost savings |
| Third-party verified light liquid capture (oil) and retention (Stormceptor EFO) | Proven performance for fuel/oil hotspot locations |
| Functions as bend, junction or inlet structure | Cost savings & design flexibility |
| Minimal drop between inlet and outlet | Site installation ease |
| Large diameter outlet riser for inspection and maintenance | Easy maintenance access from grade |

## APPLICATIONS

Stormceptor EF is designed as an 'at source' solution for commercial and industrial sites, urban environments, and residential developments. Stormceptor EF is ideal for:

- Pretreatment of wet ponds, filters, infiltration systems, bioretention, and other Low Impact Development (LID) applications
- Commercial sites
- Manufacturing/Industrial sites
- Residential developments
- Fueling stations, convenience stores, fast food restaurants
- Roads and highways
- Airports, seaports, and military bases
- Hydrocarbon spill, high pollutant load hotspots (Stormceptor EFO)

## PRODUCT DETAILS

| METRIC DIMENSIONS AND CAPACITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stormceptor Model | Inside Diameter | Minimum Surface to Outlet Invert Depth | Depth Below Outlet Pipe Invert | Wet Volume | Sediment Capacity[1] | Hydrocarbon Storage Capacity[2] | Maximum Flow Rate into Lower Chamber[3] | Peak Conveyance Flow Rate[4] |
| | (m) | (mm) | (mm) | (L) | ($m^3$) | (L) | (L/s) | (L/s) |
| EF4 / EFO4 | 1.22 | 915 | 1524 | 1780 | 1.19 | 265 | 22.1 / 10.4 | 425 |
| EF6 / EFO6 | 1.83 | 915 | 1930 | 5070 | 3.47 | 610 | 49.6 / 23.4 | 990 |
| EF8 / EFO8 | 2.44 | 1219 | 2591 | 12090 | 8.78 | 1070 | 88.3 / 41.6 | 1700 |
| EF10 / EFO10 | 3.05 | 1219 | 3251 | 23700 | 17.79 | 1670 | 138 / 65 | 2830 |
| EF12 / EFO12 | 3.66 | 1524 | 3886 | 40800 | 31.22 | 2475 | 198.7 / 93.7 | 2830 |

| U.S. DIMENSIONS AND CAPACITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stormceptor Model | Inside Diameter | Minimum Surface to Outlet Invert Depth | Depth Below Outlet Pipe Invert | Wet Volume | Sediment Capacity[1] | Hydrocarbon Storage Capacity[2] | Maximum Flow Rate into Lower Chamber[3] | Peak Conveyance Flow Rate[4] |
| | (ft) | (in) | (in) | (gal) | ($ft^3$) | (gal) | (cfs) | (cfs) |
| EF4 / EFO4 | 4 | 36 | 60 | 471 | 42 | 70 | 0.78 / 0.37 | 15 |
| EF6 / EFO6 | 6 | 36 | 76 | 1339 | 123 | 160 | 1.75 / 0.83 | 35 |
| EF8 / EFO8 | 8 | 48 | 102 | 3194 | 310 | 280 | 3.12 / 1.47 | 60 |
| EF10 / EFO10 | 10 | 48 | 128 | 6261 | 628 | 440 | 4.87 / 2.30 | 100 |
| EF12 / EFO12 | 12 | 60 | 153 | 10779 | 1103 | 655 | 7.02 / 3.31 | 100 |

1. Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
2. Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
3. EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 1135 L/min/$m^2$ (27.9 gpm/$ft^2$). EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 535 L/min/$m^2$ (13.1 gpm/$ft^2$).
4. Peak Conveyance Flow Rate is limited by a maximum velocity of 1.5 m/s (5 fps).

## UNIT DESIGN

### Sizing Methodology

Stormceptor® EF and Stormceptor® EFO are sized using local historical rainfall data for the site of interest, specific site parameters, and a performance curve for TSS removal derived from third-party testing conducted in accordance with the Canadian Environmental Technology Verification (ETV) Program's ***Procedure for Laboratory Testing of Oil-Grit Separators***. Every Stormceptor unit is designed to achieve the specified target TSS removal, however, for sites where oil/fuel capture and retention is an additional specified water quality objective Stormceptor EFO is the proper selection. The sizing methodology includes various considerations, including:

- Site parameters
- Local historical rainfall data
- Capture of the Canadian ETV particle size distribution
- Requirements for oil/fuel capture and retention
- Performance results from third-party testing and verification

State, provincial, and local regulatory agencies and municipalities may have specific sizing and design criteria for stormwater treatment systems such as OGS devices. To ensure proper sizing and design, contact your local Stormceptor representative for sizing and design assistance or visit www.imbriumsystems.com for more information.

## ONLINE APPLICATION

Stormceptor EF's internal bypass and patent-pending scour prevention technology has demonstrated very effective retention of pollutants in third-party testing and verification following the Canadian ETV's ***Procedure for Laboratory Testing of Oil-Grit Separators***. Sediment scour prevention demonstrated an effluent concentration of less than 10 mg/L for sediment particles ranging from 1 to 1,000 microns, even during peak influent flow rates associated with infrequent high intensity storm events. While Stormceptor EF will capture oil, only the Stormceptor EFO configuration has been third-party tested and verified to retain greater than 99% of captured oil.

Based on these verified performance attributes, the most efficient and widely accepted application of Stormceptor EF is an online configuration, which allows all upstream conveyance flows to enter and exit the unit. The online application eliminates the need for costly additional bypass structures, piping and installation expense.

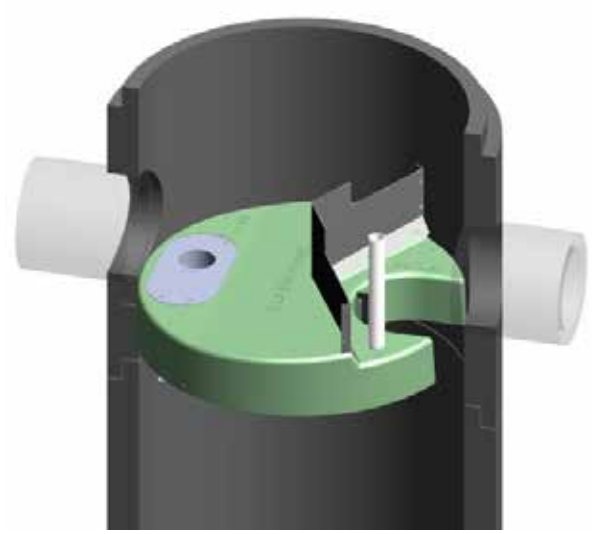


**Figure 3**

## FLOW ENTRANCE OPTIONS

***Single Inlet Pipe*** – A common design which includes one inlet pipe and one outlet pipe. A 90-degree (maximum) bend is also accepted with this configuration. **Example seen in Figure 3**.

| MAXIMUM PIPE DIAMETER | | |
|---|---|---|
| MODEL | INLET | OUTLET |
| | (in / mm) | (in / mm) |
| EF4 / EFO4 | 24 / 610 | 24 / 610 |
| EF6 / EFO6 | 36 / 915 | 36 / 915 |
| EF8 / EFO8 | 48 / 1220 | 48 / 1220 |
| EF10 / EFO10 | 72 / 1828 | 72 / 1828 |
| EF12 / EFO12 | 72 / 1828 | 72 / 1828 |

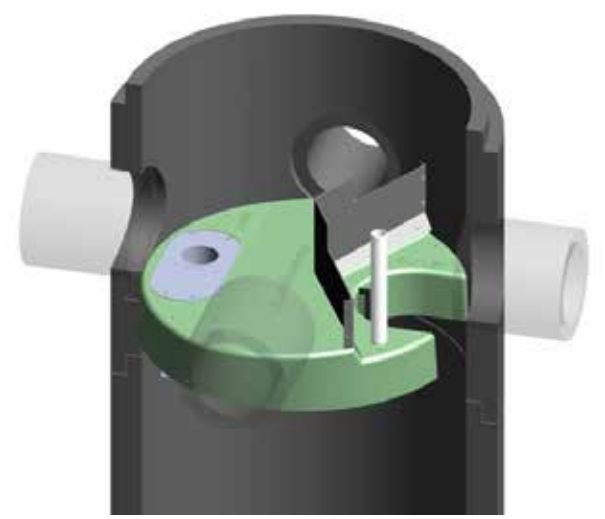


**Figure 4**

***Multiple Inlet Pipes*** – Allows for multiple inlet pipes of various diameters to enter the unit. **Example seen in Figure 4**.

| MAXIMUM PIPE DIAMETER | | |
|---|---|---|
| MODEL | INLET | OUTLET |
| | (in / mm) | (in / mm) |
| EF4 / EFO4 | 18 / 457 | 24 / 610 |
| EF6 / EFO6 | 30 / 762 | 36 / 915 |
| EF8 / EFO8 | 42 / 1067 | 48 / 1220 |
| EF10 / EFO10 | 60 / 1524 | 72 / 1828 |
| EF12 / EFO12 | 60 / 1524 | 72 / 1828 |

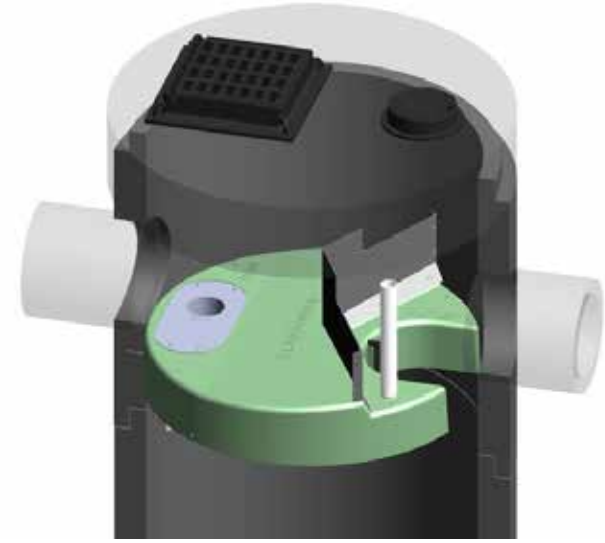


**Figure 5**

***Inlet Grate*** – Allows surface runoff to enter the unit from grade. The inlet grate option can also be used in conjunction with one inlet pipe or multiple inlet pipes. A removable flow deflector is added in the Stormceptor EF4/EFO4. **Example seen in Figure 5**.

| MAXIMUM PIPE DIAMETER | | |
|---|---|---|
| MODEL | INLET | OUTLET |
| | (in / mm) | (in / mm) |
| EF4 / EFO4 | 24 / 610 | 24 / 610 |
| EF6 / EFO6 | 36 / 915 | 36 / 915 |
| EF8 / EFO8 | 48 / 1220 | 48 / 1220 |
| EF10 / EFO10 | 72 / 1828 | 72 / 1828 |
| EF12 / EFO12 | 72 / 1828 | 72 / 1828 |

## INLET-TO-OUTLET DROP

Elevation differential between the inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit (**illustration seen in Figure 6**).

**0° – 45°**: The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

**45° – 90°**: The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

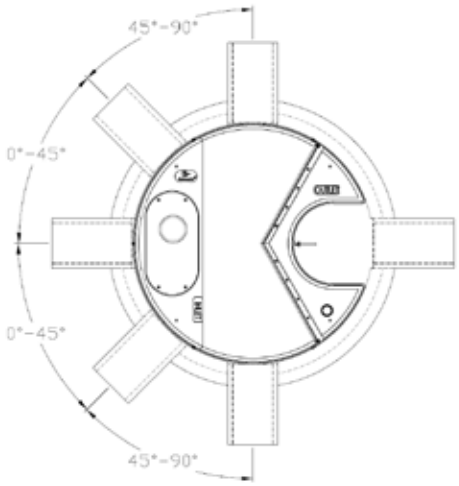



**Figure 6**

## SUBMERGED (TAILWATER) DESIGN

Submerged or tailwater conditions are defined as standing water above the insert elevation during zero-runoff conditions. A weir height modification allows Stormceptor EF to operate under submerged conditions. The following information is necessary to properly design Stormceptor EF for the submerged condition:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

NOTE: The maximum weir height for Stormceptor EF is 48 inches (1200 mm). Contact your local Stormceptor representative for design assistance.

## LIVE LOAD

Stormceptor EF is typically designed for local highway truck loading. In instances where other live loads are required, Stormceptor EF can be customized to meet the necessary structural requirements. Contact your local Stormceptor representative for design assistance.

## SHALLOW COVER

Stormceptor EF is typically designed with a minimum depth of burial to the outlet invert based on the diameter of the inlet and outlet pipes. A common minimum burial depth to the outlet invert is 48 inches (1.2 meters). In instances where there may be site constraints to the depth of burial contact your local Stormceptor representative for design assistance.

## HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

## ABOVE-GROUND INSTALLATIONS

Stormceptor EF can be designed as a free-standing above-ground unit, constructed of fiberglass as illustrated in **Figure 7**. These customized units are lightweight and can be installed within a building footprint, providing structural support and installation advantages. Contact your local Stormceptor representative for design assistance.

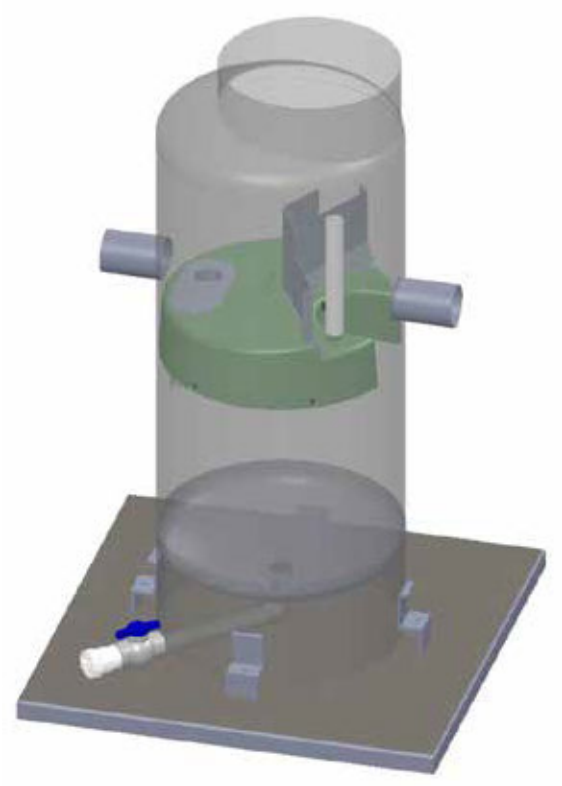


**Figure 7**

## PERFORMANCE VERIFICATION TESTING

Stormceptor EF has been third-party performance tested according to the Canadian Environmental Technical Verification (ETV) Procedure for ***Laboratory Testing of Oil-Grit Separators***, and has received ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

For more information, please visit www.imbriumsystems.com or contact your local Stormceptor representative.

## INSTALLATION

For installation details, please visit www.imbriumsystems.com and refer to the Stormceptor EF Installation Guideline or contact your local Stormceptor representative.

## INSPECTION AND MAINTENANCE

As with any stormwater treatment device, periodic inspection and maintenance of Stormceptor EF is required for long-term performance.

Inspection and maintenance is performed from grade without entering the unit. Sediment depth inspections are performed through the outlet riser, and oil presence can be determined through the oil inspection pipe. Oil presence and sediment depth are determined by inserting a Sludge Judge® or measuring stick to quantify the pollutant depths. Visual inspections of the insert can be performed to ensure there is no damage or blockages. A beneficial feature of Stormceptor EF in comparison to many other treatment practices is that once it is maintained, Stormceptor EF is functionally restored to its original condition.

When maintenance is required, a standard vacuum truck is used to remove the pollutants (sediment and floatables) from the lower chamber of the unit through the outlet riser. When an appreciable amount of oil or other hydrocarbons is present, these floatable pollutants can be removed by hydrovac from the water surface. Should an oil/fuel spill occur, or presence of oil/fuel be identified within the unit, it should be cleaned immediately by a licensed liquid waste hauler.

| RECOMMENDED SEDIMENT DEPTHS FOR MAINTENANCE SERVICE* | |
|---|---|
| MODEL | Sediment Depth (in/mm) |
| EF4 / EFO4 | 8 / 203 |
| EF6 / EFO6 | 12 /305 |
| EF8 / EFO8 | 24 / 610 |
| EF10 / EFO10 | 24 / 610 |
| EF12 / EFO12 | 24 / 610 |

* Based on a minimum distance of 40 inches (1,016 mm) from bottom of outlet riser to top of sediment bed.

The frequency of inspection and maintenance may need to be adjusted based on site conditions to ensure the unit is operating and performing as intended. Maintenance costs will vary based on the size of the unit, site conditions, local requirements, location, and transportation distance(s).

For more details on inspection and maintenance refer to the Stormceptor EF Owner's Manual at www.imbriumsystems.com.

## HYDROCARBON CAPTURE AND RETENTION

### Stormceptor EFO

Stormceptor is often installed on high-traffic pollutant hotspots where hydrocarbon spill potential exists.

The technology platform of Stormceptor EFO is the same as Stormceptor EF, however the maximum surface loading rate into the lower chamber is restricted to a lower value with Stormceptor EFO, thereby ensuring excellent oil retention. Third-party testing in accordance with the Light Liquid Re-entrainment testing provisions within the Canadian ETV protocol ***Procedure for Laboratory Testing of Oil-Grit Separators*** demonstrated greater than 99% oil retention. Stormceptor EFO is engineered to capture and retain free floating oil/chemical/fuel spills, not emulsified hydrocarbons.



Optio
Ala

### Oil Sheen

When oil is present in stormwater runoff, a sheen may be noticeable at the Stormceptor outlet. An oil rainbow or sheen can be noticeable at very low oil concentrations (< 10 mg/L). Despite the appearance of a sheen, Stormceptor EFO may still be functioning as intended.

### Disposal

Maintenance providers are to follow all federal, state/ provincial, and local requirements for disposal of hydrocarbons.

### Oil Level Alarm

As an added safeguard, an oil level alarm is available as an optional feature for Stormceptor EFO. This is an electronic monitoring system designed to trigger a visual and audible alarm when a preset level of oil is captured in the lower chamber. The oil level alarm is installed as illustrated in **Figure 8**.

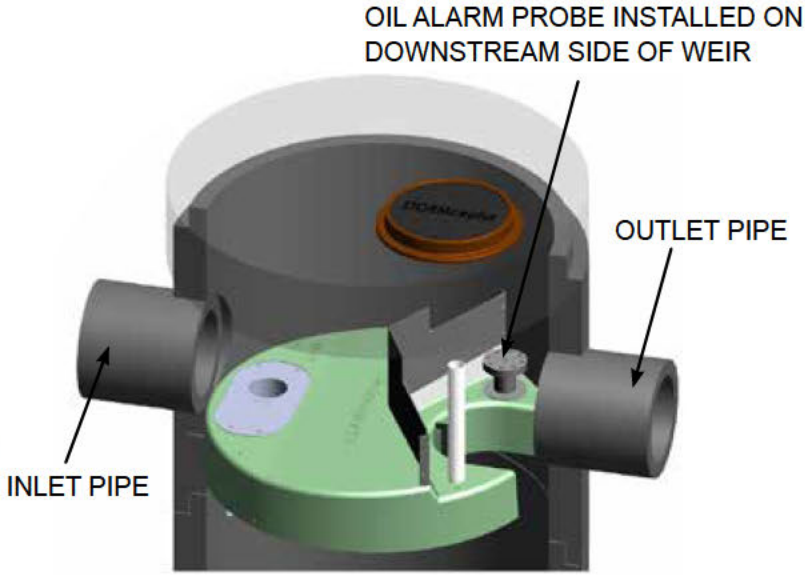



**Figure 8**

## ADDITIONAL POLLUTANT STORAGE CAPACITY

Stormceptor EF/EFO can be easily modified to increase sediment storage capacity by extending the depth of the lower chamber. Stormceptor EFO can be modified to increase hydrocarbon storage capacity by extending the outlet riser, thereby providing the storage volumes depicted in the table below.

| STORMCEPTOR EFO STORAGE VOLUME | | |
|---|---|---|
| **Stormceptor EFO Model** | **Standard Hydrocarbon Storage Capacity [1]** | **Extended Hydrocarbon Storage Capacity [1,2]** |
| | **(L / gal)** | **(L / gal)** |
| EFO4 | 265 / 70 | 395 / 105 |
| EFO6 | 610 / 160 | 1615 / 425 |
| EFO8 | 1070 / 280 | 4340 / 1145 |
| EFO10 | 1670 / 440 | NA |
| EFO12 | 2475 / 655 | NA |

1. Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert.
2. Distance from bottom of the extended outlet riser to top of the sediment maintenance depth is 914 mm (36 in).
   NA –Not available in these model sizes

Additional hydrocarbon storage capacity can be added with a draw off tank.

Contact your local Stormceptor representative for additional information and design assistance.

## HEALTH AND SAFETY

For all aspects of installation and inspection/maintenance, OSHA and appropriate local regulations should be followed to ensure safe practice.

**Contact**

**888-279-8826 / 416-960-9900**

**info@imbriumsystems.com**

**www.imbriumsystems.com**

# APPENDIX “G”

Water Balance Calculations

**VALDOR ENGINEERING INC.**
Project: Millbrook Subdivision, Phase 2
File: 23142
Date: September 2026

## Table G.1: Site Water Balance Calculations (Annual)

| Condition | Site Area (ha) | Water Balance Components | Pervious Area Without Infiltration BMPs | Impervious Area Without Infiltration BMPs | Impervious Area With Basic Infiltration BMPs | TOTAL SITE VOLUMES Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Surplus ($m^3$) | Runoff ($m^3$) | Infiltration ($m^3$) | Percent of Existing Infiltration (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing | **2.04** | Area (ha) | 2.04 | 0.00 | 0.00 | 22,128 | 10,760 | 11,368 | 4,547 | 6,821 | 100.0 |
| | | Infiltration Factor | 0.600 | 0.00 | 0.500 | | | | | | |
| | | Precipitation (mm) | 1083.1 | 1083.1 | 1083.1 | | | | | | |
| | | Evapotranspiration (mm) | 526.7 | 216.6 | 526.7 | | | | | | |
| | | Surplus (mm) | 556.4 | 866.5 | 556.4 | | | | | | |
| | | Infiltration (mm) | 333.9 | 0.0 | 278.2 | | | | | | |
| | | Runoff (mm) | 222.6 | 866.5 | 278.2 | | | | | | |
| Proposed (No Infiltration BMPs) | **2.04** | Area (ha) | 0.56 | 1.48 | 0.00 | 22,128 | 6,165 | 15,963 | 13,778 | 2,185 | 32.0 |
| | | Infiltration Factor | 0.700 | 0.00 | 0.500 | | | | | | |
| | | Precipitation (mm) | 1083.1 | 1083.1 | 1083.1 | | | | | | |
| | | Evapotranspiration (mm) | 526.7 | 216.6 | 526.7 | | | | | | |
| | | Surplus (mm) | 556.4 | 866.5 | 556.4 | | | | | | |
| | | Infiltration (mm) | 389.5 | 0.0 | 278.2 | | | | | | |
| | | Runoff (mm) | 166.9 | 866.5 | 278.2 | | | | | | |

**Valdor Engineering Inc.**
File: 23142
Date: September 2026

## Table G.2: Evapotranspiration and Surplus (Thornthwaite Method)

| Month | [1]Mean Temperature (°C) | [2]Heat Index | [3]Potential Evapo-transpiration (mm) | [4]Daylight Correction Value | Adjusted Potential Evapo-transpiration (mm) | [1]Total Precipitation (mm) | Surplus (mm) | Deficit (mm) |
|---|---|---|---|---|---|---|---|---|
| **January** | -8.9 | 0.0 | 0.0 | 0.77 | 0.0 | 110.3 | 110.3 | 0.0 |
| **February** | -8.3 | 0.0 | 0.0 | 0.87 | 0.0 | 79.6 | 79.6 | 0.0 |
| **March** | -3.5 | 0.0 | 0.0 | 0.99 | 0.0 | 81.5 | 81.5 | 0.0 |
| **April** | 3.9 | 0.7 | 21.6 | 1.12 | 24.2 | 73.1 | 48.9 | 0.0 |
| **May** | 10.9 | 3.3 | 57.6 | 1.23 | 71.1 | 80.9 | 9.8 | 0.0 |
| **June** | 15.4 | 5.5 | 80.2 | 1.29 | 103.5 | 88.9 | 0.0 | 14.6 |
| **July** | 17.8 | 6.8 | 92.2 | 1.26 | 116.4 | 80.6 | 0.0 | 35.8 |
| **August** | 17.0 | 6.4 | 88.2 | 1.17 | 102.9 | 95.6 | 0.0 | 7.3 |
| **September** | 12.9 | 4.2 | 67.7 | 1.04 | 70.7 | 99.7 | 29.0 | 0.0 |
| **October** | 7.0 | 1.7 | 37.7 | 0.92 | 34.6 | 86.0 | 51.4 | 0.0 |
| **November** | 0.7 | 0.1 | 4.2 | 0.80 | 3.3 | 104.0 | 100.7 | 0.0 |
| **December** | -5.5 | 0.0 | 0.0 | 0.74 | 0.0 | 102.9 | 102.9 | 0.0 |
| **Totals** | | **28.6** | **449.5** | | **526.7** | **1083.1** | **614.1** | **57.7** |

a: 0.95704

**[5]Total Precipitation Surplus (mm): 556.4**

**Notes:**

1) Average monthly precipitation and temperature data obtained from the Proton Station station (1971-2000 data set, ID: 6116750).

2) Monthly heat index, $I_j = (T_j/5)^{1.514}$, where $T_j$ is mean monthly temperature, $I_j = 0$ if $T_j \leq 0$, $I_{tot}$ is sum of monthly $I_j$.

3) Monthly potential evapotranspiration, $Etp = 16(10T_j/I_{tot})^a$, where $a = 6.75x10^{-7}I_{tot}^3 - 7.71x10^{-5}I_{tot}^2 + 1.792x10^{-2}I_{tot} + 0.49239$, $E_{tp} = 0$ if $T_j \leq 0$.

4) Water balance adjusted for latitude and daylight (refer to **Table F.3**).

5) Total water surplus is calculated as total precipitation minus adjusted potential evapotranspiration.

6) Total moisture surplus is calculated as total precipitation minus actual evapotranspiration.

**Valdor Engineering Inc.**
File: 23142
Date: September 2026

## Table G.3: Daylight Correction Factor

| Date | Hours of Solar Illumination per Day | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **January** | **February** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December** |
| **1** | 8.91 | 9.83 | 11.16 | 12.75 | 14.21 | 15.30 | 15.48 | 14.65 | 13.25 | 11.74 | 10.22 | 9.11 |
| **2** | 8.93 | 9.88 | 11.21 | 12.80 | 14.25 | 15.32 | 15.47 | 14.61 | 13.20 | 11.69 | 10.18 | 9.08 |
| **3** | 8.94 | 9.92 | 11.26 | 12.85 | 14.30 | 15.34 | 15.46 | 14.57 | 13.15 | 11.64 | 10.13 | 9.06 |
| **4** | 8.96 | 9.96 | 11.31 | 12.90 | 14.34 | 15.36 | 15.44 | 14.53 | 13.11 | 11.59 | 10.09 | 9.04 |
| **5** | 8.98 | 10.01 | 11.36 | 12.95 | 14.38 | 15.38 | 15.43 | 14.49 | 13.06 | 11.54 | 10.04 | 9.02 |
| **6** | 8.99 | 10.05 | 11.41 | 13.01 | 14.42 | 15.40 | 15.41 | 14.45 | 13.01 | 11.49 | 10.00 | 9.00 |
| **7** | 9.01 | 10.09 | 11.46 | 13.06 | 14.47 | 15.42 | 15.39 | 14.41 | 12.96 | 11.44 | 9.96 | 8.98 |
| **8** | 9.04 | 10.14 | 11.52 | 13.11 | 14.51 | 15.44 | 15.37 | 14.37 | 12.91 | 11.39 | 9.91 | 8.96 |
| **9** | 9.06 | 10.19 | 11.57 | 13.16 | 14.55 | 15.45 | 15.35 | 14.32 | 12.86 | 11.34 | 9.87 | 8.94 |
| **10** | 9.08 | 10.23 | 11.62 | 13.21 | 14.59 | 15.46 | 15.33 | 14.28 | 12.81 | 11.29 | 9.83 | 8.93 |
| **11** | 9.11 | 10.28 | 11.67 | 13.26 | 14.63 | 15.48 | 15.31 | 14.24 | 12.76 | 11.24 | 9.79 | 8.91 |
| **12** | 9.13 | 10.32 | 11.72 | 13.31 | 14.67 | 15.49 | 15.29 | 14.19 | 12.71 | 11.19 | 9.75 | 8.90 |
| **13** | 9.16 | 10.37 | 11.77 | 13.36 | 14.71 | 15.50 | 15.26 | 14.15 | 12.65 | 11.14 | 9.71 | 8.89 |
| **14** | 9.19 | 10.42 | 11.82 | 13.41 | 14.74 | 15.51 | 15.24 | 14.10 | 12.60 | 11.09 | 9.67 | 8.88 |
| **15** | 9.22 | 10.47 | 11.88 | 13.45 | 14.78 | 15.52 | 15.21 | 14.06 | 12.55 | 11.04 | 9.63 | 8.87 |
| **16** | 9.25 | 10.51 | 11.93 | 13.50 | 14.82 | 15.52 | 15.19 | 14.01 | 12.50 | 10.99 | 9.59 | 8.86 |
| **17** | 9.28 | 10.56 | 11.98 | 13.55 | 14.85 | 15.53 | 15.16 | 13.97 | 12.45 | 10.94 | 9.55 | 8.85 |
| **18** | 9.31 | 10.61 | 12.03 | 13.60 | 14.89 | 15.53 | 15.13 | 13.92 | 12.40 | 10.89 | 9.52 | 8.85 |
| **19** | 9.34 | 10.66 | 12.08 | 13.65 | 14.93 | 15.54 | 15.10 | 13.88 | 12.35 | 10.84 | 9.48 | 8.84 |
| **20** | 9.37 | 10.71 | 12.13 | 13.70 | 14.96 | 15.54 | 15.07 | 13.83 | 12.30 | 10.79 | 9.44 | 8.84 |
| **21** | 9.41 | 10.76 | 12.19 | 13.74 | 14.99 | 15.54 | 15.04 | 13.78 | 12.25 | 10.74 | 9.41 | 8.84 |
| **22** | 9.44 | 10.81 | 12.24 | 13.79 | 15.02 | 15.54 | 15.01 | 13.74 | 12.20 | 10.69 | 9.38 | 8.84 |
| **23** | 9.48 | 10.86 | 12.29 | 13.84 | 15.06 | 15.54 | 14.97 | 13.69 | 12.15 | 10.65 | 9.34 | 8.84 |
| **24** | 9.52 | 10.91 | 12.34 | 13.89 | 15.09 | 15.53 | 14.94 | 13.64 | 12.10 | 10.60 | 9.31 | 8.84 |
| **25** | 9.55 | 10.96 | 12.39 | 13.93 | 15.12 | 15.53 | 14.91 | 13.59 | 12.05 | 10.55 | 9.28 | 8.85 |
| **26** | 9.59 | 11.01 | 12.44 | 13.98 | 15.15 | 15.52 | 14.87 | 13.54 | 12.00 | 10.50 | 9.25 | 8.85 |
| **27** | 9.63 | 11.06 | 12.50 | 14.03 | 15.17 | 15.52 | 14.84 | 13.50 | 11.95 | 10.45 | 9.22 | 8.86 |
| **28** | 9.67 | 11.11 | 12.55 | 14.07 | 15.20 | 15.51 | 14.80 | 13.45 | 11.89 | 10.41 | 9.19 | 8.86 |
| **29** | 9.71 | | 12.60 | 14.12 | 15.23 | 15.50 | 14.76 | 13.40 | 11.84 | 10.36 | 9.16 | 8.87 |
| **30** | 9.75 | | 12.65 | 14.16 | 15.25 | 15.49 | 14.73 | 13.35 | 11.79 | 10.31 | 9.13 | 8.88 |
| **31** | 9.79 | | 12.70 | | 15.28 | | 14.69 | 13.30 | | 10.27 | | 8.89 |
| **Average** | **9.28** | **10.45** | **11.93** | **13.47** | **14.79** | **15.48** | **15.15** | **14.00** | **12.53** | **10.99** | **9.63** | **8.91** |
| **Correction Value** | **0.77** | **0.87** | **0.99** | **1.12** | **1.23** | **1.29** | **1.26** | **1.17** | **1.04** | **0.92** | **0.80** | **0.74** |

**Notes:**
1) Daily hour of solar illumination obtained from the National Research Council Canada's online Sunrise/Sunset Calculator for the subject site location.
2) The correction value was obtained by dividing the monthly average of daily hours of solar illumination by 12.

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026

## Table G.4: Infiltration Factor Calculations
## Per MOE Methodology (SWM Planning & Design Manual, MOE, March 2003)

| | |
|---|---|
| Topography | |
| 0.3 | Flat Land (avg slope < 0.06%) |
| 0.25 | 0.06% to 0.27% |
| 0.2 | Rolling Land (avg slope between 0.28% and 0.38%) |
| 0.15 | 0.39% to 2.7% |
| 0.1 | Hilly Land (avg slope between 2.8% and 4.7%) |
| Soils | |
| 0.4 | HSG A - open sandy loam |
| 0.35 | HSG AB |
| 0.3 | HSG B |
| 0.27 | HSG BC |
| 0.23 | HSG C |
| 0.2 | HSG CD - medium combinations of clay and loam |
| 0.1 | HSG D - tight impervious clay |
| Cover | |
| 0.1 | cultivated land (crops) |
| 0.15 | pasture, lawns |
| 0.2 | woodland (forest) |

Infiltration Factor Calculations

Existing Conditions

| | |
|---|---|
| 0.1 | Topography |
| 0.4 | Soils |
| 0.1 | Cover |
| **0.600** | Total Infiltration Factor (Existing Conditions) |

Proposed Conditions

| | |
|---|---|
| 0.15 | Topography |
| 0.4 | Soils |
| 0.15 | Cover |
| **0.700** | Total Infiltration Factor (Proposed Conditions) |

## Table G.5: Infiltration Trench Calculations (Roof Drainage)

**VALDOR ENGINEERING INC.**
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Project No: 23142
Date: Sept. 2026

| *Total Req'd Annual Infiltration Volume to Achieve Target ($m^3$)* | *Total Actual Annual Infiltration Volume per Design ($m^3$)* | *Soil Infiltration Rate (mm/h)* | *Minimum Total Drainage Area to Infiltration Facilities (ha)* | *Maximum Trench Length per Site Plan (m)* | *Initial Abstraction (Trench Drainage Area) (mm)* | *Retention Time (hr)* | *Total Annual Rainfall Depth (mm)* | *Total Rainfall Depth Available for Infiltration Per Rainfall Analysis Assuming Ia=5.0mm (mm)* | *Annual Rainfall Depth Needed to Achieve Target Infiltration (mm)* | *[1] Req'd Design Storm Depth to Achieve Annual Infiltration Requirements (Assuming Ia=5.0 mm) (mm)* | *Provided Event-Based Runoff Volume to be Infiltrated (Based on Req'd Design Storm Depth ($m^3$)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.636 | 1,486 | 40 | 0.34 | - | 2.0 | 48 | 752.3 | 433.57 | 1,352.4 | 15.0 | 44.6 |

| **Maximum Allowable Depth** | |
|---|---|
| P, Design Soil Infiltration Rate (mm/h): | **40** |
| T, Drawdown Time (hr): | **48** |
| d, Maximum Allowable Depth (m): | **1.92** |

| **Minimum Bottom Area** | |
|---|---|
| V, Runoff Volume to Infiltrated ($m^3$): | **45** |
| P, Design Soil Infiltration Rate (mm/h): | **40** |
| n, Void Ratio (clear stone): | **0.40** |
| Δt, Drawdown Time (hr): | **48** |
| A, Minimum Bottom Area ($m^2$): | **58** |

$$d = \frac{P \cdot T}{1000}$$ *Equation 4.2, Stormwater Management Planning and Design Manual, MOE, 2003*

$$A = \frac{1000 \cdot V}{P \cdot n \cdot \Delta t}$$ *Equation 4.3, Stormwater Management Planning and Design Manual, MOE, 2003*

**Infiltration Trench Design**

| Infiltration Trench Location | Drainage Area (ha) | Available Infiltration Volume ($m^3$) | Length (m) | Width (m) | [3]Design Depth (m) | Bottom Area ($m^2$) | Void Ratio | Storage Volume Provided ($m^3$) | Lesser of Available Infiltration Volume or Storage Volume Provided ($m^3$) |
|---|---|---|---|---|---|---|---|---|---|
| **Roof (N) - 10mm** | **0.22** | 22.3 | **55.00** | **3.40** | **0.30** | 187 | 0.40 | 22.4 | 22.3 |
| **Roof (S) - 10mm** | **0.22** | 22.3 | **70.00** | **2.70** | **0.30** | 189 | 0.40 | 22.7 | 22.3 |

| | |
|---|---|
| **Total drainage area to infiltration trenches (ha):** | **0.62** |
| **Total Bottom Area Provided ($m^2$):** | **1,070** |
| **Total Infiltration Volume Used ($m^3$):** | **44.6** |

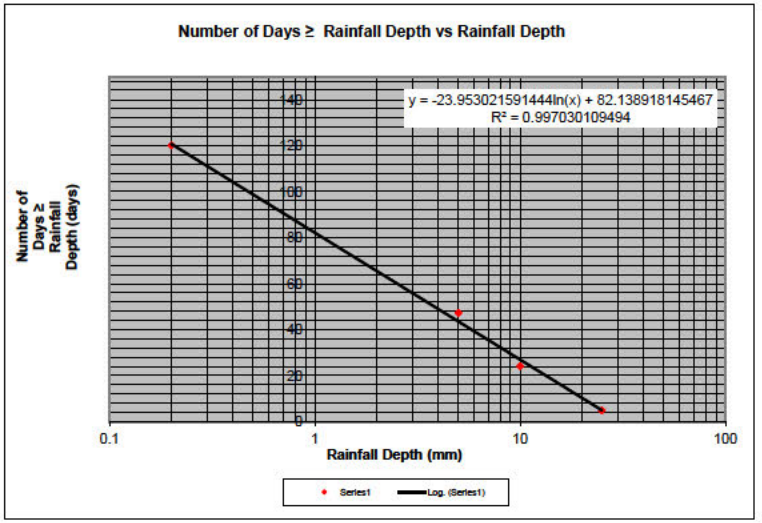
***Notes:***

Infiltration facilities are sized based on the following criteria (SWMPDM, MOE, 2003) and/or assumptions:

(1) Infiltration trench volume should be sized based on the runoff generated by a 4-hr 15-mm event or smaller.
(2) Drainage areas should be sufficient to provide required runoff quantity.
(3) The maximum allowable depth of the infiltration facility is based on the soil infiltrate rate and the retention time.
(4) It is feasible to convey the runoff to the infiltration facility.
(5) The seasonal high water table should be at least 1 m below the infiltration trench.

# Table G.6: Rainfall Analysis (IA = 2 mm)

**VALDOR ENGINEERING INC.**
File: 23142
Date: September 2026




| Normal Rainfall Depth (mm) | Normal Days ≥ Rainfall Depth (days) |
|---|---|
| 0.2 | 120 |
| 5 | 47.3 |
| 10 | 24.1 |
| 25 | 4.9 |

**Proton Station (1971 - 2000)**
752.3 Normal Annual Rainfall Depth (mm)
120 Normal Annual Days with Rainfall (≥ 0.2 mm)
1083 Normal Annual Precipitation Depth (mm)

| Simulated Depth (mm) | Simulated Days ≥ Sim Depth (days) | Average Event Depth (mm) | Simulated Days Equal to Avg Depth (days) | Assumed IA (mm) | Runoff (Rain - IA) (mm) | INF Design Storm (mm) | Event Based Maximum Design INF Depth (mm) | Event Based Design INF Depth (mm) | Annual Incremental Design INF Depth (mm) | Annual Cumulative Design INF Depth (mm) | Annual Incremental Total Rain Depth (mm) | Annual Percent of Total Rain (%) | Annual Cumulative Total Rain Depth (mm) | Annual Cumulative Percent of Total Depth (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | 120.69 | | | | | | | | | | | | | |
| 0.5 | 98.74 | 0.2 - 0.5 | 21.95 | 2.00 | 0.00 | 15.00 | 13.00 | 0.00 | 0.00 | 0.00 | | 0.000 | 0.0 | 0.000 |
| 1.5 | 72.43 | 1 | 26.32 | 2.00 | 0.00 | 15.00 | 13.00 | 0.00 | 0.00 | 0.00 | 26.32 | 0.035 | 26.3 | 0.035 |
| 2.5 | 60.19 | 2 | 12.24 | 2.00 | 0.00 | 15.00 | 13.00 | 0.00 | 0.00 | 0.00 | 24.47 | 0.033 | 50.8 | 0.068 |
| 3.5 | 52.13 | 3 | 8.06 | 2.00 | 1.00 | 15.00 | 13.00 | 1.00 | 8.06 | 8.06 | 24.18 | 0.032 | 75.0 | 0.100 |
| 4.5 | 46.11 | 4 | 6.02 | 2.00 | 2.00 | 15.00 | 13.00 | 2.00 | 12.04 | 20.10 | 24.08 | 0.032 | 99.0 | 0.132 |
| 5.5 | 41.31 | 5 | 4.81 | 2.00 | 3.00 | 15.00 | 13.00 | 3.00 | 14.42 | 34.52 | 24.03 | 0.032 | 123.1 | 0.164 |
| 6.5 | 37.30 | 6 | 4.00 | 2.00 | 4.00 | 15.00 | 13.00 | 4.00 | 16.01 | 50.52 | 24.01 | 0.032 | 147.1 | 0.196 |
| 7.5 | 33.88 | 7 | 3.43 | 2.00 | 5.00 | 15.00 | 13.00 | 5.00 | 17.14 | 67.66 | 23.99 | 0.032 | 171.1 | 0.227 |
| 8.5 | 30.88 | 8 | 3.00 | 2.00 | 6.00 | 15.00 | 13.00 | 6.00 | 17.99 | 85.65 | 23.98 | 0.032 | 195.1 | 0.259 |
| 9.5 | 28.21 | 9 | 2.66 | 2.00 | 7.00 | 15.00 | 13.00 | 7.00 | 18.65 | 104.30 | 23.98 | 0.032 | 219.0 | 0.291 |
| 10.5 | 25.82 | 10 | 2.40 | 2.00 | 8.00 | 15.00 | 13.00 | 8.00 | 19.18 | 123.48 | 23.97 | 0.032 | 243.0 | 0.323 |
| 11.5 | 23.64 | 11 | 2.18 | 2.00 | 9.00 | 15.00 | 13.00 | 9.00 | 19.61 | 143.09 | 23.97 | 0.032 | 267.0 | 0.355 |
| 12.5 | 21.64 | 12 | 2.00 | 2.00 | 10.00 | 15.00 | 13.00 | 10.00 | 19.97 | 163.06 | 23.97 | 0.032 | 291.0 | 0.387 |
| 13.5 | 19.80 | 13 | 1.84 | 2.00 | 11.00 | 15.00 | 13.00 | 11.00 | 20.28 | 183.34 | 23.96 | 0.032 | 314.9 | 0.419 |
| 14.5 | 18.08 | 14 | 1.71 | 2.00 | 12.00 | 15.00 | 13.00 | 12.00 | 20.54 | 203.88 | 23.96 | 0.032 | 338.9 | 0.450 |
| 15.5 | 16.49 | 15 | 1.60 | 2.00 | 13.00 | 15.00 | 13.00 | 13.00 | 20.77 | 224.65 | 23.96 | 0.032 | 362.8 | 0.482 |
| 16.5 | 14.99 | 16 | 1.50 | 2.00 | 14.00 | 15.00 | 13.00 | 13.00 | 19.47 | 244.12 | 23.96 | 0.032 | 386.8 | 0.514 |
| 17.5 | 13.58 | 17 | 1.41 | 2.00 | 15.00 | 15.00 | 13.00 | 13.00 | 18.32 | 262.44 | 23.96 | 0.032 | 410.8 | 0.546 |
| 18.5 | 12.25 | 18 | 1.33 | 2.00 | 16.00 | 15.00 | 13.00 | 13.00 | 17.30 | 279.74 | 23.96 | 0.032 | 434.7 | 0.578 |
| 19.5 | 10.99 | 19 | 1.26 | 2.00 | 17.00 | 15.00 | 13.00 | 13.00 | 16.39 | 296.13 | 23.96 | 0.032 | 458.7 | 0.610 |
| 20.5 | 9.79 | 20 | 1.20 | 2.00 | 18.00 | 15.00 | 13.00 | 13.00 | 15.57 | 311.71 | 23.96 | 0.032 | 482.6 | 0.642 |
| 21.5 | 8.65 | 21 | 1.14 | 2.00 | 19.00 | 15.00 | 13.00 | 13.00 | 14.83 | 326.54 | 23.96 | 0.032 | 506.6 | 0.673 |
| 22.5 | 7.56 | 22 | 1.09 | 2.00 | 20.00 | 15.00 | 13.00 | 13.00 | 14.16 | 340.70 | 23.96 | 0.032 | 530.6 | 0.705 |
| 23.5 | 6.52 | 23 | 1.04 | 2.00 | 21.00 | 15.00 | 13.00 | 13.00 | 13.54 | 354.24 | 23.96 | 0.032 | 554.5 | 0.737 |
| 24.5 | 5.52 | 24 | 1.00 | 2.00 | 22.00 | 15.00 | 13.00 | 13.00 | 12.98 | 367.21 | 23.96 | 0.032 | 578.5 | 0.769 |
| 25.5 | 4.56 | 25 | 0.96 | 2.00 | 23.00 | 15.00 | 13.00 | 13.00 | 12.46 | 379.67 | 23.96 | 0.032 | 602.4 | 0.801 |
| 26.5 | 3.64 | 26 | 0.92 | 2.00 | 24.00 | 15.00 | 13.00 | 13.00 | 11.98 | 391.65 | 23.96 | 0.032 | 626.4 | 0.833 |
| 27.5 | 2.75 | 27 | 0.89 | 2.00 | 25.00 | 15.00 | 13.00 | 13.00 | 11.53 | 403.18 | 23.96 | 0.032 | 650.3 | 0.864 |
| 28.5 | 1.90 | 28 | 0.86 | 2.00 | 26.00 | 15.00 | 13.00 | 13.00 | 11.12 | 414.30 | 23.96 | 0.032 | 674.3 | 0.896 |
| 29 | 1.48 | ≥ 29 | 1.48 | 2.00 | 27.00 | 15.00 | 13.00 | 13.00 | 19.27 | 433.57 | 78.01 | 0.104 | 752.3 | 1.000 |

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File: 23142
Date: September 2026

## Table G.7: Annual Water Balance Calculations (East Wetland)

| Condition | Wetland Drainage Area (ha) | Water Balance Components | Pervious Area Without Infiltration BMPs | Impervious Area Without Infiltration BMPs | Impervious Area With Basic Infiltration BMPs | TOTAL SITE VOLUMES Precipitation ($m^3$) | Evapotranspiration ($m^3$) | Surplus ($m^3$) | Runoff ($m^3$) | Infiltration ($m^3$) | Percent of Existing Surplus (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing | **8.890** | Area (ha) | 8.890 | 0.000 | 0.000 | 96,288 | 46,645 | 49,643 | 19,857 | 29,786 | 100.0 |
| | | Infiltration Factor | 0.600 | 0.00 | 0.375 | | | | | | |
| | | Precipitation (mm) | 1083.1 | 1083.1 | 1083.1 | | | | | | |
| | | Evapotranspiration (mm) | 524.7 | 108.3 | 524.7 | | | | | | |
| | | Surplus (mm) | 558.4 | 974.8 | 558.4 | | | | | | |
| | | Infiltration (mm) | 335.0 | 0.0 | 209.4 | | | | | | |
| | | Runoff (mm) | 223.4 | 974.8 | 349.0 | | | | | | |
| Proposed | **8.890** | Area (ha) | 7.408 | 1.482 | 0.000 | 96,288 | 40,474 | 55,814 | 26,857 | 28,957 | 112.4 |
| | | Infiltration Factor | 0.700 | 0.00 | 0.375 | | | | | | |
| | | Precipitation (mm) | 1083.1 | 1083.1 | 1083.1 | | | | | | |
| | | Evapotranspiration (mm) | 524.7 | 108.3 | 524.7 | | | | | | |
| | | Surplus (mm) | 558.4 | 974.8 | 558.4 | | | | | | |
| | | Infiltration (mm) | 390.9 | 0.0 | 209.4 | | | | | | |
| | | Runoff (mm) | 167.5 | 974.8 | 349.0 | | | | | | |

**Notes:**

1. Water balance calculations based on methodology per the **Stormwater Management Planning and Design Manual** (MOE, March 2003).

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## Table G.8: Evapotranspiration and Surplus (Thornthwaite Method)

| Month | [1]Mean Temperature (°C) | [2]Heat Index | [3]Potential Evapo-transpiration (mm) | [4]Daylight Correction Value | Adjusted Potential Evapo-transpiration (mm) | [1]Total Precipitation (mm) | Surplus (mm) | Deficit (mm) |
|---|---|---|---|---|---|---|---|---|
| **January** | -8.9 | 0.0 | 0.0 | 0.78 | 0.0 | 110.3 | 110.3 | 0.0 |
| **February** | -8.3 | 0.0 | 0.0 | 0.88 | 0.0 | 79.6 | 79.6 | 0.0 |
| **March** | -3.5 | 0.0 | 0.0 | 1.00 | 0.0 | 81.5 | 81.5 | 0.0 |
| **April** | 3.9 | 0.7 | 21.6 | 1.12 | 24.2 | 73.1 | 48.9 | 0.0 |
| **May** | 10.9 | 3.3 | 57.6 | 1.23 | 70.8 | 80.9 | 10.1 | 0.0 |
| **June** | 15.4 | 5.5 | 80.2 | 1.28 | 102.9 | 88.9 | 0.0 | 14.0 |
| **July** | 17.8 | 6.8 | 92.2 | 1.26 | 115.8 | 80.6 | 0.0 | 35.2 |
| **August** | 17.0 | 6.4 | 88.2 | 1.16 | 102.5 | 95.6 | 0.0 | 6.9 |
| **September** | 12.9 | 4.2 | 67.7 | 1.04 | 70.6 | 99.7 | 29.1 | 0.0 |
| **October** | 7.0 | 1.7 | 37.7 | 0.92 | 34.6 | 86 | 51.4 | 0.0 |
| **November** | 0.7 | 0.1 | 4.2 | 0.81 | 3.4 | 104 | 100.6 | 0.0 |
| **December** | -5.5 | 0.0 | 0.0 | 0.75 | 0.0 | 102.9 | 102.9 | 0.0 |
| **Totals** | | **28.6** | **449.5** | | **524.7** | **1083.1** | **614.5** | **56.1** |

a: 0.95704

**[5]Total Precipitation Surplus (mm): 558.4**

**Notes:**

1) Average monthly precipitation and temperature data obtained from the Proton Station station (1971-2000 data set, ID: 6116750).

2) Monthly heat index, $I_j = (T_j/5)^{1.514}$, where $T_j$ is mean monthly temperature, $I_j = 0$ if $T_j \leq 0$, $I_{tot}$ is sum of monthly $I_j$.

3) Monthly potential evapotranspiration, $Etp = 16(10T_j/I_{tot})^a$, where $a = 6.75x10^{-7}I_{tot}^3 - 7.71x10^{-5}I_{tot}^2 + 1.792x10^{-2}I_{tot} + 0.49239$, $E_{tp} = 0$ if $T_j \leq 0$.

4) Water balance adjusted for latitude and daylight (refer to **Table G.8**).

5) Total water surplus is calculated as total precipitation minus adjusted potential evapotranspiration.

6) Total moisture surplus is calculated as total precipitation minus actual evapotranspiration.

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## Table G.9: Daylight Correction Factor

| Date | Hours of Solar Illumination per Day | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **January** | **February** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December** |
| **1** | 8.99 | 9.90 | 11.19 | 12.75 | 14.17 | 15.23 | 15.40 | 14.58 | 13.21 | 11.74 | 10.25 | 9.17 |
| **2** | 9.01 | 9.94 | 11.24 | 12.80 | 14.21 | 15.25 | 15.38 | 14.54 | 13.16 | 11.69 | 10.21 | 9.15 |
| **3** | 9.02 | 9.98 | 11.29 | 12.85 | 14.25 | 15.27 | 15.37 | 14.50 | 13.12 | 11.64 | 10.17 | 9.13 |
| **4** | 9.04 | 10.02 | 11.34 | 12.90 | 14.30 | 15.29 | 15.36 | 14.46 | 13.07 | 11.59 | 10.12 | 9.11 |
| **5** | 9.06 | 10.07 | 11.39 | 12.95 | 14.34 | 15.31 | 15.34 | 14.42 | 13.02 | 11.54 | 10.08 | 9.09 |
| **6** | 9.07 | 10.11 | 11.44 | 13.00 | 14.38 | 15.33 | 15.32 | 14.38 | 12.97 | 11.49 | 10.04 | 9.07 |
| **7** | 9.09 | 10.15 | 11.49 | 13.05 | 14.42 | 15.34 | 15.31 | 14.34 | 12.92 | 11.44 | 9.99 | 9.05 |
| **8** | 9.12 | 10.20 | 11.54 | 13.10 | 14.46 | 15.36 | 15.29 | 14.30 | 12.87 | 11.39 | 9.95 | 9.03 |
| **9** | 9.14 | 10.24 | 11.59 | 13.15 | 14.50 | 15.37 | 15.27 | 14.26 | 12.82 | 11.34 | 9.91 | 9.01 |
| **10** | 9.16 | 10.29 | 11.64 | 13.19 | 14.54 | 15.39 | 15.25 | 14.22 | 12.78 | 11.29 | 9.87 | 9.00 |
| **11** | 9.19 | 10.33 | 11.69 | 13.24 | 14.58 | 15.40 | 15.23 | 14.17 | 12.73 | 11.24 | 9.83 | 8.99 |
| **12** | 9.21 | 10.38 | 11.74 | 13.29 | 14.62 | 15.41 | 15.20 | 14.13 | 12.68 | 11.19 | 9.79 | 8.97 |
| **13** | 9.24 | 10.42 | 11.79 | 13.34 | 14.65 | 15.42 | 15.18 | 14.09 | 12.63 | 11.15 | 9.75 | 8.96 |
| **14** | 9.26 | 10.47 | 11.84 | 13.39 | 14.69 | 15.43 | 15.16 | 14.04 | 12.58 | 11.10 | 9.71 | 8.95 |
| **15** | 9.29 | 10.52 | 11.89 | 13.44 | 14.73 | 15.43 | 15.13 | 14.00 | 12.53 | 11.05 | 9.68 | 8.94 |
| **16** | 9.32 | 10.56 | 11.95 | 13.48 | 14.76 | 15.44 | 15.10 | 13.96 | 12.48 | 11.00 | 9.64 | 8.94 |
| **17** | 9.35 | 10.61 | 12.00 | 13.53 | 14.80 | 15.45 | 15.08 | 13.91 | 12.43 | 10.95 | 9.60 | 8.93 |
| **18** | 9.38 | 10.66 | 12.05 | 13.58 | 14.83 | 15.45 | 15.05 | 13.87 | 12.38 | 10.90 | 9.57 | 8.92 |
| **19** | 9.41 | 10.71 | 12.10 | 13.63 | 14.87 | 15.45 | 15.02 | 13.82 | 12.33 | 10.86 | 9.53 | 8.92 |
| **20** | 9.45 | 10.75 | 12.15 | 13.67 | 14.90 | 15.45 | 14.99 | 13.78 | 12.28 | 10.81 | 9.50 | 8.92 |
| **21** | 9.48 | 10.80 | 12.20 | 13.72 | 14.93 | 15.45 | 14.96 | 13.73 | 12.23 | 10.76 | 9.46 | 8.92 |
| **22** | 9.52 | 10.85 | 12.25 | 13.77 | 14.96 | 15.45 | 14.93 | 13.68 | 12.18 | 10.71 | 9.43 | 8.92 |
| **23** | 9.55 | 10.90 | 12.30 | 13.81 | 14.99 | 15.45 | 14.90 | 13.64 | 12.13 | 10.67 | 9.40 | 8.92 |
| **24** | 9.59 | 10.95 | 12.35 | 13.86 | 15.02 | 15.45 | 14.86 | 13.59 | 12.08 | 10.62 | 9.37 | 8.92 |
| **25** | 9.62 | 11.00 | 12.40 | 13.90 | 15.05 | 15.44 | 14.83 | 13.54 | 12.03 | 10.57 | 9.34 | 8.92 |
| **26** | 9.66 | 11.05 | 12.45 | 13.95 | 15.08 | 15.44 | 14.80 | 13.50 | 11.98 | 10.53 | 9.31 | 8.93 |
| **27** | 9.70 | 11.09 | 12.50 | 13.99 | 15.11 | 15.43 | 14.76 | 13.45 | 11.93 | 10.48 | 9.28 | 8.94 |
| **28** | 9.74 | 11.14 | 12.55 | 14.04 | 15.13 | 15.42 | 14.73 | 13.40 | 11.88 | 10.43 | 9.25 | 8.94 |
| **29** | 9.78 | | 12.60 | 14.08 | 15.16 | 15.42 | 14.69 | 13.36 | 11.84 | 10.39 | 9.22 | 8.95 |
| **30** | 9.82 | | 12.65 | 14.13 | 15.18 | 15.41 | 14.65 | 13.31 | 11.79 | 10.34 | 9.20 | 8.96 |
| **31** | 9.86 | | 12.70 | | 15.21 | | 14.62 | 13.26 | | 10.30 | | 8.98 |
| **Average** | **9.36** | **10.50** | **11.95** | **13.45** | **14.74** | **15.39** | **15.07** | **13.94** | **12.50** | **11.01** | **9.68** | **8.99** |
| **Correction Value** | **0.78** | **0.88** | **1.00** | **1.12** | **1.23** | **1.28** | **1.26** | **1.16** | **1.04** | **0.92** | **0.81** | **0.75** |

**Notes:**
1) Daily hour of solar illumination obtained from the National Research Council Canada's online Sunrise/Sunset Calculator for the subject site location.
2) The correction value was obtained by dividing the monthly average of daily hours of solar illumination by 12.

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**Table G.10: Infiltration Factor Calculations**
**Per MOE Methodology (SWM Planning & Design Manual, MOE, March 2003)**

| | |
|---|---|
| Topography | |
| 0.3 | Flat Land (avg slope < 0.06%) |
| 0.25 | 0.06% to 0.27% |
| 0.2 | Rolling Land (avg slope between 0.28% and 0.38%) |
| 0.15 | 0.39% to 2.7% |
| 0.1 | Hilly Land (avg slope between 2.8% and 4.7%) |
| Soils | |
| 0.4 | HSG A - open sandy loam |
| 0.35 | HSG AB |
| 0.3 | HSG B |
| 0.27 | HSG BC |
| 0.23 | HSG C |
| 0.2 | HSG CD - medium combinations of clay and loam |
| 0.1 | HSG D - tight impervious clay |
| Cover | |
| 0.1 | cultivated land (crops) |
| 0.15 | pasture, lawns |
| 0.2 | woodland (forest) |

Infiltration Factor Calculations

Existing Conditions

| | |
|---|---|
| 0.1 | Topography |
| 0.4 | Soils |
| 0.1 | Cover |
| **0.600** | Total Infiltration Factor (Existing Conditions) |

Proposed Conditions

| | |
|---|---|
| 0.15 | Topography |
| 0.4 | Soils |
| 0.15 | Cover |
| **0.700** | Total Infiltration Factor (Proposed Conditions) |

# APPENDIX “H”

Excerpts from Hydrogeological Report

**Soil Engineers Ltd.**
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
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| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 542-2759 |


**A REPORT TO**
**BRAIRWOOD (DUNDALK) LTD.**

# HYDROGEOLOGICAL ASSESSMENT
# PROPOSED RESIDENTIAL DEVELOPMENT
# CON 2 SWTSR PT LOT 234
# SOUTHEAST OF GREY ROAD 9 AND IDA STREET

**TOWNSHIP OF SOUTHGATE (DUNDALK)**

DRAFT

**REFERENCE NO. 2310-W058 (Rev. 1)**

**SEPTEMBER 18, 2026**

**DISTRIBUTION**

Digital Copy - Briarwood (Dundalk) Ltd.
Digital Copy - Soil Engineers Ltd. (Richmond Hill)

# 7.0 LOCAL HYDROGEOLOGICAL STUDY

## 7.1 Monitoring Well Development and Groundwater Level Monitoring

The groundwater levels in the monitoring wells were measured, manually on November 20, 2023, December 11, 2023 and January 10, 2024 to record the fluctuation of the shallow groundwater table beneath the Subject Site.

Monitoring wells were developed and groundwater levels were monitored over three (3) monitoring events. SEL measured the groundwater levels using an interface probe (Solinst Interface Metre). A summary of the groundwater level observations and their corresponding elevations are provided in **Table 7-1**.

**Table 7-1**- A Summary of Groundwater Monitoring

| MW* ID | Unit | Groundwater Level | | |
|---|---|---|---|---|
| | | November 20, 2023 | December 11, 2023 | January 10, 2024 |
| BH/MW 1** | Mbgs | 1.36 | 0.72 | 0.40 |
| | Masl | 511.69 | 512.33 | **512.65** |
| BH/MW 2** | Mbgs | 0.83 | 0.22 | -0.05* |
| | Masl | 511.48 | 512.09 | 512.36 |
| BH/MW 4** | Mbgs | 0.83 | 0.43 | 0.24 |
| | Masl | 510.84 | 511.24 | 511.43 |
| BH/MW 6 | Mbgs | 1.86 | 0.79 | 0.35 |
| | Masl | 509.58 | 510.65 | 511.10 |
| BH/MW 8 | Mbgs | 1.66 | 0.63 | 0.26 |
| | Masl | 510.30 | 511.33 | 511.70 |
| BH/MW 9 | Mbgs | 0.56 | 0.25 | 0.23 |
| | Masl | 510.33 | 510.64 | 510.66 |
| BH/MW 11 | Mbgs | 0.90 | 0.71 | 0.59 |
| | Masl | **509.51** | 509.70 | 509.82 |

Notes:
mbgs metres below ground surface
masl metres above sea level
*- groundwater level measured above ground surface
** Located within Study Area

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As shown in **Table 7-1**, the highest shallow stabilized groundwater levels elevations were measured at an El. 512.65 masl at BH/MW 1 location, whereas the lowest shallow groundwater levels elevations were measured at an El. 509.51 masl at BH/MW 11 location.

## 7.2 Shallow Groundwater Flow Pattern

The shallow groundwater flow pattern was prepared using the highest measured groundwater levels within all the installed monitoring wells. Due to the presence of surface water onsite and absence of

monitoring wells within the flooded area, the groundwater flow pattern for the eastern portion and western portion was interpreted independently. The prepared groundwater flow pattern indicates that the shallow groundwater flows in a southerly direction in both eastern and western portions. **Drawing 9** presents the interpreted shallow groundwater flow pattern.

## 7.3 Single Well Response Test

All BH/MW underwent a single well response testing (SWRTs) to assess the hydraulic conductivity (K) for saturated shallow aquifer or water bearing unit at the depths of the well screens. The monitoring well was equipped with a digital transducer to record the fluctuation made to complete the SWRT. The results of the SWRT tests are presented in **Appendix C**, with a summary of the findings provided in **Table 7-2**.

**Table 7-2**- A Summary of Falling Head Hydraulic Conductivity Testing

| Well ID | Ground El. (masl) | Monitoring Well Depth (mbgs) | Screen Interval (mbgs) | Screened Soil Strata | Hydraulic Conductivity (K in m/s) | Test Method | Infiltration Rate (mm/hr) |
|---|---|---|---|---|---|---|---|
| BH/MW 1* | 513.05 | 6.1 | 3.1-6.1 | Sandy Silt Till | $7.63 \times 10^{-7}$ | Falling Head Test | 44.73 |
| BH/MW 2* | 512.31 | 6.1 | 3.1-6.1 | Sandy Silt Till | $4.45 \times 10^{-6}$ | Falling Head Test | 71.53 |
| BH/MW 4* | 511.67 | 6.1 | 3.1-6.1 | Sandy Silt Till | $1.45 \times 10^{-7}$ | Falling Head Test | 31.00 |
| BH/MW 6 | 511.44 | 6.1 | 3.1-6.1 | Sandy Silt Till | $1.86 \times 10^{-8}$ | Falling Head Test | 13.72 |
| BH/MW 8 | 511.96 | 6.1 | 3.1-6.1 | Sandy Silt Till | $3.45 \times 10^{-8}$ | Falling Head Test | 16.90 |
| BH/MW 9 | 510.89 | 6.1 | 3.1-6.1 | Sandy Silt Till | $8.75 \times 10^{-8}$ | Falling Head Test | 27.50 |
| BH/MW 11 | 510.41 | 6.1 | 3.1-6.1 | Sandy Silt Till | $4.16 \times 10^{-9}$ | Falling Head Test | 11.75 |

Notes:
mbgs metres below ground surface
masl metres above sea level
* Located within Study Area

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## 7.4 Groundwater Quality

One (1) set of groundwater samples was collected for analysis from the monitoring well BH/MW 2 on January 10, 2024 by SEL. The samples were submitted for analysis and evaluation against the Township of Southgate combined Sanitary and Storm Sewer Use By-Law (BL_13_2011) parameters. Upon sampling, all of the bottles were placed in a cooler for shipment to the analytical laboratory. Sample analysis was performed by SGS Canada Inc., which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Results of the analysis are provided in **Appendix D**, with a discussion of the findings provided below. The chain of custody number for the submitted samples that underwent analysis is 038147.

The groundwater samples collected, comprised of unfiltered groundwater. As per the protocols for Township of Southgate sewer use analysis, a complete set of unfiltered groundwater samples were




References: Ontario Ministry of Natural Resources and Forestry
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Key Map



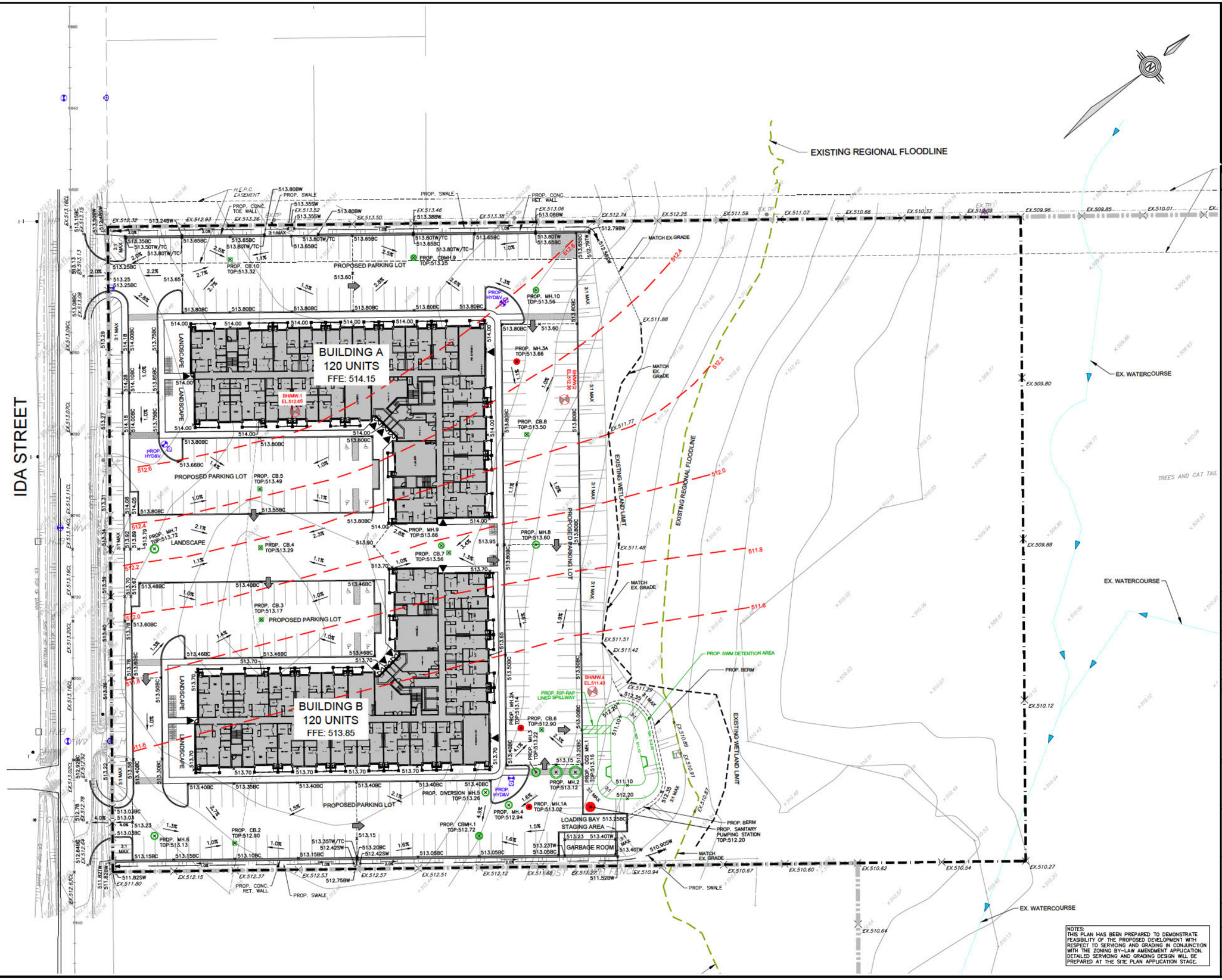

**Legend**

- Approximate Boundary Of Subject Site
- Study Area
- Major Road

# APPENDIX "I"

Functional Servicing and Grading Plans

VALDOR







KEY PLAN
N.T.S

## LEGEND:

- SUBDIVISION BOUNDARY
- SITE BOUNDARY
- Ex.REGIONAL FLOOD LINE
- PROPOSED FLOOD LINE
- GROUNDWATER CONTOURS
- PROPOSED FLOOD LINE ELEVATION
- EXISTING ELEVATION
- EXISTING CONTOUR
- DRAINAGE FLOW DIRECTION AND SLOPE
- PROPOSED ELEVATION
- STORM MANHOLE
- CATCHBASIN
- SANITARY MANHOLE
- VALVE AND BOX
- VALVED HYDRANT
- WATERMAIN SERVICE CONNECTION
- PROP. OVERLAND FLOW DIRECTION
- EXTERIOR DOOR LOCATION
- BOREHOLE / MONITORING WELL LOCATION
- PROPOSED WATERMAIN
- PROPOSED STORM SEWER
- PROPOSED DRAINAGE BREAK

## METRIC

DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

## NOTES:

BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS A AND B, BY REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0).
FOR BEARING COMPARISONS, A ROTATION OF 00°24'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN P6.
A ROTATION OF 00°28'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN P4 AND P3.
A ROTATION OF 00°20'55" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON D1.
A ROTATION OF 00°25'55" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P8.
A ROTATION OF 00°30'55" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P5.
A ROTATION OF 00°25'30" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P7.
ALL SET SSIB AND PB MONUMENTS WERE USED DUE TO LACK OF OVERBURDEN AND/OR PROXIMITY OF UNDERGROUND UTILITIES IN ACCORDANCE WITH SECTION 11 (4) OF O.REG. 525/91.

| No. | DATE | REVISIONS | BY. |
|---|---|---|---|
| 2. | SEP 24, 2026 | ISSUED FOR COORDINATION | D.G. |
| 1. | JAN 27, 2025 | ISSUED FOR ZBA | D.G. |

NOTES:
THIS PLAN HAS BEEN PREPARED TO DEMONSTRATE FEASIBILITY OF THE PROPOSED DEVELOPMENT WITH RESPECT TO SERVICING AND GRADING IN CONJUNCTION WITH THE ZONING BY-LAW AMENDMENT APPLICATION. DETAILED SERVICING AND GRADING DESIGN WILL BE PREPARED AT THE SITE PLAN APPLICATION STAGE.

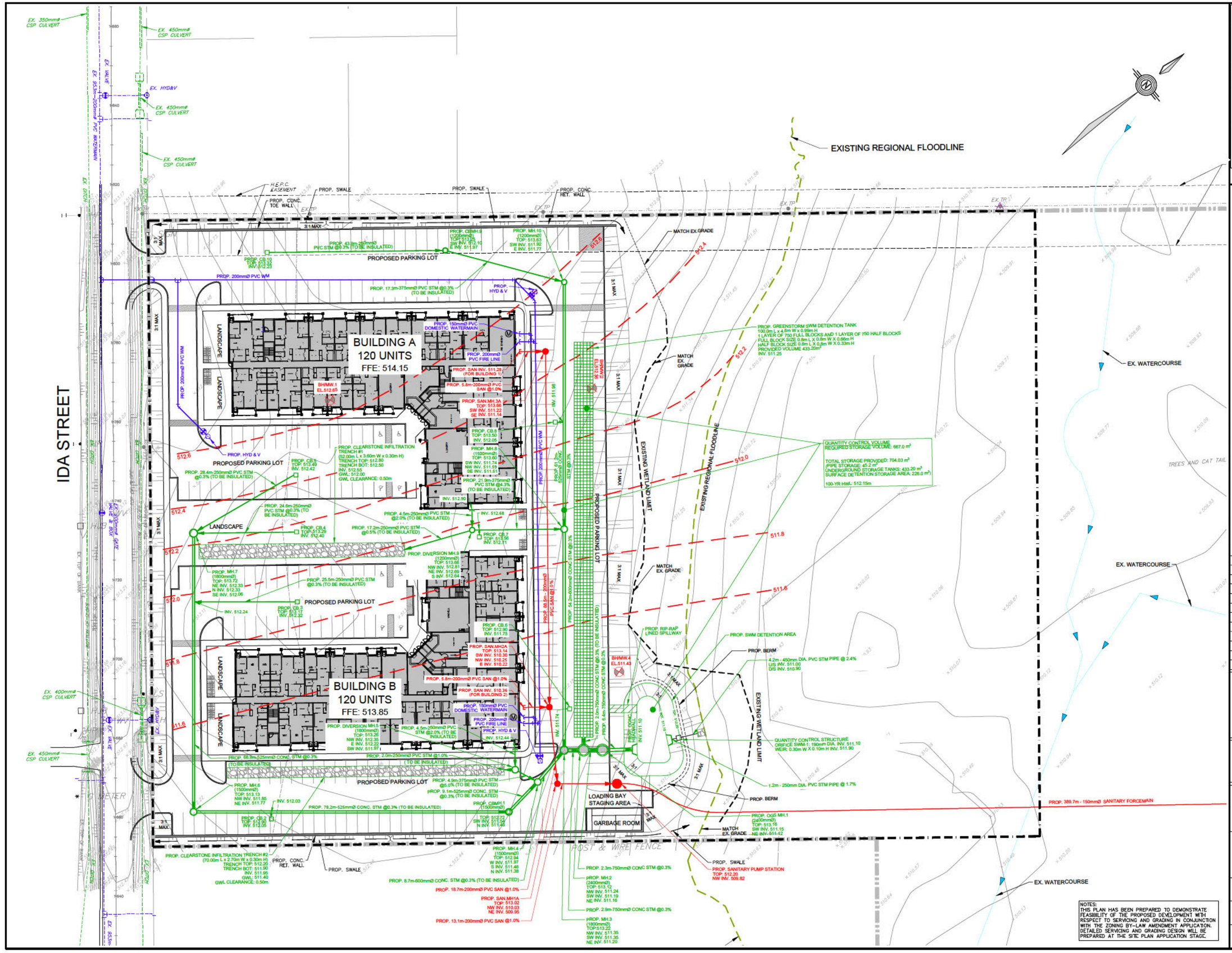
# PRELIMINARY

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www.valdor-engineering.com

# PROPOSED CONDOMINIUM APARTMENTS
IDA STREET, DUNDALK
TOWNSHIP OF SOUTHGATE

## FUNCTIONAL GRADING PLAN

| SCALE: | DATE: | PROJECT No.: |
|---|---|---|
| 1:400 | SEP. 27, 2024 | 23142 |
| DRAWN BY: D.N.Z. | DRAWING No.: FGP-1 | |
| CHKD BY: D.A.G. | | |







KEY PLAN
N.T.S

## LEGEND:

- SUBDIVISION BOUNDARY
- SITE BOUNDARY
- Ex.REGIONAL FLOOD LINE
- PROPOSED FLOOD LINE
- GROUNDWATER CONTOURS
- + FL 510.90 — PROPOSED FLOOD LINE ELEVATION
- + 301.08 — EXISTING ELEVATION
- 188.5 — EXISTING CONTOUR
- 2% — DRAINAGE FLOW DIRECTION AND SLOPE
- X126.50 — PROPOSED ELEVATION
- STORM MANHOLE
- CATCHBASIN
- SANITARY MANHOLE
- VALVE AND BOX
- VALVED HYDRANT
- WATERMAIN SERVICE CONNECTION
- PROP. OVERLAND FLOW DIRECTION
- BH/MW — BOREHOLE / MONITORING WELL LOCATION
- PROPOSED WATERMAIN
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER

## METRIC

DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

## NOTES:

BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS A AND B, BY REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0),

FOR BEARING COMPARISONS, A ROTATION OF 00°24'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN P8,
A ROTATION OF 00°28'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN AND P3,
A ROTATION OF 00°00'50" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON D1,
A ROTATION OF 00°29'50" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P6,
A ROTATION OF 00°30'50" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P1,
A ROTATION OF 00°29'30" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P7,

ALL SET SSIB AND PB MONUMENTS WERE USED DUE TO LACK OF OVERBURDEN AND/OR PROXIMITY OF UNDERGROUND UTILITIES IN ACCORDANCE WITH SECTION 11 (4) OF O.REG. 525/91.

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# PROPOSED CONDOMINIUM APARTMENTS

IDA STREET, DUNDALK
TOWNSHIP OF SOUTHGATE

## FUNCTIONAL SERVICING PLAN

| SCALE: | DATE: | PROJECT No.: |
|---|---|---|
| 1:400 | SEP. 27, 2024 | 23142 |
| DRAWN BY: D.N.Z. | DRAWING No.: FSP-1 | |
| CHKD BY: D.A.G. | | |

NOTES:
THIS PLAN HAS BEEN PREPARED TO DEMONSTRATE FEASIBILITY OF THE PROPOSED DEVELOPMENT WITH RESPECT TO SERVICING AND GRADING IN CONJUNCTION WITH THE ZONING BY-LAW AMENDMENT APPLICATION. DETAILED SERVICING AND GRADING DESIGN WILL BE PREPARED AT THE SITE PLAN APPLICATION STAGE.