FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

GLENELG PHASE 3
DUNDALK VILLAGE TWO INC.

TOWNSHIP OF SOUTHGATE

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
1 FIRST STREET, SUITE 200
COLLINGWOOD, ONTARIO
L9Y 1A1

1st SUBMISSION: AUGUST 2022
2ND SUBMISSION: JUNE 2023
3rd SUBMISSION: AUGUST 2023

CFCA FILE NO. 1060-6220

CROZIER
CONSULTING ENGINEERS

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

1.0 INTRODUCTION

C.F. Crozier & Associates Inc. ("Crozier") has been retained by Dundalk Village Two Inc. ("the Developer") to prepare a Functional Servicing and Stormwater Management Report in support of a Draft Plan of Subdivision Application for Glenelg Phase 3 ("Subject Development") located in the north end of the Community of Dundalk, Township of Southgate, County of Grey. The proposed development is herein referred to as the Subject Development. Please refer to **Figure 1** for the Site Location.

The Developer's overall property is approximately 132 ha. The property is legally described as Lots 227, 226, 225, 224, 223, Concession 1, southwest of the Toronto and Sydenham Road as well as Lots 226, 225 Concession 2, southwest of the Toronto and Sydenham Road Geographic Township of Proton, Township of Southgate, County of Grey.

The Subject Development is approximately 33.27 ha and is bounded by CP Rail Trail to the west, wetlands to the east, farmland to the north and residential properties to the south. The Subject Development is located northeast of Glenelg Residential Development – Phase 2.

The Subject Development will consist of 300 single-detached units, 1 future lot, 24 semi-detached units, 75 townhouse units, a school block, a park block, walkways/trails, a stormwater management block, an environmental protection area, 0.40 ha of future Right-of-Way (ROW) and approximately 6.87 ha of urban ROW. The Draft Plan prepared by MHBC Planning (August 18, 2023) has been included in **Figure 2**.

The Developer has assembled a multi-disciplinary consulting team to assist with the technical studies in support of this development. The consulting team includes:

- SLR Consulting Ltd. (SLR) (environmental and hydrogeological)
- Soil Engineers Ltd. (SEL) (geotechnical)
- MHBC (planning)
- CF Crozier & Associates Inc. (civil and transportation engineering)
- GEO Morphix Ltd. (geomorphology)

This report should be read in conjunction with the studies, plans and reports prepared by other members of the development team.

This report has been prepared to provide information concerning the servicing (water, sewer, utilities, and roads) and stormwater management strategy for the development.

2.0 DEVELOPMENT BACKGROUND

The Subject Development is currently designated as Neighborhood Area, within Schedule 'A' Map 2 of the Township of Southgate Official Plan (2022) and associated amendments. The hazard lands are taken into consideration in the Draft Plan and designated as Environmental Protection.

Nearby Draft Plan Approved developments currently undergoing the detailed design process include the 155-unit Glenelg Residential Development – Phase 2 bordering the west limits of the Subject Development and the 88-unit White Rose Park – Phase 3 Development located to the south currently under construction.

3.0 SITE DESCRIPTION

The overall 33.27 ha Subject Development consists largely of agricultural fields, and a natural heritage area exists in the east portion of the site. The limits of the Natural Heritage area have been staked and an appropriate development setback has been applied from dripline through consultation with the Grand River and Saugeen Valley Conservation Authorities. The natural heritage constraints on site have been investigated in detail by SLR. Refer to the Environmental Impact Study (SLR, May 2023) which has been provided in **Appendix G** for more information.

The property topography consists of rolling hills with a central depression with a low point at the northern property line. On site elevations range from 515.5 to 525.2 m. The site lies within the regulatory boundary of the Grand River and Saugeen Valley Conservation Authorities. Site drainage is further discussed in **Section 7.2**.

A Geotechnical Investigation was completed by Soil Engineers Ltd. in January 2023. The investigation revealed that beneath a topsoil layer, the subject site is underlain by strata of sandy silt till/silty sand till, and sand deposits. Please refer to **Appendix G** for the Geotechnical Investigation.

A Hydrogeological Assessment was completed by SLR Consulting Ltd. in May 2023. The Assessment characterized the hydrogeological conditions across the study area and evaluated potential impacts of the proposed development. Please refer to **Appendix G** for the Hydrogeological Assessment.

4.0 ROAD STANDARD

Access to the Development is proposed to be provided through two entrances from Glenelg Residential Development – Phase 2, as well as an entrance on the southern boundary from Bradley Street. Roadways and entrances will be constructed in conformance with the Township of Southgate Engineering Standards.

A Traffic Impact Study has been prepared by our Office under separate cover, which details transportation engineering considerations and mitigative measures related to the Development. Roadway slopes will range between 0.5% and 8% in conformance with Township of Southgate Engineering Standards (20m ROW Typical Cross-section Modified Town STD R). The general grading concept for the Development is presented in **Figure 3.**

Design criteria for the entrances will meet municipal guidelines as well as the applicable sections from the Ontario Building Code (i.e., fire routes).

The internal roadways of the Development will be assumed by the Municipality upon registration of the subdivision.

5.0 SANITARY SEWAGE SYSTEM

5.1 Existing Sanitary Sewer Infrastructure

5.1.1 Wastewater Treatment Facility Capacity

The existing Dundalk Wastewater Treatment Facility (WWTF) is located on Eco Parkway at the south end of Dundalk. The facility treats sewage and discharges the treated effluent to the Foley Drain/ Grand River. Per the Township of Southgate 2023 Reserve Capacity Study (Triton Engineering, 2023), the facility currently operates on average at 1,124 m^3/day. The uncommitted reserve capacity for the sewage treatment facility is 293 new development ERU's (Equivalent Residential Units). Since this

reserve capacity will not be sufficient to service various potential developments that have been granted Draft Plan Approval the municipality is currently in the process of upgrading the wastewater treatment facility to increase capacity in Dundalk from 1,832 m^3/day to 3,025 m^3/day to support growth. Refer to **Appendix A** for relevant wastewater treatment facility capacity calculations.

Table 1 details the Township of Southgate '2023 Reserve Sewage Capacity' and project the wastewater treatment capacities after the upgrades have been completed.

Table 1: Township of Southgate Dundalk Sewage Treatment Facility Capacity Projections

Dundalk Sewage Treatment Facility Summary		
Description	**2023**	**Post-Upgrades**
Wastewater Treatment Facility Design Capacity (m^3/day)	1,832	3,025
Current Daily Average Flow (m^3/day)	1,124	
Available Capacity (m^3/day)	708	1,901
Average New Development Per Capita Flow	0.300	0.300
Additional Population that can be Served	2,362	6,334
Person Per ERU [(1)]	2.61	2.61
Additional ERU Capacity	905	2,427
Committed ERUs	612	562
Available Uncommitted ERUs	293	1,815

[(1)] 2022 DC Background Study.

5.1.2 Existing Infrastructure

The existing sewage infrastructure within the vicinity of the Subject Development includes the following:

- Two (2) 250 mm diameter sanitary sewer stubs located at Aitchison Avenue and Corbett Street (Glenelg Residential Development – Phase 1 Lands).
- One (1) 200 mm diameter sanitary sewer that currently ends at a Maintenance Hole at the end of Bradley Street

5.1.3 Future Infrastructure

- Two (2) 250 mm diameter sanitary sewer stubs located at Corbett Street (Glenelg Residential Development – Phase 2 Lands).
- One (1) 200 mm diameter sanitary sewer that the Bradley Street Extension (White Rose Development – Phase 3)

5.2 Proposed Sanitary Sewer Infrastructure

Sanitary servicing for the development will be supplied by way of connection to the existing Dundalk sanitary sewer collection network. Flows from the Subject Development will ultimately be conveyed to the future expanded Wastewater Treatment Facility.

The Subject Development will be serviced via a gravity sanitary sewer system that follows the alignment of the internal roadway network, with individual service connections to each lot. A substantial amount of fill will be required in portions of the site to ensure adequate cover over the sanitary sewer. Options to reduce fill quantities will be explored during the detailed design process. Upon subdivision registration, sewers and associated roadways will be assumed by the Municipality.

The proposed sanitary sewer for the development will connect to a 200 mm diameter sanitary sewer stub on Bradley Street as well as two 250 mm diameter connections from Glenelg Residential Development Phase 2. The estimated sanitary flow to Glenelg Phase 2 was found to be 13.00 L/s. The estimated flow to the Bradley Street connection was found to be 6.47 L/s. The conveyance capacity of downstream sanitary sewer network, through the Glenelg Residential Development – Phase 2, has been determined to be adequate. A preliminary assessment of the sewers downstream of the Bradley Street connection was completed and have been determined to be adequate as well. The conveyance capacity of all downstream infrastructure will be subject to confirmation by the Township's Engineering Consultant. Sanitary infrastructure for the proposed development is illustrated in **Figure 4**. Refer to **Appendix A** for the sanitary flow calculations.

Sanitary flow estimates for the development were estimated in conjunction with the Township of Southgate Engineering Design Standards and the "New Development Unit Flow Rates" as described within the 2023 Reserve Capacity, prepared by the Township's Engineering Consultant.

6.0 POTABLE WATER SUPPLY

6.1 Existing Potable Water Supply Infrastructure

Potable water for the development will be supplied by the Township's municipal water distribution system.

The existing water treatment system in Dundalk includes three existing production wells. Per the 2023 Reserve Capacity Study, the well system operates at a maximum daily flow of 1008 m^3/day. This value represents approximately 36% of the system's allowable withdrawal capacity of 2,817 m^3/day, as specified in the Township's Permit to Take Water. Based on this, the existing system has ample capacity to support Glenelg Phase 3 Development. Refer to **Appendix B** for relevant water capacity calculations.

The existing water distribution infrastructure within the vicinity of the Subject Development includes the following:

- Two (2) 150mm diameter watermain connection stubs located at Aitchison Avenue and Corbett Street (Glenelg Residential Development – Phase 1 Lands).
- One (1) 150mm diameter watermain that dead ends at Bradley Street.

6.2 Future Infrastructure

- Two (2) 150mm diameter watermain connection stubs located at Corbett Street (Glenelg Residential Development – Phase 2 Lands).
- One (1) 150mm diameter watermain that dead ends at Bradley Street Extension (White Rose Development – Phase 3).

6.3 Proposed Servicing Strategy

The Subject Development will be serviced via three future watermain connections. There will be two watermain connections at the future ROWs within the Glenelg Residential Development – Phase 2. Additionally, there will be a connection to the watermain at the future White Rose Park – Phase 3.

These three connections will facilitate a looped distribution network and satisfy the Township and Ministry of Environment, Conservation and Park's requirements for a looped water distribution system. The Draft Plan does not include any watermain dead-ends and therefore there should be no issue with respect to providing adequate water circulation and preventing the potential for stagnant potable water.

Watermain with individual service connections for each unit will follow the alignment of the proposed internal roadways according to Township Standards. Fire hydrants will be spaced as required to provide the necessary fire protection per municipal standards. Required domestic water flows have been calculated in conformance with the Township of Southgate's Engineering Design Standards and the "New Development Unit Flow Rates" specified within the 2023 Reserve Capacity Study. The maximum day and peak hour water demands have been estimated to be 10.54 L/s and 18.97 L/s, respectively. Additional water supply considerations including fire suppression requirements will be determined during the detailed design phase. Internal watermain sizing will be subject to detailed design and confirmation by the Township's Engineering Consultant.

Refer to **Appendix B** for relevant water demand calculations. The proposed watermain layout is presented in **Figure 4.**

7.0 PROPOSED STORMWATER MANAGEMENT, SITE GRADING AND DRAINAGE

7.1 Stormwater Management (SWM) Criteria

The management of stormwater and site drainage for the proposed development must comply with the policies and standards of the various agencies including the Township of Southgate, Grand River Conservation Authority (GRCA), Saugeen Valley Conservation Authority (SVCA) and the Ministry of Environment, Conservation and Parks (MECP).

The stormwater management criteria for the Subject Development includes:

- Water Quantity Control
  - Control of post-development peak flows to pre-development levels for all storms up to and including the 100-year event.

- Water Quality Control
  - 80% removal efficiency of total suspended solids per MECP "enhanced protection" requirements.

- Erosion Control
  - Minimum 24-hour detention of the 25mm event.

- Development Standards
  - Urban cross section for public roadway with 5-year storm sewer system.
  - Lot grading at 2% optimum.
  - Minor and major drainage system to convey frequent and infrequent rainfall/runoff events, respectively.

In meeting the applicable policies and standards of the aforementioned agencies, the development will also be required to meet the following criteria:

- Manage the internal stormwater by safely conveying peak flows to suitable outlets and provide the necessary water quality controls.
- Manage any external drainage entering the site by providing safe conveyance across the Subject Development.
- Confirm that the development lands are not susceptible to flood inundation during all assessed storm events.

7.2 Existing Drainage Conditions

Topographic survey indicates that the terrain has rolling hills with a draw in the middle of the site sloping toward a low point at the north property line. There is a high point near the east corner of the site where runoff drains towards the natural heritage area and the east property line. The rest of the site drains towards a point on the southeast property line, towards the CP Rail Trail and to the residential lands to the south (White Rose Phase 3 Development).

To the west of the development lies the CP Rail Trail. This trail represents an elevated linear structure bounding the property line and has been constructed with side ditches preventing external flows from entering the development site.

To facilitate the pre-development stormwater analysis, the following five (5) catchments have been delineated based on the existing drainage conditions.

- **Catchment PRE-1**: This catchment area is approximately 4.32 ha and is located along the west border of the site. It consists of active agricultural fields. Stormwater from this catchment drains to the west towards the CP trail (outlet #1). Flows entering the CP trail drain in the north direction to a tile drain located on a neighboring property to the north. The flows in the tile drain ultimately are discharged to the northeast wetland.
- **Catchment PRE-2**: This catchment area is approximately 13.33 ha and is in the middle of the site. It consists of active agricultural fields. Stormwater from this catchment drains to the north tile drain (outlet #2). The flows in the tile drain are discharged to the northeast wetland.
- **Catchment PRE-3**: This catchment area is approximately 2.66 ha and is located along the eastern corner of the subject site. It consists of active agricultural fields. Stormwater from this catchment drains to the east tile drain (outlet #3). Flows entering the east tile drain are conveyed to a wetland located within the SVCA regulation area.
- **Catchment PRE-4**: This catchment area is approximately 1.93 ha and is located along the southeastern corner of the subject site. It consists of active agricultural fields. Stormwater from this catchment drains to the southeast tile drain (outlet #4). Flows entering the southeast tile drain are conveyed to a wetland located within the GRCA regulation area.
- **Catchment PRE-5**: This catchment area is approximately 3.00 ha and is located along the south boundary of the subject site. It consists of active agricultural fields. Stormwater from this catchment drains to the residential subdivision to the south.

The existing drainage patterns of the site and conservation authority regulated areas have been reflected in the Pre-Development Drainage Plan **(Figure 5)**. Additional information on the pre-development drainage and tile drain locations is provided in **Figure 6.** For the pre-development hydroparameter sheets, please refer to **Appendix C**.

7.3 Proposed Drainage Conditions

The Subject Development will be constructed to a fully urbanized system complete with curb and gutter and storm sewers. A dual drainage approach will consist of minor and major stormwater flow routes to provide adequate conveyance for runoff. The minor drainage system will consist of storm sewers and catchbasins sized to convey the 5-year design storm event. The major drainage system will provide overland stormwater flow routes within the road allowance. Refer to **Figure 4** for proposed storm sewer layout.

To facilitate the post-development stormwater analysis, the following nine (9) catchments have been delineated based on the proposed drainage conditions.

- **Catchment POST-1:** This catchment area is approximately 1.02 ha and consists of a portion of the proposed developed area. The catchment consists of the grassed backlots of the single-detached units and walkways. Runoff from this catchment will drain uncontrolled to the Grey County CP Trail (outlet #1). Flows entering the CP trail drain in the north direction to a tile drain located on a neighboring property to the north. The flows in the tile drain ultimately are discharged to the northeast wetland.
- **Catchment POST-2:** This catchment area is approximately 17.13 ha and consists of a large portion of the proposed developed area. The catchment consists of single-family residential, semi-detached residential, townhouses, walkways, and roads. Runoff from this catchment will drain to the SWM facility that discharges to outlet #2. The flows then enter the northeast wetland.
- **Catchment POST-3:** This catchment area is approximately 0.71 ha and consists of a portion of the proposed developed area. The catchment consists of front lots of single-detached residential units and road area. The minor system will be captured and conveyed to the SWMF and outlet #2. The major system will be conveyed overland to outlet #1.
- **Catchment POST-4:** This catchment area is approximately 0.58 ha and consists of a portion of the proposed developed area. The catchment consists of the grassed backlots of single-detached units and park lands. Runoff from this catchment will drain uncontrolled to outlet #4 (southeast tile drain).
- **Catchment POST-5:** This catchment area is approximately 0.45 ha and consists of back lots of single-detached residential units, and walkway area. Runoff from this catchment will drain uncontrolled via sheet flow to outlet #3 (east tile drain).
- **Catchment POST-6:** This catchment area is approximately 0.45 ha and consists of back lots of single-detached residential units, walkways and roads. Runoff from this catchment will drain uncontrolled via sheet flow to outlet #2 (north tile drain). Flows are then discharged to the northeast wetland.
- **Catchment POST-7:** This catchment area is approximately 3.32 ha and consists of a school block. Runoff from this catchment will drain controlled to outlet #4 (southeast tile drain).
- **SWMF:** This catchment represents the proposed 1.56 ha SWM Facility block. Runoff from this catchment will drain to the SWM Facility. The SWM Facility will then discharge flows to outlet #2 (north tile drain). Flows are then discharged to the northeast wetland.
- **Catchment TR-1:** This catchment area is approximately 0.78 ha and consists of the backlots of the single-detached units in Glenelg Phase 2. Runoff from this external catchment will drain uncontrolled to the Grey County CP Trail (outlet #1). Flows entering the CP trail drain in the north direction to a tile drain located on a neighboring property to the north. The flows in the tile drain ultimately are discharged to the northeast wetland. This drainage was taken into consideration from the Glenelg Phase 2 Lands.

The post-development drainage conditions and catchment areas have been presented in **Figure 8.**

Under post-development conditions, the majority of the stormwater from the Subject Development is currently proposed to drain to the SWM facility and outlet to the north tile drain (outlet #2). A portion of the site will drain to each outlet to mimic pre-development conditions. The exception to this is the pre-development catchment draining into the southern residential subdivision (PRE-5). In post-development conditions, flows will not drain to the residential subdivision to the south, as the subdivision was not designed to accommodate the drainage.

7.4 Proposed SWM Strategy

The stormwater management strategy varies for each of the nine (9) post-development catchment areas.

For catchment POST-1, runoff from grassed backlots of the single-detached units and walkways will be conveyed via sheet flow into the CP Trail ditch (Outlet #1). The clean water from the backlots of the single-detached units and walkways is proposed to flow uncontrolled and will not require quality treatment. Flows entering outlet #1 (CP Trail) will be conveyed to the north in the CP trail ditch to a neighboring tile drain that ultimately discharges runoff to the northeast wetland.

Catchment POST-2 consists of the SWMF (SWM pond). The SWMF is adequately sized to provide quantity, quality, and erosion control for the contributing drainage area. The proposed stormwater management facility has been designed as a hybrid wet pond/wetland system. The hybrid wet pond/wetland system consists of a wet pond element and a wetland element. The facility incorporates a sediment forebay and a permanent pool within the deep-water component and wetland component to provide appropriate water quality treatment. The SWMF will also incorporate extended detention of the 25mm storm event to provide erosion protection. An outlet from the facility will be provided to release flows through to the northeast wetland via outlet #2. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #2 (north tile drain).

Catchment POST-3 has a separate outlet for the major and minor storm events. For the minor storm events (up to the 5-year design storm), the front lots of the single-detached units and road area will be captured and conveyed to the SWMF and Outlet #2. For the major storm events (flow exceeding the 5-year design storm), runoff will flow overland via sheet flow to outlet #1 (CP Trail). Quality control will be achieved for the minor system within the SWMF and for the major system within the CP trail ditch regraded as an enhanced grassed swale.

For catchment POST-4, clean water from the back lots of the residential units and park lands will drain to outlet #4. Runoff will drain uncontrolled via sheet flow to outlet #4 and the southeast wetland. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #4 (southeast tile drain) and the southeast wetland.

For catchment POST-5, runoff from back lots of the single-detached units and walkways will be directed to outlet #3. Clean runoff from the backlots will drain uncontrolled via sheet flow to outlet #3 (east tile drain) and the east wetland. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #3 (east tile drain) and the east wetland.

POST-6 is comprised of backlots of the single-detached units, walkways and a small road area adjacent to the SWM facility. Clean runoff will flow overland uncontrolled to outlet #2. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #2 (north tile drain).

Catchment POST-7 consists of the school block. Runoff will be captured and controlled via block storage and directed to outlet #4. Quality control will be achieved within the school block. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #4 (southeast tile drain) and the southeast wetland.

Catchment SWMF consists of the SWM Pond. The SWMF is adequately sized to provide quantity, quality, and erosion control for the contributing drainage area. The conceptual proposed stormwater management facility has incorporated a permanent pool, a sediment forebay, and a wetland cell to provide appropriate water quality treatment. The SWMF will also incorporate extended detention for erosion protection. An outlet from the facility will be provided to release flows through to outlet #2, the northeast wetland. Quantity control will be achieved to ensure pre-development peak flows are not exceeded to outlet #2.

Catchment TR-1 consists of the backlots of the single-detached units in Glenelg Phase 2. Runoff from this external catchment will drain uncontrolled to the Grey County CP Trail (outlet #1). Flows entering the CP trail drain in the north direction to a tile drain located on a neighboring property to the north. The flows in the tile drain ultimately are discharged to the north wetland. This drainage was taken into consideration from the Glenelg Phase 2 Lands.

7.5 Hydrologic Analysis

A hydrologic model was prepared for the pre-development and post-development scenarios using the stormwater management hydrologic computer program Visual OTTHYMO 6.1 (VO6). The purpose of the modeling was to demonstrate that quantity control requirements are met (i.e., post-development peak flow rates do not exceed the pre-development flows to the respective drainage area).

To accurately assess the peak flows from the individual catchments, the NasHyd command in VO6 was used to model the pre-development drainage areas. Design storms were generated for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year events utilizing both 3-hour Chicago and 24-hour SCS Type II rainfall distributions. The Township of Southgate Engineering Standards requires only the modeling of the 3-hour Chicago distribution storms for quantity control facilities. Nevertheless, the 24-hour SCS distribution has been included in the design to ensure the provision of adequate and conservative quantity control. The 25mm Chicago quality event was also modeled within VO6. Intensity-Duration- Frequency (IDF) values were derived from the Ministry of Transportation IDF tool for the Community of Dundalk and are provided in **Appendix D.**

7.5.1 Pre-Development Model Setup

To establish the pre-development peak flows, the pre-drainage areas mentioned in *Section 7.2* were modeled within VO6. Please refer to **Figure 5** for the Pre-Development Drainage Plan and **Appendix C** for the pre-development hydrological parameter sheets. **Table 2** summarizes the pre-development peak flows rates obtained from the VO6 model.

Table 2: Summary of Pre-Development Peak Flow Rates

Return Period	Pre-Development Peak Flow Rates (m^3/s)				
	PRE-1 Drainage to CP Trail (4.32 ha)	**PRE-2 Drainage to North Tile Drain (13.33 ha)**	**PRE-3 Drainage to East Tile Drain (2.66 ha)**	**PRE-4 Drainage to Southeast Tile Drain (1.93 ha)**	**PRE-5 Drainage to South Residential (3.00 ha)**
3-Hour 10 min Chicago					
2-Year	0.044	0.100	0.038	0.027	0.047
5-Year	0.086	0.190	0.076	0.055	0.093
10-Year	0.119	0.261	0.107	0.078	0.131
25-Year	0.166	0.361	0.150	0.109	0.186
50-Year	0.204	0.442	0.186	0.135	0.230
100-Year	0.244	0.528	0.223	0.162	0.278
24-Hour 15 min SCS Type II					
2-Year	0.143	0.296	0.134	0.097	0.162
5-Year	0.239	0.495	0.223	0.162	0.269
10-Year	0.311	0.643	0.289	0.210	0.349
25-Year	0.404	0.839	0.375	0.272	0.455
50-Year	0.477	0.990	0.442	0.320	0.537
100-Year	0.551	1.146	0.510	0.370	0.621

7.5.2 Post-Development Model Setup

The post-development model was prepared by adding the post-development drainage catchments as referenced in *Section 7.3*. Refer to **Figure 8** for the Post-Development Drainage Plan and **Appendix C** for the post-development hydrologic parameter sheets.

To model the post-development condition, the respective drainage areas were modelled via a combination of StandHyds, NasHyds, RouteReservoirs, and DuHyds commands. Using these tools, the post-development peak flows were analyzed to ensure that quantity control targets were met in the post-development condition. The DuHyd commands were applied to separate the minor and major system flows. For additional information regarding the layout of the VO6 model, please refer to the VO schematic presented in **Appendix D**.

7.5.3 Quantity Control

'Post-to-Pre' peak flow control is proposed for the four outlets for all storm events up to and including the 100-year storm event.

Outlet #1: Grey County CP Trail

Table 3 presents the pre-development and post-development peak flows to outlet #1. As shown, the post-development flows are less than the pre-development flows for all storms.

Table 3: Summary of Pre- and Post-Development Peak Flows (Outlet #1)

Return Period	Pre-Development (m^3/s) [4.32 ha]	Post-Development (m^3/s) [2.51 ha] (1)
3-Hour 10 min Chicago		
2-Year	0.044	0.030
5-Year	0.086	0.045
10-Year	0.119	0.082
25-Year	0.166	0.134
50-Year	0.204	0.174
100-Year	0.244	0.239
24-Hour 15 min SCS Type II		
2-Year	0.143	0.070
5-Year	0.239	0.113
10-Year	0.311	0.174
25-Year	0.404	0.273
50-Year	0.477	0.337
100-Year	0.551	0.402

(1) Catchment area from External TR-1 (0.78 ha), POST-3-major system (0.71 ha), and POST-1 (1.02 ha).

Outlet #2: North Tile Drain

The proposed SWM Facility will be a hybrid wet pond/wetland system located on the north side of the development that will provide the required stormwater quantity, quality, and erosion controls. The SWM pond will discharge stormwater to outlet #2 into the northeast wetland.

A outlet structure has been designed as a multi-stage outlet to address both quality and quantity control requirements. The outlet structure will consist of a 205 mm diameter extended detention orifice set at the permanent pool elevation. A secondary orifice has been included above the extended detention storage elevation to control effluent from the pond for storms exceeding the 25 mm event.

Using the ROUTE RESERVOIR command in VO6, the volume of detention storage required in the SWMF to attenuate the post-development peak flows to pre-development levels was determined based on a storage – discharge relationship. The ROUTE RESERVOIR command was used to model the hybrid pond storage. To meet quantity control requirements, it was concluded that approximately 15,410 m^3 of active detention storage is required in the SWM Facility. **Table 4** presents the required storage volume for the SWMF. Please refer to **Appendix E** for detailed SWMF calculations. The preliminary design of the SWM Facility has been presented in **Figure 9.**

Table 4: Summary of SWM Facility – Required Storage Volumes

Return Period	Storage Volume (m^3)	
	3-Hour 10 min Chicago	24-Hour 15 min SCS Type II
2-Year	3,657	5,125
5-Year	4,720	6,821
10-Year	5,374	7,936
25-Year	6,209	9,345
50-Year	6,853	10,333
100-Year	7,472	11,317
Hazel	15,410	

Table 5 presents the pre-development and post-development peak flows to outlet #2. As shown, the post-development flows are less than the pre-development flows for all storms.

Table 5: Summary of Pre- and Post-Development Peak Flows (Outlet #2)

Return Period (Years)	Pre-Development (m^3/s) [13.33 ha]	Post-Development (m^3/s) [19.85 ha][1]
3-Hour 10 min Chicago		
2-Year	0.100	0.098
5-Year	0.190	0.177
10-Year	0.261	0.241
25-Year	0.361	0.322
50-Year	0.442	0.384
100-Year	0.528	0.467
24-Hour 15 min SCS Type II		
2-Year	0.296	0.216
5-Year	0.495	0.380
10-Year	0.643	0.534
25-Year	0.839	0.750
50-Year	0.990	0.922
100-Year	1.146	1.097

(1) Catchment area from SWMF (1.56 ha), POST-6 (0.45 ha), POST-2 (17.13 ha), and POST-3 -minor system (0.71 ha).

Outlet #3: East Tile Drain

Table 6 presents the pre-development and post-development peak flows to outlet #3. As shown, the post-development flows are less than the pre-development flows for all storms.

Table 6: Summary of Pre- and Post-Development Peak Flows (Outlet #3)

Return Period (Years)	Pre-Development (m^3/s) [2.66 ha]	Post-Development (m^3/s) [0.45 ha][1]
3-Hour 10 min Chicago		
2-Year	0.038	0.038
5-Year	0.076	0.052
10-Year	0.107	0.063
25-Year	0.150	0.076
50-Year	0.186	0.086
100-Year	0.223	0.096
24-Hour 15 min SCS Type II		
2-Year	0.134	0.045
5-Year	0.223	0.065
10-Year	0.289	0.079
25-Year	0.375	0.105
50-Year	0.442	0.121
100-Year	0.510	0.137

(1) Catchment area from POST-5 (0.45 ha).

Outlet #4: Southeast Tile Drain

Using the ROUTE RESERVOIR command in VO6, the required volume of detention storage to attenuate the post-development peak flows to pre-development levels was determined based on a storage – discharge relationship. The ROUTE RESERVOIR command was used to model the school block storage. To meet quantity control requirements, it was concluded that approximately 1600 m^3 of storage is required within the school block. Block storage will be provided via roof storage or underground storage. The design will be refined during the site plan stage.

Table 7 presents the pre-development and post-development peak flows to outlet #4. As shown, the post-development flows are less than the pre-development flows for all storms. Please refer to **Appendix D** for the detailed VO output.

Table 7: Summary of Pre- and Post-Development Peak Flows (Outlet #4)

Return Period (Years)	Pre-Development (m^3/s) [1.93 ha]	Post-Development (m^3/s) [3.90 ha][1]
3-Hour 10 min Chicago		
2-Year	0.027	0.027
5-Year	0.055	0.041
10-Year	0.078	0.052
25-Year	0.109	0.086
50-Year	0.135	0.114
100-Year	0.162	0.139
24-Hour 15 min SCS Type II		
2-Year	0.097	0.057
5-Year	0.162	0.123
10-Year	0.210	0.165
25-Year	0.272	0.193
50-Year	0.320	0.221
100-Year	0.370	0.367

(1) Catchment area from POST-4 (0.58 ha) and POST-7 (3.32 ha).

7.5.4 Stormwater Quality

As mentioned in **Section 7.4,** the SWM strategy varies based on the post-development drainage area. The contributing area to POST-1, POST-4, POST-5, POST-6, and TR-1 requires no quality control due to these catchments being comprised of clean water areas (walkways, roofs, and backlots of residential units).

For POST-3, the major system will drain to the CP trail ditch (outlet #1). The CP trail ditch will be regraded to act as an enhanced grass swale.

For POST-2, POST-3 (minor system), and SWMF, quality control will be also provided by the SWM Facility. The conceptual design of the proposed SWM Facility has incorporated a permanent pool and a sediment forebay to provide "enhanced protection" (*Stormwater Management Planning and Design Manual*, Ministry of the Environment, 2003). A sediment forebay has been provided to facilitate enhanced quality treatment in conformance with MECP forebay design guidelines. See **Appendix E** for forebay sizing calculations.

The Subject Development drainage area for the SWM Facility is 19.40 ha with an associated imperviousness of 68%. As such, the minimum water quality volume for the SWMF is 220 m^3/ha (*Stormwater Management Planning and Design Manual, Ministry of the Environment, 2003)*. The total water quality volume consists of 180 m^3/ha for the permanent pool and 40 m^3/ha for extended detention.

Erosion control will be principally achieved by incorporating extended detention into the operation of the SWMF. Sizing was based on providing the minimum 24 hour extended detention of the runoff volume produced during a 25 mm storm event. The required and provided extended detention and permanent pool values have been summarized in **Table 8**. Refer to **Appendix E** for the water quality and extended detention calculations.

Table 8: Stormwater Management Facility Quality and Erosion Control

	SWM Facility	
	Required Volume (m^3)	**Provided Volume (m^3)**
Permanent Pool	3,498	3,894
MOE Extended Detention	776	3,559
Erosion Control	3,128	

7.5.5 Stormwater Management Facility Operating Conditions

Considering the water quantity and quality storage requirements for the POST-2, POST-3 and SWMF drainage areas, a preliminary design for the SWM Facility has been completed to demonstrate that the SWM block is adequately sized. A preliminary operating profile of the SWM facility is presented in **Table 9.**

Table 9: SWM Facility Operating Characteristics

Component	Elevation (m)	Storage Required (m^3)	Storage Provided (m^3)
Bottom	515.50	--	--
Permanent Pool	516.50	3,498	3,894
Extended Detention	517.05	3,128	3,559
Regional High Water Level	518.50	15,410	15,716
Top of Berm	518.80	--	18,552

As evidenced by **Table 9**, the pond presented herein is sufficiently sized to provide the required stormwater quantity and quality controls. Permits and other regulatory instruments such as an Environmental Compliance Approval (MECP) and Conservation Authority approval will be secured at the detailed design stage.

7.6 Water Balance

A feature-based water balance was completed for the subject site due to the proximity of nearby wetland features. The pre-development subject site was delineated into five (5) drainage areas as mentioned in **Section 7.2.** The pre-development water balance was then used to determine the annual pre-development runoff volumes to each drainage area.

In post-development conditions (without mitigation), runoff is increased by 147% annually over the entire subject site compared with pre-development conditions. Mitigation measures were introduced on-site via the proposed LIDs to reduce the annual runoff in post-development conditions. These mitigation measures are proposed to reduce the amount of runoff by volume draining to each of the outlets that feed downstream wetlands. With mitigation measures, the runoff in post-development conditions increases by 119% over the entire subject site compared with pre-development conditions.

The following LID measures are proposed for the Subject Development to increase infiltration/evaporation and reduce runoff. Please refer to **Appendix F** for the water balance and LID-specific calculations. The proposed LID locations are presented in **Figure 10.**

- Bioretention Cells

Two bioretention cells are proposed within the school block. Runoff from the school block will be directed to the bioretention cells where filtered runoff can infiltrate into the native soils. Based on the proposed sizing and contributing drainage area, the bioretention cells would mitigate 2,107 m^3 of infiltration annually in post-development conditions. A minimum clearance of 1 m is provided between the bottom of the LID and the groundwater elevation. In the sizing of the bioretention cells, a percolation rate of 30 mm/hr was determined based on the closest borehole with a safety factor of 2 giving a design percolation rate of 15 mm/hr.

- Enhanced Topsoil Depth

The second mitigation strategy proposed for the Subject Development is the use of enhanced topsoil within pervious areas across the site to promote storage, evapotranspiration, and infiltration. A topsoil depth of 300 mm will be required across the pervious area thereby providing increased opportunities for infiltration in the topsoil layout. The expected increased topsoil depth (300 mm) is expected to reduce runoff volume by 25% based on HSG 'C' type soil as per the TRCA and CVC LID manual. The use of enhanced topsoil would mitigate 6,193 m^3 of infiltration annually in post-development conditions.

- Green Roof

The third mitigation strategy proposed is a green roof within the school block. The green roof will help achieve water balance objectives by reducing runoff volumes via evapotranspiration. Based preliminary design specification provided by Next Level Stormwater Management (included in **Appendix F**), 84% of the precipitation draining to the roof will be evaporated and 16% of the precipitation will become runoff. As a result, the green roof will reduce runoff by 9,912 m^3 annually, in post-development conditions.

- Wetland Cell of Hybrid Wet Pond/Wetland Facility

Lastly, a wetland cell is proposed within the Stormwater Management Pond. The wetland cell will help achieve water balance objectives by reducing runoff volumes via evapotranspiration. Aquatic plants will be concentrated on the shallow shelves of the perimeter of the wetland cell to enhance evapotranspiration. Based on preliminary estimates with native aquatic vegetation, the contributing drainage area and the proposed layout of the facility, the wetland cell will mitigate 432 m^3 of runoff per year in post-development conditions.

With the mitigation measures, the following annual runoff is expected in post-development conditions:

- Runoff draining to outlet #1 (CP Trail) decreased by 47% (5,269 m^3/year),
- Runoff draining to outlet #2 (north tile drain) increased by 281% (96,597 m^3/year),
- Runoff draining to outlet #3 (east tile drain) decreased by 70% (4,793 m^3/year), and,
- Runoff draining to outlet #4 (southeast tile drain) increased by 67% (3,344 m^3/year).

Due to site constraints, the runoff draining to outlet #2 in post-development conditions increased by 281% (by volume) compared to pre-development conditions. Additional geomorphological and ecological studies are underway to analyze the receiving capacity of the northeast wetland. Pending the results of the geomorphological and ecological studies, the proposed LID measures will be revised if required.

8.0 UTILITIES

The development will be serviced with natural gas, telephone, cable TV and hydro. All such utilities are available in the area of development. Coordination for extension of and connection to existing services will be undertaken as development approvals advance. Utilities are proposed to follow the alignment of the internal road network, with individual service connections to each lot.

9.0 CONCLUSIONS & RECOMMENDATIONS

Based on the foregoing, we conclude that Glenelg Phase 3 Development can be adequately serviced.

- Access to the Subject Development will be provided by two entrances from Glenelg Residential Development – Phase 2 and one entrance through Bradley Street. The internal roadways will meet Township Standards and provide access for emergency vehicles.
- Gravity sanitary services for the Subject Development will be provided via three connections, one to the White Rose Phase 3 Development and two to the Glenelg Phase 2 Development, further refinement of the sanitary design detailed design may be required to reduce overall site fill requirements.
- An internal watermain will be a looped system and will be provided through two connections at Glenelg Residential Development – Phase 2 and one connection at White Rose Phase 3.
- The development will be fully serviced by hydro, natural gas, cable, and telecommunications.
- The proposed LID measures and the Stormwater Management Facility will provide quality control for the subject site. The proposed LID measures and SWM Facility is adequately sized to provide "enhanced protection" level treatment. Quantity control is met for the subject site by controlling post-development flows to pre-development levels for all storms up to the 100-year storm event. The SWM facility will incorporate a minimum 24-hour retention of the 25mm event to provide erosion control.
- The runoff draining to outlet #2 in post-development conditions increased by 281% (by volume) compared to pre-development conditions. Due to the expected increase of runoff volume in post-development conditions, additional geomorphological and ecological studies are underway to analyze the receiving capacity of the northeast wetland. Pending the results of the geomorphological and ecological studies, the proposed LID measures will be revised if required.
- Natural hazard constraints (floodplain) do not exist within the Subject Development.
- Further study of the impacts to the downstream drainage features including ecological and geomorphological investigations are underway to confirm SWM Facility outfall design.

Based on the above, we recommend approval of the Planning Applications for the Subject Lands from the perspective of engineering servicing requirements.

C.F. CROZIER & ASSOCIATES INC.

Justin L'Abbe, P.Eng
Project Engineer

C.F. CROZIER & ASSOCIATES INC.

Kim Swain, P.Eng.
Project Engineer

JL'A/AM/KS/AW/NO

J:\1000\1060-Flato Dev\6220- Glenelg Expansion Lands\Reports\FSRSWM\3rd Submission\2023.08.11_FSRSWM Report.docx