MEMO

TO:	Toad One Inc.
FROM:	Aakash Bagchi, P.Eng., Dillon Consulting Limited
DATE:	April 4, 2022
SUBJECT:	Stormwater Management for Mixed-Use Development at 51 and 57 Sandwich Street South, Town of Amherstburg
OUR FILE:	22-3779

1.0 Introduction

Dillon Consulting Limited (Dillon) has been retained by Toad One Inc. to complete the planning approvals for a proposed Mixed-Use development in the Town of Amherstburg.

This Stormwater Management (SWM) memo has been prepared to support the conceptual design of the proposed development. The total site area is 0.42 ha and is located south east of the intersection of Alma Street and Sandwich Street South, and north-east of the Elm Avenue and Sandwich Street South intersection, in the Town of Amherstburg.

The proposed development will drain into the existing 0.6 m diameter storm sewer along Sandwich Street South that conveys flows south and eventually drains to the Detroit River through the outfall along Rankin Avenue. Under existing conditions, the site is developed and consists of a single-detached residential development on each of the two lots, 51 and 57 Sandwich Street South. The general slope of the ground directs flows westwards. The proposed development consists of two buildings. One of the buildings is primarily commercial while the second building is a multi-storey mixed-use development consisting of both commercial and residential.

This memo summarizes the SWM measures proposed to restrict the peak outflow from the site to an allowable release rate from the proposed development.

1.1 SWM Criteria

The following items were referred to while conducting the current analysis to evaluate the condition of the existing and proposed SWM infrastructure:

- Windsor-Essex Region Stormwater Management Standards Manual (ERCA, 2018) [WERSMSM]; and
- Pre-consultation through e-mail with the Town of Amherstburg to identify allowable release rate.

The criteria for SWM is to control flows from proposed developments to the estimated allowable release rate for all design storm event simulations, up to and including the 1:100 year return period event.

In addition, the maximum depth of ponding on site during the governing 1:100 year return period event simulation should not exceed 0.30 m above the lowest CB grate elevation.

The Urban Stress Test (approximately 1.4 times more volume than the 1:100 year event) design storm event is to be simulated to assess the proposed SWM infrastructure's resiliency to adapt to impacts of climate change.

The following design storm events, as recommended in the WERSMSM, were used to assess the on-site storage requirements under post-development conditions:

- 1:5 year, 4 hour design storm using Chicago distribution with a 15 minute time interval and a total rainfall depth of 49.5 mm;
- 1:2 year, 4 hour design storm using Chicago distribution with a 15 minute time interval and a total rainfall depth of 32 mm (Water Quality Storm);
- 1:100 year, 4 hour design storm using Chicago distribution with a 15 minute time interval and a total rainfall depth of 81.6 mm to determine the required 100 year design on-site storage;
- 1:100 year, 24 hour design storm using SCS distribution with a 2 hour time interval and a total rainfall depth of 108 mm to determine the required 100 year design on-site storage, and;
- 1:100 year, 24 hour design storm using Chicago distribution with 15 minute time interval and an additional 42 mm uniformly distributed, with a total rainfall depth of 150 mm. (Urban Stress Test Storm)

1.2 Hydrologic and Hydraulic Modelling Tool

Hydrologic and hydraulic modelling for both existing and proposed conditions was undertaken using the PCSWMM 2020 software distributed by CHI. PCSWMM is a modelling software for stormwater, wastewater, and watershed systems which provides a graphic user interface (GUI) for the United States Environmental Protection Agency's Stormwater Management Model (EPA SWMM).

The following information was used to populate the necessary subcatchment parameters for the site.

Based on the soil survey of Essex County (Richards et al, 1949) and the Ontario Ministry of Agriculture, Food, and Rural Affairs' (OMAFRA) soil mapping data, the stormwater catchment's soils are composed of Brookston Clay which has a hydrologic soil group (HSG) D classification.

The stormwater assessment for this development was completed using the Horton infiltration method for hydrologic calculations. With the soil group as class D, the following parameters were used in the PCSWMM model. The values below are recommended in the WERSMSM for hydrologic soil type D.

- Max. Infiltration rate = 75 mm/hr
- Min. Infiltration rate = 0.5 mm/hr
- Decay Constant = 4 /hr

For hydraulic conveyance, the stormwater assessment for this development was completed using the dynamic wave routing method.

2.0 Allowable Release Rate

Dillon conducted an analysis to estimate the allowable release rate for the development. The existing conditions modelling parameters and results of the analysis are represented in Table 1. Figure 1 shows the drainage area used for the existing conditions analysis to estimate allowable release rates for the development, in comparison to the total development area.

The Town of Amherstburg was consulted during this analysis. The Town identified that allowable release rates needed to be estimated based on a runoff coefficient ('c') value of 0.20, considering a drainage area from the property line along Sandwich Street South to the centre of the existing homes. This corresponds to a drainage area of 0.04 ha, while the total site area is 0.42 ha. A 'c' value of 0.20 is approximately equal to a percentage imperviousness of 0% (no paved or impervious area) for the purposes of the modeling analysis.

TABLE 1: EXISTING CONDITIONS SUBCATCHMENT PARAMETERS AND RELEASE RATE

Catchment	Area (Ha)	Percent Impervious (%)	Other Subcatchment Parameters	Design Storm Event	Release Rate (L/s)
Existing Development Site	0.04	0	Flow Length = 37 m Slope = 0.3% Impervious Depression Storage = 2.5 mm Pervious Depression Storage = 7.5 mm Manning's N Impervious = 0.013 Manning's N Pervious = 0.24 Subarea Routing = Outlet (100%) Horton Infiltration Parameters: Max. Infiltration = 75 mm/hr Min. Infiltration = 0.5 mm/hr Decay Constant = 4 /hr	1:5 year, 4 hour (Chicago)	1.4

For estimation of on-site storage required during post-development conditions, 1.4 L/s was estimated to be the allowable release rate for this development, for all design storm events up to and including the 1:100 year return period event. In order to prevent any adverse impacts on the downstream system due to the increased imperviousness level on the proposed development area, the maximum flow rate from the site is expected to be maintained at or below the allowable release rate for all events up to and including the 1:100 year event.

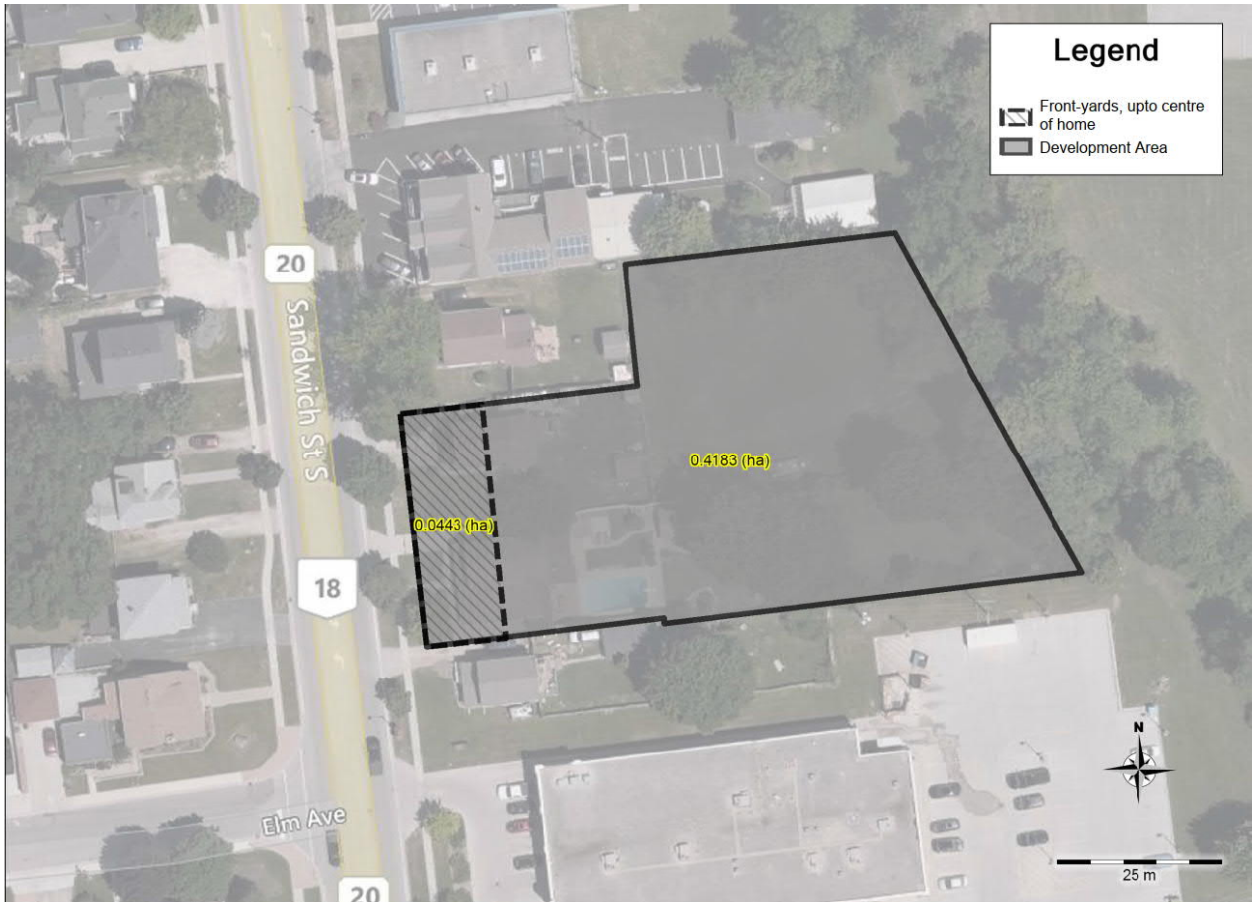


FIGURE 1: EXISTING CONDITIONS ANALYSIS DRAINAGE AREA COMPARED TO TOTAL DEVELOPMENT AREA

3.0 Proposed Conditions Analysis

For the proposed conditions analysis, a lumped modelling approach was used. The site was modelled as one lumped subcatchment in PCSWMM. A plan view of the post-development modeling schematic is shown in Figure 2 as attached. A consolidated storage node was used to represent both the on-site surface stormwater storage above catch basins and in sub-surface chambers. The volume of storage on the surface, around catch-basin (CB) locations in the parking lot area was estimated based on the available parking lot area (Appendix B) and Dillon's experience with similar developments in the past. Any additional storage volume required for peak flow attenuation will need to be accommodated in sub-surface storage. Sub-surface storage can be through oversized storm sewers, or in underground storage chambers, or a combination of both. A more accurate estimate of total available storage on the surface and sub-surface storage required to meet allowable release rate criteria will be completed during detailed design. Outflow to the downstream 0.6 m diameter storm sewer along Sandwich Street is restricted using a 0.025 m diameter orifice.

A fixed head was applied at the model outfall location to simulate tailwater conditions downstream, in the 0.6 m diameter storm sewer, during the 1:5 year, 1:100 year and UST events. The downstream head was fixed at 179.55 m based on a review of existing topography in the region. The Ontario Digital Terrain Model (Lidar-Derived) made available online by the Ontario Ministry of Natural Resources and Forestry was used to review the topography around the site. A review of the existing topography shows that maximum water surface elevation on the Sandwich Street South roadway is expected to be approximately 179.55 m before it spills further west towards Detroit River.

The modelling parameters for the lumped catchment under proposed conditions are represented in Table 2.

TABLE 2: PROPOSED CONDITIONS ANALYSIS: SUBCATCHMENT PARAMETERS

Catchment	Area (Ha)	Percent Impervious	Other Subcatchment Parameters
Proposed Development Site	0.42	90	Flow Length = 107 m Slope = 1.0% Impervious Depression Storage = 2.5 mm Pervious Depression Storage = 10 mm Manning's N Impervious = 0.013 Manning's N Pervious = 0.24 Subarea Routing = Outlet (100%) Horton Infiltration Parameters: Max. Infiltration = 75 mm/hr Min. Infiltration = 0.5 mm/hr Decay Constant = 4 /hr

Stormwater runoff is proposed to be contained within the site boundaries and is proposed to drain towards various catch basins around the site. Through a network of storm pipes, stormwater will be ultimately discharged to the 0.60 m diameter storm sewer along Sandwich Street South. A 0.025 m diameter orifice is required to restrict flows to the allowable release rate. Since smaller diameter orifices are susceptible to clogging, flow restriction is recommended using a vortex flow regulator. A specific product will be recommended during detailed design.

Our analysis revealed a storage requirement of 375 m^3 during the 1:100 year, 24 hour design storm simulation, which corresponds to a maximum 0.30 m storage depth above the lowest catch basin lid, in addition to storage underground in sub-surface chambers. A flap gate is recommended to be installed to prevent backflow from the Sandwich Street South storm sewers.

3.1 Peak Flow Attenuation and Stormwater Storage

Peak flows into the municipal storm sewers through the 0.03 m diameter orifice, and stormwater storage on-site, for all design storm events analyzed, are represented in Table 3.

TABLE 3: PROPOSED CONDITIONS MODEL RESULTS (PEAK OUTFLOW AND STORMWATER STORAGE)

Design Storm Events	Peak Flow Rate (L/s)	Storage on Site				Fixed Tailwater Condition Elevation (m)
		Total Volume (m^3)	Surface Storage (m^3)	Subsurface Storage (m^3)	Max. depth of surface storage at CB locations (m)	
Water Quality Test	1.1	103	0	103	0	(Free Outfall)
1:5 year, 4 hour (Chicago)	1.0	180	15	165	0.02	179.55
1:100 year, 4 hour (Chicago)	1.1	311	146	165	0.21	179.55
1:100 year, 24 hour (SCS)	1.2	375	210	165	0.30	179.55
Urban Stress Test	1.4	532*	367*	165	0.53*	179.55

* Total volume and maximum depth of storage on-site during the UST simulation will be confirmed during detailed design after site-grading design is completed.

For the 1:100 year 24 hour event (SCS Type-II) simulation, approximately 375 m^3 is required to be stored on site. The peak flow rates through the orifice restriction into the 0.6 m diameter storm sewer are less than the estimated allowable release rates during all design storm events in the proposed conditions analysis, which considers the effects of tail-water conditions. The total volume of stormwater on site includes surface ponding and subsurface storage.

3.2 Site overflow during storms more intense than 1:100 year event

The proposed conditions PCSWMM model was simulated using the Urban Stress Test design storm event to analyze response during storm events more intense than the 1:100 year return period events. The Urban Stress Test design storm has a total rainfall depth of 150 mm and a total duration of 24 hours. This is approximately 40% higher intensity and volume than a 1:100 year, 24 hour Chicago storm event.

During this simulation, approximately 532 m^3 is proposed to be stored on site. This volume includes storage around CB locations as surface ponding and subsurface storage in underground chambers. It corresponds to a maximum depth of water at surface storage locations around CBs of 0.53 m.

It is to be noted that the maximum possible depth of ponding on-site will be determined at the detailed design stage once site grading design is completed. The spillover elevation, which is the maximum possible elevation of stored stormwater on-site, will be estimated at the detailed design stage. The maximum

volume of water stored on-site and the maximum ponded depth, during the UST simulation, will be confirmed at the detailed design stage.

4.0 Flood-proofing Elevation

All buildings in the development are to be built with a finished floor elevation that is 0.30 m higher than the 1:100 year water surface elevation on site, and higher than the maximum water surface elevation on site during the UST simulation. The ultimate build-out lowest finished floor elevation will be confirmed during the detailed design.

5.0 Stormwater Quality Control

Since the impervious area on the subject site is increasing as compared to existing conditions, measures have to be undertaken to treat the quality of the stormwater runoff being discharged into receiving watercourses/sewers. Stormwater quality treatment will be provided using an oil-grit separator (OGS) positioned upstream of the Sandwich Street storm sewer. The 1200 mm diameter, FD-4HC unit supplied by ADS, or an approved equivalent, is recommended for this application.

The OGS unit is designed to meet the Ministry of Environment, Conservation and Parks (MECP) design requirements for 70% TSS removal (normal level of protection). Sizing details for the Water Quality Unit (WQU) recommended for the proposed development, provided by the supplier, are included in Appendix A.

5.1 Erosion and Sediment Control During Construction

Erosion and sediment control measures are to be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987) and "Construction Specification for Temporary Erosion and Sediment Control Measures" (OPSS 805).

6.0 Summary and Conclusions

This SWM Memo has been prepared to support planning approvals for the mixed-use development at 51 and 57 Sandwich Street South.

The PCSWMM software package was used for hydrologic and hydraulic modelling of the development.

The proposed development will drain into the existing 0.6 m diameter storm sewer along Sandwich Street South, which eventually drains into the Detroit River through the Rankin Avenue outfall.

The findings for the subject site are summarized below:

- The maximum allowable release rate from the site is 1.4 L/s. The peak discharge from the site will be restricted to this value for all events up to and including the 1:100 year return period rainfall event.

- It has been demonstrated through a modelling analysis that the peak outflow from the site during all proposed conditions simulations was less than the allowable release rate.
- Outflow from the site is controlled using a 0.025 m diameter orifice in the modelling analysis. A vortex flow regulator is recommended to restrict flows and prevent clogging of the outlet.
- Stormwater runoff storage on site was provided using surface ponding around CB locations in the parking lot area and underground storage chambers.
- During the 1:100 year, 24 hour (SCS Type-II), proposed conditions simulation, a maximum surface ponding depth of 0.30 m was observed. The total on-site storage provided was approximately 375 m^3 during this simulation. This included surface storage around CB locations in the parking lot area and underground storage chambers.
- During the Urban Stress Test rainfall event, a maximum surface ponding depth greater than 0.30 m was observed. The total on-site storage and maximum water surface elevation during the UST simulation will be confirmed at the detailed design stage.
- A flood-proofing elevation of 0.30 m higher than the 1:100 year water surface elevation on-site, and the maximum water surface elevation during the UST event simulation, is required as the minimum finished floor elevation of the proposed building.
- Stormwater quality control will be provided on site using an OGS unit, providing 70% TSS removal. The 1200 mm diameter, FD-4HC unit supplied by ADS, or an approved equivalent, is recommended.

We trust that our findings provide you with the information that you require at this time. We would be pleased to meet with you to review our findings in further detail.

If you have any questions in the interim, please feel free to contact the undersigned.

Yours sincerely,

DILLON CONSULTING LIMITED

Aakash Bagchi, P.Eng.
Water Resources Engineer

Amal Siddiqui
Principal Modeler

Figures

Figure 2
Post-development
Model Schematic

Appendix A

ADS OGS Sizing Summary

Project Name: Dillon Amherstburg Project

Consulting Engineer: Dillon Consulting

Location: Amherstburg, ON

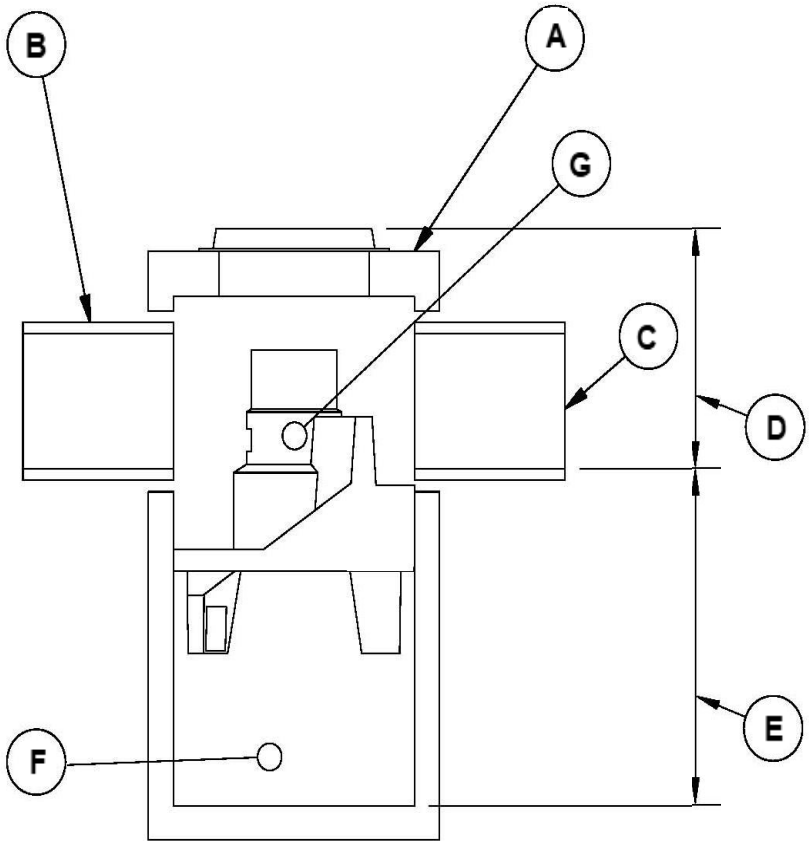
Sizing Completed By: C. Neath **Email:** cody.neath@ads-pipe.com

Treatment Requirements		
Treatment Goal:	Normal (MOE)	
Selected Parameters:	70% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.42 ha
% Impervious:	90%
Rational C:	0.84
Rainfall Station:	Windsor, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	---

Summary of Results		
Model	**TSS Removal**	**Volume Treated**
FD-4HC	84.0%	>90%
FD-5HC	88.0%	>90%
FD-6HC	90.0%	>90%
FD-8HC	94.0%	>90%
FD-10HC	96.0%	>90%

FD-4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	2000 mm
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s



Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	98.00
Outlet Pipe Elevation:	98.00

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Project Name:	Dillon Amherstburg Project
Consulting Engineer:	Dillon Consulting
Location:	Amherstburg, ON

Net Annual Removal Efficiency Summary: FD-4HC

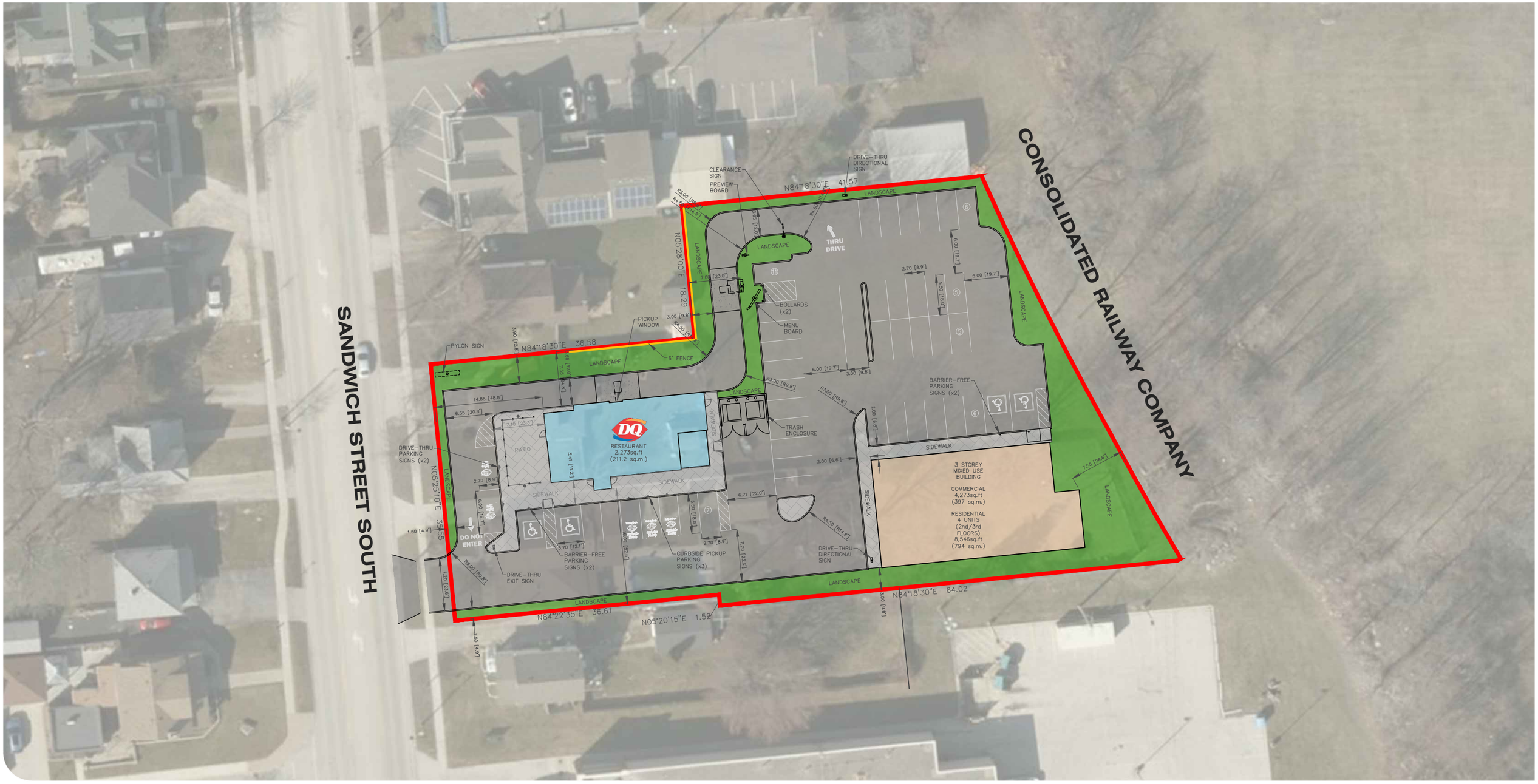
Rainfall Intensity[(1)]	Rational Equation Flowrate	Surface Loading Rate	Fraction of Rainfall[(1)]	FD-4HC Removal Efficiency	Weighted Net-Annual Removal Efficiency
mm/hr	L/s	L/min/m^2	%	%	%
3.00	2.9	156	13.2%	94%	12.4%
4.00	3.9	208	9.6%	92%	8.8%
5.00	4.9	260	7.5%	90%	6.7%
6.00	5.9	312	6.0%	88%	5.3%
7.00	6.9	364	4.8%	87%	4.2%
8.00	7.8	416	4.1%	86%	3.5%
9.00	8.8	468	3.6%	85%	3.1%
10.00	9.8	520	3.2%	84%	2.7%
11.00	10.8	572	2.8%	83%	2.3%
12.00	11.8	624	2.5%	83%	2.1%
15.00	14.7	780	6.6%	81%	5.3%
20.00	19.6	1040	8.3%	79%	6.5%
25.00	24.5	1300	5.8%	77%	4.5%
30.00	29.4	1560	4.6%	76%	3.5%
35.00	34.3	1820	3.8%	75%	2.8%
40.00	39.2	2080	2.9%	74%	2.1%
45.00	44.1	2340	2.4%	73%	1.8%
50.00	49.0	2600	1.8%	72%	1.3%
65.00	63.7	3379	6.6%	71%	4.7%
				Total Net Annual Removal Efficiency:	84.0%
				Total Runoff Volume Treated:	99.9%

Notes:

(1) Based on Windsor/Essex Region Stormwater Manual 2018, Table 3.4.1.5

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

Appendix B



TOAD ONE INC.
51 & 57 SANDWICH ST. S., AMHERSTBURG, ON

MIXED USE DEVELOPMENT
CONCEPTUAL DEVELOPMENT PLAN

SUBJECT AREA (± 0.42 ha / 1.04 ac)

PROPOSED RESTAURANT WITH DRIVE-THRU

PROPOSED MIXED USE BUILDING

PROPOSED LANDSCAPE

PROPOSED SIDEWALK

PROPOSED FENCE

File Location:
c:\pw working directory\projects 2022\dillon_34jmm\dms13189\dq conceptual development plan.dwg
May, 04, 2022 3:49 PM

MAP/DRAWING INFORMATION
Base mapping from County of Essex Interactive Mapping.

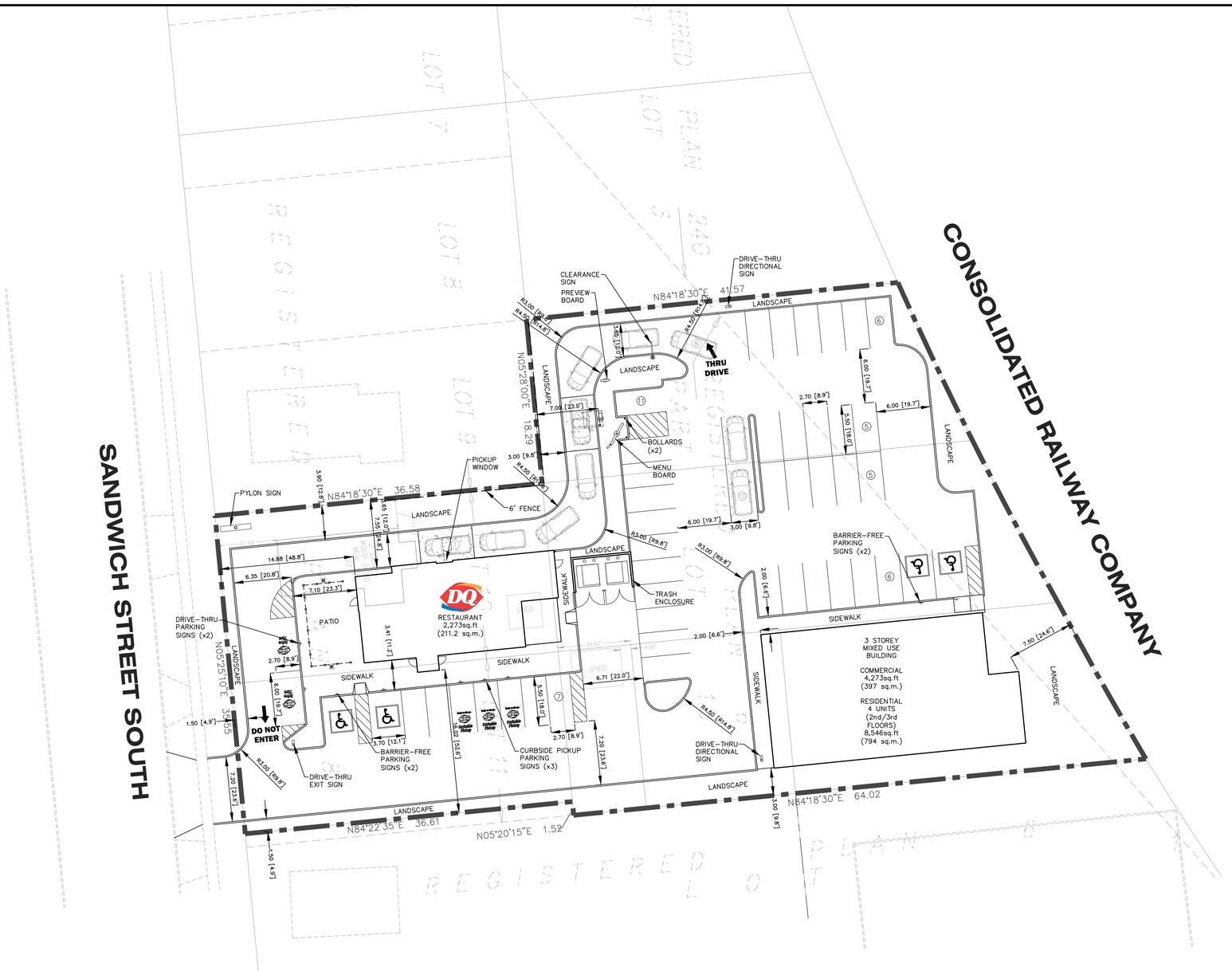
CREATED BY: JMM
CHECKED BY: AMF

SCALE 1:500
0 5 10 20m

N W E S

DILLON CONSULTING

PROJECT: 22 3779
STATUS: FOR SUBMISSION
DATE: 22.05.04



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DILLON CONSULTING

No.	ISSUED FOR	DATE	BY
2	ISSUED FOR OPA/ZBA	22.05.04	JMM
1	ISSUED FOR REVIEW	22.04.04	JMM

DESIGN | REVIEWED BY
DRAWN: JMM | CHECKED BY
DATE: April 2022
SCALE: 1:250

51 & 57 Sandwich Street S, Amherstburg ON

Site Plan

PROJECT NO. 22 3779

SHEET NO. **SP**