Stormwater Management Report

104 White Crescent

City of Barrie, County of Simcoe

PEARSON ENGINEERING

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18058

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Stormwater Management Report
104 White Crescent, Barrie

1. Introduction

PEARSON Engineering Ltd. has been retained by Michler Holdings Ltd. (Client) to prepare a Stormwater Management Report for the proposed 8 Unit Townhouse Development located at 104 White Crescent in the City of Barrie (City), County of Simcoe (County).

The subject property is approximately 0.21 ha in size and is currently a vacant lot. The existing site drains to the east sloping towards Veterans Drive at an average slope of 0.6%. The Townhouse Units will front onto Veterans Drive with the driveway entrance connecting onto White Crescent. The location of the site can be seen on Figure 1.

1.1. Terms of Reference

The intent of this SWM Brief is to:

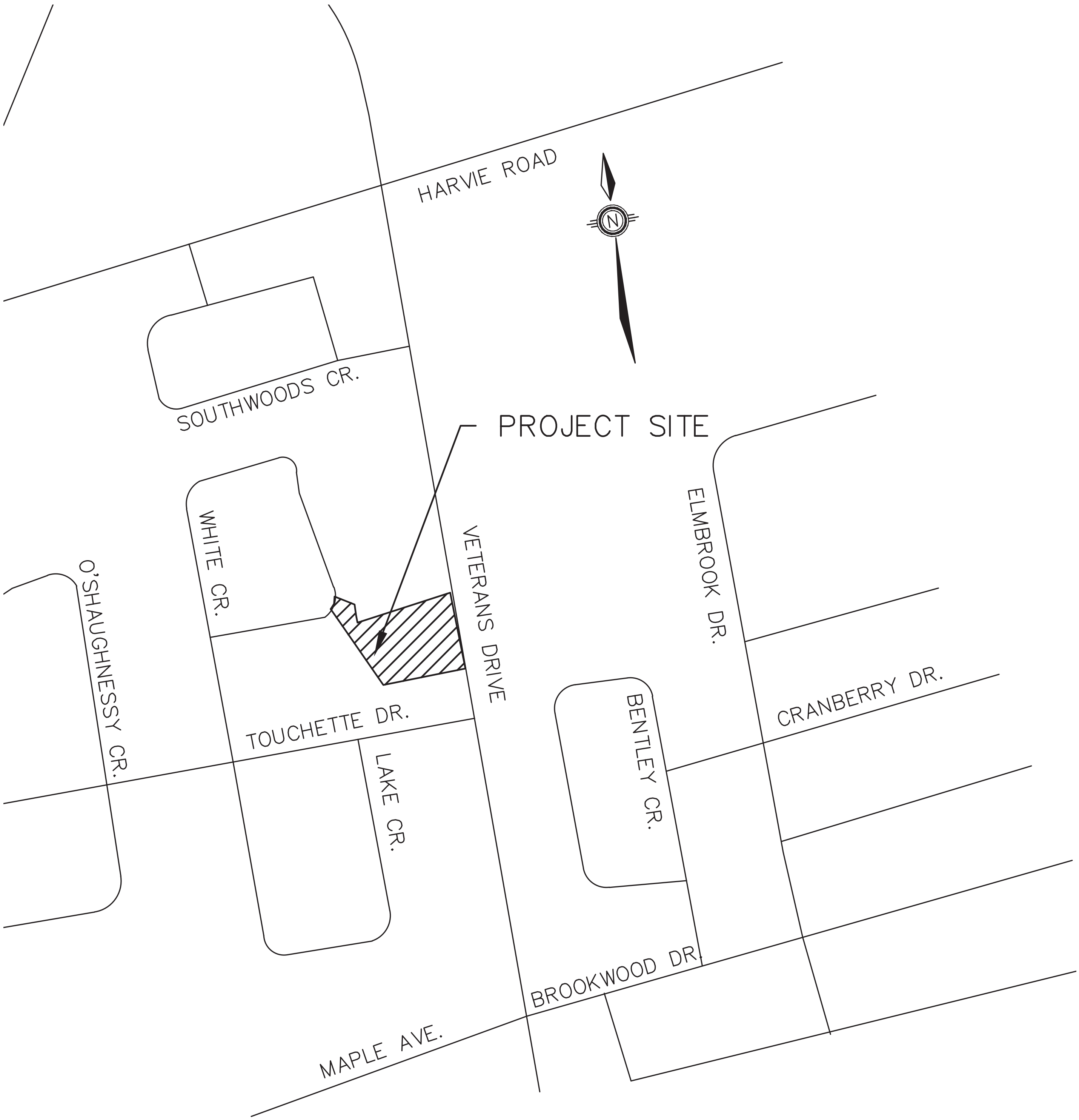
- Identify the existing site characteristics including any external drainage conditions;
- Illustrate the design of the stormwater conveyance, capable of accommodating both minor and major storm flows from the site;
- Incorporate the appropriate Best Management Practices for controlling on-site erosion and sedimentation during construction while ultimately ensuring that the post-development release of stormwater is of adequate quality; and
- Summarize this design in a technically comprehensive and concise manner.

2. Stormwater Management

A key component of the Development is the need to address environmental and related Stormwater Management issues. These are examined in a framework aimed at meeting the City of Barrie and MECP requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This Report focuses on the necessary measures to satisfy the approval agency's SWM requirements.

The objectives of the SWM plan are to:

- Protect life and property from flooding and erosion;
- Maintain existing storm drainage and runoff patterns;
- Maintain water quality for ecological integrity, recreational opportunities etc.;
- Protect aquatic and fisheries habitats.
- Incorporate Low Impact Development (LID) practices to promote infiltration and reduce phosphorus levels to downstream watercourses.



104 WHITE CRESCENT
CTY OF BARRIE

SITE LOCATION PLAN

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DESIGNED BY	PCO	HORIZ SCALE	NTS	PROJECT #	18058
DRAWN BY	ZZ	VERT SCALE		DRAWING #	FIG-1
CHECKED BY	GMP	DATE	DEC 2018	REVISION #	0

2.1. Analysis Methodology

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, December 2017
- Lake Simcoe Region Conversation Authority Technical Guidelines for Stormwater Management Submissions – September 2016

In order to design the facilities to meet these requirements, it is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Modified Rational Method is appropriate for the design for the SWM system.

2.2. Existing Drainage Conditions

The project site is approximately 0.21 hectares in size and is currently a vacant lot with a large gravel area. The majority of the site's stormwater flows from west to east overland at approximately 0.6%. Flows from the site either enter directly into the existing storm sewer system on Veterans Drive or flow through the adjacent lots on Touchette Drive prior to entering the storm sewer system. The storm sewer systems on White Crescent, Touchette Drive and Veterans Drive ultimately outlet into the downstream SWM pond as indicated in the attached G-10 drawing (prepared by Jones Consulting Group Ltd.) in Appendix D.

According to the report completed by Soil Engineers Ltd in January 2004, “beneath a layer of topsoil, 15 to 35 cm thick, a stratum of silty sand till extends to the maximum investigated depths in 6 boreholes. Occasional deposits of fine sand and silty clay were found below the silty sand till deposit.” According to their findings, this soil is characterized as having high frost susceptibility, low water erodibility, and is relatively permeable.

According to the Development Charge Background Study for the Whiskey Creek Stormwater Management Works, by Watson & Associates, April 29, 2011, the design of the downstream SWM Pond has allocated a runoff coefficient of 0.48 for the project site. However, according to the *Sunfield Homes Veterans Drive, Storm Servicing Plan North As Constructed,* by Pearson-McCuaig Engineering Ltd., November 2011, the surrounding storm sewers have been designed to allow the site to contribute flows towards White Crescent, Veterans Drive, and through the adjacent lots on Touchette Drive utilizing a runoff coefficient of 0.45. As such, allowable flows for the 2 and 5 year storm event have been designed to the 0.45 runoff coefficient to ensure sufficient capacity within the storm sewer and the 10 to 100 year allowable flows have been designed to the 0.48 runoff coefficient. Allowable peak flows for the site can be seen in Table 1 below. Detailed calculations for the existing drainage conditions can be found in Appendix A.

Table 1: Allowable Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Flow to White Crescent (m^3/s)	0.003	0.004	0.005	0.006	0.007	0.008
Total Flow to Veterans Drive (m^3/s)	0.014	0.019	0.023	0.030	0.036	0.041
Total Flow to Adjacent Lots (m^3/s)	0.005	0.007	0.008	0.011	0.013	0.015
Total Allowable Flow (m^3/s)	**0.022**	**0.029**	**0.036**	**0.046**	**0.056**	**0.064**

2.3. Proposed Drainage Conditions

The proposed development includes construction of 8 Townhouse Units with a curbed asphalt parking area located west of the proposed buildings. The proposed drainage from the majority of the development will flow overland towards permeable pavers located within the parking stalls on the south side of the parking lot. Stormwater that is captured within the perforated pipe at the base of the permeable pavers as well as that which is captured within the catch basin located within the permeable pavers will direct stormwater runoff into the storm sewer system. An orifice tube will be located south of MH1, restricting flows into the underground storage chambers. Stormwater from the east side of the townhouse units will drain via overland flow uncontrolled towards Veterans Drive, and a small area of sidewalk and landscape area on the south side of the site will flow uncontrolled easterly towards existing residential units on Touchette Drive.

In the event of a major storm, defined as storms larger than the 5-year event, the storm sewer will surcharge, forcing stormwater to the site's surface. All major storm flow will be contained within the curbed parking lot and conveyed to White Crescent through the driveway entrance. The proposed drainage patterns can be seen on the Post Development Storm Catchment Plan DWG STM-1 under Appendix D.

2.4. Stormwater Quantity Control

The existing stormwater management features have been previously designed assuming the Project Site would have a runoff coefficient of 0.45. The calculated post-development runoff coefficient of 0.72 is greater than the allowable runoff coefficient, and so considerations were taken to reduce post development peak flows to allowable values.

Quantity control for the site will be achieved through the use of an orifice tube, underground storage chambers and surface ponding. Calculations indicate that 39 m^3 of storage is required for the 100-year storm event. A 75 mm diameter orifice tube is located downstream of MH1 restricting storms up to the 10 year flow into 17 StormTech SC-310 underground storage units which will provide 19 m^3 and are located in the west parking area. Storms greater than the 10 year storm event will surcharge to the surface and the remaining 10 m^3 of storage will be provided by surface ponding. The driveway entrance is used as a major storm control weir directing flows towards White Crescent. The controlled post development peak flows are shown in Table 2. Detailed calculations can be seen in Appendix A.

Table 2: Post Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Controlled Area (To White Cres.) (m^3/s)	0.014	0.020	0.021	0.021	0.022	0.022
Uncontrolled Flow to White Crescent (m^3/s)	0.001	0.001	0.002	0.002	0.002	0.002
Uncontrolled Flow to Veterans Drive (m^3/s)	0.009	0.012	0.014	0.016	0.018	0.019
Uncontrolled Flow to Adjacent Lots (m^3/s)	0.001	0.002	0.002	0.002	0.002	0.003
Total Site (m^3/s)	**0.025**	**0.035**	**0.039**	**0.041**	**0.044**	**0.046**

Comparing flows from Table 1 and Table 2, the post development flows are less than allowable for all storm events.

2.5. Stormwater Quality Control

The Ministry of the Environment, Conservation and Parks (MECP) in March 2003 issued a "Stormwater Management Planning and Design Manual". This manual has been adopted by a variety of agencies including the City of Barrie. The objective of our Stormwater Quality Control will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

The majority of the proposed drainage from the parking lot area will be conveyed to a system of permeable pavers complete with a perforated underdrain which will convey stormwater to the storm sewer system designed to convey the 5 year storm event.

Runoff from rooftop of the west side of the proposed townhouse units will flow towards underground infiltration units located within the grassed area on the west side of the site. An overflow spout will be provided on the downspouts to direct water overland in the event that the system surcharges.

Low Impact Development features are an emerging technology and therefore the guidelines listed above are subject to change. As standard details and specifications are still being developed, all details and locations are to be reviewed and approved by the City.

2.5.1. Permanent Quality Control

The developments active parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand and oils on the paved surfaces. The existing downstream SWM Pond has been sized to provide quality/erosion control for the project site area for 70% long-term suspended solids removal assuming a runoff coefficient of 0.48 as per Table 3.2 in the MECP “Stormwater Management Planning and Design Manual”, March 2003. The site has a runoff coefficient of 0.72, however the size of the site is small and thus only an additional 26.2 m^3 would be required to treat the site to Enhanced 80% long-term removal within the downstream SWM Pond. Given the size of the downstream SWM pond and the pre-treatment provided through permeable pavers and rooftop infiltration, this volume requirement is nominal and can easily be accommodated within the downstream SWM pond, therefore, no additional quality control measures are proposed.

2.5.2. Quality Control during Construction

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure the stormwater runoff’s quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties.
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways.
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed/exposed shall not exceed 30 days.
- Reduce stormwater drainage velocities where possible.
- Minimize the amount of existing vegetation removed.

3. Phosphorus Budget

Local conservation authorities have determined the importance of reducing phosphorus levels in water courses in this area. The reduction was based on conservative values derived from the LSRCA. As this site is subject to the Lake Simcoe Phosphorous Offsetting Policy (LSPOP), post-development phosphorous levels are to be reduced to 0 kg.

The existing site generates approximately 0.01 kg of phosphorus annually and the proposed Project will generate approximately 0.28 kg of phosphorus annually if uncontrolled. Best efforts will be used in order to reduce the phosphorus loading as much as is reasonably possible.

To minimize the amount of phosphorus discharged from the site, a treatment train approach is to be utilized. Rooftop runoff from the west side of the proposed buildings will be directed to underground infiltration units and parking lot runoff will be conveyed to permeable paver units. Stormwater from the site will then flow through the storm sewer system and into the downstream wet pond.

According to the LSRCA Phosphorus Loading Development Tool, the typical phosphorus reduction is 60% for infiltration, 45% for permeable pavers and 63% for a wet pond.

The following chart details the anticipated phosphorous loadings for the pre and post-development conditions.

Table 3.1: Phosphorus Loadings

	Total P (kg)
Pre-Development	0.01
Uncontrolled Post Development	0.28
Controlled Post Development	0.06

Detailed calculations can be found in Appendix B.

3.1. Phosphorous Offsetting Policy

The LSRCA has implemented a Phosphorous Offsetting Policy in September 2017 which has a goal that all new development must reduce 100% of the phosphorous leaving the property. A fee of $87,500 per annual kg is required for anything above a net 0 kg of phosphorous running off the site. Therefore, the required fee for the proposed development is as follows:

LSPOP Fee = $35,000 x 2.5 x 0.07 kg = **$6,125**

Refer to Appendix B for detailed phosphorous budget calculations.

4. Water Balance

Since the post-development state will increase the imperviousness of the site, considerations were taken in regards to groundwater recharge. According to the Infiltration Test Summary completed by WSP dated November 3,2020, the in-situ testing demonstrated the soil has an infiltration rate of 52 mm/hr (1.3×10^{-6}). These results have been included in Appendix C.

Calculations were completed utilizing pre-development to post development volume requirements as well as the City of Barrie minimum infiltration volume requirements of 5 mm over the total area of the site. The City of Barrie values govern the infiltration requirements and thus 11 m^3 of storage is required. Stormwater runoff from the west half of the rooftop of the building will be directed into 4 underground StormTech SC-740 infiltration units located in the grassed area on the west side of the site to provide 11.8 m^3 of infiltration storage. In the event of a storm event greater than the available storage volume in the infiltration chambers, an overflow will be installed on the roof downspout at the building which will allow stormwater to be conveyed via overland flow to the storm sewer. Detailed calculations can be found in Appendix D.

5. Maintenance

5.1. StormTech Chambers

The StormTech Chambers are proposed to provide 11.8 m^3 of underground infiltration volume and 19.0 m^3 of storage volume. The chambers should be inspected every 6 months and after each major rainfall event during the first year to ensure that the storm tanks are free of any debris. In subsequent years, the chambers should be inspected semi-annually, or more if deemed necessary for this specific site.

If the average depth of sediment exceeds 3 inches throughout the length of the chamber, a cleanout should be performed. Maintenance should be executed using a vacuum pump truck to evacuate sediment and debris from system. The system should be flushed with clean water, with care taken to avoid extreme direct water pressures and is to be performed in dry weather. Material removed from the unit will be disposed of in a similar manner to that of other stormwater management facilities.

The owner should keep a Record of Maintenance Book to log inspection results and cleanout frequency. The maintenance manual from the manufacturer is included in Appendix C.

5.2. Permeable Pavers

Permeable pavement requires regular inspection and maintenance to ensure that it functions properly. The limiting factor for permeable pavers is clogging within the aggregate layers, filler, or underdrain. The pavers themselves can be reused. Annual inspections of permeable pavement should be conducted in the spring to ensure continued infiltration performance. These inspections should check for spilling or deterioration and investigate whether water is draining between storms. The pavement reservoir should drain completely within 48 hours of the end of the storm event.

6. Conclusions

Quantity control for the development is provided in underground storage units, surface ponding as well as the downstream SWM Pond.

Quality control for the site will be provided within permeable pavers, soakaway pits, and the downstream SWM Pond. Phosphorus levels will be reduced using best efforts with the implementation of rooftop infiltration, permeable pavers, and within the downstream SWM Pond.

Water balance for the site is achieved by rooftop infiltration and infiltration within the permeable pavers.

All of which is respectfully submitted,
Pearson Engineering Ltd.

Taylor Arkell, P. Eng.
Project Engineer

Mike Dejean, P. Eng.
Manager of Engineering Services

Appendix A

Stormwater Management Calculations

104 White Crescent, Barrie, Ontario
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.16	0.95	0.95	0.60	0.95	Weighted
Surface Cover	=	*Grass	Asphalt	Building	Gravel	Concrete	Runoff Coefficient
PRE DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	2106	671	0	0	1435	0	0.46
Pre Total	2106	671	0	0	1435	0	0.46
POST DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	1333	303	729	226	0	75	0.77
2	55	7	44	0	0	5	0.86
3	580	210	0	280	0	90	0.66
4	138	96	0	0	0	41	0.40
Post Total	2106	616	773	506	0	211	0.72

*Value taken from Soil Engineers Ltd. Soil Report, January 2004

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104 White Crescent, Barrie, Ontario
Allowable Peak Flows

Storm (yrs)	City of Barrie Coeff A	Coeff B	Coeff C
2	678.085	4.699	0.781
5	853.608	4.699	0.766
10	975.865	4.699	0.760
25	1146.275	4.922	0.757
50	1236.152	4.699	0.751
100	1426.408	5.273	0.759

Modified Rational Method
$Q = C_iCIA / 360$

Where:

Q -	Flow Rate (m^3/s)
Ci -	Peaking Coefficient
C -	Rational Method Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)

Area Number	1- To White Cres.	2- To Veteran's Drive	3-To Adjacent Lots
Area	0.03 ha	0.14 ha	0.05 ha
Runoff Coefficient (2 and 5 Year)	0.45	0.45	0.45
Runoff Coefficient (10 to 100 Year)	0.48	0.48	0.48
Time of Concentration	10 min	10 min	10 min
Return Rate	2 year	2 year	2 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	83.1 mm/hr	83.1 mm/hr	83.1 mm/hr
Pre-Development Peak Flow	0.003 m^3/s	0.014 m^3/s	0.005 m^3/s
Return Rate	5 year	5 year	5 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	108.9 mm/hr	108.9 mm/hr	108.9 mm/hr
Pre-Development Peak Flow	0.004 m^3/s	0.019 m^3/s	0.007 m^3/s
Return Rate	10 year	10 year	10 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	126.5 mm/hr	126.5 mm/hr	126.5 mm/hr
Pre-Development Peak Flow	0.005 m^3/s	0.023 m^3/s	0.008 m^3/s
Return Rate	25 year	25 year	25 year
Peaking Coefficient (C_i)	1.1	1.1	1.1
Rainfall Intensity	148.2 mm/hr	148.2 mm/hr	148.2 mm/hr
Pre-Development Peak Flow	0.006 m^3/s	0.030 m^3/s	0.011 m^3/s
Return Rate	50 year	50 year	50 year
Peaking Coefficient (C_i)	1.2	1.2	1.2
Rainfall Intensity	164.2 mm/hr	164.2 mm/hr	164.2 mm/hr
Pre-Development Peak Flow	0.007 m^3/s	0.036 m^3/s	0.013 m^3/s
Return Rate	100 year	100 year	100 year
Peaking Coefficient (C_i)	1.25	1.25	1.25
Rainfall Intensity	180.2 mm/hr	180.2 mm/hr	180.2 mm/hr
Pre-Development Peak Flow	0.008 m^3/s	0.041 m^3/s	0.015 m^3/s

104 White Crescent, Barrie, Ontario
Post-Development Peak Flows

Storm (yrs)	City of Barrie Coeff A	Coeff B	Coeff C
	678.085	**4.699**	**0.781**
5	**853.608**	**4.699**	**0.766**
10	**975.865**	**4.699**	**0.760**
25	**1146.275**	**4.922**	**0.757**
50	**1236.152**	**4.699**	**0.751**
100	**1426.408**	**5.273**	**0.759**

Modified Rational Method
$Q = C_i CIA / 360$

Where:

Q -	Flow Rate (m^3/s)
Ci -	Peaking Coefficient
C -	Rational Method Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)

	Area to Quantity Control	Uncontrolled to White Cres.	Uncontrolled to Veterans	Uncontrolled to Adjacent Lots
Area Number	1	2	3	4
Area	0.13 ha	0.006 ha	0.06 ha	0.01 ha
Runoff Coefficient	0.77	0.86	0.66	0.40
Time of Concentration	10 min	10 min	10 min	10 min
Return Rate	2 year	2 year	2 year	2 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	83.1	83.1	83.1	83.1
Post-Development Peak Flow	0.02 m^3/s	0.001 m^3/s	0.009 m^3/s	0.001 m^3/s
Return Rate	5 year	5 year	5 year	5 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	108.9	108.9	108.9	108.9
Post-Development Peak Flow	0.03 m^3/s	0.001 m^3/s	0.012 m^3/s	0.002 m^3/s
Return Rate	10 year	10 year	10 year	10 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	126.5	126.5	126.5	126.5
Post-Development Peak Flow	0.04 m^3/s	0.002 m^3/s	0.014 m^3/s	0.002 m^3/s
Return Rate	25 year	25 year	25 year	25 year
Peaking Coefficient (C_i)	1.10	1.10	1.10	1.10
Rainfall Intensity	148.2	148.2	148.2	148.2
Post-Development Peak Flow	0.04 m^3/s	0.002 m^3/s	0.016 m^3/s	0.002 m^3/s
Return Rate	50 year	50 year	50 year	50 year
Peaking Coefficient (C_i)	1.20	1.20	1.20	1.20
Rainfall Intensity	164.2	164.2	164.2	164.2
Post-Development Peak Flow	0.05 m^3/s	0.002 m^3/s	0.018 m^3/s	0.002 m^3/s
Return Rate	100 year	100 year	100 year	100 year
Peaking Coefficient (C_i)	1.25	1.25	1.25	1.25
Rainfall Intensity	180.2	180.2	180.2	180.2
Post-Development Peak Flow	0.05 m^3/s	0.002 m^3/s	0.019 m^3/s	0.003 m^3/s

104 White Crescent, Barrie, Ontario
Stage-Storage-Discharge Table

Elevation (m)	Area (m^2)	Volume (m^3)	Cum. Vol. (m^3)	Orifice 1 Head (m)	Orifice 1 Flow (m^3/s)	Weir Head (m)	Weir Flow (m^3/s)	Total Flow (m^3/s)
310.90	0	0	0	0.02	0.002	0.00	0.000	0.002
310.95	0	0	0	0.07	0.004	0.00	0.000	0.004
311.00	0	0.0	0	0.12	0.005	0.00	0.000	0.005
311.05	0	1.1	1	0.17	0.007	0.00	0.000	0.007
311.10	0	1.1	2	0.22	0.007	0.00	0.000	0.007
311.15	0	1.1	3	0.27	0.008	0.00	0.000	0.008
311.20	0	1.9	5	0.32	0.009	0.00	0.000	0.009
311.25	0	1.8	7	0.37	0.010	0.00	0.000	0.010
311.30	0	1.8	9	0.42	0.010	0.00	0.000	0.010
311.35	0	1.7	10	0.47	0.011	0.00	0.000	0.011
311.40	0	1.6	12	0.52	0.011	0.00	0.000	0.011
311.45	0	1.5	13	0.57	0.012	0.00	0.000	0.012
311.50	0	1.3	15	0.62	0.012	0.00	0.000	0.012
311.55	0	1.1	16	0.67	0.013	0.00	0.000	0.013
311.60	0	1.1	17	0.72	0.013	0.00	0.000	0.013
311.65	0	1.1	18	0.77	0.014	0.00	0.000	0.014
311.70	0	1.1	19	0.82	0.014	0.00	0.000	0.014
311.75	0	0.0	19	0.87	0.015	0.00	0.000	0.015
311.80	0	0.0	19	0.92	0.015	0.00	0.000	0.015
312.20	0	0.0	19	1.32	0.018	0.00	0.000	0.018
312.21	3	0.0	19	1.33	0.018	0.00	0.000	0.018
312.22	8	0.1	19	1.34	0.018	0.00	0.000	0.018
312.23	16	0.1	19	1.35	0.018	0.00	0.000	0.018
312.24	27	0.2	19	1.36	0.018	0.00	0.000	0.018
312.25	40	0.3	20	1.37	0.018	0.00	0.000	0.018
312.26	56	0.5	20	1.38	0.018	0.00	0.000	0.018
312.27	75	0.7	21	1.39	0.018	0.00	0.000	0.018
312.28	94	0.8	22	1.40	0.019	0.00	0.000	0.019
312.29	115	1.0	23	1.41	0.019	0.00	0.000	0.019
312.30	134	1.2	24	1.42	0.019	0.00	0.000	0.019
312.31	151	1.4	25	1.43	0.019	0.00	0.000	0.019
312.32	168	1.6	27	1.44	0.019	0.00	0.000	0.019
312.33	184	1.8	29	1.45	0.019	0.00	0.000	0.019
312.34	200	1.9	31	1.46	0.019	0.00	0.000	0.019
312.35	217	2.1	33	1.47	0.019	0.00	0.000	0.019
312.36	233	2.2	35	1.48	0.019	0.00	0.000	0.019
312.37	250	2.4	37	1.49	0.019	0.00	0.000	0.019
312.38	267	2.6	40	1.50	0.019	0.00	0.000	0.019
312.39	283	2.7	43	1.51	0.019	0.00	0.000	0.019
312.40	301	2.9	46	1.52	0.019	0.00	0.000	0.019
312.41	319	3.1	49	1.53	0.019	0.01	0.010	0.029
312.42	337	3.3	52	1.54	0.019	0.02	0.027	0.046
312.43	355	3.5	56	1.55	0.020	0.03	0.049	0.069
312.44	373	3.6	59	1.56	0.020	0.04	0.076	0.096
312.45	403	3.9	63	1.57	0.020	0.05	0.106	0.126
312.46	428	4.2	67	1.58	0.020	0.06	0.140	0.160

Orifice 1	
Diameter	75 mm
Invert Elevation	310.84
Orifice Constant	0.80
Orifice Centroid	310.88
Orifice Flow Formula	$0.80\pi(D/2000)^2 x(2x9.81xH)^{0.5}$

Major Storm Control Weir	
Width	5.60 m
Invert of Weir	312.42 m
Weir Flow Formula	$1.7WH^{1.5}$

104 White Crescent, Barrie, Ontario
Quantity Control Volume Calculations

DATE:	09-Mar-21
FILE:	18058
CONTRACT/PROJECT:	104 White Crescent
COMPLETED BY:	MKRW

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
0.03	0.13	10	5	*0.45	0.77
				**0.48	

*Runoff Coefficient for 2 and 5 year storm
*Runoff Coefficient for 10 to 100 year storm
Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Allowable Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.45	0.45	0.48	0.48	0.48	0.48
C_i	1.00	1.00	1.00	1.10	1.20	1.25
I	83.11	108.92	126.55	148.15	164.22	180.15
A	0.03	0.03	0.03	0.03	0.03	0.03
Q	0.003	0.004	0.005	0.006	0.007	0.008

Note: $Q= 0.00278CC_iIA$

Rainfall Station	Barrie

SWM Pond Design Input

Storm (yrs)	Chicago Storm Coefficient	Chicago Storm Coefficient	Chicago Storm Coefficient	Allowable Outflow	Post Development Runoff Coefficient
	A	B	C	(m3/s)	
2	678.085	4.699	0.781	0.010	0.77
5	853.608	4.699	0.766	0.012	0.77
10	975.865	4.699	0.760	0.014	0.77
25	1146.275	4.922	0.757	0.019	0.85
50	1236.152	4.699	0.751	0.019	0.92
100	1426.408	5.273	0.759	0.019	0.96

Results

Storm Event	Storage m^3	Time min
2	10	20
5	14	25
10	18	30
25	22	30
50	30	35
100	39	40

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time (min)	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3	Difference	5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3	Difference
5	114.99	0.03	0.01	5	3	149.77	0.04	0.01	7	4
10	83.11	0.02	0.01	8	1	108.92	0.03	0.01	11	2
15	66.12	0.02	0.01	9	0	87.04	0.02	0.01	13	1
20	55.41	0.02	0.01	10	0	73.19	0.02	0.01	14	0
25	47.98	0.01	0.01	10	0	63.55	0.02	0.01	14	0
30	42.49	0.01	0.01	9	0	56.41	0.02	0.01	14	0
35	38.25	0.01	0.01	9	-9	50.89	0.01	0.01	14	-1
40	34.87	0.01	0.00	0	0	46.47	0.01	0.01	13	-1
45	32.09	0.01	0.00	0	0	42.84	0.01	0.01	13	-13
50	29.78	0.01	0.00	0	0	39.81	0.01	0.00	0	0
55	27.81	0.01	0.00	0	0	37.23	0.01	0.00	0	0
60	26.12	0.01	0.00	0	0	35.00	0.01	0.00	0	0
65	24.64	0.01	0.00	0	0	33.06	0.01	0.00	0	0

Time (min)	10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	Difference	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3	Difference
5	173.57	0.05	0.01	9	5	201.77	0.06	0.02	11	6
10	126.55	0.04	0.01	14	2	148.15	0.05	0.02	17	3
15	101.30	0.03	0.01	16	1	119.04	0.04	0.02	20	1
20	85.30	0.02	0.01	17	0	100.48	0.03	0.02	21	1
25	74.15	0.02	0.01	17	0	87.49	0.03	0.02	22	0
30	65.88	0.02	0.01	18	0	77.83	0.02	0.02	22	0
35	59.47	0.02	0.01	17	0	70.33	0.02	0.02	21	-1
40	54.35	0.02	0.01	17	-1	64.32	0.02	0.02	21	-1
45	50.14	0.01	0.01	16	-16	59.39	0.02	0.02	20	-20
50	46.61	0.01	0.00	0	0	55.25	0.02	0.00	0	0
55	43.62	0.01	0.00	0	0	51.72	0.02	0.00	0	0
60	41.03	0.01	0.00	0	0	48.68	0.02	0.00	0	0
65	38.77	0.01	0.00	0	0	46.02	0.01	0.00	0	0

Time (min)	50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3	Difference	100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	Difference
5	224.41	0.08	0.02	15	8	243.43	0.09	0.02	17	10
10	164.22	0.06	0.02	22	4	180.15	0.06	0.02	27	5
15	131.81	0.05	0.02	26	2	145.31	0.05	0.02	32	3
20	111.22	0.04	0.02	29	1	122.92	0.04	0.02	35	2
25	96.84	0.03	0.02	30	1	107.18	0.04	0.02	37	1
30	86.16	0.03	0.02	30	0	95.44	0.03	0.02	38	0
35	77.87	0.03	0.02	30	0	86.31	0.03	0.02	39	0
40	71.24	0.02	0.02	30	-1	78.97	0.03	0.02	39	0
45	65.78	0.02	0.02	30	-1	72.93	0.03	0.02	39	0
50	61.21	0.02	0.02	29	-1	67.87	0.02	0.02	38	-1
55	57.32	0.02	0.02	28	-28	63.55	0.02	0.02	37	-1
60	53.96	0.02	0.00	0	0	59.82	0.02	0.02	37	-1
65	51.03	0.02	0.00	0	0	56.56	0.02	0.02	36	-36

Maximum Storage Volume

104 White Crescent, Barrie, Ontario
Quality Control Calculations

Given that the downstream SWM Pond is designed to provide 70% long-term S.S. removal for the site at a runoff coefficient of 0.48

Storage Volume accounted for in pond	=	21.9	m^3	from Table 3.2 Water Quality Storage Requirements
Volume Requred for Enhanced long-term S.S. removal in wet pond	=	48.1	m^3	from Table 3.2 Water Quality Storage Requirements
Deficit storage in wet pond	=	26.2	m^3	

Therefore 26.9m^3 of storage is required within the downstream SWM pond to provide Enhanced long term S.S. removal.

PEARSON ENGINEERING

104 White Crescent, Barrie, Ontario
Permeable Pavers Sizing Calculations

Infiltration volumes from MOE Stormwater Management Planning and Design Manual to size Bioretention Filter Table 3.2 Water Quality Storage Requirements are as follows:

Design Area Total	=	0.21	ha	
Total Imperviousness	=	71%		
Storage Volume	=	35	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 1 Storage Volume Required	=	0.21	x	35.4
	=	7.4	m^3	

Find Storage Volume provided in Permeable Pavers:

Area of Pavers (A)	=	17.0	m^2
Depth of Trench (d)	=	1.10	m
Storage Volume (V)	=	0.4(A x d)	
	=	7.5	m^3

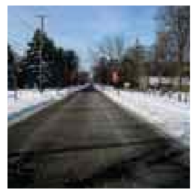
Use Equation 4.12 to find Area of Permeable Pavers:

Depth of Controlling Filter Medium (d)	=	1.10	m
Coefficient of Permeability of the Controlling Filter Media (k)	=	45.0	mm/hr
Operating Head of Water On the Filter (h)	=	0.18	m
Design Drawdown Time (t)	=	36	hr
Surface Area Of Filter (A)	=	$\frac{1000Vd}{k(h+d)t}$	
	=	4.0	m^2

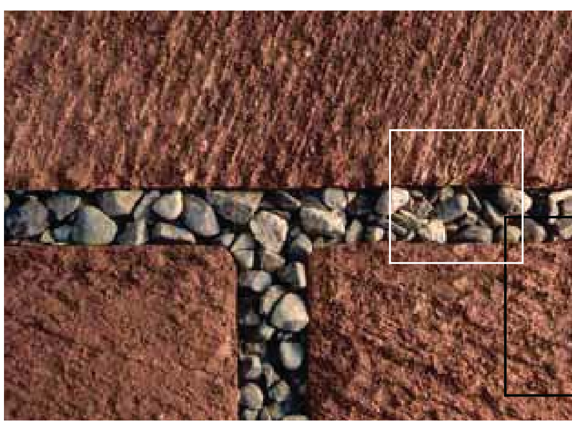
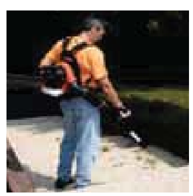
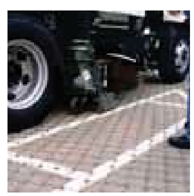
		Required		Provided	
Area 1 Surface Area	=	4.0	m^2	17.0	m^2







Permeable Paver Maintenance Guide

This guide is specific for Unilock permeable pavers as a maintainable system for stormwater runoff and does not cover cleaning concrete pavers themselves. Please see the Unilock Paver Care for information on cleaning concrete pavers. The maintenance information in this guide is intended for Unilock permeable paver systems only and not for other types of permeable pavers or pervious systems.

Much like any impervious paving surfaces with catch basins and underground infrastructure, maintenance is necessary with any type of permeable systems. Over the lifetime of the permeable paver system there will be a need to clean any sediment, soil, dirt and debris from the joint aggregate material to maintain a sufficient infiltration rate. Every project will vary in performance needs, as well as to the frequency in which the joint material must be cleaned. The surface infiltration rate must be greater than the regional, 100 year rainfall intensity to adequately ensure no runoff is generated, which is only one goal for using permeable pavers. Unilock suggests establishing a maintenance plan using the techniques in this document to prevent clogging.

Preceding Maintenance 3

Examples of Common Maintenance Issues 3

Maintenance Types 4

Maintenance Equipment 5

Strategic Procedures for Maintaining Infiltration 7

Recommended Seasonal Maintenance Schedule 8

Winter Maintenance and De-icing 9

Preceding Maintenance

Before providing maintenance on permeable paver systems, proper installation and protection during construction is required. Here are a few conditions to observe, require and prevent for establishing a successful system:

1. Verify correct installation and materials:
- Hire contractors with knowledgeable experience installing permeable pavers.
- Review and approve all sub-base, base and joint aggregate materials.
- Do not allow sand and dense-graded aggregates.

2. Prevent construction damage:
- Limit subgrade soil compaction when infiltration is necessary.
- Restrict vehicles with muddy tires from driving over newly placed pavers.
- Do not mix aggregate materials.

3. Refill joint material:
- Once between 3 and 6 months after initial installation.
- Repeat as needed - approximately every 5-10 years.

4. Avoid stockpiling of materials such as:
- Topsoil.
- Mulch.

The proper materials and installation execution can be found in the Unilock specifications for permeable pavers. Both residential and commercial projects will utilize the same base, setting bed and joint aggregates. Some projects many not require sub-base materials, underdrainage or geotextile. It is not necessary to separate the setting bed from the base aggregates with a geotextile.

Examples of Common Maintenance Issues

Below are several warning signs and visual clues of common maintenance issues which must be prevented and addressed or remediated to ensure continued surface infiltration.

1. Slow Draining/Runoff:
- Verify with simple infiltration testing or observe after rain storms.
- Surface should drain immediately.

2. Ponding and Bird Baths:
- Rule of thumb: if more than a nickel deep one minute after a rainfall event, maintenance is necessary.
- Verify correct materials were installed.
- Exceptions at bottom of slopes.

3. Surface Crusting:
- Identify if there is a problem such as run on sediments.
- Increase cleaning frequency in troubled areas.
- Remove debris immediately.

4. Weeds:
- Weeds will not germinate unless there is a collection of soil or moisture.
- Remove weeds immediately.
- Clean sediment from joint material.
- Chemical treatment may be required prior to maintenance removal.

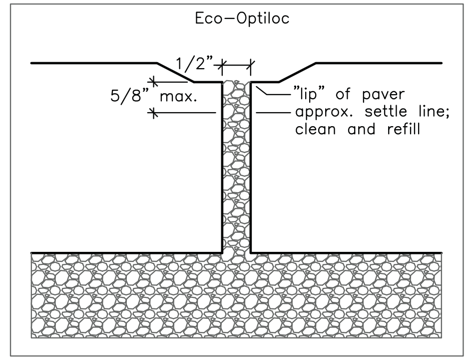
5. Covered Joint Material:
- Identify problem and correct.
- Remove immediately.
- Joint material should appear as photo on right.

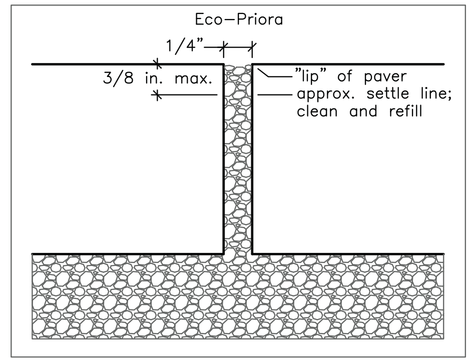
These common problems can often be easily remedied by maintaining the proper joint aggregate level.

Maintenance Types
There are two service types for maintaining the integrity of a permeable paver system.

1. **Preventative** – removes most miscellaneous debris before being trapped in the joint aggregate material causing clogging. This usually does not require removal of any joint material to restore infiltration.

2. **Restorative** – requires some removal or complete removal of the joint material to renew infiltration. Occurs after miscellaneous debris has been captured and lodged in the joint aggregate.





***Note:** *Both maintenance types will be most effective when the joint aggregate material is filled to the "lip" of the paver. If the joint material has settled more than the joint width, plus 1/8 inch below the paver lip, the maintenance equipment is significantly less effective and potentially more expensive.*

Maintenance Equipment
There are two service types for maintaining the integrity of a permeable paver system.

<u>**Project Type 1:**</u> For smaller pedestrian type areas such as sidewalks, driveways, plazas, patios or similar:

Preventative:

1. Hand-Held Bristle Broom
- Available at any hardware store.
- Sweep as needed to keep the surface clear of debris.
- Approximate cost: $15.

2. Leaf Blower
- Electric or gas powered.
- Minimum air speed of 120 mph.
- Joint aggregate material will remain in place while removing debris from paver surface.
- Approximate cost: $50 to $300.

3. Rotary Brush
- Poly bristles only.
- Flips debris from joint.
- Will require slight refilling of the joint aggregate material.
- Approximate cost: varies depending on attachment vehicle.

Restorative:

1. Wet/Dry Shop Vacuum
- Minimum 4 HP (peak) motor with 130 cubic feet per minute suction.
- Will remove some joint aggregate material.
- Replenish removed joint aggregate material to "lip" of paver.
- Approximate cost: $50 to $150.

2. Riding Litter Vacuum
- Tennant ATLV 4300.
- 48 inch wide vacuum head.
- 110 gallon capacity.
- Can also be used as a preventative technique.
- Will evacuate most debris from joint except for aggregate material.
- Approximate cost: approx. $25K new.

3. Powerwasher
- Capable of spraying 1,400 to 1,800 psi.
- Spray at a 30 degree angle approximately 18 to 24 inches from the surface.
- Will evacuate joint material.
- Replenish removed joint aggregate material to "lip" of paver.
- Approximate cost: $125 to $500.

__Project Type 2:__ For larger vehicular areas such as roads, parking lots, alleys, plazas or similar that can support vehicles:

Preventative:

1. Rotary Brush
- Poly bristles only.
- Flips debris from joint.
- Will require slight refilling of the joint aggregate material.
- Approximate cost: Varies depending on attachment vehicle.

2. Broom Sweepers
- Typical "street sweeper" type.
- Rotating curb brushes with center pickup.
- Poly bristles only.
- Do not utilize water to clean the surface as this can have detrimental effects on the cleaning.
- Best for seasonal cleaning.
- Approximate cost: $100 to $120 per hour from a service company.

3. Regenerative Air Sweepers
- Light duty suction cleaning.
- Utilizes stream of air blowing horizontally across surface and vacuuming.
- No rotating brushes.
- Approximate cost: $45 to $65 per hour from a service company.

Restorative:

1. Vacuum Sweepers
- Vacall Dynamic Multi-Purpose Vacuum. *(top photo)*
- Elgin Whirlwind. *(bottom photo)*
- Heavy duty cleaning.
- Minimum suction of 14,000 cubic feet per minute.
- Complete evacuation of joint aggregate material.
- Replenish removed joint aggregate material to "lip" of paver.
- Approximate cost: $2.50 to $4.50 per parking space.

2. Powerwashers
- Capable of spraying 1,400 to 1,800 psi.
- Spray at a 30 degree angle approximately 18 to 24 inches from the surface.
- Will evacuate joint aggregate material.
- Replenish removed joint aggregate material to "lip" of paver.

Strategic Procedures for Maintaining Infiltration

Observe and implement the following habitual procedures to ensure longevity of the system.

1. Weekly – prevent contamination from routine landscape maintenance such as grass clippings from mowing, hedge trimming, mulching plant beds, etc. by implementing the following joint opening cleaning procedures immediately after contamination occurs:
- Hand broom debris from the paver surface.
- Blow debris from the paver surface with backpack blower type device, collect and dispose.
- Mechanically sweep paver surface.

2. Monthly – observe any collection areas of debris, dirt, topsoil, mulch, etc. after season events such as snowfall, rain storms, leaf litter, etc. and investigate if clogging is occurring. Immediately restore infiltration using the following cleaning options:
- Break up any crust covering the joint aggregate material with hand broom for smaller areas or mechanically with a rotary sweeper for larger areas. Remove debris material.
- When necessary, restore infiltration using wet/dry shop vacuum for small areas or vacuum truck for larger areas by removing debris from joint aggregate material.
- Replenish joint aggregate material to "lip" of paver.

3. Yearly – establish a seasonal maintenance schedule that includes the following:
- Sweep entire permeable paving surface with appropriate preventative sweeping devices.
- Replenish joint aggregate material to "lip" of paver.

4.Ten years plus – plan long term maintenance to rejuvenate infiltration rates:
- Complete restoration of the joint aggregate material.
- Replenish joint with cleaned or new aggregate material to "lip" of paver.

Recommended Seasonal Maintenance Schedule
Unilock suggests establishing a best practices maintenance program to ensure longevity of the systems before restorative action is required. Biannual preventative maintenance is suggested as shown in the schedule below. This includes sweeping once in the early spring and once again in the late fall. Below is a preventative maintenance timeline that includes four maintenance suggestions:

1. After the snow melt – March 1 through April 15
- Broom, blow, rotary brush or sweep entire surface.
- Clean debris from paver surface in location of snow stockpile area.
- Replenish joint aggregate material after cleaning.
- Every fifth year, vacuum or power wash problem areas and refill joint material.

2. Late Spring – April 1 through May 15
- Broom, blow, rotary brush or sweep flowers from trees and shrubs.
- Collect any additional debris from areas mulched or planted with annual flowers.
- Replenish joint aggregate material as necessary.

3. Late Summer – July 15 through August 30
- Broom, blow, rotary brush or sweep lawn and shrub clippings or tree fruits.
- Collect any additional debris from summer activities such as charcoal coals inadvertently dumped on the permeable surface, beach sand, etc.
- Replenish joint aggregate material as necessary.

4. Late Fall – October 15 through November 30
- Broom, blow, rotary brush or sweep plant leaves.
- Replenish joint aggregate material as necessary.

Various factors will affect each project's preventative maintenance timeline and must be reviewed individually.

See the Recommended Seasonal Maintenance Schedule chart on next page.

	Recommended Maintenance Schedule	Seasonal BMP			
		After Snow Melt	Late Spring	Late Summer	Late Fall
Techniques	**Project Type 1: Preventative - choose one**		1x per season	optional	1x per season
	Bristle Broom	**	*	*/**	*
	Leaf Blower	**	*	*/**	*
	Rotary Brush		*	*/**	*
	Project Type 1: Restorative		**		**
	Wet-Dry Vacuum	**	**	**	**
	Riding Litter Vacuum		*	**1x every 5 yrs.	*
	Powerwasher	**	**	**	**
	Project Type 2: Preventative - choose one		1x per season	optional	1x per season
	Rotary Brush		*	*	*
	Broom Sweepers		*		*
	Regenerative Air Sweepers		*		*
	Project Type 2: Restorative				
	Vacuum Sweepers			** 1x every 10 yrs.	
	Powerwasher	**	**	**	**

* recommended
** as needed per Strategic Procedures

Winter Maintenance and De-icing
Durability is one benefit that Unilock paving stones are known for. Almost all Unilock paving stones have a slight bevel around the edge of the stone. This helps protect the edges from potential chipping by snow clearing equipment. Always use a plastic snow shovel for paving stones. Also fit snow blowers with plastic shoes on the adjustable gliders and on the scoop edge.

When using commercial snow removal companies, confirm in writing they have protective edges on the snowplow equipment to avoid scratching the surface. Although the metal on snow clearing equipment will not adversely affect Unilock paving stones structurally, the contact of any steel on concrete can potentially leave tiny particles of metal in the paver surface which will rust and leave unsightly brown streaks. (A good example of this can be seen on the municipal curbs at the street). To reduce aesthetic damage to the paver surface, only use a polymer or rubber cutting edge on the plow.

De-icing substances, when used in proper amounts, will not damage good-quality concrete. They will, however, speed up the surface wear on some styles of pavers. Many of the exposed aggregate products and tumbled products are unaffected by virtue of their style.

There are three primary types of de-icing salts:
- Sodium chloride (common rock salt) is the most popular de-icing salt. It is widely available and it will melt snow and ice at temperatures down to approximately 16° F. Below 16° F, rock salt stops melting snow and ice. Sodium chloride can damage adjacent grass, plants and metal. Apply with caution and use as sparingly as possible.

- Calcium chloride is another de-icing salt. It generally looks like small, white, round, pellets. It will melt snow down to about 0° F. It can irritate skin. Studies indicate that depending on the concentration, calcium chloride is less damaging to grass than sodium chloride is. Heavy concentrations of calcium chloride can chemically attack concrete.

- Potassium chloride is a de-icing salt available in some markets. It will not hurt skin or damage plants. However, it melts ice only when the air temperature is above 15° F, but it can be combined with sand to improve effectiveness.

Note: *Do not use Magnesium chloride.*

Note: *Do not use sand for anti-skid with permeable pavers as it will clog the joint material.*

Note: *Fertilizers that contain ammonium nitrate and ammonium sulfate should not be used for de-icing since these substances attack the integrity of concrete. Always read the manufacturer's recommendations for use and heed all warnings and cautions.*

Notes

"When we take care of the earth, it will ultimately take care of us."

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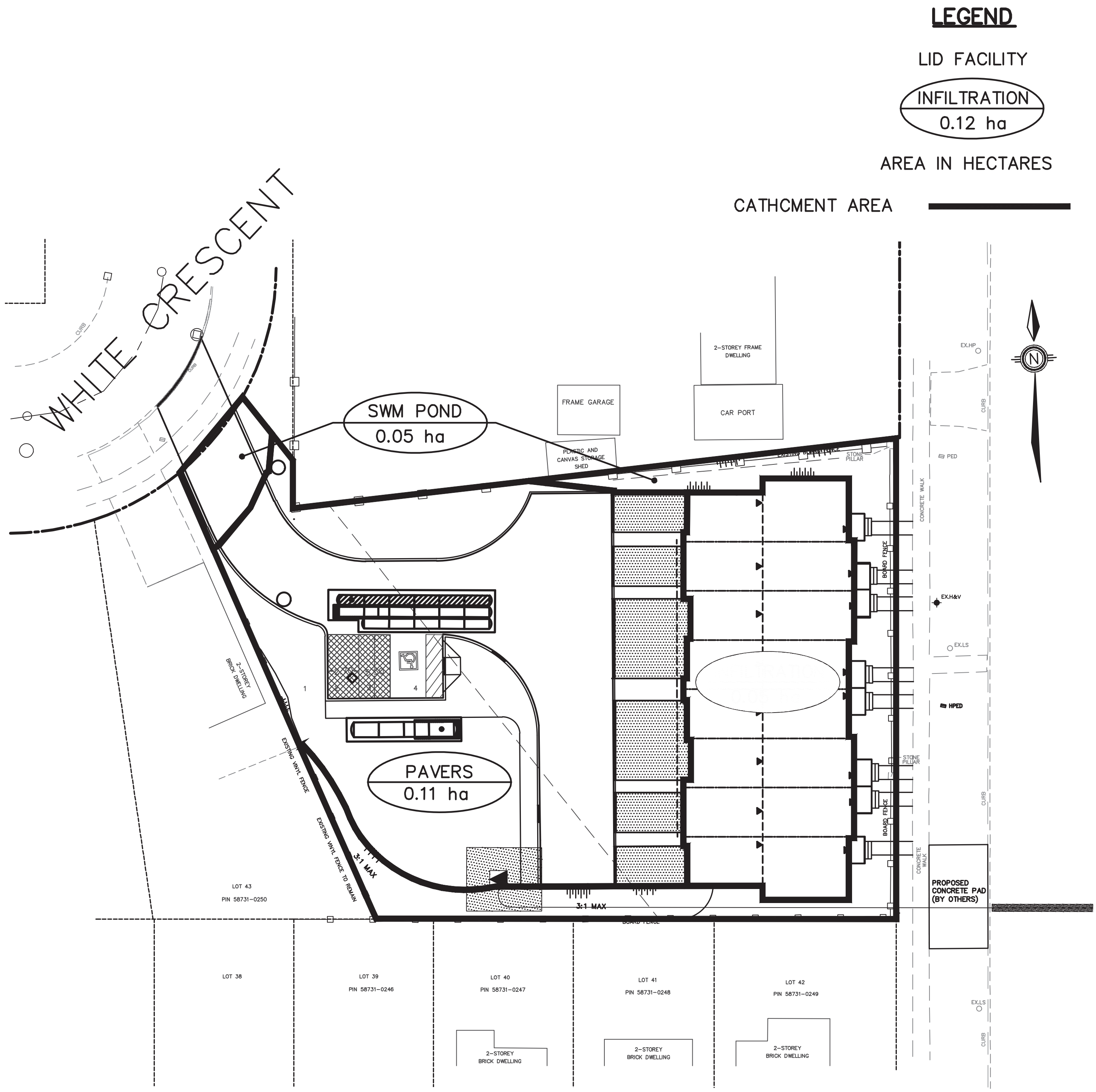
Appendix B

Phosphorus Budget Calculations



104 WHITE CRESCENT
MICHLER HOLDINGS LTD.
BARRIE, ON

PHOSPHORUS CATCHMENT AREAS

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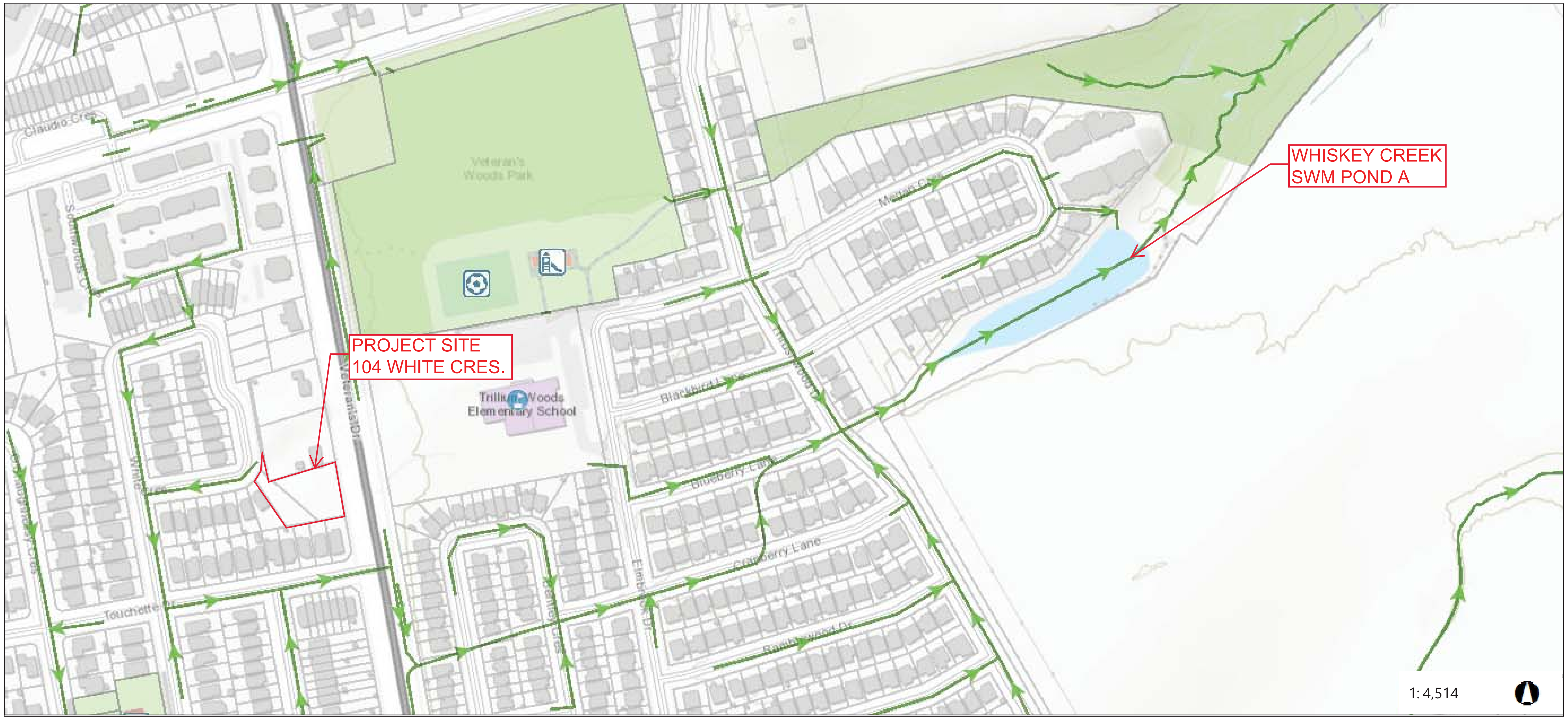
DESIGNED BY	MWD	HORIZ SCALE	1:500	PROJECT #	18058
DRAWN BY	PG	VERT SCALE	VERT	DRAWING #	FIG-2
CHECKED BY	MWD	DATE	JUNE 2020	REVISION #	0

Barrie

Discover More Printout



0.2 | 0 | 0.11 | 0.2 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

The City of Barrie does not warrant the accuracy, completeness, content, or currency of the information provided.

This is not a legal Plan of Survey.

Legend

- Assessment Parcels
- City Facilities
  - Other Facilities
  - Municipal Facility
  - Water Supply or Treatment Facility
  - Landfill
  - Library
  - Museum
  - Theatre
  - Marina
- Fire Halls
- Barrie Police Facilities
- OPP Facilities
- Medical Facilities
  - Other Facilities
  - Hospital
- Transit Stations
  - Other Stations
  - Bus Terminal
  - Train Station
- Airports
- Roads
  - Highway
  - Ramp
  - Major Road
  - Local Road
  - Private Road
- Railway Lines
- Storm Pipes
- Recreation Facilities
  - Other Recreation Facilities

Notes

PEARSON ENGINEERING

104 White Crescent, Barrie, Ontario
Phosphorus Budget Tool

	Residential	Commercial	Low Intensity	Forest
Phosphorus Export (kg/ha/year)	1.32	1.82	0.07	0.05

Pre-Development Condition

	Residential	Commercial	Low Intensity	Forest
Area (ha):	0.00	0.00	0.21	0.00
Total P (kg):	0.00	0.00	0.01	0.00
Total Pre-Development P (kg):		**0.01**		

Post-Development Condition (Uncontrolled)

Total Area	Residential	Commercial	Low Intensity	Forest
Area (ha):	0.21	0.00	0.00	0.00
Total P (kg):	0.28	0.00	0.00	0.00
Total Post-Development P (kg):		**0.28**		

Post Development Condition (Controlled)

Area Draining to Rooftop Infiltration				
Area (ha):	0.05	0.00	0.00	0.00
Total P (kg):	0.07	0.00	0.00	0.00
Rooftop Infiltration Treatment				
Rooftop Infiltration Proficiency (%):		60		
P Removed (kg):		0.04		
P Remaining (kg):		0.03		
Area Draining to Permeable Pavers				
Area (ha):	0.11	0.00	0.00	0.00
Total P (kg):	0.15	0.00	0.00	0.00
Permeable Pavers Treatment				
Permeable Pavers Proficiency (%):		45		
P Removed (kg):		0.07		
P Remaining (kg):		0.08		
Area Draining to Wet Pond Only				
Area (ha):	0.05	0.00	0.00	0.00
Total P (kg):	0.07	0.00	0.00	0.00
Wet Pond Treatment				
Total P to be Treated (Total Leaving Site) (kg):		0.17		
Wet Pond Proficiency (%):		63		
P Removed (kg):		0.11		
P Remaining (kg):		0.06		
Total Post-Development P (kg) :	=	**0.06**		

Appendix C

Water Balance Calculations

PEARSON ENGINEERING

104 White Crescent, Barrie, Ontario
Pre Development Water Balance

Catchment Designation	Site			
	Grassed	Gravel	Total	
Area	671	1435	2106	
Pervious Area	671	0	671	
Impervious Area	0	1435	1435	
Infiltration Factors				
Topography Infiltration Factor	0.2	0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.2	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0		
MOE Infiltration Factor	0.5	0		
Actual Infiltration Factor	0.5	0		
Run-Off Coeffiecient	0.5	1		
Runoff from Impervious Surfaces	0	0.6		
Inputs (per Unit Area)				
Precipitation	914	914	914	(Precipitation values from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed)
Run-On	0	0	0	
Other Inputs	0	0	0	
Total Inputs	914	914	914	
Outputs (per Unit Area)				
Precipitation Surplus	343.0	548.4	483.0	
Net Surplus	343.0	548.4	483.0	
Evapotranspiration	571.0	365.6	431.0	(Evapotranspiration values for pervious area from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed for impervious areas is the difference between the total precipitation and the net surplus)
			0.0	
Infiltration	171.5	0.0	54.6	
Rooftop Infiltration	0.0	0.0	0.0	
Total Infiltration	171.5	0.0	54.6	
Runoff Pervious Areas	171.5	0.0	54.6	
Runoff Impervious Areas	0.0	548.4	373.7	
Total Runoff	171.5	548.4	428.3	
Total Outputs	914.0	914.0	914.0	
Difference (Inputs - Outputs)	0.0	0.0	0.0	
Inputs (Volumes)				
Precipitation	613	1312	1925	
Run-On	0	0	0	
Other Inputs	0	0	0	
Total Inputs	613	1312	1925	
Outputs (Volumes)				
Precipitation Surplus	230	787	1017	
Net Surplus	230	787	1017	
Evapotranspiration	383	525	908	
Infiltration	115	0	115	
Rooftop Infiltration	0	0	0	
Total Infiltration	115	0	115	
Runoff Pervious Areas	115	0	115	
Runoff Impervious Areas	0	787	787	
Total Runoff	115	787	902	
Total Outputs	613	1312	1925	
Difference (Inputs - Outputs)	0	0	0	

Note: Highlighted cells are input cells.

PEARSON ENGINEERING

104 White Crescent, Barrie, Ontario
Post Development Water Balance (No Infiltration)

Catchment Designation	Site				
	Grassed	Paved	Building	Total	
Area	616	984	506	2106	
Pervious Area	616	0	0	616	
Impervious Area	0	984	506	1490	
Infiltration Factors					
Topography Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0	0		
MOE Infiltration Factor	0.5	0	0		
Actual Infiltration Factor	0.5	0	0		
Run-Off Coeffiecient	0.5	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	914	914	914	914	(Precipitation values from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	914	914	914	914	
Outputs (per Unit Area)					
Precipitation Surplus	343.0	868.3	868.3	714.6	
Net Surplus	343.0	868.3	868.3	714.6	
Evapotranspiration	571.0	45.7	45.7	199.4	(Evapotranspiration values for pervious area from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed for impervious areas is the difference between the total precipitation and the net surplus)
Infiltration	171.5	0.0	0.0	50.2	
Rooftop Infiltration	0.0	0.0	0.0	0.0	
Total Infiltration	171.5	0.0	0.0	50.2	
Runoff Pervious Areas	171.5	0.0	0.0	50.2	
Runoff Impervious Areas	0.0	868.3	868.3	614.2	
Total Runoff	171.5	868.3	868.3	664.4	
Total Outputs	914.0	914.0	914.0	914.0	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	563	899	462	1925	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	563	899	462	1925	
Outputs (Volumes)					
Precipitation Surplus	211	854	439	1505	
Net Surplus	211	854	439	1505	
Evapotranspiration	352	45	23	420	
Infiltration	106	0	0	106	
Rooftop Infiltration	0	0	0	0	
Total Infiltration	106	0	0	106	
Runoff Pervious Areas	106	0	0	106	
Runoff Impervious Areas	0	854	439	1294	
Total Runoff	106	854	439	1399	
Total Outputs	563	899	462	1925	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

104 White Crescent, Barrie, Ontario
Post Development Water Balance (With Infiltration)

Catchment Designation	Site Grassed	Site Paved	Site Building (with Infiltration)	Site Total	
Area	616	984	506	2106	
Pervious Area	616	0	0	616	
Impervious Area	0	984	506	1490	
Infiltration Factors					
Topography Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0	0		
MOE Infiltration Factor	0.5	0	0		
Actual Infiltration Factor	0.5	0	0		
Run-Off Coeffiecient	0.5	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	914	914	914	914	(Precipitation values from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	914	914	914	914	
Outputs (per Unit Area)					
Precipitation Surplus	343.0	868.3	868.3	714.6	
Net Surplus	343.0	868.3	868.3	714.6	
Evapotranspiration	571.0	45.7	45.7	199.4	(Evapotranspiration values for pervious area from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed for impervious areas is the difference between the total precipitation and the net surplus)
Infiltration	171.5	0.0	0.0	50.2	
Rooftop Infiltration	0.0	0.0	**23.5**	5.6	Depth of rainfall over the rooftop required to be infiltrated to achieve water balance.
Total Infiltration	171.5	0.0	23.5	55.8	
Runoff Pervious Areas	171.5	0.0	0.0	50.2	
Runoff Impervious Areas	0.0	868.3	844.8	608.6	
Total Runoff	171.5	868.3	844.8	658.8	
Total Outputs	914.0	914.0	914.0	914.0	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	563	899	462	1925	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	563	899	462	1925	
Outputs (Volumes)					
Precipitation Surplus	211	854	439	1505	
Net Surplus	211	854	439	1505	
Evapotranspiration	352	45	23	420	
Infiltration	106	0	0	106	
Rooftop Infiltration	0	0	12	12	
Total Infiltration	106	0	12	118	
Runoff Pervious Areas	106	0	0	106	
Runoff Impervious Areas	0	854	427	1282	
Total Runoff	106	854	427	1387	
Total Outputs	563	899	462	1925	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

PEARSON ENGINEERING

104 White Crescent, Barrie, Ontario
Water Balance Calculations

Annual Rainfall Depth Req'd

Req'd Rainfall Depth	=	23.5	mm	(From Post-Development Water Balance (With Infiltration))

Find Percent of Annual Rainfall that Req'd Rainfall Depth represents

Annual Rainfall for Study Area	=	914.0	mm	(Precipitation values from Lake Simcoe Climate Data Values, Lovers Creek Subwatershed)
% Annual Rainfall	=	23.5	mm	
		914	mm	
	=	3%		

From MOE Figure C-2, 3% of annual rainfall occurs for storm events of 15 mm or less.

Find storage volume required for rainfall events of 15 mm to Rooftop Infiltration Gallery

Roof Top Area	=	280	m^2	
Rainfall Depth	=	15	mm	
Storage Volume Req'd	=	A	x	D
	=	280	x	15
	=	4	m^3	

Minimum Infiltration Volume as per City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines Section 4.1.3 is as follows:

Storage Volume Req'd	=	Site Area	x	5	mm
	=	2106	x	0.005	
	=	10.5	m^3		

Therefore,City of Barrie guidelines governs over water balance/infiltration requirements.

Roof Top Infiltration

Infiltrate the 50 mm Storm Event

Area of Rooftop to be infiltrated	=	226	m^2	(East Half of Roof)
Amount to be Infiltrated	=	50	mm	
	=			
Volume	=	Area x Depth		
	=	226	x	50
	=	11.3	m^3	
Volume Provided	=	11.8	m^3	

Therefore water balance for the site is achieved.

104 White Crescent, Barrie, Ontario
Rooftop Infiltration Calculations

Using the Governing 5 mm Storm Event over the Site Area as per Water Balance Calculations:

Site Area (A)	=	2,106	m^2	(from Water Balance Calculations)
Storm Event (D)	=	5	mm	(from Water Balance Calculations)
Volume (V)	=	A x D		
	=	10.5	m^3	

Calculate Design Infiltration Rate:

Infiltration Rate at the Bottom of the BMP	=	52	mm/hr	Note: Conservative Infiltration Rate Estimates an In-Situ Infiltration Rate of 20 mm/hr. To Be Confirmed Prior to Construction.
Infiltration Rate of Least Permeable Soil on Site	=	52	mm/hr	
Ratio of Mean Measured Infiltration Rates	=	$\frac{52}{52}$		
	=	1.0		

Therefore, based on the TRCA LID Guide, Appendix C, Table C2, the Infiltration Safety Correction Factor is:

Safety Correction Factor	=	2.5	
Design Infiltration Rate (i)	=	$\frac{52}{2.5}$	
	=	20.8	mm/hr

Calculate Required TRCA Maximum Allowable Infiltration Chamber Depth:

Design Infiltration Rate (i)	=	20.8	mm/hr	
Drawdown time (t_s)	=	48	hr	
Porosity (V_r)	=	0.4		(for Clear Stone)
Maximum Depth ($d_{r\ max}$)	=	$\frac{i \times t_s}{V_r}$		
	=	2,496	mm	
Depth Provided	=	1,060	mm	

Therefore, 4 StormTech infiltration chambers for the project will achieve infiltration targets and meet the requirements for a drawdown time of 48 hours.

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual


SC-740


MC-3500


MC-4500

THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

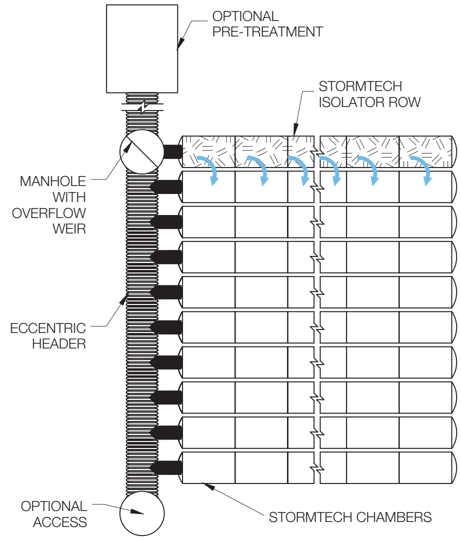
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

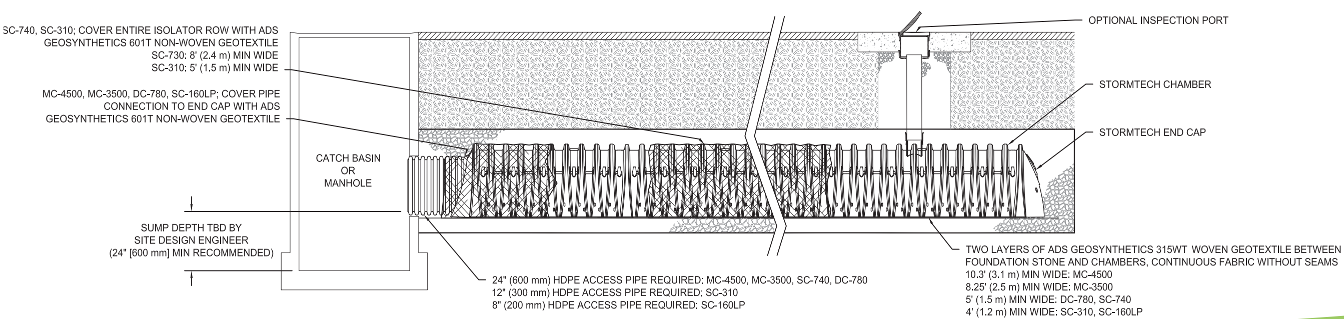
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ADS

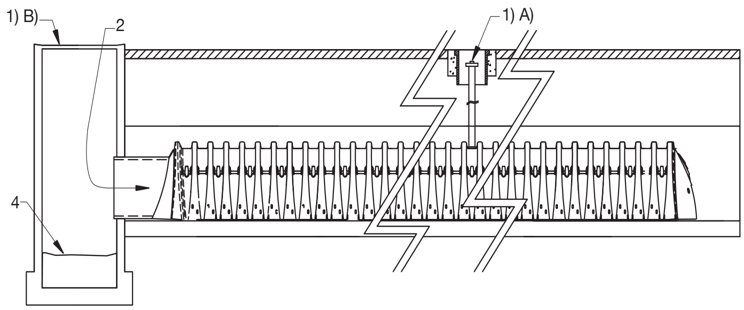
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
A) Inspection ports (if present)
  i. Remove lid from floor box frame
  ii. Remove cap from inspection riser
  iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
B) All Isolator Rows
  i. Remove cover from manhole at upstream end of Isolator Row
  ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings: Fixed point to chamber bottom (1)	Stadia Rod Readings: Fixed point to top of sediment (2)	Sediment Depth (1)–(2)	Observations/Actions	Inspector
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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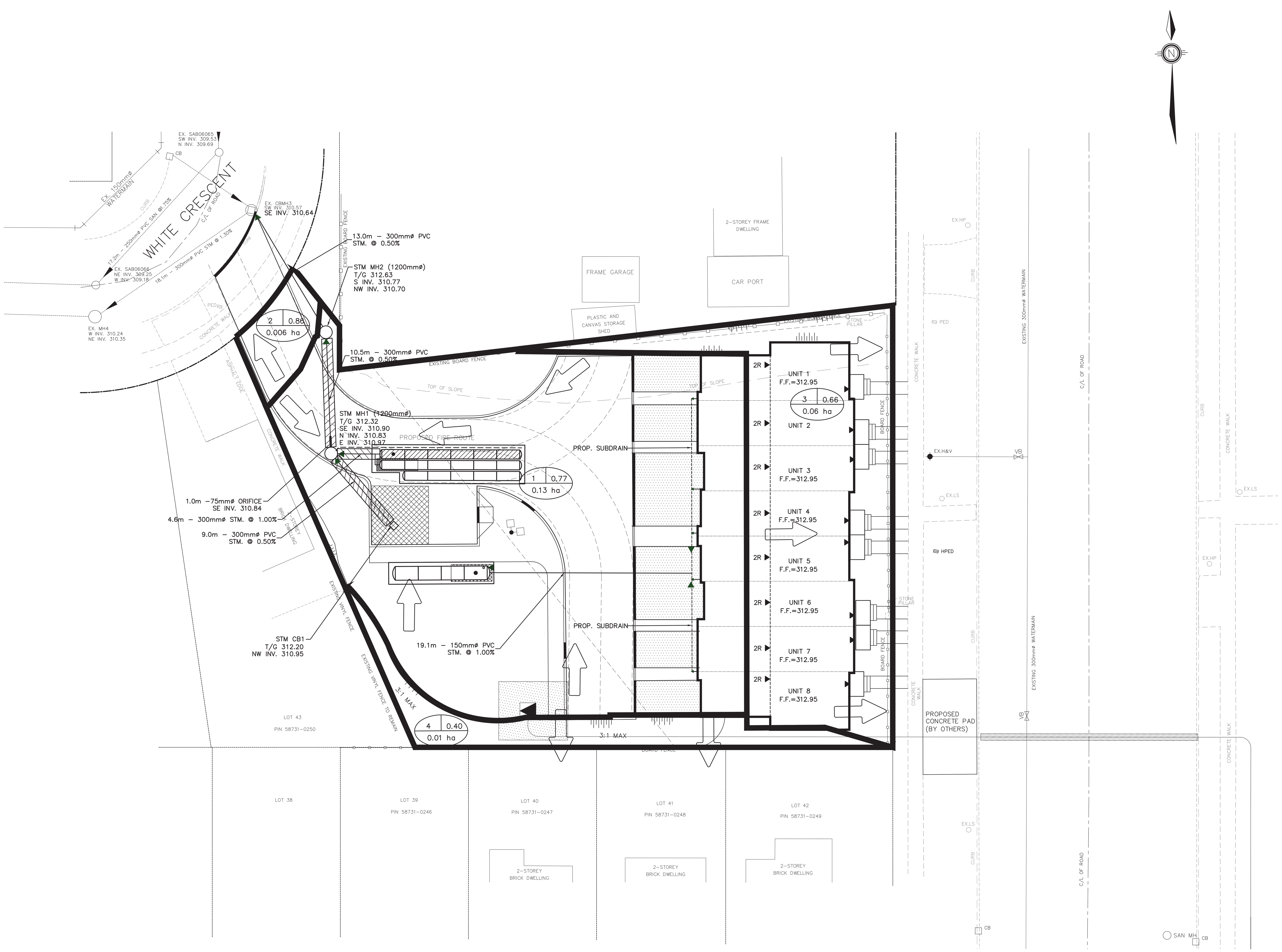
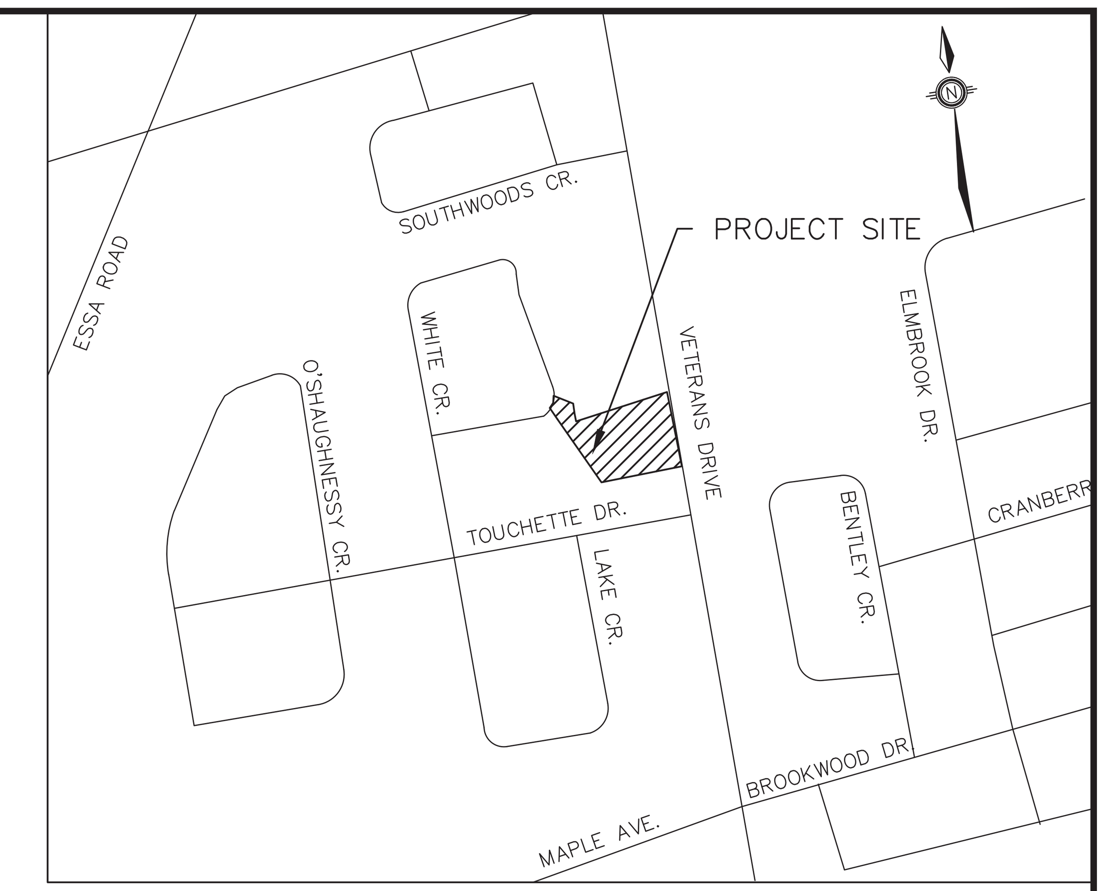
A division of ADS

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Appendix D

Engineering Drawings





KEY PLAN
NTS

LEGEND

- CB — CATCH BASIN
- CBMH — CATCH BASIN MANHOLE
- MH — STORM MANHOLE
- MH — SANITARY MANHOLE
- SERVICE CAP
- HYD. — FIRE HYDRANT
- VB — WATER VALVE
- CS — 25mm WATER SERVICE C/W CURB STOP
- 254.63 / 254.09 — PROPOSED ELEVATION / EXISTING ELEVATION
- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA 1 — 0.75 RUNOFF COEFFICIENT — 1.00 ha AREA IN HECTARES
- CATCHMENT BOUNDARY

NO.	REVISION NOTE	DATE	BY
4.	AS PER CITY COMMENTS	03/18/21	PG
3.	AS PER CITY COMMENTS	11/23/20	PG
2.	AS PER CITY COMMENTS	01/08/20	ZZ
1.	REVISED AS PER ZONING COMMENTS	04/03/19	ZZ

BENCHMARK:

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120030018 HAVING A PUBLISHED ELEVATION OF 306.589 METRES.

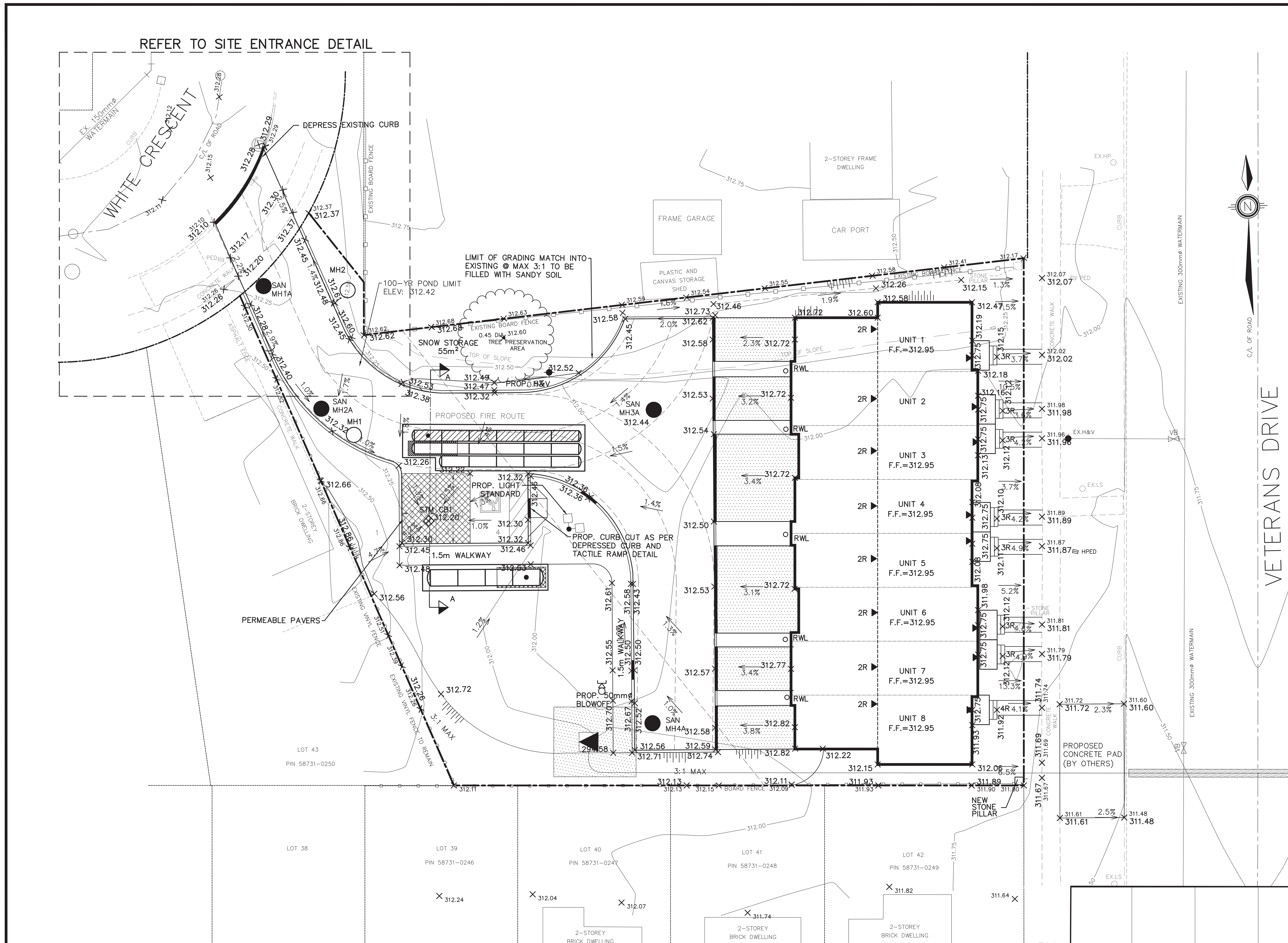
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
March 18, 2021
PROVINCE OF ONTARIO

104 WHITE CRESCENT
MICHLER HOLDINGS LTD.
BARRIE, ON

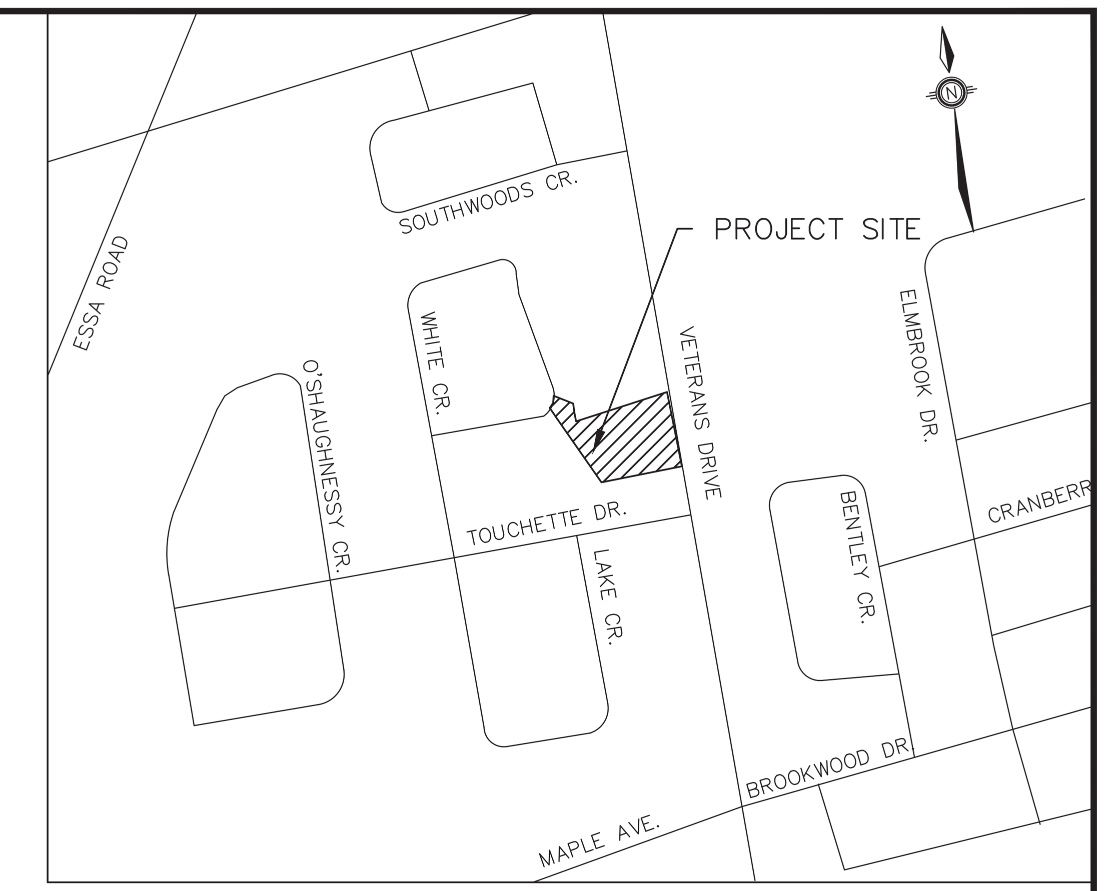
POST DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MW/MD	HORIZ SCALE	1:200	PROJECT #	18058
DRAWN BY	ZZ	VERT SCALE		DRAWING #	STM–1
CHECKED BY	GMP	DATE	DECEMBER 2018	REVISION #	4



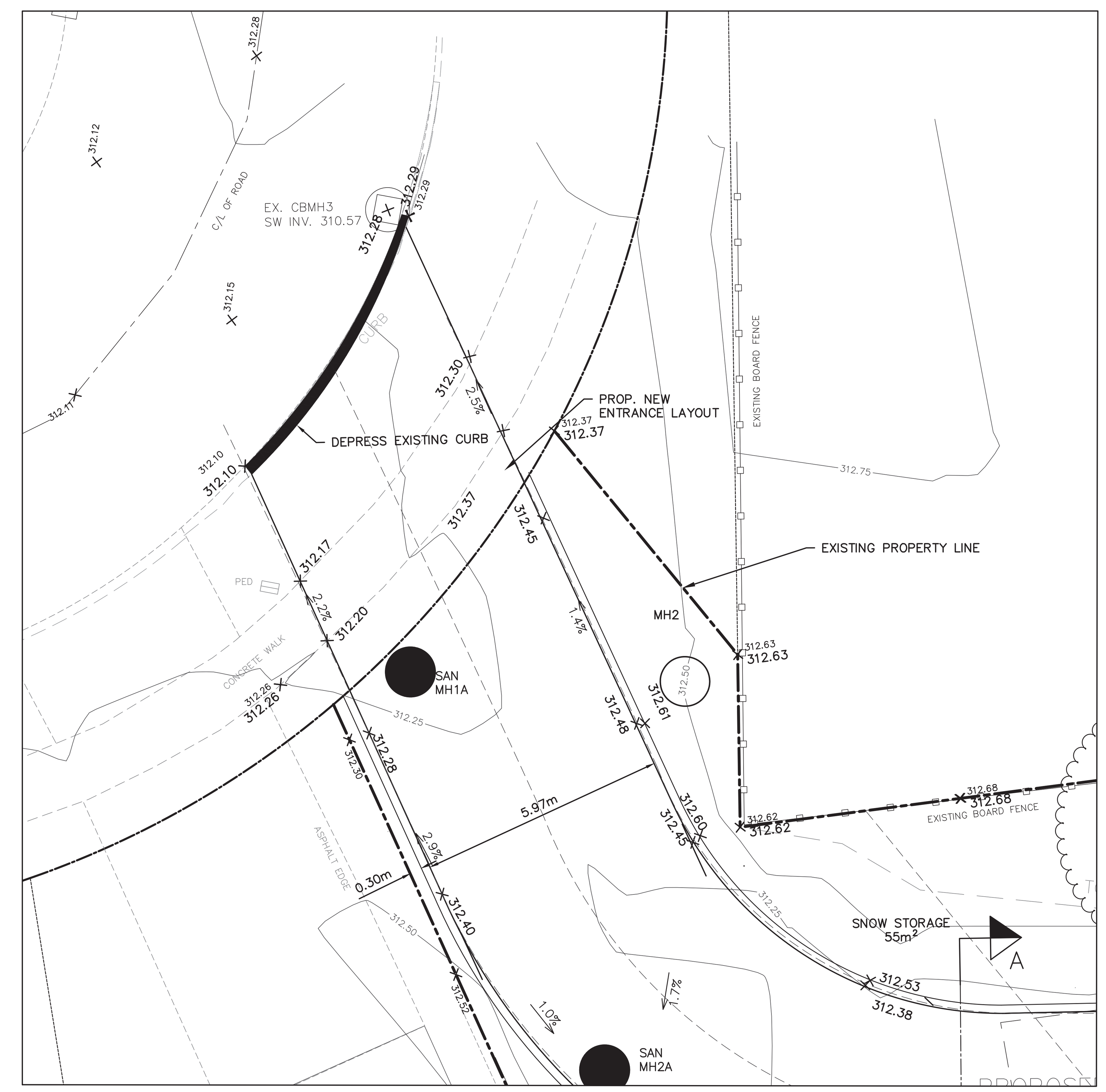
SITE GRADING PLAN
SCALE 1:200



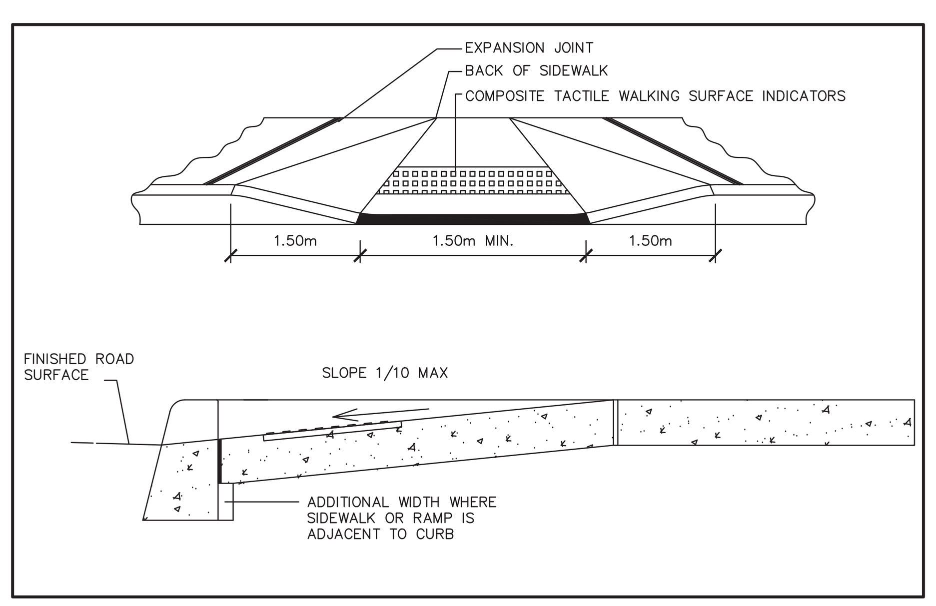
KEY PLAN
NTS

LEGEND

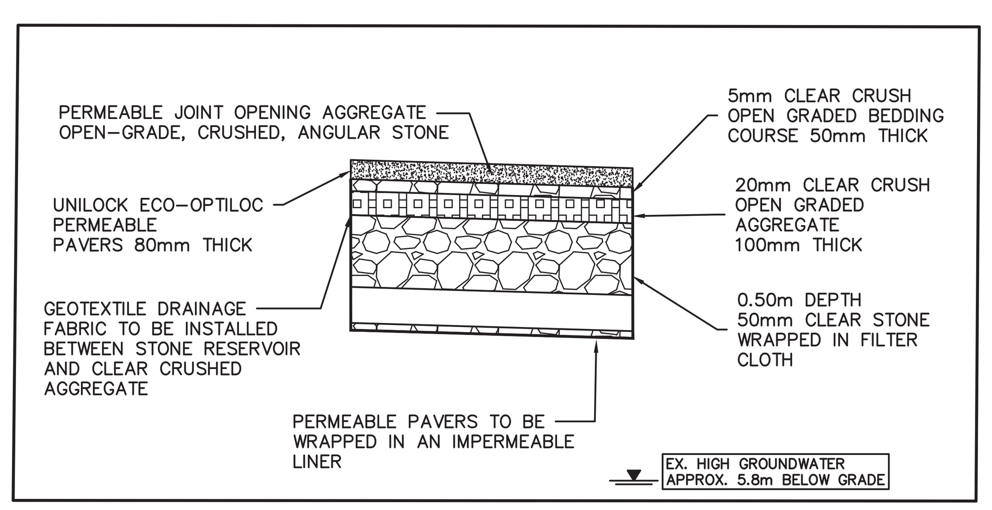
- CB — CATCH BASIN
- CBMH — CATCH BASIN MANHOLE
- MH — STORM MANHOLE
- MH — SANITARY MANHOLE
- SERVICE CAP
- HYD. — FIRE HYDRANT
- VB — WATER VALVE
- CS — 25mm WATER SERVICE C/W CURB STOP
- 254.63 / 254.09 — PROPOSED ELEVATION / EXISTING ELEVATION
- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- 100-YEAR PONDING LIMIT
- RWL — RAIN WATER LEADER



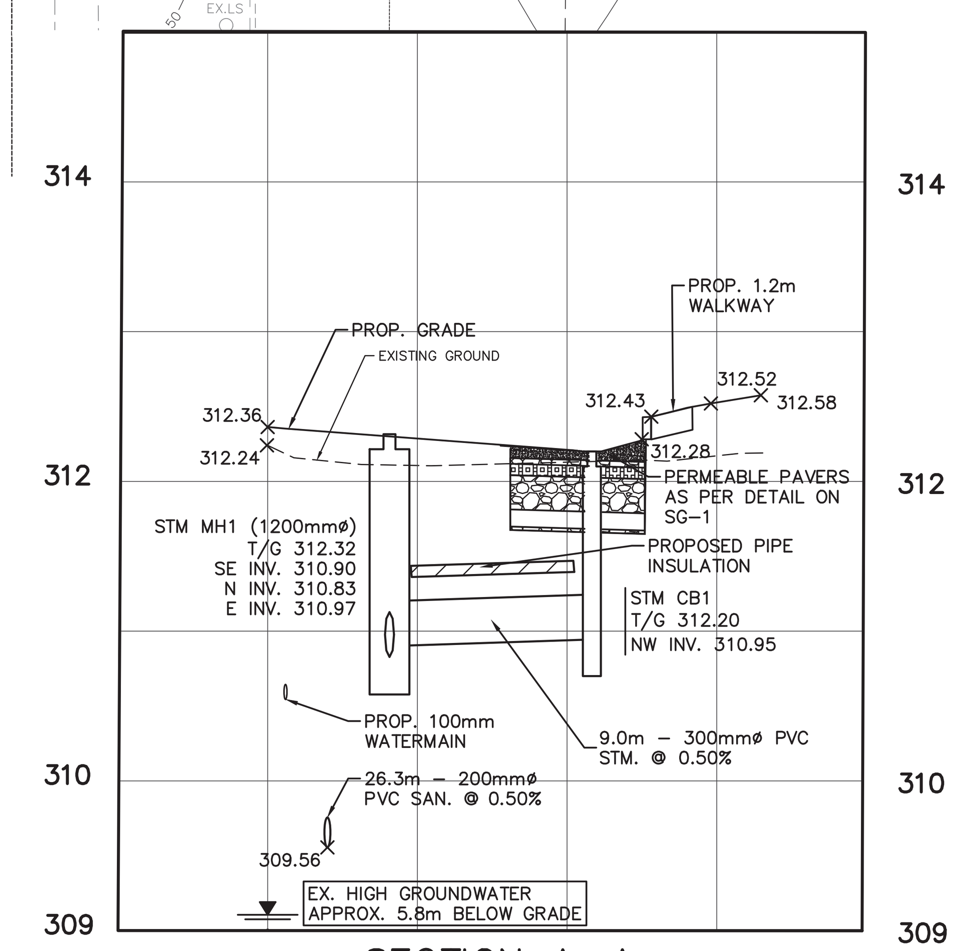
SITE ENTRANCE DETAIL
SCALE 1:100



DEPRESSED CURB & TACTILE RAMP DETAIL
N.T.S.



TYPICAL PERMEABLE PAVERS DETAIL
NTS



SECTION A–A
VERTICAL SCALE 1:200
HORIZONTAL SCALE: 1:50

NO.	REVISION NOTE	DATE	BY
4.	AS PER CITY COMMENTS	03/18/21	PG
3.	AS PER CITY COMMENTS	11/23/20	PG
2.	AS PER CITY COMMENTS	01/08/20	ZZ
1.	REVISED AS PER ZONING COMMENTS	04/03/19	ZZ

BENCHMARK:

ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE CITY OF BARRIE BENCH MARK No 03120030018 HAVING A PUBLISHED ELEVATION OF 306.589 METRES.

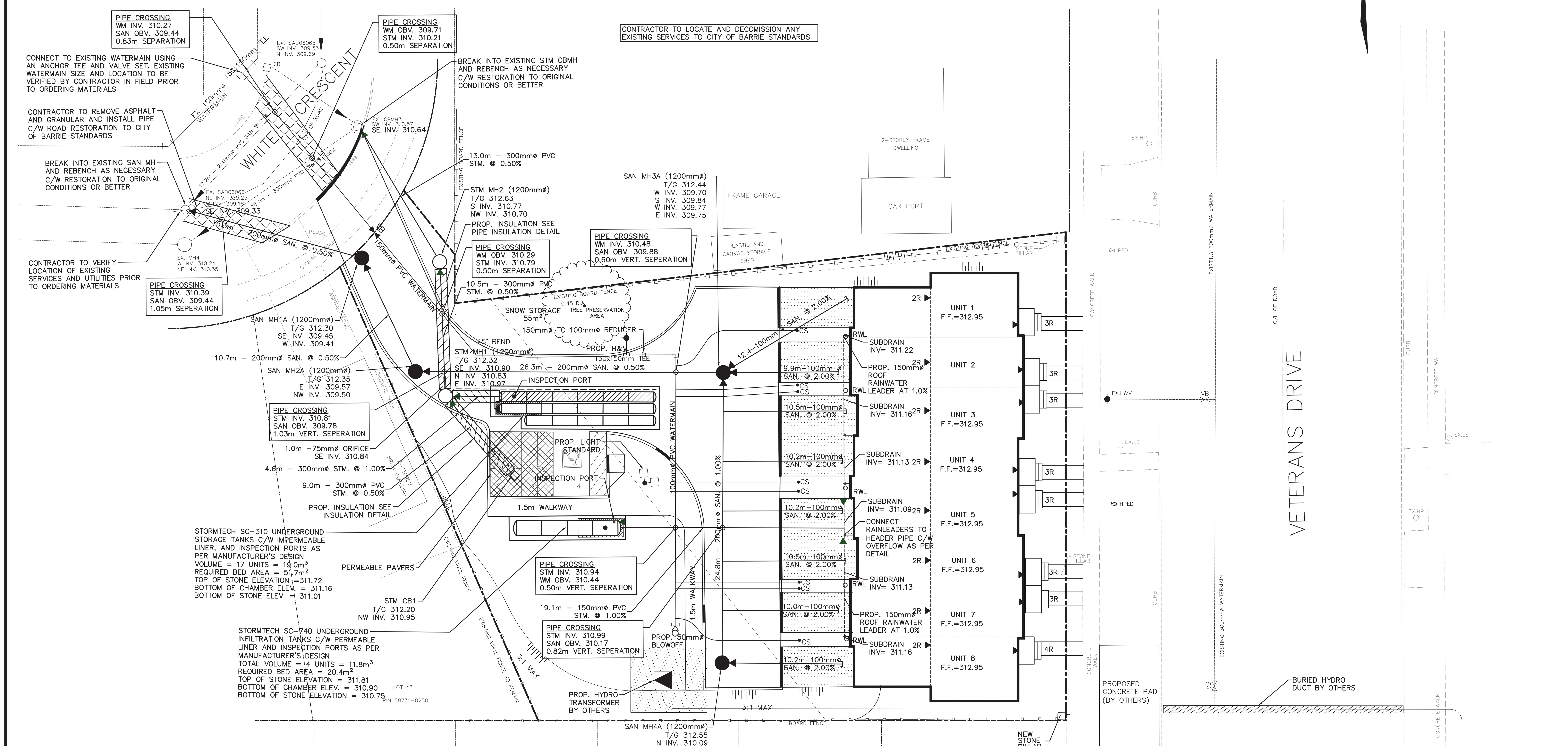
LICENSED PROFESSIONAL ENGINEER
M.W. DEJEAN
March 18, 2021
PROVINCE OF ONTARIO

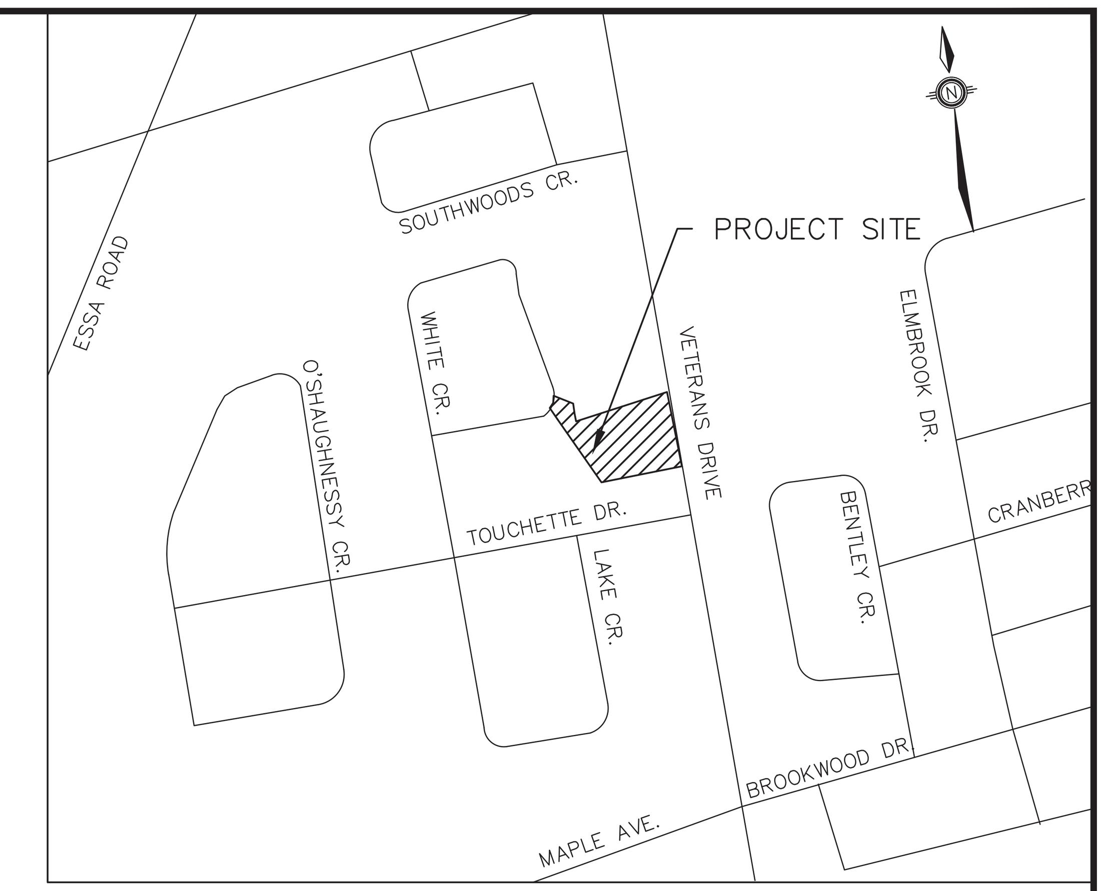
104 WHITE CRESCENT
MICHLER HOLDINGS LTD.
BARRIE, ON

SITE GRADING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY: MW/MD	HORIZ SCALE: AS SHOWN	PROJECT #: 18058	
DRAWN BY: ZZ	VERT SCALE	DRAWING #: SG-1	
CHECKED BY: GMP	DATE: DECEMBER 2018	REVISION #: 4	

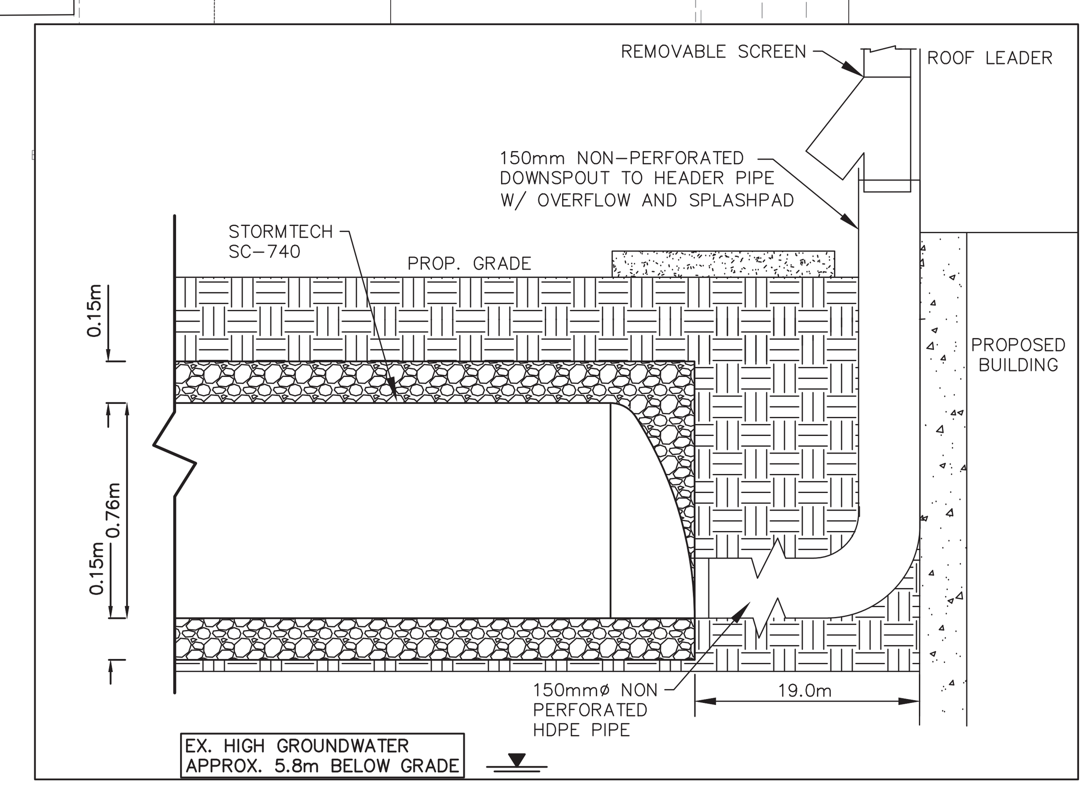




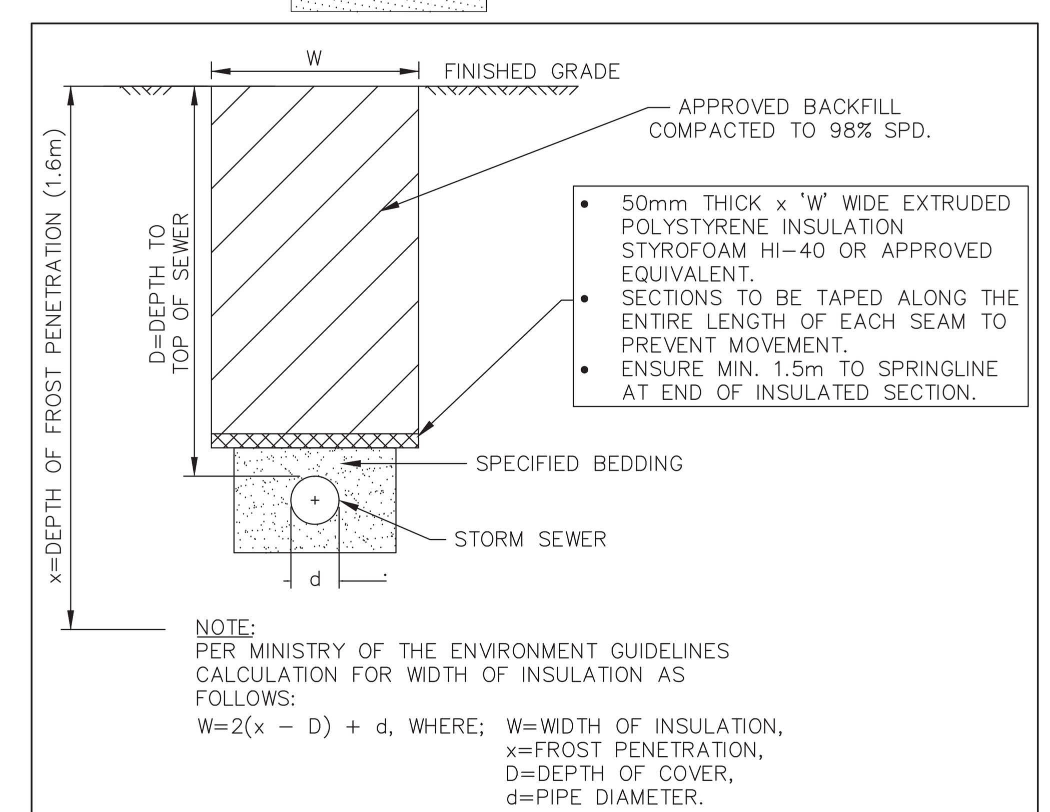
KEY PLAN
NTS

LEGEND

- CB – CATCH BASIN
- CBMH – CATCH BASIN MANHOLE
- MH – STORM MANHOLE
- MH – SANITARY MANHOLE
- SERVICE CAP
- HYD. – FIRE HYDRANT
- VB – WATER VALVE
- CS – 25mm WATER SERVICE C/W CURB STOP
- 254.63 / 254.09 – PROPOSED ELEVATION / EXISTING ELEVATION
- 1.5% – PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (HIGH POINT
- PROPOSED 50mmø BLOWOFF AS PER BSD-516
- RWLO – RAIN WATER LEADER
- PROPOSED PIPE INSULATION
- ROAD RESTORATION
- PROPOSED TRANSFORMER W/ GROUNDING GRID



RAIN WATER LEADER DETAIL
NTS



PIPE INSULATION DETAIL
(N.T.S.)

NO.	REVISION NOTE	DATE	BY
4.	AS PER CITY COMMENTS	03/18/21	PG
3.	AS PER CITY COMMENTS	11/23/20	PG
2.	AS PER CITY COMMENTS	01/08/20	ZZ
1.	REVISED AS PER ZONING COMMENTS	04/03/19	ZZ

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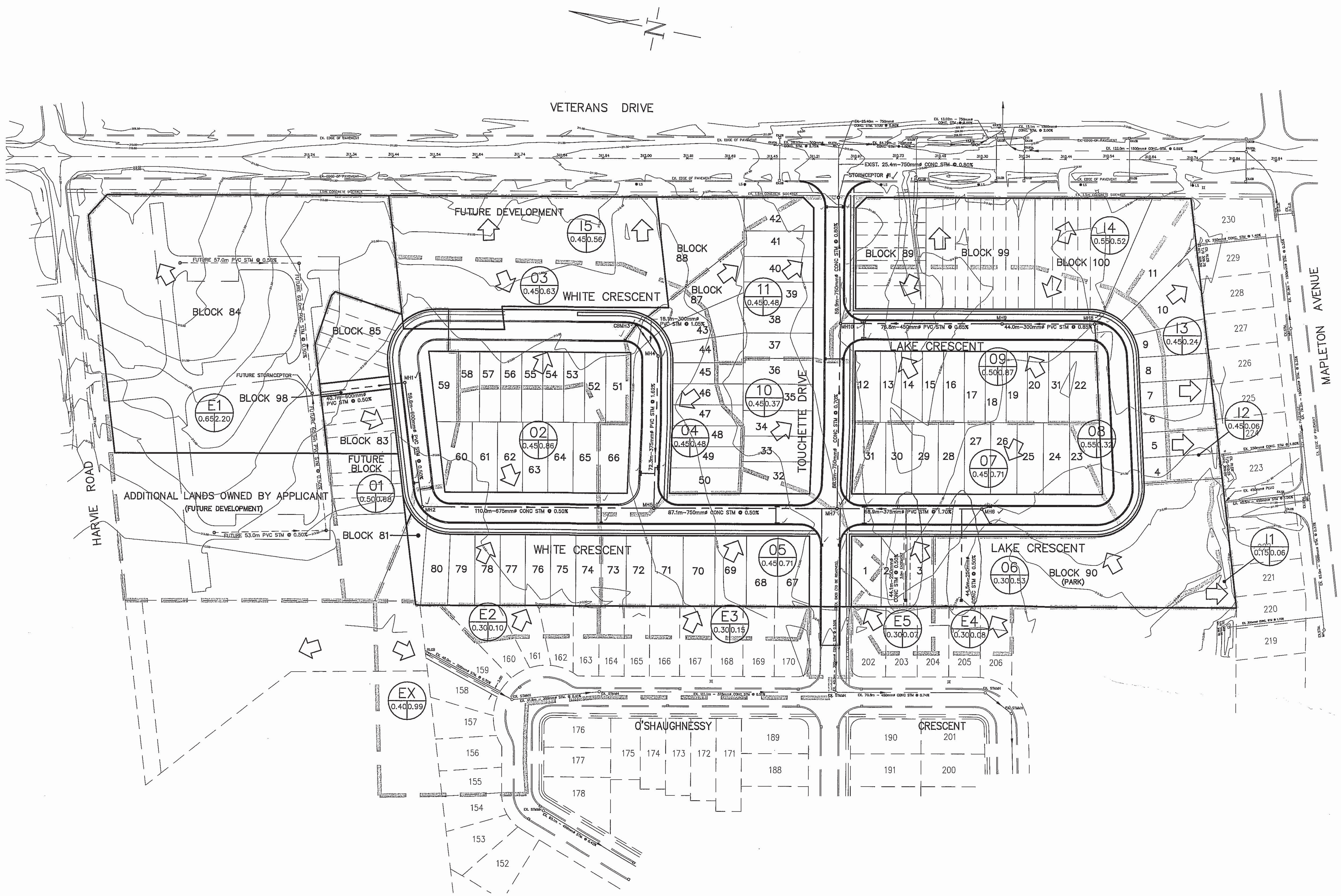
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
March 18, 2021
PROVINCE OF ONTARIO

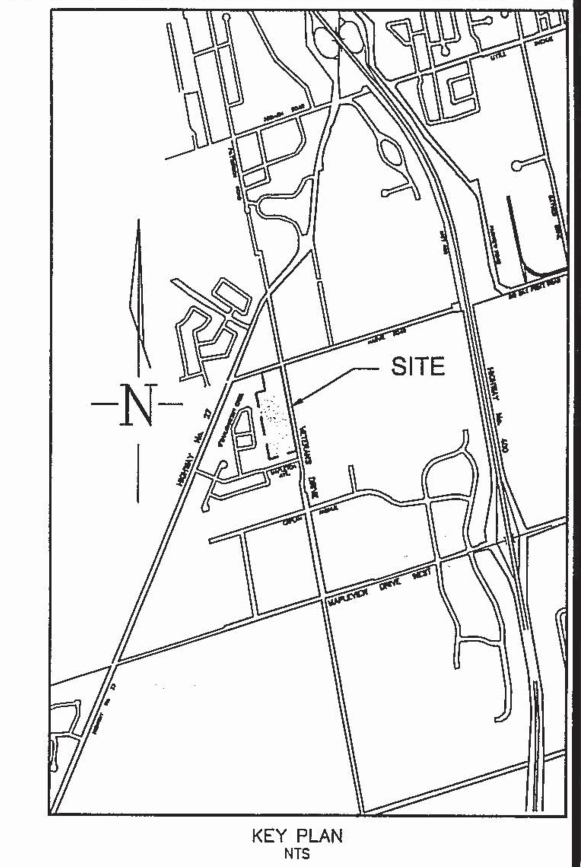
104 WHITE CRESCENT
MICHLER HOLDINGS LTD.
BARRIE, ON

SITE SERVICING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MW/MD	HORIZ SCALE	1:200	PROJECT #	18058
DRAWN BY	ZZ	VERT SCALE		DRAWING #	SS-1
CHECKED BY	GMP	DATE	DECEMBER 2018	REVISION #	4





LEGEND:

○	PROP. MANHOLE
□	PROP. CATCHBASIN
▭	PROP. DOUBLE CATCHBASIN
⊙	PROP. CATCHBASIN MANHOLE
68.6m–250ø PVC STM @ 1.00%	PROP. STORM SEWER
EX. 70.0m–250mmø STM	EXIST. STORM SEWER
→	DIRECTION OF FLOW
	CATCHMENT AREA BOUNDARY
⇨	OVERLAND FLOW DIRECTION
311.00	EXISTING ELEVATION CONTOUR

06 / 0.40 / 0.60 — STORM CATCHMENT AREA NUMBER; RUN-OFF CO-EFFICIENT; AREA (ha.)

FUTURE STORMCEPTOR (STC 750)
(BLOCK 84)

IMPERVIOUS DRAINAGE AREA	1.43 ha
REQUIRED TREATMENT	50% TSS REMOVAL
PROVIDED TREATMENT	60% TSS REMOVAL

ALL STORM SEWERS DOWN TO WHISKEY CREEK POND 1 TO RECEIVE LEVEL III (60% REMOVAL).

STORMCEPTOR #1 (STC 750)
(TOUCHETTE DRIVE @ VETERANS DRIVE)

IMPERVIOUS DRAINAGE AREA	3.06 ha
REQUIRED TREATMENT	50% TSS REMOVAL
PROVIDED TREATMENT	56% TSS REMOVAL

NOTE:

AREA E1 BASED ON PRELIMINARY DESIGN FOR BLOCK 84
& ADDITIONAL LANDS OWNED BY APPLICANT (FUTURE DEVELOPMENT)

AREA E2 – E5, AND EX1 BASED ON EMC DRAWING 89110–3A (COB #2000–56)

APPROVED FOR CONSTRUCTION
DATE OCT 2 0 2005

GENERAL NOTES

REFER TO CURRENT CITY OF BARRIE STANDARDS FOR APPLICABLE GENERAL NOTES.

BENCH MARKS

DISTANCE NOTE

DISTANCES SHOWN HEREON ARE GROUND DISTANCES AND CAN BE CONVERTED TO GRID DISTANCES BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.9996884

BEARING NOTE

BEARINGS HEREIN ARE GRID BEARINGS AND ARE DERIVED FROM CONTROL MONUMENTS 031820053 (N=4908053.302, E=603963.132) AND 03197001 (N=4909644.399, E=603654.554). AND ARE REFERRED TO THE CENTRAL MERIDIAN (81 DEGREES OF LONGITUDE) IN ZONE, 17 AND ARE BASED ON NAD27 (76 ADJUSTMENT).

BENCH MARK V010865451

300.306 – BRASS TABLET SET IN CONCRETE HEADWALL ON EAST SIDE OF REDFERN AVENUE, 0.15km NORTH OF DYER BLVD. TABLET IS SET HORIZONTALLY IN EAST FACE, 16.3m EAST OF CENTRELINE OF ROAD, 0.52m WEST OF THE SOUTH END, 0.42m BELOW THE TOP.

BENCH MARKS WILL BE FROM CITY OF BARRIE VERTICAL CONTROL NETWORK. INITIAL BENCH MARK TO BE OF 2nd ORDER ACCURACY

NO.	REVISIONS	DATE	APPROVED
1	MYLAR SUBMISSION	30AUG05	HGG

CITY OF BARRIE
APPROVED
DATE. . . . .
DIRECTOR OF ENGINEERING

LICENSED PROFESSIONAL ENGINEER
H.G. GEMMELL
100081079
Sept. 26/05
PROVINCE OF ONTARIO

RICHARDSON FOSTER LTD.
CONSULTING ENGINEERS
PHONE: (705) 728–0009 TOLL FREE (1–877) 220–2461 FAX: (705) 727–7774
4 CEDAR POINT DRIVE, UNIT L BARRIE, ONTARIO L4N 5B7

SUNFIELD HOMES LTD.

STORM DRAINAGE PLAN

CITY OF BARRIE INCORPORATED 1853

CITY of BARRIE
ENGINEERING DEPARTMENT

DS No.

SCALE HOR.	1:1000	VERT.		SHEET NO.	4
DESIGN	MO	DRAWN	MO/DS	DRAWING NO.	0464–ST
REVIEWED	HGG	DATE	2004.06.25		

P:\0464-E5 Sunfield Homes\dwg\0464-Base-MYLAR SUBMISSION.dwg, Storm, 9/26/2005 3:34:33 PM, don