Paramedic Response Station
53 Jacob Keffer Parkway, Concord, ON
FSR & Stormwater Management Report

Prepared for:

Thomas Brown Architects

Prepared by:

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File No. 2020-051

Date: March 16th, 2021

Issued by Addendum 4

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1. Purpose of Report

MGM Consulting Inc. has been retained by Thomas Brown Architects Inc. to prepare a Stormwater Management Report in support of a Site Plan Application for a proposed single-storey two (2) bay tandem Paramedic Response Station to be constructed on the Planning Block 17, located at 53 Jacob Keffer Parkway in Vaughan, Ontario. This report details the site-specific stormwater management, site-servicing, and grading requirements based on City of Vaughan and Region of York standards and requirements.

The legal description of the subject lands is Plan 65M-2795, Lot 4, City of Vaughan, Regional Municipality of York.

2. Existing Conditions

The overall subject land is approximately 0.13 ha of undeveloped land, situated in an existing ICI area as indicated in **Figure No. 1**. Of the 0.313 ha, 0.23 ha of the subject property is proposed for development. North of the development area, there are two existing buildings, a school and fast-food joint. To the south of the development area there are two industrial buildings. Domestic water supplies to surrounding existing buildings are provided with independent connections to existing municipal watermains on Jacob Keffer Parkway. Sanitary servicing for existing servicing outlets to the existing 200 mm sanitary sewer on Jacob Keffer Parkway, both with independent water supplies and metering.

The existing site generally drains overland from west to east, towards the existing adjacent watercourse, along the eastern property limit.

Existing ground elevations within the site range from 218.41 m in the northwest corner of the site down to 215.91 m at the southeast corner of the property. The existing conditions are seen in **Figure 2**.

3. Proposed Site Development

The proposed development includes for the construction of a single-storey building with a 500 m^2 footprint, located in the middle third of the site. The site will also contain 17 proposed parking spaces, 3 of them being for visitors including 1 with accessibility parking.

The proposed site development has been included in **Figure 3**.

4. Proposed Site Grading

The proposed site grading will consider the existing topography, perimeter elevations at the property line, the proposed vehicular access at the fire access route and eastern parking lot spaces, and as required to achieve the stormwater management objectives for the site. Grading is proposed as required to provide safe vehicular and pedestrian movements and access within the site and as required to convey storm flows to proposed drainage features (catchbasins and catchbasin manholes). Proposed slopes within paved areas of the site will typically range from 1.0% to 5.0% while slopes within the landscaped areas will be limited to a maximum of 3:1.

5. Stormwater Management

5.1 Stormwater Quantity Controls

The storm drainage for the subject land outlets to the municipal sewer located at the north-east corner of site which ultimately discharged in the adjacent wetland. The site's internal sewer network is proposed to be utilized to route drainage from the new development to the municipal sewers. Stormwater rate controls are to be provided with the installation of a 100mm orifice tube designed to control peaks flows to below existing rates. Required on-site storage is provided by two 150mm, one 200 mm, two 300mm, three 450 mm, and three 600mm diameter underground storm sewers located upstream of the orifice. These account for 33 m^3 of on-site storage. On-site storage is also provided by catch basin manhole structures, two 1200 mm, and one 1500 mm for a total of 13.9 m^3 of storage. The proposed on-site SWM system allows for the existing internal storm system to function consistent with the existing condition. The pipes are sized to contain both the 5-year and 100-year storm events with 6.8 m^3 of surface ponding contained in the parking lot east of the proposed building.

The stormwater management calculations have been included in **Appendix A**.

5.2 Stormwater Quality Controls

Current stormwater quality control objectives are to provide an "Enhanced" level of treatment which is equivalent to removing an estimated 80% of the total suspended solids from the site runoff. SWM quality control objectives are achieved with the installation of a jellyfish 4-1-1, installed at the downstream outlet of the internal storm system. The provided jellyfish unit is sized to provide 90% TSS removal for the site, in conjunction with two infiltration galleries.

The jellyfish sizing calculations have been included in **Appendix G**.

5.3 Water Balance and Low impact Development (LID)

LID measures can help improve sustainable development by improving water quality from discharged flows and better maintain the predevelopment site hydrology. For this site, a LID infiltration gallery is proposed to help restore the onsite water balance closer to pre-development levels. The infiltration galleries each have a volumetric size of 9.3 m^3 and 16.2m^3 respectfully to achieve 10mm of retention, weighted over the entire site. The infiltration gallery will be comprised of a trench lined with filter fabric and filled with 150 mm diameter clear stone to allow storm water to infiltrate into the native soil. A 0.3m deep sand layer, wrapped in geotextile, will underlay the clear stone. The gallery will receive clean runoff from the route to prevent groundwater contamination.

The Infiltration Gallery sizing calculations have been included in **Appendix F**.

5.3.1 Operations and Maintenance Manual – Infiltration Pit

Underground infiltration systems act as a filtration system that temporarily stores "clean" stormwater from roof drainage that promotes infiltration to recharge groundwater. Infiltration galleries require regular inspection to ensure they continue to function efficiently. Routine inspections are as frequent as bi-annually or twice a year, ideally in the spring and late fall. Inspections should include:

- Hydraulic Operations of the facility including observation of detention time and occurrence of overflows;
- Conditions in and around the facility;
- Checks for evidence obstructions at the inlet and outlet;

Filter bed should be routinely checked for sediment accumulation by the process of flushing from standpipe cleanout and hydro vacuuming from the inlet maintenance hole. The perforated pipe must be kept free of obstructions and routinely flushed with water to reduce the risk of clogging. Inlet maintenance hole that provides access to the subdrains to be routinely inspected for damage, obstruction, and sediment accumulation. Standpipe should be securely capped and undamaged to prevent sediment from entering. If the infiltration pit has the potential to be exposed to flows containing salt, particularly in the winter months, the inlet should be closed during these periods. If the infiltration pit has accompanying pre-treatment facilities, it is important that these facilities are properly maintained as per their respective Operations and Maintenance manuals to ensure their operation does not adversely impact the infiltration pit.

6. Proposed Storm Servicing

6.1 Minor Storm System

The minor storm system will consist of a series of storm structures and underground storm sewers which will collect runoff from the newly developed area and route them to the existing 1350 mm storm sewer located north-east of the proposed development. The minor system has been designed using the Rational Method, an initial time of concentration of 7 minutes and the City of Vaughan's IDF curve for a 5-year return period. **Figure 3** shows the existing drainage areas while **Figure 4** shows the proposed drainage areas, utilized to size the storm sewers.

A storm sewer design sheet has been included in **Appendix B**.

6.2 Major Storm System

In the event the major storm, or when an outlet is blocked, emergency overland flow from the site will be conveyed to the existing watercourse east of the site. All the overland flow is to be directed towards the wetland behind the property. Drainage of the property will ultimately discharge at the top of curb elevation of 217.50m which is 0.68m below finished floor elevation.

7. Proposed Sanitary Servicing

The sanitary service for the proposed development will require the construction of a 200mm diameter service, connecting to the existing maintenance hole (fronting the site), discharging the 200mm diameter sewer within Jacob Keffer Parkway right-of-way.

Sanitary flow projections and the sanitary sewer design are provided in **Appendix C.**

8. Proposed Domestic Water Supply and Fire Protection

To adequately supply the building with domestic and fire lines, a 50mm and a 150mm water service (to be confirmed by mechanical engineer) is proposed, connecting to the existing 300mm watermain on Jacob Keffer Parkway as indicated on the Servicing Plan **CV-3**. Furthermore, a valve chamber will be placed at the property line.

9. Erosion & Sediment Control During Construction

In 2006, The Greater Golden Horseshoe Area Conservation Authorities prepared a guideline entitled "Erosion & Sediment Control Guideline for Urban Construction". Based on the guideline, all projects involving the removal of topsoil or site alteration requires an ESC (Erosion and Sediment Control) Plan in place prior to commencing construction. Failure to adhere to the plan could lead to the potential for prosecution under the various pieces of environmental legislation.

The following principles assist in creating an effective ESC Plan. (Ref. Erosion and Sediment Control Guidelines for Urban Construction)

- Adopt a multi-barrier approach to provide erosion and sediment control through erosion controls first.
- Retain existing ground cover and stabilize exposed soils with vegetation where possible.
- Limit the duration of soil exposure and phase construction where possible.
- Limit the size of disturbed areas by minimizing nonessential clearing and grading.
- Minimize slope length and gradient of disturbed areas.
- Maintain overland sheet flow and avoid concentrated flows.
- Store/stockpile soil away (e.g., greater than 15 meters) from watercourses, drainage features and top of steep slopes.
- Ensure contractors and all involved in the ESC practices are trained in ESC Plan, implementation, inspections, maintenance, and repairs.
- Adjust ESC Plan at construction site to adapt to site features.
- Assess all ESC practices before and after all rainfall and significant snowmelt events.

The guideline stresses that prevention of erosion is the preferred mitigation measure for reducing the potential for sedimentation.

Erosion and sediment control measures can be categorized as Erosion prevention controls and Sediment controls.

Erosion controls include minimizing the reduction in vegetative ground cover or immediate stabilization of disturbed areas by top soiling, seeding, sodding, mulching, erosion control blankets, etc.

Sediment Controls are further broken down into Perimeter Controls, Settling Controls and Filtration Controls. Some major perimeter controls include silt fences, cut-off swales and mud-mats. Settling controls reduce run-off velocity allowing the soil particles to settle out. Settling controls include sediment traps, rock check dams, straw bales, and sediment control ponds. Filtration controls are achieved by filtering silt laden water using a filer media such as a geotextile or sand. Filtration controls include storm inlet filter cloths, sediment bags and filter rings.

10. Conclusions and Recommendations

Based on our analysis provided in this report, the site development can be adequately serviced with storm, sanitary and water servicing and can be designed to meet the City of Vaughan, the Region of York and Toronto Region Conservation Authority's stormwater management objectives.

Prepared by:
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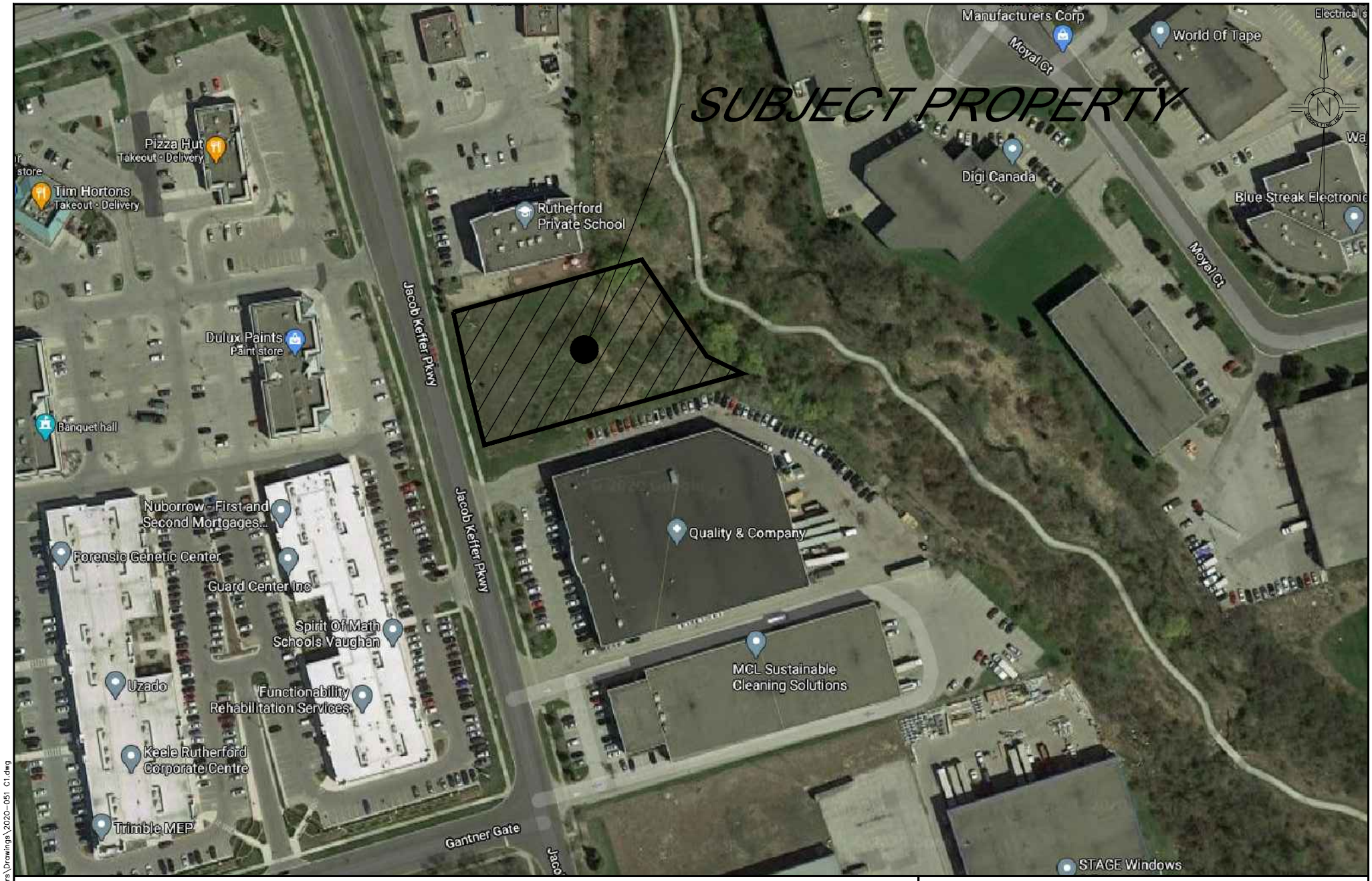
Blake Zielke

M.L.Stairs, P. Eng

FIGURES



53 JACOB KEFFER PARKWAY, CONCORD, ONTARIO
PARAMEDIC STATION

SITE LOCATION

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FIGURE # 1

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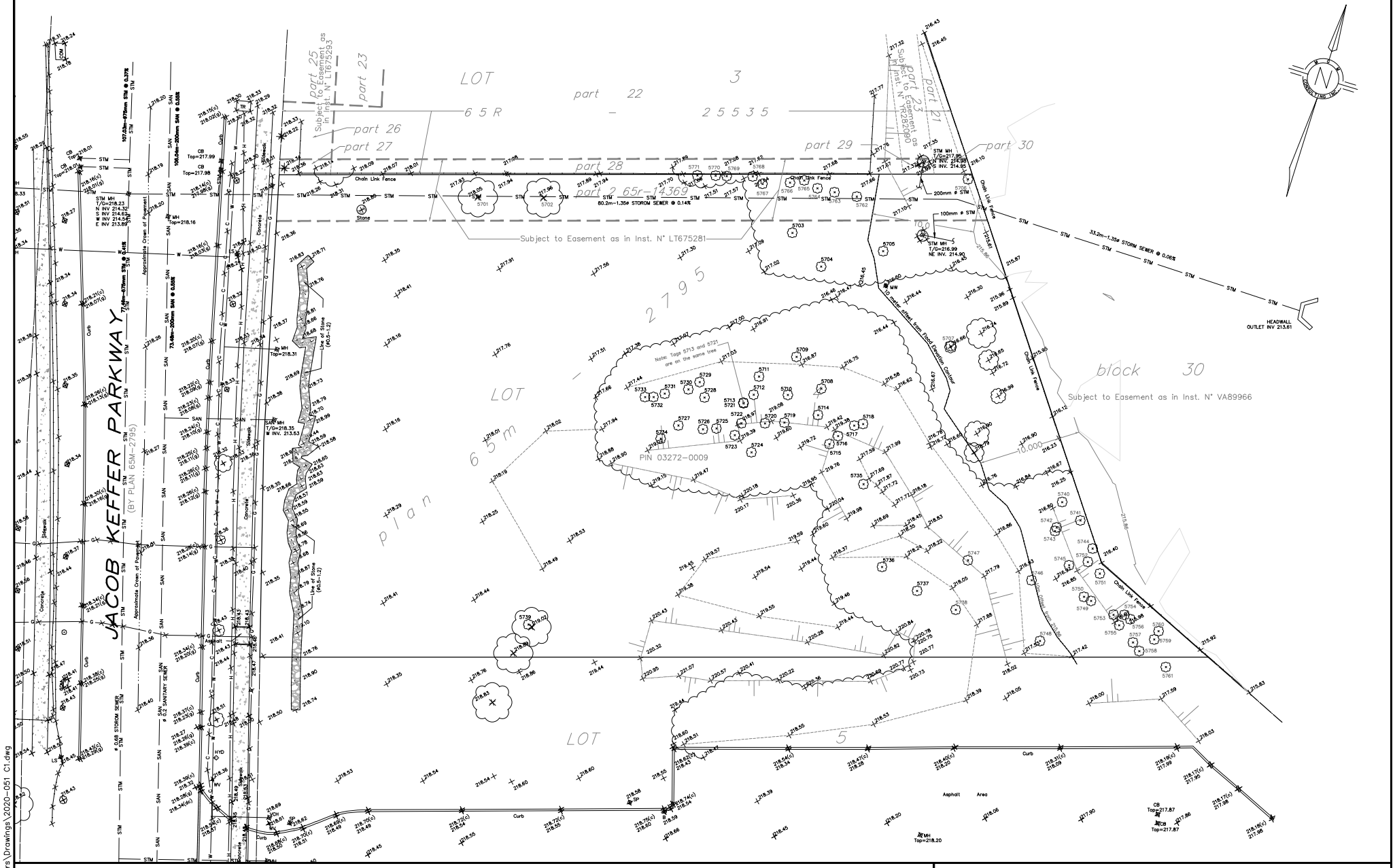

53 JACOB KEFFER PARKWAY, CONCORD, ONTARIO
PARAMEDIC STATION

EXISTING SITE CONDITIONS & TOPOGRAPHY

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FIGURE # 2

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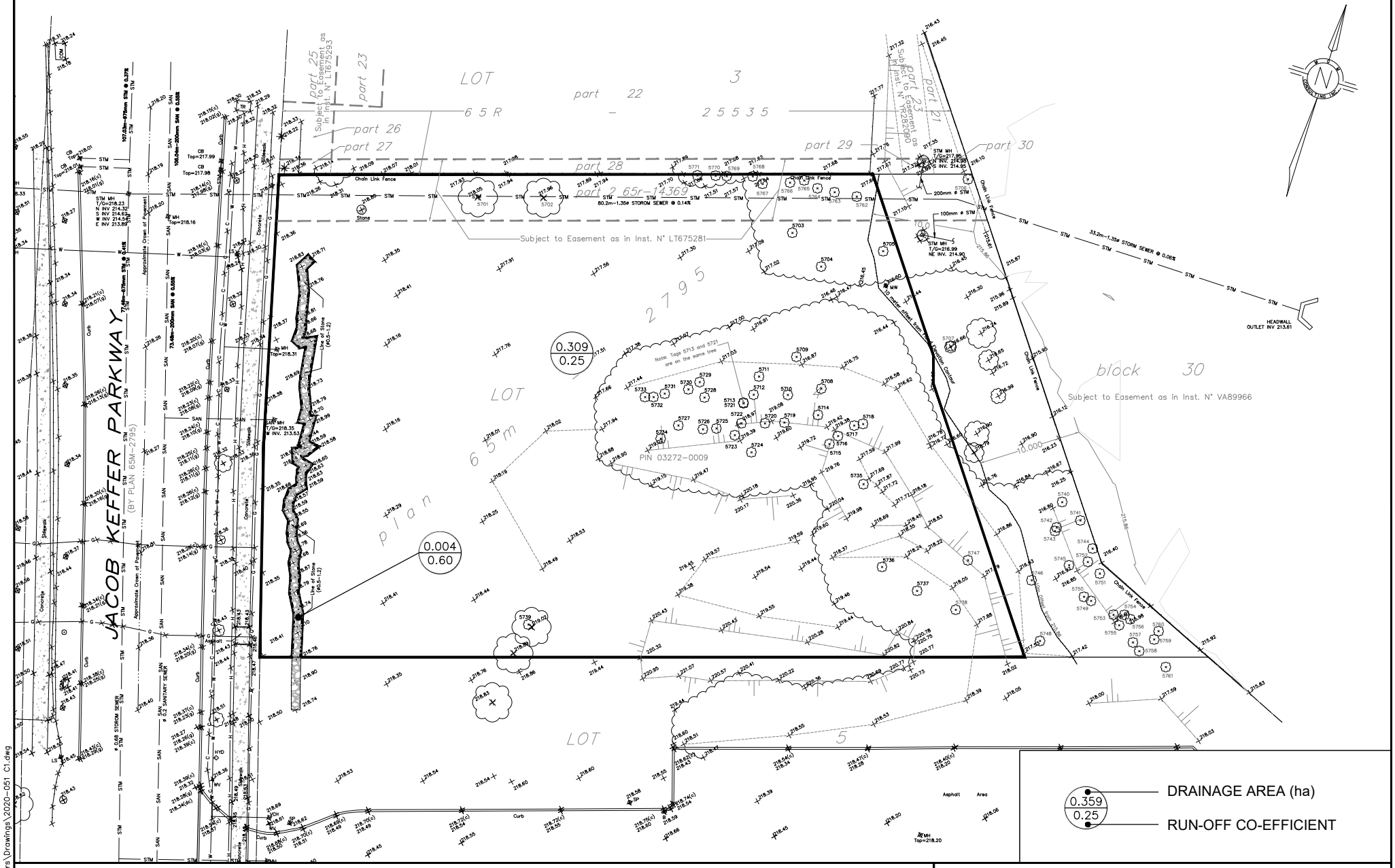

53 JACOB KEFFER PARKWAY, CONCORD, ONTARIO
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EXISTING DRAINAGE

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FIGURE # 3

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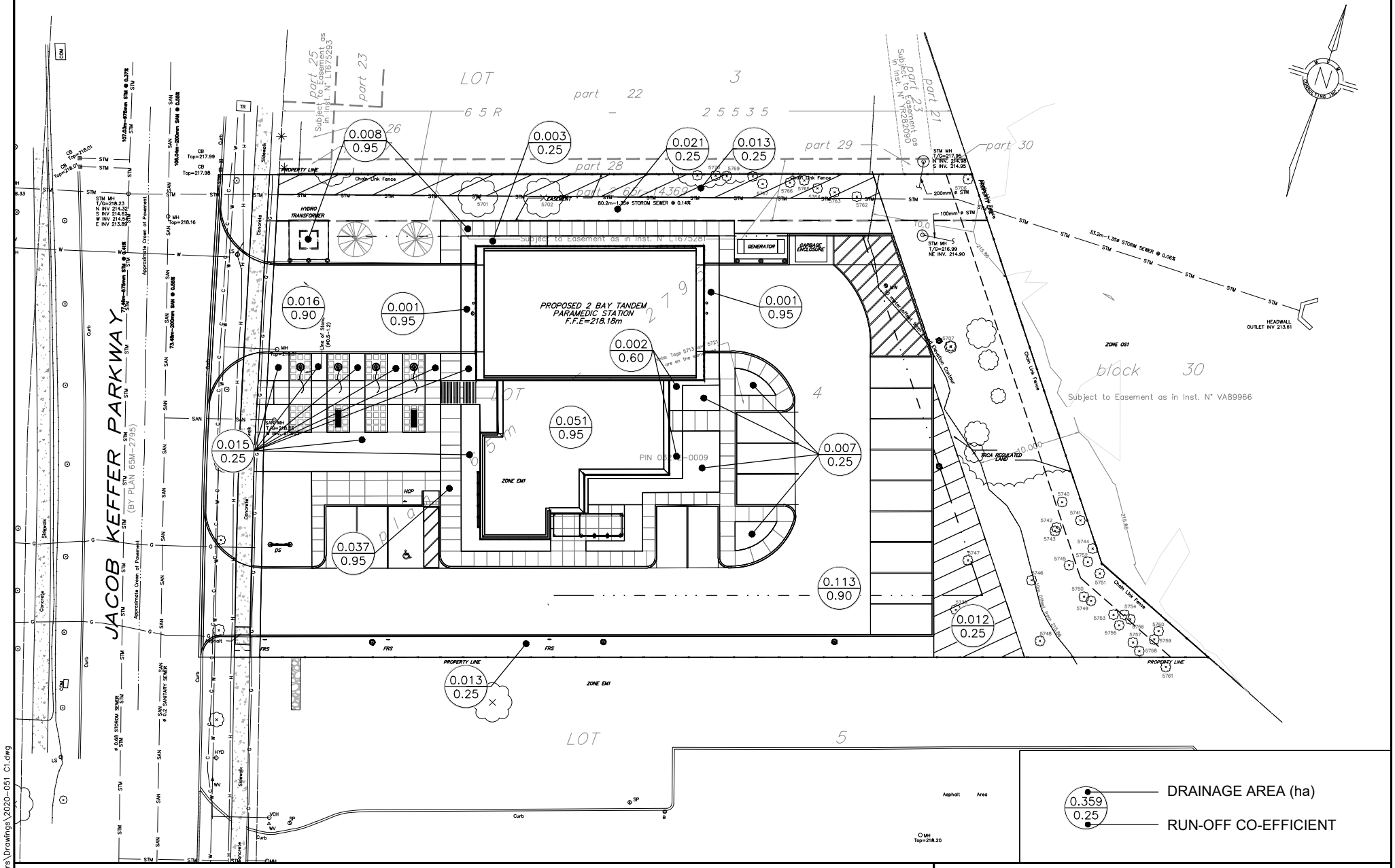

53 JACOB KEFFER PARKWAY, CONCORD, ONTARIO
PARAMEDIC STATION

PROPOSED DRAINAGE

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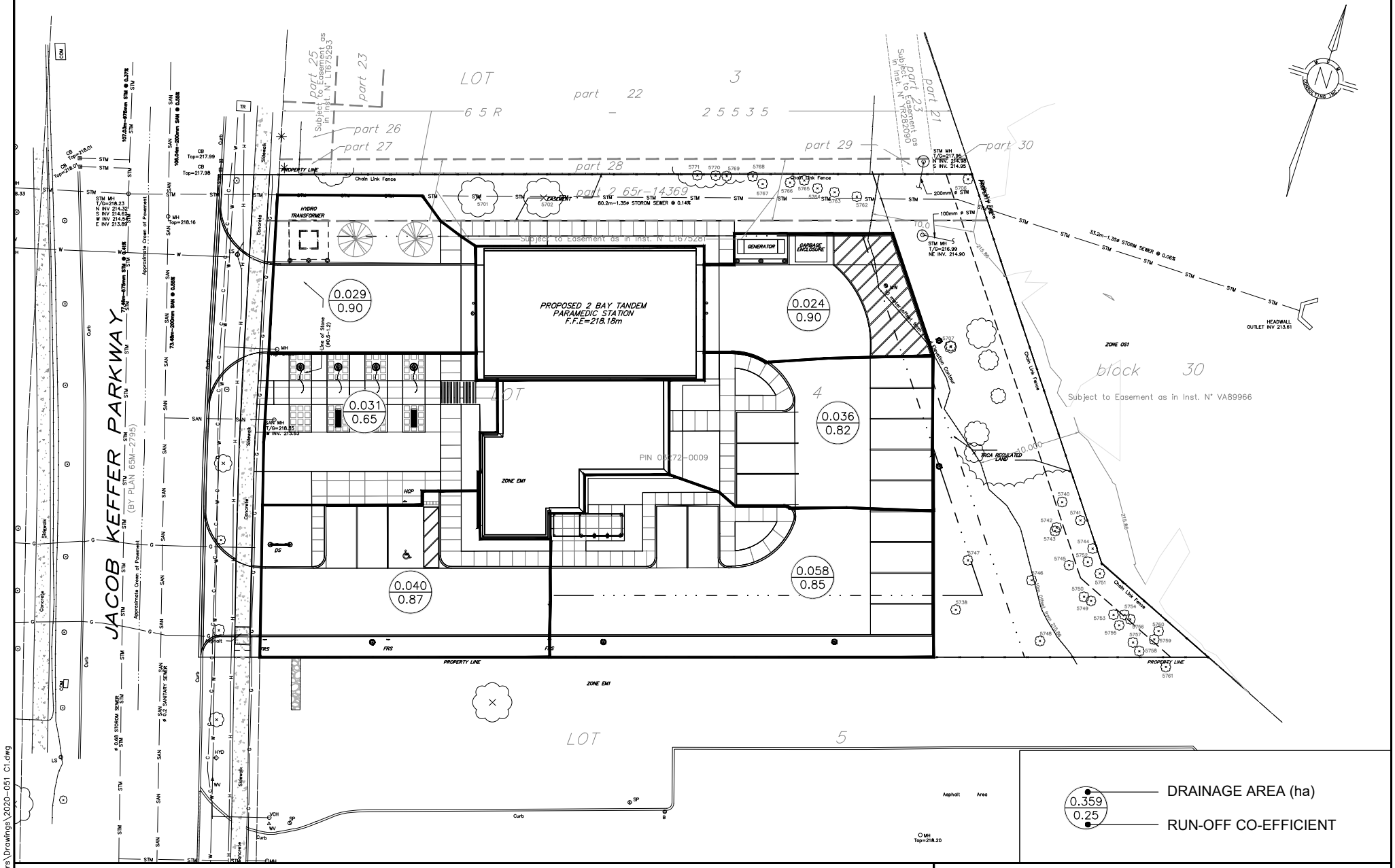

53 JACOB KEFFER PARKWAY, CONCORD, ONTARIO
PARAMEDIC STATION

POST DEVELOPMENT DRAINAGE AREAS
SEWER DESIGN

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FIGURE # 5

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APPENDIX A

STORMWATER MANAGEMENT CALCULATIONS

STORMWATER MANAGEMENT CALCULATIONS

53 Jacob Keffer Parkway, Concord, Ontario

1.0 Drainage Characteristics

1.1 Existing Drainage Areas: (See Figure 2)

		"c"	Area [ha]
Attenuated Areas:			
	Roof	0.95	0.000
	Concrete	0.95	0.000
	Asphalt	0.90	0.000
	Gravel	0.60	0.004
	Landscaped Area	0.25	0.309
Weighted C / Total		**0.25**	**0.313**

		"c"	Area [ha]
Unattenuated Areas:			
	Roof	0.95	0.000
	Concrete	0.95	0.000
	Asphalt	0.90	0.000
	Landscaped Area	0.25	0.000
Weighted C / Total		**0.00**	**0.000**
Total Area			**0.313**
Runoff Coefficient (Entire Site)			**0.25**

1.2 Proposed Drainage Areas: (See Figure 3)

		"c"	Area [ha]
Attenuated Areas:			
	Asphalt	0.90	0.129
	Landscaped Area	0.25	0.059
	Gravel	0.60	0.002
	Roof	0.95	0.051
	Concrete	0.95	0.047
Weighted C / Total		**0.78**	**0.288**

		"c"	Area [ha]
Unattenuated Areas:			
	Asphalt	0.90	0.000
	Landscaped Area	0.25	0.025
	Roof	0.95	0.000
	Concrete	0.95	0.000
Weighted C / Total		**0.25**	**0.025**
Total Area			**0.313**
Runoff Coefficient (Entire site)			**0.74**
Imperviousness			**73.2%**

2.0 Allowable Post Development Flows

2.1 Allowable Flows from Area to be Redeveloped

Post development flows from the redevelopment area for the 5 and 100 year storm event are to be controlled to the pre-development flow rate for designed drainage area

Storm (years)	Tc (min)	a	b	c	I (mm/hr)	A (ha)	Q (allow.) (cms)
2	7	647.7	4	-0.784	98.84	0.313	0.021
5	**7**	**929.6**	**4**	**-0.798**	**137.17**	**0.313**	**0.029**
10	7	1021	3	-0.787	166.73	0.313	0.036
25	7	1100	2	-0.776	199.94	0.313	0.043
50	7	1488	3	-0.803	234.21	0.313	0.050
100	**7**	**1770**	**4**	**-0.820**	**247.76**	**0.313**	**0.053**

3.0 Rooftop Controlled Flow and Storage Calculations

Flow from roof area is to be controlled with the installation of Zurn " Control-Flo" roof drains.

Total Roof Area =	0.051	ha
Total No. of Hoppers=	4	
1 weir per Hopper		
Weir Rating=	0.15	l/sec/cm
Max ponding depth =	150	mm.
Peak Flow from roof =	0.0090	m^3/sec
Storage provided =	25.5	m^3

4.0 Storage Calculations

4.1 Five Year Site Storage

Rainfall Duration min.	s	5 Year Rainfall Intensity (I) mm/h	Controlled Roof Flow cms	Attenuated Flow From External cms	Attenuated Flow cms	Total Attenuated Flow cms	Unattenuated Flow cms	Controlled Flow cms	Aprox. Detention Volumes cu.m.
7	420	137.2	0.0000	0.0000	0.0853	0.0853	0.0024	0.0240	25.7
10	600	113.2	0.0000	0.0000	0.0704	0.0704	0.0020	0.0240	27.8
20	1200	73.6	0.0000	0.0000	0.0458	0.0458	0.0013	0.0240	26.1
30	1800	55.7	0.0000	0.0000	0.0347	0.0347	0.0010	0.0240	19.1
40	2400	45.4	0.0000	0.0000	0.0282	0.0282	0.0008	0.0240	10.1
50	3000	38.5	0.0000	0.0000	0.0240	0.0240	0.0007	0.0240	-0.2
60	3600	33.6	0.0000	0.0000	0.0209	0.0209	0.0006	0.0240	-11.2
70	4200	30.0	0.0000	0.0000	0.0186	0.0186	0.0005	0.0240	-22.7
80	4800	27.1	0.0000	0.0000	0.0168	0.0168	0.0005	0.0240	-34.5

4.1 One Hundred Year Site Storage

Rainfall Duration min.	s	5 Year Rainfall Intensity (I) mm/h	Controlled Roof Flow cms	Attenuated Flow From External cms	Attenuated Flow cms	Total Attenuated Flow cms	Unattenuated Flow cms	Controlled Flow cms	Aprox. Detention Volumes cu.m.
7	420	247.8	0.0000	0.0000	0.1541	0.1541	0.0043	0.0416	47.2
10	600	203.3	0.0000	0.0000	0.1265	0.1265	0.0035	0.0416	50.9
20	1200	130.7	0.0000	0.0000	0.0813	0.0813	0.0023	0.0416	47.6
30	1800	98.2	0.0000	0.0000	0.0611	0.0611	0.0017	0.0416	35.0
40	2400	79.5	0.0000	0.0000	0.0495	0.0495	0.0014	0.0416	18.8
50	3000	67.2	0.0000	0.0000	0.0418	0.0418	0.0012	0.0416	0.5
60	3600	58.5	0.0000	0.0000	0.0364	0.0364	0.0010	0.0416	-18.9
70	4200	51.9	0.0000	0.0000	0.0323	0.0323	0.0009	0.0416	-39.2
80	4800	46.8	0.0000	0.0000	0.0291	0.0291	0.0008	0.0416	-60.2

5.0 Controlled Flow Calculations

Flows from the proposed storm system are to be controlled with the installation of an orifice over the outlet at manhole 1 as indicated on the site servicing plan.

5 year ponding elevation =	216.00	m.
100 year ponding elevation =	217.42	m.

Orifice equation: Q = CA(2hg)^0.5, where,

orifice invert elev. =	215.24	m.
c =	0.82	
g =	9.81	cu.m./sec
Orifice Diameter =	100	mm.
A =	0.0079	sq.m.
centreline orifice =	215.29	m.

	h (m)	Q (cms)	Attenuated Flow + Unattenuated Flow = Total Site Flow (cms)
5 year storm =	0.71	0.0240	0.0264
100 year storm =	2.13	0.0416	0.0459

6.0 On-Site Storage Provided

Pipe Storage

The detention volume available within the storm sewer pipes are as follows:

From	To	Size	Length	Vol. (cu.m.)
TRENCH DRAIN	CBMH 1	150	9.7	0.2
CBMH 1	CBMH 2	450	16.3	2.6
CBMH 2	CBMH 3	600	41.9	11.8
CBMH3	HEADER PIPE	600	1.9	0.5
HEADER PIPE	STORAGE PIPE	600	41.9	11.8
CBMH 3	CBMH 4	450	13.8	2.2
BLDG	MH 3	300	13.8	1.0
MH 3	CBMH 4	375	7.2	0.8
CBMH 4	STM MH 2	450	15.3	2.4
Total Pipe Storage				33

From	Size (mm)	Area m^2	Depth (m)	Volume (m^3)
CBMH1	1200mm	1.13	1.4	1.582
CBMH2	1200mm	1.13	1.79	2.0227
CBMH3	1500mm	1.77	1.83	3.2391
CBMH4	1200mm	1.13	1.89	2.1357
STM MH2	1200mm	1.13	2.24	2.5312
STM MH3	1200mm	1.13	2.08	2.3504
Total Structure Storage				13.86

7. Surface Ponding

CBMH4	4.2
CBMH3	2.6
Total Surface Ponding	6.8

	Allowable Pre-development Flow rate (cu.m/s)	Total Post-development Flow Rate (cu.m/s)	Storage Required (cu.m)	Storage Provided (cu.m)
5 Year	0.0294	0.0264	27.8	43.3
100 Year	0.0532	0.0459	50.9	54.1

APPENDIX B

STORM SEWER CALCULATIONS

MGM CONSULTING INC.
5-YEAR STORM SEWER DESIGN

Project No.: 2020-051
Subdivision:
Date: 01-Mar-21 Revised: 05-Mar-21
Des. By: MR Chk. By: BZ

Location				Areas		A * C			Rainfall			Sewer Design						Surcharge
Manhole from	Invert m.	Manhole to	Invert m.	Area ha	Cumulative Area ha	Coefficent C	Incremental A * C	Cumulative A * C	Time min	Intensity 5-year mm/hr.	Q Total cms	Equiv. Circ. Pipe Diameter mm.	Slope %	Max. Flow Q cap cms	Max Velocity V max m./sec.	Length m.	Time in Section min.	Actual Flow to Max. Allowable Flow Ratio %
DRAIN		CBMH1		0.029	0.029	0.71	0.020	0.020	7.0	137.2	0.008	150	2.00	0.022	1.22	9.7	0.13	36%
CBMH1		CBMH2		0.031	0.060	0.65	0.020	0.041	7.1	135.9	0.015	450	2.00	0.404	2.54	16.3	0.11	4%
CBMH2		CBMH3		0.040	0.100	0.79	0.032	0.072	7.2	134.8	0.027	600	0.90	0.583	2.06	41.9	0.34	5%
CBMH3		CBMH4		0.058	0.158	0.77	0.045	0.117	7.6	131.7	0.043	450	0.50	0.202	1.27	13.8	0.18	21%
BLDG		MH3		0.051	0.051	0.95	0.048	0.048	7.0	137.2	0.018	300	5.00	0.217	3.06	13.8	0.08	9%
MH2		CBMH4		0.000	0.051	0.00	0.000	0.048	7.1	136.4	0.018	300	4.60	0.208	2.94	7.2	0.04	9%
CBMH4		STM MH4		0.036	0.245	0.82	0.029	0.195	7.1	136.0	0.074	450	0.50	0.202	1.27	11.3	0.15	36%
CB1		STM MH2		0.024	0.02	0.85	0.020	0.020	7.0	137.2	0.008	200	0.70	0.027	0.88	2.0	0.04	28%
STM MH2		ST-MH1		0.00	0.27	0.000	0.000	0.020	CONTROLLED FLOW		0.024	200	4.20	0.067	2.14	4.5	0.03	36%
ST-MH1		EX. MH		0.0000	0.27	0.000	0.000	0.020	CONTROLLED FLOW		0.024	250	0.50	0.042	0.86	4.2	0.08	57%

n = 0.013

$$5\ Year\ I = \frac{929.6}{(T + 4.0)^{0.798}}\ \text{mm/hr}$$

5 Year Storm
Intial T_c = 10 minutes
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APPENDIX C

SANITARY SEWER CALCULATIONS

Proposed Paremedic Response Station

53 Jacob Keffer, Concord, ON

SANITARY DESIGN FLOWS:

Industrial Usage

Industrial Floor Area:		0.029	ha
Industrial Sewage Generation Rate:		0.5	L/s/ha
Average Industrial Sewage Flow:		0.01	l/s
Peak Factor:		1.000	
Peak Industrial Flow:		0.010	l/s

Office Usage

Office Floor Area:		0.022	ha
Industrial Sewage Generation Rate:		0.6	L/s/ha
Average Industrial Sewage Flow:		0.01	l/s
Peak Factor:		1.000	
Peak Industrial Flow:		0.010	l/s

Contributing Area:		0.31	ha
Infiltration Allowance:	0.23 l/s/ha	0.07	l/s

Total Sanitary Usage	**0.09**	l/s

Notes: 1. Industrial flows are calculated based on an average flow of 0.5 litres/s/ha which includes peaking
2. Office flows are calculated based on an average flow of 0.6 litres/s/ha which includes peaking
3. Infiltration is calculated based on the area contributing to the subject sewer segment x 0.23 l/sec/ha.

MGM CONSULTING INC.
SANATARY SEWER DESIGN

Project No.: 2020-051
Subdivision:
Date: 02-Mar-21 Revised: 03-Mar-21
Des. By: BZ Chk. By: DK

Location					Sewer Design						Surcharge
Manhole from	Invert m.	Manhole to	Invert m.	Q Total cms	Equiv. Circ. Pipe Diameter mm.	Slope %	Max. Flow Q cap cms	Max Velocity V max m./sec.	Length m.	Time in Section min.	Actual Flow to Max. Allowable Flow Ratio %
BLDG		EX MH		0.000090	200	5.00	0.073	2.34	20.7	0.15	0.12%

n = 0.013

Issued by Addendum 4

Appendix D
WATER DEMAND CALCULATIONS

WATER DEMAND ANALYSIS
Proposed Institutional Development
53 Jacob Keffer Parkway, Concord, ON

WATER CONNECTION - Proposed building

Connection Point-				
Pressure Zone of Connection Point- Pressure Zone				
	Residential[1]	Retail[2]	Office[3]	Industrial
Total equivalent population to be serviced (persons)	0	0	18	18
Total Lands to be Serviced (ha)	0.000	0	0.022	0.029

1.Office population is calculated based on population densities of 115 persons/ha

2. Industrial population is calculated based on population density of 95 persons/h

Hydrant Flow Test Location			
	Hydrant Flow Test Location		
		Pressure (kPa)	Time
Minimum water pressure		N/A	
Maximum water pressure		N/A	

Toronto

Population Type	Avg. Consumption Rate	Peak hr factor	Max day Factor	
Residential (L/cap/day)	450	2.25	1.5	
Retail (L/s)	0.32	2	2	
Office (L/s)	0.32	2	2	
Industrial/Commercial (L/s)	0.35	2	2	

		Water Demands				
	Demand type	Demand (units)				
No.		Residential	Retail	Office	Industrial	Total
1	Average day flow (l/s)	0.00	0.00	0.01	0.01	0.02
2	Maximum day flow (l/s)	0.00	0.00	0.01	0.02	0.03
3	Peak hour flow (l/s)	0.00	0.00	0.02	0.02	0.04
4	Fire Flow (l/s)	83.33				83.33
Analysis						
5	Maximum day plus fire flow (l/s)			83.36		
6	Peak hour flow (l/s)			0.04		
7	Maximum demand flow (l/s)			83.36		

Note: Fire flow calculated based on the largest proposed building on the site.

Appendix E
FIRE DEMAND CALCULATIONS

Proposed 1-Storey Parmamedic Station
53 Jacob Keffer Parkway, Concord, ON
Preliminary Fire Flow Calculation

Fire Flow Calculation
Industrial Development

The FUS requires that a minimum water supply source 'F' be provided at 140 kPa
The min flow 'F' can be calculated as such:

$F=220C\sqrt{A}$
where:
F- Required fire flow in L/min
C- Coefficient related to construction
A- Total area in sq.m

C = 1.5 (Wood construction)

For ordinary construction, the area shall be a total of all floors (excluding basements at least 50 percent below grade) in the building being considered.

A = 504 sq.m

Therefore,

F= 7408.48 L/min
= 7000.000 L/min (rounded to nearest 1000)

Modified Flow

$F'=F*(1-f1)*(1-f2+f3)$

where:
f1- Occupancy factor reduction
Combustable 0%

f2- Sprinkler protection factor reduction
Based on a proposed sprinkler system conforming to HFPA 13, with a standard water supply for both the system and fire department hose lines
f2 = 50%

where:
f3- Exposure factor addition
Exposure factor is not to exceed 75%
Separation between subject building and other structures, and associated charges are as follows:

Proposed 1-Storey Parmamedic Station
53 Jacob Keffer Parkway, Concord, ON
Preliminary Fire Flow Calculation

	Distance (m)	Charge
North Side	14	15%
South Side	33	5%
East Side	Water Course	0%
West Side	Road	0%
Total		**20%**

The total increase for exposures is 20%

The resulting required minimum modified flow, F' = **4900** l/min

Therefore a minimum flow of approximately **5000** L/min must be available at the nearest hydrant with a minimum pressure of 140 kPa.

Note: This fireflow calculation has been prepared as a guide only. Confirmation should be obtained from a Fire Protection professional for confirmation

Appendix F
INFILTRATION GALLERY CALCULATIONS

INFILTRATION TRENCH CALCULATIONS
53 Jacob Keffer Parkway, CONCORD ON

Water balance is provided through infiltration via proposed infiltration pit, soft landscaped areas, and through evap/transpiration off of impervious surfaces as follows:

Proposed Infiltration Pit A

Material Type:	Clear Stone	
Void Space =	40	%
Length =	9	m
Width =	5.5	m
Depth =	0.47	m
Volume =	23.265	m^3
Available Storage =	9.306	m^3

Infiltration Time

Depth of Pit =	470.00	mm
"T" time =	16.50	mm/hr
Time to infiltrate =	28	hrs

Proposed Infiltration Pit B

Material Type:	Clear Stone	
Void Space =	40	%
Length =	11.5	m
Width =	7.5	m
Depth =	0.47	m
Volume =	40.5375	m^3
Available Storage =	16.215	m^3

Infiltration Time

Depth of Pit =	470.00	mm
"T" time =	16.50	mm/hr
Time to infiltrate =	28	hrs

Provide Water Balance

Surface	Area (ha)	Initial Abstraction (mm)	Volume (cu.m)
Soft Landscaping	0.082	5.0	4.1
Asphalt/Gravel	0.132	1.0	1.3
Roof	0.051	1.0	0.5
Concrete	0.048	1.0	0.5
Infiltration Pits	-	-	25.5
Total	**0.31**		**31.93**

Provided Water Balance = 10.2 mm.

Issued by Addendum 4

Appendix G
JELLYFISH CALCULATIONS & CONFIGURATION

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Wednesday, February 24, 2021
Project Name	53 Jacob Keffer Pkwy.
Project Number	
Location	Vaughan

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	7.6	85

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

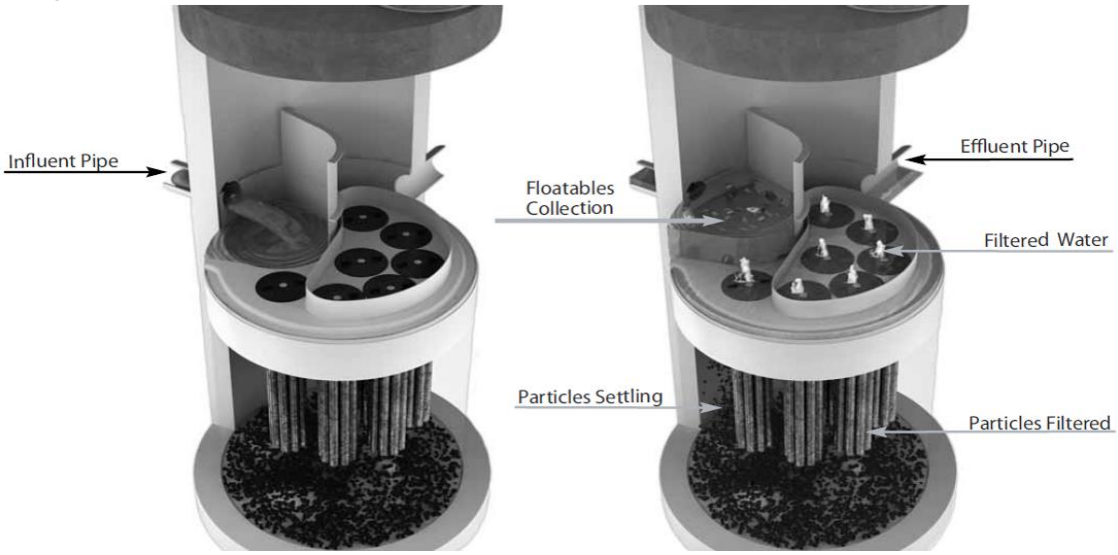
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Project Information

Date:	Wednesday, February 24, 2021
Project Name:	53 Jacob Keffer Pkwy.
Project Number:	
Location:	Vaughan

Designer Information

Company:	MGM Consulting Inc.
Contact:	Blake Zielke
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	0.313 ha
Imperviousness:	73.1%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**7.4 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 1378 m³, with a suspended sediment concentration of 60 mg/L.	**83 kg**

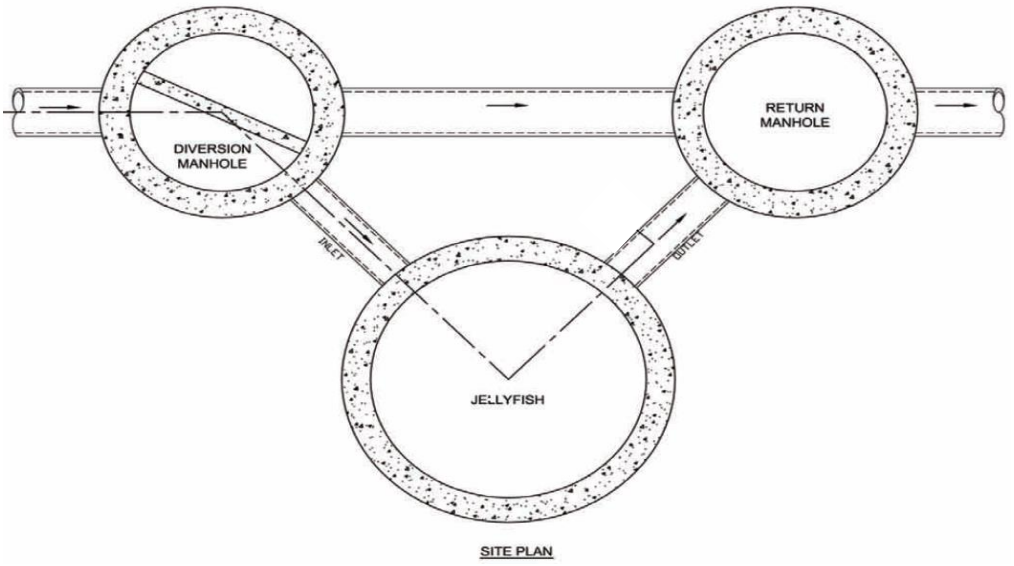
Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	**1**	**1**	**1.2**	**2313**	**0.34**	**379**	**7.6**	**85**
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	**62º**	**150**	**200**
1.8	59º	200	250
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION