15-23 Toryork Drive - Mixed Use Development

City of Toronto - Engineering & Construction Services

Dry Weather Flow Design Sheet

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NOTES

Pre-development domestic sewage flow based upon a unit flow of 250.0 Lpcd.
Post-development domestic sewage flow based upon a unit flow of 250.0 Lpcd (for downstream sewer analysis purposes).
Infiltration flow based upon a unit flow of 0.26 L/s/ha.
Maximum flow velocity for pipe flowing full = 3.0 m/s.
Minimum flow velocity for pipe flowing partially full (actual flow) = 0.6 m/s.

Designed By: **Angela Mokin**, P.Eng.
Checked By: **Paolo Albanese**, P.Eng.
File No.: 20131
Date: 28 February 2023

Location	from M.H.	to M.H.	DESIGN FLOW CALCULATIONS											SEWER DESIGN & ANALYSIS							Remarks
			Area (ha)	No. of Units	Density (pers/ha)	Population (persons)	Cumulative Area (ha)	Cumulative Population (persons)	Peaking Factor (M)	Sewage Flow (1) (L/s)	Infiltration Flow (2) (L/s)	Foundation Flow (3) (L/s)	Total Flow, Qd (1)+(2)+(3) (L/s)	Nominal Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Nominal Capacity, Qf (L/s)	Full Flow Velocity (m/s)	Qd/Qf (%)	Actual Velocity V (m/s)	
Pre-Development Dry Weather Flow Analysis																					
											0.26 L/s/ha										
A1 - Subject Site		MH 17A	0.77	2828	0.027	77	0.8	77													East Side of Subject Site (15 & 19 Toryork Dr)
A3 - Torkyork Drive		MH 17A	0.15	0	0.0	0	0.1	0													
Toryork Drive (A1 + A3)	MH 17A	MH 16A	0.00	0	0.0	0	0.9	77	4.27	1.0	0.2	0.0	1.2	250	0.55%	47.6	45.9	0.90	2.6%	0.39	
A2 - Subject Site		MH 16A	0.80	3896	0.027	106	0.8	106													West Side of Subject Site (21 & 23 Toryork Dr)
A4 - Torkyork Drive		MH 16A	0.84	0	136.0	114	0.8	114													
Toryork Drive (A2 + A4)	MH 16A	MH 15A	0.00	0	136.0	0	2.6	297	4.08	3.5	0.7	0.0	4.2	250	2.42%	84.8	96.5	1.90	4.3%	0.95	
A5 - Torkyork Drive	MH 15A	MH 14A	0.13	0	0.0	0	2.7	297	4.08	3.5	0.7	0.0	4.2	250	3.11%	65.6	109.4	2.16	3.8%	1.04	
EXT E1 - Toryork		MH 14A	362.56	0	136/86	49106	362.6	49106	2.27	322.8	94.3		417.1								
A6 - Easement	MH 14A	MH 13A	0.00	0	0.0	0	365.2	49403	2.27	324.4	95.0	0.0	419.4	600	3.41%	17.6	1182.4	4.05	35.5%	3.70	
A7 - Easement	MH 13A	MH 12A	0.10	0	0.0	0	365.3	49403	2.27	324.4	95.0	0.0	419.4	600	4.36%	71.3	1337.6	4.58	31.4%	4.05	
A8 - Easement	MH 12A	MH 11A	0.13	0	0.0	0	365.5	49403	2.27	324.4	95.0	0.0	419.4	600	1.21%	94.5	703.6	2.41	59.6%	2.52	
A9 - Easement	MH 11A	TRUNK	0.13	0	0.0	0	365.6	49403	2.27	324.4	95.1	0.0	419.5	600	4.10%	94.5	1296.3	4.44	32.4%	3.96	
		TRUNK												750							

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City of Toronto - Engineering & Construction Services

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fabian papa & partners

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Post-development domestic sewage flow based upon a unit flow of 250.0 Lpcd (for downstream sewer analysis purposes).
Infiltration flow based upon a unit flow of 0.26 L/s/ha.
Maximum flow velocity for pipe flowing full = 3.0 m/s.
Minimum flow velocity for pipe flowing partially full (actual flow) = 0.6 m/s.

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File No.: 20131
Date: 28 February 2023

Location	from M.H.	to M.H.	DESIGN FLOW CALCULATIONS Area (ha)	No. of Units	Density (pers/ha)	Population (persons)	Cumulative Area (ha)	Cumulative Population (persons)	Peaking Factor (M)	Sewage Flow (1) (L/s)	Infiltration Flow (2) (L/s)	Foundation Flow (3) (L/s)	Total Flow, Qd (1)+(2)+(3) (L/s)	SEWER DESIGN & ANALYSIS Nominal Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Nominal Capacity, Qf (L/s)	Full Flow Velocity (m/s)	Qd/Qf (%)	Actual Velocity V (m/s)	Remarks
Post-Development Dry Weather Flow Analysis																					
											0.26 L/s/ha										
A3 - Torkyork Drive	MH 17A	MH 16A	0.15	0	0.0	0	0.15	0	4.50	0.0	0.0	0.0	0.0	250	0.55%	47.6	45.9	0.90	0.1%	0.14	
A1 - Subject Site		MH 16A	0.67	550		1078	**Population for East Side of Subject Site**					0.95	**Max. Foundation Groundwater Sump Pump Discharge Rate**								
A4 - Torkyork Drive	MH 0A	MH 16A	0.84	0	136.0	114															
Torkyork Drive (A1 + A3 + A4)	MH 16A	MH 15A	0.00	0	0.0	0	1.66	1192	3.75	12.9	0.4	0.95	14.3	250	2.42%	84.8	96.5	1.90	14.8%	1.36	
A2 - Subject Site		MH 15A	0.90	627		1245	**Population for West Side of Subject Site**					1.25	**Max. Foundation Groundwater Sump Pump Discharge Rate**								
A5 - Torkyork Drive	MH 15A	MH 14A	0.13	0	0.0	0	2.7	2437	3.52	24.8	0.7	2.2	27.7	250	3.11%	65.6	109.4	2.16	25.3%	1.80	
EXT E1 - Toryork		MH 14A	362.56	0	136/86	49106	362.6	49106	2.27	322.8	94.3		417.1								
A6 - Easement	MH 14A	MH 13A	0.00	0	0.0	0	365.3	51543	2.25	335.9	95.0	2.2	433.1	600	3.41%	17.6	1182.4	4.05	36.6%	3.73	
A7 - Easement	MH 13A	MH 12A	0.10	0	0.0	0	365.4	51543	2.25	335.9	95.0	2.2	433.1	600	4.36%	71.3	1337.6	4.58	32.4%	4.09	
A8 - Easement	MH 12A	MH 11A	0.13	0	0.0	0	365.5	51543	2.25	335.9	95.0	2.2	433.1	600	1.21%	94.5	703.6	2.41	61.6%	2.53	
A9 - Easement	MH 11A	TRUNK	0.13	0	0.0	0	365.6	51543	2.25	335.9	95.1	2.2	433.2	600	4.10%	94.5	1296.3	4.44	33.4%	4.00	
		TRUNK												750							

15-23 Toryork Drive - Mixed Use Development

City of Toronto - Engineering & Construction Services

Wet Weather Flow Design Sheet

fabian papa & partners

NOTES

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Infiltration flow based upon a unit flow of 0.26 L/s/ha.
Maximum flow velocity for pipe flowing full = 3.0 m/s.
Minimum flow velocity for pipe flowing partially full (actual flow) = 0.6 m/s.

Designed By: **Angela Mokin**, P.Eng.
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File No.: 20131
Date: 28 February 2023

Location	from M.H.	to M.H.	DESIGN FLOW CALCULATIONS: Area (ha)	No. of Units	Density (pers/ha)	Population (persons)	Cumulative Area (ha)	Cumulative Population (persons)	Peaking Factor (M)	Sewage Flow (1) (L/s)	Infiltration Flow (2) (L/s)	Foundation Flow (3) (L/s)	Total Flow, Qd (1)+(2)+(3) (L/s)	SEWER DESIGN & ANALYSIS: Nominal Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Nominal Capacity, Qf (L/s)	Full Flow Velocity (m/s)	Qd/Qf (%)	Actual Velocity V (m/s)	Remarks
Pre-Development Wet Weather Flow Analysis																					
											3.00 L/s/ha	<50 ha									
											2.00 L/s/ha	>50 ha									
											0.26 L/s/ha	New Sewers									
A1 - Subject Site		MH 17A	0.77	2828	0.027	77	0.8	77	**East Side of Subject Site (15 & 19 Toryork Dr)**												
A3 - Torkyork Drive		MH 17A	0.15	0	0.0	0	0.1	0													
Toryork Drive (A1 + A3)	MH 17A	MH 16A	0.00	0	0.0	0	0.9	77	4.27	1.0	0.00	0.0	1.0	250	0.55%	47.6	45.9	0.90	2.1%	0.36	
A2 - Subject Site		MH 16A	0.80	3896	0.027	106	0.8	106	**West Side of Subject Site (21 & 23 Toryork Dr)**												
A4 - Torkyork Drive		MH 16A	0.84	0	136.0	114	0.8	114													
Toryork Drive (A2 + A4)	MH 16A	MH 15A	0.00	0	136.0	0	2.6	297	4.08	3.5	5.47	0.0	9.0	250	2.42%	84.8	96.5	1.90	9.3%	1.19	
A5 - Torkyork Drive	MH 15A	MH 14A	0.13	0	0.0	0	2.7	297	4.08	3.5	5.86	0.0	9.4	250	3.11%	65.6	109.4	2.16	8.6%	1.32	
EXT E1 - Toryork		MH 14A	362.56	0	136/86	49106	362.6	49106	2.27	322.8	773.73		1096.5								
A6 - Easement	MH 14A	MH 13A	0.00	0	0.0	0	365.2	49403	2.27	324.4	779.10	0.0	1103.5	600	3.41%	17.6	1182.4	4.05	93.3%	4.60	
A7 - Easement	MH 13A	MH 12A	0.10	0	0.0	0	365.3	49403	2.27	324.4	779.30	0.0	1103.7	600	4.36%	71.3	1337.6	4.58	82.5%	5.12	
A8 - Easement	MH 12A	MH 11A	0.13	0	0.0	0	365.5	49403	2.27	324.4	779.56	0.0	1104.0	600	1.21%	94.5	703.6	2.41	156.9%	2.44	
A9 - Easement	MH 11A	TRUNK	0.13	0	0.0	0	365.6	49403	2.27	324.4	779.82	0.0	1104.2	600	4.10%	94.5	1296.3	4.44	85.2%	4.99	
		TRUNK												750							

15-23 Toryork Drive - Mixed Use Development

City of Toronto - Engineering & Construction Services

Wet Weather Flow Design Sheet

fabian papa & partners

NOTES

Pre-development domestic sewage flow based upon a unit flow of 250.0 Lpcd.
Post-development domestic sewage flow based upon a unit flow of 250.0 Lpcd (for downstream sewer analysis purposes).
Infiltration flow based upon a unit flow of 0.26 L/s/ha.
Maximum flow velocity for pipe flowing full = 3.0 m/s.
Minimum flow velocity for pipe flowing partially full (actual flow) = 0.6 m/s.

Designed By: **Angela Mokin**, P.Eng.
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File No.: 20131
Date: 28 February 2023

			DESIGN FLOW CALCULATIONS											SEWER DESIGN & ANALYSIS							
Location	from M.H.	to M.H.	Area (ha)	No. of Units	Density (pers/ha)	Population (persons)	Cumulative Area (ha)	Cumulative Population (persons)	Peaking Factor (M)	Sewage Flow (1) (L/s)	Infiltration Flow (2) (L/s)	Foundation Flow (3) (L/s)	Total Flow, Qd (1)+(2)+(3) (L/s)	Nominal Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Nominal Capacity, Qf (L/s)	Full Flow Velocity (m/s)	Qd/Qf (%)	Actual Velocity V (m/s)	Remarks
Post-Development Wet Weather Flow Analysis																					
											3.00 L/s/ha	<50 ha									
											2.00 L/s/ha	>50 ha									
											0.26 L/s/ha	New Sewers									
A3 - Torkyork Drive	MH 17A	MH 16A	0.15	0	0.0	0	0.15	0	4.50	0.0	0.46	0.0	0.5	250	0.55%	47.6	45.9	0.90	1.0%	0.29	
A1 - Subject Site		MH 16A	0.67	550		1078	**Population for East Side of Subject Site**					0.95	**Max. Foundation Groundwater Sump Pump Discharge Rate**								
A4 - Torkyork Drive		MH 16A	0.84	0	136.0	114															
Torkyork Drive (A1 + A3 + A4)	MH 16A	MH 15A	0.00	0	0.0	0	1.66	1192	3.75	12.9	3.15	1.0	17.0	250	2.42%	84.8	96.5	1.90	17.7%	1.43	
A2 - Subject Site		MH 15A	0.90	627		1245	**Population for West Side of Subject Site**					1.25	**Max. Foundation Groundwater Sump Pump Discharge Rate**								
A5 - Torkyork Drive	MH 15A	MH 14A	0.13	0	0.0	0	2.69	2437	3.52	24.8	6.22	2.2	33.2	250	3.11%	65.6	109.4	2.16	30.4%	1.89	
EXT E1 - Toryork		MH 14A	362.6	0	136/86	49106	362.6	49106	2.27	322.8	773.96		1096.8								
A6 - Easement	MH 14A	MH 13A	0.00	0	0.0	0	365.3	51543	2.25	335.9	779.34	2.2	1117.4	600	3.41%	17.6	1182.4	4.05	94.5%	4.61	
A7 - Easement	MH 13A	MH 12A	0.10	0	0.0	0	365.4	51543	2.25	335.9	779.54	2.2	1117.6	600	4.36%	71.3	1337.6	4.58	83.6%	5.13	
A8 - Easement	MH 12A	MH 11A	0.13	0	0.0	0	365.5	51543	2.25	335.9	779.79	2.2	1117.9	600	1.21%	94.5	703.6	2.41	158.9%	2.44	
A9 - Easement	MH 11A	TRUNK	0.13	0	0.0	0	365.6	51543	2.25	335.9	780.05	2.2	1118.2	600	4.10%	94.5	1296.3	4.44	86.3%	5.00	
		TRUNK												750							

15-23 Toryork Drive - Mixed Use Development

City of Toronto - Engineering & Construction Services

Wet Weather Flow HGL Analysis

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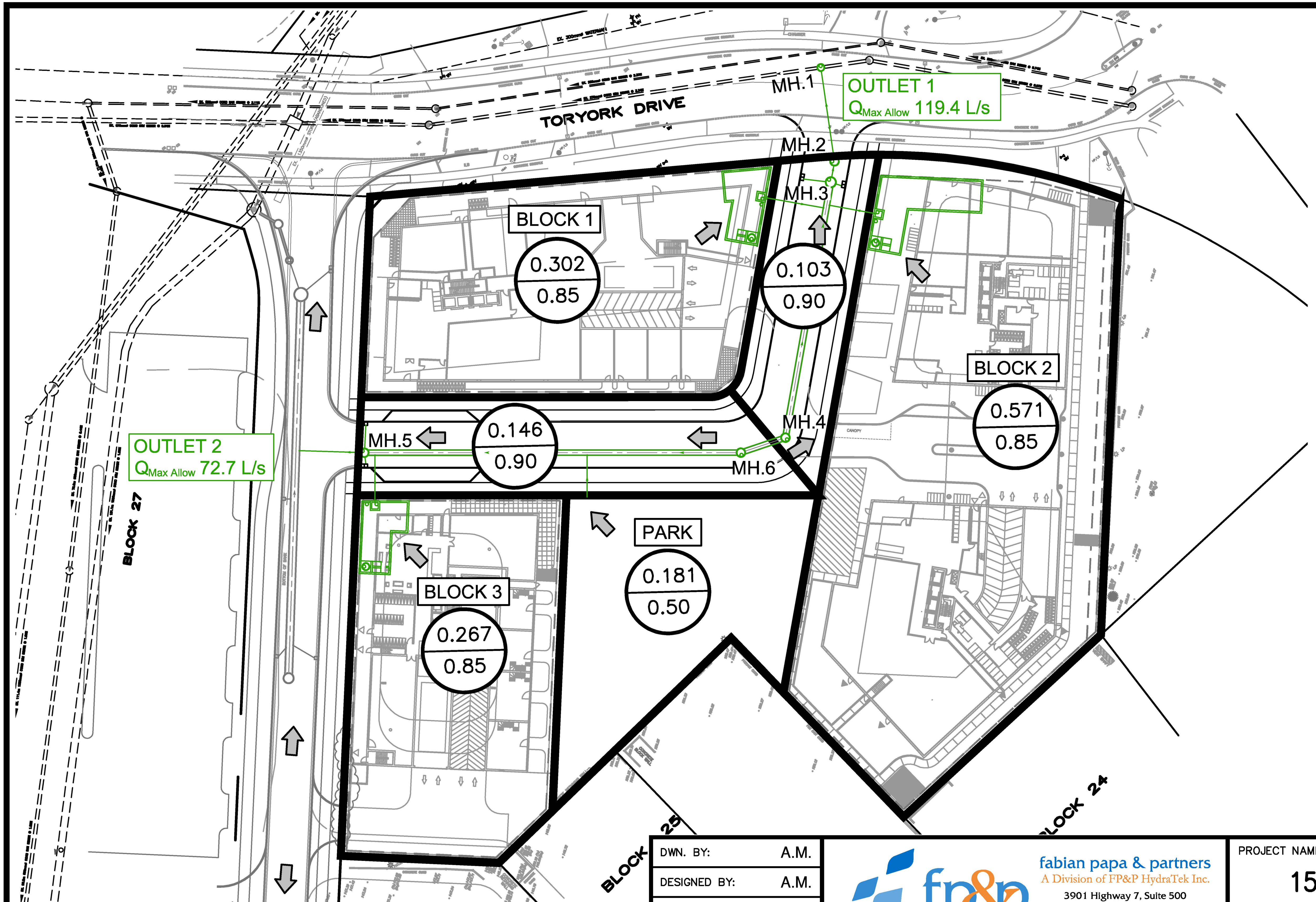
Designed By: Angela Mokin, P.Eng.
Checked By: Paolo Albanese, P.Eng.
File No.: 20131
Date: 28 February 2023

Street	From MH	To MH	Invert Elevation u/s (m)	Invert Elevation d/s (m)	MH Rim u/s (m)	Pipe Diameters Eq. Ht. (mm)	Pipe Diameters Nom. Ht. (mm)	Length (m)	'n'	TOTAL Combined Flow (l/s)	Q-cap (l/s)	Q-in / Q-cap	Surcharge u/s (m)	HGL u/s (m)	HGL d/s (m)	HGL u/s to Ground (m)	Remarks
Pre-Development Wet Weather Flow Analysis																	
Subject Site		MH 16A															
Toryork Drive (A2 + A4)	MH 16A	MH 15A	147.07	145.02	151.00	250	254	84.8	0.013	9.0	96.46	0.09	0.00	147.32	145.27	3.68	No Surcharge
A5 - Torkyork Drive	MH 15A	MH 14A	145.02	142.98	148.79	250	254	65.6	0.013	9.4	109.40	0.09	0.00	145.27	143.23	3.52	No Surcharge
A6 - Easement	MH 14A	MH 13A	141.54	140.94	147.60	600	610	17.6	0.013	1103.5	1182.38	0.93	0.68	142.83	142.30	4.77	> 1.8 m
A7 - Easement	MH 13A	MH 12A	140.94	137.83	148.29	600	610	71.3	0.013	1103.7	1337.62	0.83	0.75	142.30	140.14	5.99	> 1.8 m
A8 - Easement	MH 12A	MH 11A	137.80	136.66	149.00	600	610	94.5	0.013	1104.0	703.55	1.57	1.73	140.14	137.27	8.86	> 1.8 m
A9 - Easement	MH 11A	TRUNK	136.63	132.76	147.30	600	610	94.5	0.013	1104.2	1296.28	0.85	0.00	137.24	133.37	10.06	No Surcharge
						750								132.09	**Trunk Obvert**		
Post-Development Wet Weather Flow Analysis																	
Subject Site		MH 16A															
Torkyork Drive (A1 + A3 + A4)	MH 16A	MH 15A	147.070	145.020	151.000	250	254	84.8	0.013	17.0	96.46	0.18	0.00	147.32	145.27	3.68	No Surcharge
A5 - Torkyork Drive	MH 15A	MH 14A	145.020	142.980	148.790	250	254	65.6	0.013	33.2	109.40	0.30	0.00	145.27	143.23	3.52	No Surcharge
A6 - Easement	MH 14A	MH 13A	141.540	140.940	147.600	600	610	17.6	0.013	1117.4	1182.38	0.95	0.82	142.97	142.43	4.63	> 1.8 m
A7 - Easement	MH 13A	MH 12A	140.940	137.830	148.290	600	610	71.3	0.013	1117.6	1337.62	0.84	0.88	142.43	140.21	5.86	> 1.8 m
A8 - Easement	MH 12A	MH 11A	137.800	136.660	149.000	600	610	94.5	0.013	1117.9	703.55	1.59	1.80	140.21	137.27	8.79	> 1.8 m
A9 - Easement	MH 11A	TRUNK	136.630	132.760	147.300	600	610	94.5	0.013	1118.2	1296.28	0.86	0.00	137.24	133.37	10.06	No Surcharge
						750								132.09	**Trunk Obvert**		

APPENDIX E


LEGEND:
0.123
0.90
AREA (ha)
RUNOFF COEFFICICENT
15-23 Toryork Drive
RESIDENTIAL DEVELOPMENT
PRE-DEVELOPMENT STORM
DRAINAGE AREA PLAN
OVERALL SITE
1.569
0.88
Toryork Dr
0.042
0.25
1.527
0.90
Weston Rd
Finch Ave W
100 m
fp&p

METRIC
ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE SHOWN



LEGEND:

STORM DRAINAGE AREA

DRAINAGE AREA (Ha) (e.g. 0.26)

RUNOFF COEFFICIENT (e.g. 0.90)

OVERLAND FLOW DIRECTION

DWN. BY:	A.M.
DESIGNED BY:	A.M.
CHECKED BY:	P.F.A.
SCALE:	1: 750
DATE:	FEB 2023
SHEET NO:	1 OF 1

fp&p
fabian papa & partners
A Division of FP&P HydraTek Inc.
3901 Highway 7, Suite 500
Vaughan, Ontario, L4L 8L5
t: 905-264-2420
www.fabianpapa.com

PROJECT NO:	DWG NO:	REV NO:
20131	STM–2	1

PROJECT NAME:

15–23 TORYORK DRIVE

RESIDENTIAL DEVELOPMENT

DRAWING TITLE:

POST–DEVELOPMENT STORM DRAINAGE AREA PLAN

H:\FP&P HydraTek\Projects\2020\20131 - 15-23 Toryork Drive, Toronto\Drawings\Subdivision\2nd Submission\20131 - Civil Engineering Plans.dwg (Feb 24, 2023 - 10:34am)

15-23 Toryork Drive Subdivision Development

City of Toronto - Engineering & Construction Department

2 / 100 YEAR STORM SEWER DESIGN SHEET

fp&p

2-Year IDF Curve $I_{2-Yr} = \frac{21.8}{T^{0.78}}$

100-Year IDF Curve $I_{100-Yr} = \frac{59.7}{T^{0.80}}$

Designed By: **Angela Mokin**, P.Eng.
Checked By: **Paolo F. Albanese**, P.Eng.
File No.: 20131
Date: 23 February 2023

Street	From MH	To MH	A (ha)	R	A x R	Accum. A x R	T_c (min)	I (mm/hr)	Q_{act} (l/s)	Size of Pipe (mm)	Slope (%)	Nominal Capacity Q_{cap} (l/s)	Full Flow Velocity (m/s)	Actual Flow Velocity (m/s)	Length (m)	Time in Sect. (min)	Total Time (min)	Q_{act}/Q_{cap}	Remarks
ACTUAL PRE-DEVELOPMENT SITE RELEASE RATE (2-YEAR DESIGN FLOW)																			
Building / Asphalt Area			1.527	0.90	1.374	1.374	10.0	88.2	336.62										
Landscaped Area			0.042	0.25	0.011	0.011	10.0	88.2	2.57										
Total Discharge to STM Sewer			1.57			1.385			**339.19**	←	Total Actual Site Release Rate to Storm Sewer System								
Total			1.57	0.88	←						Total Developable Site Area and Ex. Weighted Run-off Coefficient								
ALLOWABLE PRE-DEVELOPMENT SITE RELEASE RATE (2-YEAR DESIGN FLOW)																			
Blocks 1-3, Park, Road	Total Site Area =		1.57	0.50	0.784	0.784	10.0	88.2	**192.15**	←	Total Allowable Site Release Rate to Storm Sewer System								
					per WWFMG's														
ALLOWABLE RELEASE RATE (per block)																			
Block 1			0.30					19.2%	36.96										
Block 2			0.57					36.4%	69.89										
Block 3			0.27					17.0%	32.68										
Park			0.18					11.5%	22.15		Based on Pro-Rata Share of Total Allowable Site Release Rate								
Road (E-W)			0.15					9.3%	17.87										
Road (N-S)			0.10					6.6%	12.61										
			1.57					100.0%	**192.15**										
UN-ATTENUATED 2-YEAR POST DEVELOPMENT DESIGN FLOW (per block)																			
Block 1			0.30	0.85	0.257	0.257	10.0	88.2	62.88										
Block 2			0.57	0.85	0.485	0.485	10.0	88.2	118.90										
Block 3			0.27	0.85	0.227	0.227	10.0	88.2	55.60										
Park			0.18	0.50	0.091	0.091	10.0	88.2	22.17										
Road (E-W)			0.15	0.90	0.131	0.131	11.0	81.9	29.88										
Road (N-S)			0.10	0.90	0.093	0.093	10.0	88.2	22.71										
			1.57	0.82	1.284				312.14										

15-23 Toryork Drive Subdivision Development

City of Toronto - Engineering & Construction Department

2 / 100 YEAR STORM SEWER DESIGN SHEET

2-Year IDF Curve $I_{2-Yr} = \frac{21.8}{T^{0.78}}$

100-Year IDF Curve $I_{100-Yr} = \frac{59.7}{T^{0.80}}$

Designed By: **Angela Mokin**, P.Eng.
Checked By: **Paolo F. Albanese**, P.Eng.
File No.: 20131
Date: 23 February 2023

Street	From MH	To MH	A (ha)	R	A x R	Accum. A x R	T_c (min)	I (mm/hr)	Q_{act} (l/s)	Size of Pipe (mm)	Slope (%)	Nominal Capacity Q_{cap} (l/s)	Full Flow Velocity (m/s)	Actual Flow Velocity (m/s)	Length (m)	Time in Sect. (min)	Total Time (min)	Q_{act}/Q_{cap}	Remarks
UN-ATTENUATED 100-YEAR POST DEVELOPMENT DESIGN FLOW (per block)																			
Block 1			0.30	0.85	0.257	0.257	10.0	250.3	178.49										
Block 2			0.57	0.85	0.485	0.485	10.0	250.3	337.48										
Block 3			0.27	0.85	0.227	0.227	10.0	250.3	157.81										
Park			0.18	0.50	0.091	0.091	10.0	250.3	62.93										
Road (E-W)			0.15	0.90	0.131	0.131	10.0	250.3	91.37										
Road (N-S)			0.10	0.90	0.093	0.093	10.0	250.3	64.46										
			1.57	0.82	1.284				892.53										
ATTENUATED 100-YEAR POST DEVELOPMENT DESIGN FLOWS (per block)										Discharge Flow Rates Taken from "Storage" Spreadsheets									
Block 1			0.30						33.67	250	2.19	91.81	1.79	1.64	11.4	0.1	0.1	0.37	
Block 2			0.57						65.39	300	2.81	169.11	2.29	2.14	8.3	0.1	0.1	0.39	
Road (N-S)			0.10																
		MH.1							111.00	375	0.91	174.49	1.51	1.60	16.5	0.2	0.2	0.64	
Block 3			0.27						29.54	250	3.00	107.45	2.10	1.77	8.9	0.1	0.1	0.27	
Park			0.18						14.71	200	2.50	54.10	1.65	1.39	8.0	0.1	0.1	0.27	
Road (E-W)			0.15																
		MH.5							65.80	375	0.86	169.62	1.47	1.38	11.6	0.1	0.1	0.39	
			1.57						**176.80**	Total Post-Development Controlled Site Release Rate									
PIPE SEGMENT DESIGN WITHIN NEW MUNICIPAL ROAD																			
OUTLET 1																			
Block 1 Controlled Discharge		MH.4							33.7										
Block 2 Controlled Discharge		MH.4							65.4										
Road Drainage Area (N-S)	DCB.'s	MH.4	0.05	0.90	0.046	0.046	10.0	250.3	32.2	300	7.80	281.75	3.82	2.49	1.3	0.0	10.0	0.11	
	DCB.'s	MH.4	0.05	0.90	0.046	0.046	10.0	250.3	32.2	300	3.52	189.27	2.57	1.88	4.3	0.0	10.0	0.17	
	MH.4	MH.3	0.00	0.90	0.000	0.093	10.0	249.8	163.4	900	0.53	1374.91	2.07	1.38	47.2	0.4	10.4	0.12	
Orifice-Controlled Flow	MH.3	MH.2	0.00	0.90					111.0	375	2.13	266.95	2.32	2.19	2.4	0.0	0.0	0.42	
	MH.2	MH.1	0.00	0.90					111.0	375	0.91	174.49	1.51	1.60	16.5	0.2	0.2	0.64	
OUTLET 2																			
Park Controlled Discharge		MH.6							14.7										
Block 3 Controlled Discharge		MH.6							29.5										
Road Drainage Area (E-W)	DCB.'s	MH.6	0.07	0.90	0.066	0.066	10.0	250.3	45.7	300	3.50	188.73	2.56	2.09	1.4	0.0	10.0	0.24	
	DCB.'s	MH.6	0.07	0.90	0.066	0.066	10.0	250.3	45.7	300	1.13	107.24	1.45	1.39	4.4	0.1	10.1	0.43	
	MH.4	MH.6	0.00	0.90	0.000	0.066	10.0	250.3	89.9	825	0.68	1234.87	2.21	1.28	7.4	0.1	10.1	0.07	
	MH.6	MH.5	0.00	0.90	0.000	0.131	10.1	249.2	135.2	825	0.36	898.50	1.61	1.15	69.5	0.7	10.8	0.15	
Orifice-Controlled Flow	MH.5	Sewer	0.00	0.90					65.8	375	0.86	169.62	1.47	1.38	11.6	0.1	0.1	0.39	

15-23 Toryork Drive Subdivision Development
Stormwater Storage Calculations using Rational Method
100-Year Major Storm - City of Toronto IDF Data

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SWM Tank Design (Block 1)

Project No.	**20131**		Area (ha)	0.3020
Analysis By:	**Angela Mokin, P.Eng.**		Total Runoff Coefficient	0.85
Last Revised:	**23 February 2023**		Maximum Site Discharge (L/s)	33.7

Time (min)	Intensity (mm/hr)	Q-100 (cu.m/s)	Q-stored (cu.m/s)	Storage Volume (cu.m)
0	0.0	0.000	0.000	0.000
10	250.3	0.178	0.145	86.891
20	143.8	0.103	0.069	82.613
30	103.9	0.074	0.040	72.800
40	82.6	0.059	0.025	60.498
50	69.1	0.049	0.016	46.744
60	59.7	0.043	0.009	32.027
70	52.8	0.038	0.004	16.622
80	47.4	0.034	0.000	0.696
90	43.2	0.031	0.000	0.000
100	39.7	0.028	0.000	0.000
110	36.8	0.026	0.000	0.000
120	34.3	0.024	0.000	0.000
130	32.2	0.023	0.000	0.000
140	30.3	0.022	0.000	0.000
150	28.7	0.020	0.000	0.000
160	27.2	0.019	0.000	0.000
170	25.9	0.019	0.000	0.000
180	24.8	0.018	0.000	0.000
190	23.7	0.017	0.000	0.000
200	22.8	0.016	0.000	0.000
210	21.9	0.016	0.000	0.000
220	21.1	0.015	0.000	0.000
230	20.4	0.015	0.000	0.000
240	19.7	0.014	0.000	0.000
250	19.1	0.014	0.000	0.000
260	18.5	0.013	0.000	0.000
270	17.9	0.013	0.000	0.000
280	17.4	0.012	0.000	0.000
290	16.9	0.012	0.000	0.000
300	16.5	0.012	0.000	0.000
310	16.0	0.011	0.000	0.000
320	15.6	0.011	0.000	0.000
330	15.3	0.011	0.000	0.000
340	14.9	0.011	0.000	0.000
350	14.6	0.010	0.000	0.000
360	14.2	0.010	0.000	0.000

Orifice (mm)	125	Storage Volume Required (cu.m)	**86.9**
Tank Dimensions	77 m^2 x 1.30 m	Storage Volume Provided (cu.m)	**100.1**

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15-23 Toryork Drive Subdivision Development

Stormwater Storage Calculations using Rational Method
100-Year Major Storm - City of Toronto IDF Data

SWM Tank Design (Block 2)

Project No.	**20131**		Area (ha)	0.5710
Analysis By:	**Angela Mokin, P.Eng.**		Total Runoff Coefficient	0.85
Last Revised:	**23 February 2023**		Maximum Site Discharge (L/s)	65.4

Time (min)	Intensity (mm/hr)	Q-100 (cu.m/s)	Q-stored (cu.m/s)	Storage Volume (cu.m)
0	0.0	0.000	0.000	0.000
10	250.3	0.337	0.272	163.257
20	143.8	0.194	0.128	154.135
30	103.9	0.140	0.075	134.552
40	82.6	0.111	0.046	110.260
50	69.1	0.093	0.028	83.223
60	59.7	0.080	0.015	54.367
70	52.8	0.071	0.006	24.208
80	47.4	0.064	0.000	0.000
90	43.2	0.058	0.000	0.000
100	39.7	0.053	0.000	0.000
110	36.8	0.050	0.000	0.000
120	34.3	0.046	0.000	0.000
130	32.2	0.043	0.000	0.000
140	30.3	0.041	0.000	0.000
150	28.7	0.039	0.000	0.000
160	27.2	0.037	0.000	0.000
170	25.9	0.035	0.000	0.000
180	24.8	0.033	0.000	0.000
190	23.7	0.032	0.000	0.000
200	22.8	0.031	0.000	0.000
210	21.9	0.030	0.000	0.000
220	21.1	0.028	0.000	0.000
230	20.4	0.027	0.000	0.000
240	19.7	0.027	0.000	0.000
250	19.1	0.026	0.000	0.000
260	18.5	0.025	0.000	0.000
270	17.9	0.024	0.000	0.000
280	17.4	0.023	0.000	0.000
290	16.9	0.023	0.000	0.000
300	16.5	0.022	0.000	0.000
310	16.0	0.022	0.000	0.000
320	15.6	0.021	0.000	0.000
330	15.3	0.021	0.000	0.000
340	14.9	0.020	0.000	0.000
350	14.6	0.020	0.000	0.000
360	14.2	0.019	0.000	0.000

Orifice (mm)	175	Storage Volume Required (cu.m)	**163.3**
Tank Dimensions	144.0 m^2 x 1.4 m	Storage Volume Provided (cu.m)	**201.6**

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15-23 Toryork Drive Subdivision Development

Stormwater Storage Calculations using Rational Method
100-Year Major Storm - City of Toronto IDF Data

Municipal Road Storage - Supersized Pipes (N-S Portion)

Project No.	**20131**	Area (ha)	0.103
Analysis By:	**Angela Mokin, P.Eng.**	Total Runoff Coefficient	0.90
Last Revised:	**23 February 2023**	Maximum Site Discharge (l/s)	111.00

Time (min)	Intensity (mm/hr)	Q_{100} from Block 1 (L/s)	Q_{100} from Block 2 (L/s)	Q_{100} from Road (L/s)	Q-stored (L/s)	Storage Volume (cu.m)
0	0.0	0.0	0.0	0.0	0.0	0.0
10	250.3	33.7	65.4	64.5	52.5	31.5
20	143.8	33.7	65.4	37.0	25.1	30.1
30	103.9	33.7	65.4	26.8	14.8	26.7
40	82.6	33.7	65.4	21.3	9.3	22.4
50	69.1	33.7	65.4	17.8	5.8	17.5
60	59.7	33.7	65.4	15.4	3.4	12.4
70	52.8	33.7	65.4	13.6	1.6	6.9
80	47.4	33.7	63.9	12.2	0.0	0.0
90	43.2	30.8	58.2	11.1	0.0	0.0
100	39.7	28.3	53.5	10.2	0.0	0.0
110	36.8	26.2	49.6	9.5	0.0	0.0
120	34.3	24.4	46.2	8.8	0.0	0.0
130	32.2	22.9	43.4	8.3	0.0	0.0
140	30.3	21.6	40.9	7.8	0.0	0.0
150	28.7	20.5	38.7	7.4	0.0	0.0
160	27.2	19.4	36.7	7.0	0.0	0.0
170	25.9	18.5	35.0	6.7	0.0	0.0
180	24.8	17.7	33.4	6.4	0.0	0.0
190	23.7	16.9	32.0	6.1	0.0	0.0
200	22.8	16.2	30.7	5.9	0.0	0.0
210	21.9	15.6	29.5	5.6	0.0	0.0
220	21.1	15.1	28.5	5.4	0.0	0.0
230	20.4	14.5	27.5	5.2	0.0	0.0
240	19.7	14.0	26.6	5.1	0.0	0.0
250	19.1	13.6	25.7	4.9	0.0	0.0
260	18.5	13.2	24.9	4.8	0.0	0.0
270	17.9	12.8	24.2	4.6	0.0	0.0
280	17.4	12.4	23.5	4.5	0.0	0.0
290	16.9	12.1	22.8	4.4	0.0	0.0
300	16.5	11.7	22.2	4.2	0.0	0.0
310	16.0	11.4	21.6	4.1	0.0	0.0
320	15.6	11.2	21.1	4.0	0.0	0.0
330	15.3	10.9	20.6	3.9	0.0	0.0
340	14.9	10.6	20.1	3.8	0.0	0.0
350	14.6	10.4	19.6	3.7	0.0	0.0
360	14.2	10.2	19.2	3.7	0.0	0.0

Storage Volume Required (cu.m)	**31.5**
Storage Volume Provided (cu.m)	**31.5**
Depth of Storage (m) =	0.849
Orifice Size (mm) =	250
Orfice Flow (L/s) =	111.0

15-23 Toryork Drive Subdivision Development

Stormwater Storage Calculations using Rational Method
100-Year Major Storm - City of Toronto IDF Data

SWM Tank Design (Block 3)

Project No.	**20131**		Area (ha)	0.2670
Analysis By:	**Angela Mokin, P.Eng.**		Total Runoff Coefficient	0.85
Last Revised:	**23 February 2023**		Maximum Site Discharge (L/s)	29.5

Time (min)	Intensity (mm/hr)	Q-100 (cu.m/s)	Q-stored (cu.m/s)	Storage Volume (cu.m)
0	0.0	0.000	0.000	0.000
10	250.3	0.158	0.128	76.957
20	143.8	0.091	0.061	73.310
30	103.9	0.066	0.036	64.772
40	82.6	0.052	0.023	54.031
50	69.1	0.044	0.014	42.007
60	59.7	0.038	0.008	29.132
70	52.8	0.033	0.004	15.648
80	47.4	0.030	0.000	1.704
90	43.2	0.027	0.000	0.000
100	39.7	0.025	0.000	0.000
110	36.8	0.023	0.000	0.000
120	34.3	0.022	0.000	0.000
130	32.2	0.020	0.000	0.000
140	30.3	0.019	0.000	0.000
150	28.7	0.018	0.000	0.000
160	27.2	0.017	0.000	0.000
170	25.9	0.016	0.000	0.000
180	24.8	0.016	0.000	0.000
190	23.7	0.015	0.000	0.000
200	22.8	0.014	0.000	0.000
210	21.9	0.014	0.000	0.000
220	21.1	0.013	0.000	0.000
230	20.4	0.013	0.000	0.000
240	19.7	0.012	0.000	0.000
250	19.1	0.012	0.000	0.000
260	18.5	0.012	0.000	0.000
270	17.9	0.011	0.000	0.000
280	17.4	0.011	0.000	0.000
290	16.9	0.011	0.000	0.000
300	16.5	0.010	0.000	0.000
310	16.0	0.010	0.000	0.000
320	15.6	0.010	0.000	0.000
330	15.3	0.010	0.000	0.000
340	14.9	0.009	0.000	0.000
350	14.6	0.009	0.000	0.000
360	14.2	0.009	0.000	0.000

Orifice (mm)	120	Storage Volume Required (cu.m)	**77.0**
Tank Dimensions	60 m^2 x 1.3 m	Storage Volume Provided (cu.m)	**90.0**

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15-23 Toryork Drive Subdivision Development

Stormwater Storage Calculations using Rational Method

100-Year Major Storm - City of Toronto IDF Data

SWM Tank Design (Park)

Project No.	**20131**		Area (ha)	0.1810
Analysis By:	**Angela Mokin, P.Eng.**		Total Runoff Coefficient	0.50
Last Revised:	**23 February 2023**		Maximum Site Discharge (L/s)	14.7

Time (min)	Intensity (mm/hr)	Q-100 (cu.m/s)	Q-stored (cu.m/s)	Storage Volume (cu.m)
0	0.0	0.000	0.000	0.000
10	250.3	0.063	0.048	28.930
20	143.8	0.036	0.021	25.718
30	103.9	0.026	0.011	20.555
40	82.6	0.021	0.006	14.514
50	69.1	0.017	0.003	7.962
60	59.7	0.015	0.000	1.070
70	52.8	0.013	0.000	0.000
80	47.4	0.012	0.000	0.000
90	43.2	0.011	0.000	0.000
100	39.7	0.010	0.000	0.000
110	36.8	0.009	0.000	0.000
120	34.3	0.009	0.000	0.000
130	32.2	0.008	0.000	0.000
140	30.3	0.008	0.000	0.000
150	28.7	0.007	0.000	0.000
160	27.2	0.007	0.000	0.000
170	25.9	0.007	0.000	0.000
180	24.8	0.006	0.000	0.000
190	23.7	0.006	0.000	0.000
200	22.8	0.006	0.000	0.000
210	21.9	0.006	0.000	0.000
220	21.1	0.005	0.000	0.000
230	20.4	0.005	0.000	0.000
240	19.7	0.005	0.000	0.000
250	19.1	0.005	0.000	0.000
260	18.5	0.005	0.000	0.000
270	17.9	0.005	0.000	0.000
280	17.4	0.004	0.000	0.000
290	16.9	0.004	0.000	0.000
300	16.5	0.004	0.000	0.000
310	16.0	0.004	0.000	0.000
320	15.6	0.004	0.000	0.000
330	15.3	0.004	0.000	0.000
340	14.9	0.004	0.000	0.000
350	14.6	0.004	0.000	0.000
360	14.2	0.004	0.000	0.000

Orifice (mm)	75	Storage Volume Required (cu.m)	**28.9**
Tank Dimensions	18 m^2 x 2.0 m	Storage Volume Provided (cu.m)	**36.0**

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15-23 Toryork Drive Subdivision Development

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100-Year Major Storm - City of Toronto IDF Data

Municipal Road Storage - Supersized Pipes (E-W Portion)

Project No.	**20131**	Area (ha)	0.146
Analysis By:	**Angela Mokin, P.Eng.**	Total Runoff Coefficient	0.90
Last Revised:	**23 February 2023**	Maximum Site Discharge (l/s)	65.80

Time (min)	Intensity (mm/hr)	Q_{100} from Block 3 (L/s)	Q_{100} from Park (L/s)	Q_{100} from Road (L/s)	Q-stored (L/s)	Storage Volume (cu.m)
0	0.0	0.0	0.0	0.0	0.0	0.0
10	250.3	29.5	14.7	91.4	69.8	41.9
20	143.8	29.5	14.7	52.5	30.9	37.1
30	103.9	29.5	14.7	37.9	16.4	29.5
40	82.6	29.5	14.7	30.1	8.6	20.6
50	69.1	29.5	14.7	25.2	3.7	11.0
60	59.7	29.5	14.7	21.8	0.2	0.9
70	52.8	29.5	13.3	19.3	0.0	0.0
80	47.4	29.5	11.9	17.3	0.0	0.0
90	43.2	27.2	10.9	15.8	0.0	0.0
100	39.7	25.0	10.0	14.5	0.0	0.0
110	36.8	23.2	9.2	13.4	0.0	0.0
120	34.3	21.6	8.6	12.5	0.0	0.0
130	32.2	20.3	8.1	11.7	0.0	0.0
140	30.3	19.1	7.6	11.1	0.0	0.0
150	28.7	18.1	7.2	10.5	0.0	0.0
160	27.2	17.2	6.8	9.9	0.0	0.0
170	25.9	16.4	6.5	9.5	0.0	0.0
180	24.8	15.6	6.2	9.0	0.0	0.0
190	23.7	15.0	6.0	8.7	0.0	0.0
200	22.8	14.4	5.7	8.3	0.0	0.0
210	21.9	13.8	5.5	8.0	0.0	0.0
220	21.1	13.3	5.3	7.7	0.0	0.0
230	20.4	12.8	5.1	7.4	0.0	0.0
240	19.7	12.4	5.0	7.2	0.0	0.0
250	19.1	12.0	4.8	7.0	0.0	0.0
260	18.5	11.6	4.6	6.7	0.0	0.0
270	17.9	11.3	4.5	6.5	0.0	0.0
280	17.4	11.0	4.4	6.4	0.0	0.0
290	16.9	10.7	4.3	6.2	0.0	0.0
300	16.5	10.4	4.1	6.0	0.0	0.0
310	16.0	10.1	4.0	5.9	0.0	0.0
320	15.6	9.9	3.9	5.7	0.0	0.0
330	15.3	9.6	3.8	5.6	0.0	0.0
340	14.9	9.4	3.7	5.4	0.0	0.0
350	14.6	9.2	3.7	5.3	0.0	0.0
360	14.2	9.0	3.6	5.2	0.0	0.0

Storage Volume Required (cu.m)	**41.9**
Storage Volume Provided (cu.m)	**41.9**
Depth of Storage (m) =	0.721
Orifice Size (mm) =	200
Orfice Flow (L/s) =	65.8

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15-23 Toryork Drive - Residential Development

Water Quality, Initial Abstraction and Water Balance Calculations
Based on WWFMG - City of Toronto

Designed By: **Angela Mokin**, P.Eng.
Checked By: **Paolo Albanese**, P.Eng.

File No. 20131
Date: 24 February 2023

Water Quality Management

BLOCK 1

Inferred Water Quality			% TSS Removal	Overall
Roof Bare	1824.0	60.4%	80	48.3
Green Roof	350.0	11.6%	80	9.3
Landscape	0.0	0.0%	80	0.0
Permeable	0.0	0.0%	80	0.0
Hard Surface	846.0	28.0%	0	0.0
	3020.0	100%		57.6

* Media filtration units are necessary.

BLOCK 2

Water Quality With Treatment			% TSS Removal	Overall
Roof Bare	3130.0	54.8%	80	43.9
Green Roof	440.0	7.7%	80	6.2
Landscape	150.0	2.6%	80	2.1
Permeable	0.0	0.0%	80	0.0
Hard Surface	1990.0	34.9%	0	0.0
	5710.0	100%		52.1

* Media filtration units are necessary.

BLOCK 3

Water Quality With Treatment			% TSS Removal	Overall
Roof Bare	1557.0	58.3%	80	46.7
Green Roof	50.0	1.9%	80	1.5
Landscape	160.0	6.0%	80	4.8
Permeable	0.0	0.0%	80	0.0
Hard Surface	902.0	33.8%	0	0.0
	2669.0	100%		53.0

* Media filtration units are necessary.

ROAD (N-S)

Water Quality With Treatment			% TSS Removal	Overall
Landscape	198.0	19.2%	80	15.4
Permeable	0.0	0.0%	80	0.0
Hard Surface	832.0	80.8%	0	0.0
	1030.0	100%		15.4

* Quality units are necessary.

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Water Quality With Treatment			% TSS Removal	Overall
Landscape	1100.0	60.8%	80	48.6
Permeable	0.0	0.0%	80	0.0
Hard Surface	710.0	39.2%	0	0.0
	1810.0	100%		48.6

* Quality units are necessary.

ROAD (E-W)

Water Quality With Treatment			% TSS Removal	Overall
Landscape	289.1	19.8%	80	15.8
Permeable	0.0	0.0%	80	0.0
Hard Surface	1171.0	80.2%	0	0.0
	1460.0	100%		15.8

* Quality units are necessary.

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Water Balance Management

BLOCK 1

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Roof Bare	1824.0	60.4%	1	0.6
Green Roof	350.0	11.6%	5	0.6
Landscape	0.0	0.0%	5	0.0
Permeable	0.0	0.0%	5	0.0
Hard Surface	846.0	28.0%	1	0.3
	3020.0	100%		1.5

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	1.5
Water Balance Shortfall (mm)	3.5
Required Infiltration Volume (m^3):	10.7

BLOCK 2

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Roof Bare	3130.0	54.8%	1	0.5
Green Roof	440.0	7.7%	5	0.4
Landscape	150.0	2.6%	5	0.1
Permeable	0.0	0.0%	5	0.0
Hard Surface	1990.0	34.9%	1	0.3
	5710.0	100%		1.4

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	1.4
Water Balance Shortfall (mm)	3.6
Required Infiltration Volume (m^3):	20.5

BLOCK 3

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Roof Bare	1557.0	58.3%	1	0.6
Green Roof	50.0	1.9%	5	0.1
Landscape	160.0	6.0%	5	0.3
Permeable	0.0	0.0%	5	0.0
Hard Surface	902.0	33.8%	1	0.3
	2669.0	100%		1.3

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	1.3
Water Balance Shortfall (mm)	3.7
Required Infiltration Volume (m^3):	9.8

ROAD (N-S)

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Landscape	198.0	19.2%	5	1.0
Permeable	0.0	0.0%	5	0.0
Hard Surface	832.0	80.8%	1	0.8
	1030.0	100%		1.8

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	1.8
Water Balance Shortfall (mm)	3.2
Required Infiltration Volume (m^3):	3.3

PARK

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Landscape	1100.0	60.8%	5	3.0
Permeable	0.0	0.0%	5	0.0
Hard Surface	710.0	39.2%	1	0.4
	1810.0	100%		3.4

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	3.4
Water Balance Shortfall (mm)	1.6
Required Infiltration Volume (m^3):	2.8

ROAD (E-W)

Post-Development Initial Abstraction			I.A. (mm)	V (mm)
Landscape	289.1	19.8%	5	1.0
Permeable	0.0	0.0%	5	0.0
Hard Surface	1171.0	80.2%	1	0.8
	1460.0	100%		1.8

Water Balance Target (mm)	5.0
Initial Abstraction (mm):	1.8
Water Balance Shortfall (mm)	3.2
Required Infiltration Volume (m^3):	4.7

APPENDIX F

15-23 Toryork Drive, Toronto, ON

M9L 1X9
Hydrogeological Investigation

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Type of Document:
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Project Name:
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2019-07-23
Revised: 2020-10-14

4 Results

4.1 Monitoring Well Details

The monitoring well network installed as part of the Geotechnical and Hydrogeological Investigations at the Site consists of the following:

- Five (5) shallow monitoring wells, including BH/MW 1, BH/MW 3, BH/MW 4, BH/MW 6, BH/MW 10 are completed to an approximate depth range from 12.1 to 14.6 mbgs;
- One (1) deep monitoring well (BH/MW 7) is completed to an approximate depth of 21.4 mbgs;
- Each monitoring well is equipped with a 50-mm (2-inch) diameter casing and a three (3)-meter long screen;
- Each monitoring well is completed with either over-ground or flush mount well protective casing.

Borehole and monitoring well installation logs are provided in Appendix B. The monitoring well locations are shown on Figure 4.

4.2 Water Level Monitoring

As part of the Hydrogeological Investigation, static water levels in the monitoring wells were recorded in six (6) monitoring events, including between May 13, 2019 and February 19, 2020. A summary of all static water level data as it relates to the elevation survey is summarized in Appendix C.

The groundwater elevations recorded for the shallow wells ranged from 139.60 masl (10.61 mbgs at BH/MW 3 on February 19, 2020) to 146.76 masl (3.93 mbgs at BH/MW 6 on May 13 and 30, 2019). The groundwater elevations recorded for the deep well ranged from 141.02 masl (9.45 mbgs on October 25, 2019 and January 22, 2020) to 141.37 masl (9.10 mbgs at BH/MW 7 on May 30, 2019).

A groundwater contour map is delineated for the shallow water-bearing zone for the Site (Figure 6). Accordingly, the groundwater flow directions in the shallow water-bearing zones interpreted to be southwest of the Site, towards Emery Creek, one of the tributaries of Humber River.

It should be noted that groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions; this may also affect the direction and rate of flow. It is recommended to conduct seasonal groundwater level measurements to provide more information on seasonal groundwater level fluctuations.

4.3 Hydraulic Conductivity Testing

A total of six (6) Single Well Response Tests (SWRT's) were completed in monitoring wells labeled as BH/MW1, BH/MW 3, BH/MW 4, BH/MW 6, BH/MW 7, and BH/MW 10 on May 13, 2019. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths.

The static water level within each monitoring well was measured prior to the start of testing. In advance of performing SWRTs, each monitoring well underwent development to remove fines introduced into the screens following construction. The development process involved purging of the monitoring wells to induce the flow of fresh formation water through the screen. Each monitoring well was permitted to fully recover prior to performing SWRTs.

Hydraulic conductivity values were calculated from the SWRT and constant rate test data as per Hvorslev's solution included in the AQTESOLV Pro. V.4.5 software package. The semi-log plots for normalized drawdown versus time are included in Appendix D.

A summary of the hydraulic conductivity (K) values estimated from the SWRTs are provided in Table 4-1.

Table 4-1: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs)*	Screen Interval (mbgs)		Soil Formation Screened**	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH/MW 1	14.6	11.6	14.6	Sand and Silt Till	8.2×10^{-8}
BH/MW 3	13.7	10.7	13.7	Sand and Silt Till/Clayey Silt Till	5.5×10^{-7}
BH/MW 4	12.1	9.1	12.1	Sand and Silt Till	1.6×10^{-7}
BH/MW 6	12.5	9.5	12.5	Sand and Silt Till/Clayey Silt Till	8.5×10^{-8}
BH/MW 7	21.4	18.4	21.4	Sand and Silt Till	1.9×10^{-8}
BH/MW 10	13	10	13	Sand and Silt Till	3.8×10^{-8}
Highest Estimated K Value					5.5×10^{-7}
Geometric Mean of Estimated K Values					8.7×10^{-8}

Notes:
*Well depth is based on the field measurements
** Soil descriptions are based on the borehole logs.

SWRTs provide estimates of K for the geological formation in the immediate media zone surrounding the well screens and may not be representative of bulk formation hydraulic conductivity. As shown in Table 3-2, the highest K for the tested water-bearing zones is estimated to be 5.5 x 10-7 m/s, and the geometric mean of the K values is to be 8.7 x 10-8 m/s.

4.4 Groundwater Quality

To assess the suitability for discharge of pumped groundwater to City of Toronto Sanitary and Strom Sewer during dewatering activities, one (1) groundwater sample was collected from monitoring well BH/MW 6 on May 30, 2019 using a bladder pump. Prior to the collection of noted water sample, approximately three (3) standing well volumes of groundwater were purged from the noted well.

The sample was collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The groundwater samples were submitted to a CALA certified independent laboratory, Bureau Veritas, in Mississauga, Ontario for analysis.

When compared to the Sanitary Sewer By-Law Limits (Table 1), the laboratory Certificate of Analysis (CofA) showed that all parameters were detected at concentrations below the Sanitary By-Law limits (Table 1).

When compared to the Storm Sewer By-Law Limits (Table 2), the CofA indicated that the concentrations of Total Suspended Solids (TSS) and Total Manganese (Mn) were reported above the Storm Sewer Use By-Law criteria.

Analytical results are provided in Appendix E. A summary of the pertinent results is provided in Table 4-2.

Table 4-2: Summary of Analytical Results

Parameter	City of Toronto Sanitary and Combined Sewer Discharge Limit (Table 1)	City of Toronto Storm Sewer Discharge Limit (Table 2)	Concentration BH/MW 6 May 30, 2019
Total Suspended Solids (mg/L)	350	15	90
Total Manganese (Mn) (µg/L)	5,000	50	170

Notes:
Bold indicates concentration exceeds the City of Toronto Storm Sewer Use By-Law Limit

For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed the both Sanitary and Storm By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.

For the long-term dewatering discharge to the Sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to discharge without a treatment system.

For the long-term dewatering discharge to the Storm sewer system (post-development phase) and based on the water quality results, it is recommended to implement a suitable pre-treatment as required.

It is noted that the water quality results presented in this report are not representative of the long-term condition of groundwater quality onsite. As such, regular water quality monitoring is recommended for the post-construction phase as required by the City.

An agreement to discharge to the City of Toronto will be required prior to discharging dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

5 Construction Dewatering Assessment

5.1 Construction Dewatering Rate Assumptions

It is in our understanding that the proposed development is anticipated to consist of an eighteen (18) -storey residential tower with P2 or P3 levels of common underground parking garage covering the entire Site area. As such two (2) separate construction dewatering scenarios have been considered for the Site.

Based on the Geotechnical Investigation Report (EXP, 2019), raft/mat foundation is recommended for the proposed structure. Should the foundation drainage not be permitted for the proposed building, the foundation is to be water-proofed to resists the uplifting hydrostatic pressure (EXP, 2019).

It should be noted that shoring drawings were not available at the time of this report. For this assessment, it was assumed that the proposed construction plans include an excavation with shoring extending to the Site boundaries. EXP should be retained to review the assumptions outlined in this section, should the proposed shoring design change. Table 5-1 presents the assumptions used to calculate the dewatering rate for the site.

Table 5-1 Dewatering Estimate Assumptions

Input Parameter		Assumption	Notes
Ground surface elevation		151.32 masl	Highest ground elevation shown on borehole logs (EXP, 2019)
Lowest Slab	P2		
	P3		
Lowest footing elevation	P2	144.2 masl	Based on the geotechnical report (EXP, 2019), the foundation is anticipated to be rested at 1.0 and 3.0 meters below the slab elevations for P2 and P3, respectively.
	P3	139.5 masl	
	P2	143.2 masl	
	P3	138.5 masl	
Base of the water-bearing zone	P2	141.10 masl	Based on the geotechnical borehole logs (EXP, 2019)
	P3	133.90 masl	

Input Parameter	Assumption	Notes
Groundwater elevation	146.76 masl	The highest representative groundwater elevation measured across the Site at BH/MW 6 (3.93 mbgs on May 13 and 30, 2019)
Hydraulic Conductivity (K)	5.5 x 10-7 m/s	Highest K values estimated for overburden

5.1.1 Dewatering Flow Rate Estimate and Zone of Influence

The Dupuit equation for steady linear flow to both sides of an excavation through an unconfined aquifer resting on a horizontal impervious surface was used to obtain a flow rate estimate. Dewatering flow rate is expressed as follows:

$$Q_w = xK(H^2 - h^2)/Lo$$

Where:

Qw = Rate of pumping (m3/sec)

X = Length of excavation (m)

K = Hydraulic conductivity (m/sec)

H = Saturated thickness of water-bearing zone beyond the influence of pumping (static groundwater elevation) (m)

h = Saturate thickness above the base of water-bearing zone in an excavation (m)

Lo = Distance of Influence (m)

It is expected that the initial dewatering rate will be higher to remove groundwater from the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint, as groundwater will have been removed, primarily from storage, resulting in lower seepage rates into the excavation.

5.1.2 Radius of Influence

The radius of influence (ROI) for the construction dewatering was calculated based on the empirical analytical solution developed by Cooper and Jacob. This equation is used to predict the radius of influence of pumping at a certain time during the dewatering operation.

The estimated radius of influence (Ro) of pumping based on the Copper-Jacob formulation is expressed as follows:

$$\mathrm{R_o} = \sqrt{\frac{2.25.K.D.t}{S}}$$

Where:

Ro = Estimated radius of influence (m)

K = Hydraulic Conductivity (m/sec)

D = Saturated thickness (m)

t = Elapsed time since pumping began (sec)

S = Storage (unitless)

Based on the Copper and Jacob formula using the highest K value and the storage of 0.1 for an unconfined water-bearing zone (storage=specific yield), the estimated zone of influences (Lo = Ro/2) from the sides of excavation for two (2) scenarios are presented in Table 5-2 below. A forty-five (45) day period is assumed to estimate the highest representative dewatering flow rates during the construction phase. The calculations for radius of influence and zone of influence are provided in Appendix F.

Table 5-2 Radius of Influence and Zone of Influence after 45 Days

Scenario	Radius of Influence (m) (Ro)	Zone of Influence (m) (Lo=Ro/2)
P2	16.5	8.2
P3	24.9	12.4

5.2 Stormwater

Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Therefore, the dewatering rates at the Site should also include removing direct input of stormwater into the excavation.

A 10 mm precipitation event was utilized for the estimate. Given that the total area of the excavation is approximately 15,600 m^2 the estimated volume of direct precipitation to be collected in the excavation is approximately 156 m^3 for a 10 mm precipitation event. The calculations for the stormwater estimate is included in Appendix F.

The estimate for stormwater only includes direct precipitation into the excavation. The dimensions of the excavation are considered in the dewatering calculations. Runoff from outside of the excavation's footprint is excluded and it should be directed away from the excavation.

During precipitation events greater than 10 mm (ex: 100-year storm), measures should be taken by the contractor to retain stormwater onsite in a safe manner to not exceed the allowable water taking and discharge limits, as necessary. A two (2) and a one hundred (100) year storm event over a 24-hour period are 57.3 and 124.9 mm, respectively, which would correspond to 895 and 1,952 m^3 of water from direct precipitation.

5.3 Results of Construction Dewatering Rate Estimate

Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows:

Table 5-3 Summary of Dewatering Flow Rate Estimate

Scenario	Dewatering Flow Rate, including Stormwater Collection Volume (m^3/day)		Notes
	Without Factor of Safety	With Factor of Safety	
P2	200	220	Representative hydraulic conductivity scenario-flow from overburden water-bearing zone
P3	295	365	

Construction dewatering flow rate estimate is provided in Appendix F.

Due to the presence of granular material (sand and silt till) below approximate elevation of 143 masl, pressure relief wells will be required for P3 during construction phase.

This peak dewatering flow rates accounts for accumulation of some precipitation, seasonal fluctuations in the groundwater table, flow from beddings of existing sewers, and variation in hydrogeological properties beyond those encountered during the course of this study. This peak dewatering flow rate also provides additional capacity for the dewatering contractor.

Pits (elevator, sump pits) are assumed to have the same excavation depth and dewatering target as the main excavation; deeper pits may require localized dewatering and revised dewatering estimates.

Localized dewatering may be required for pits (elevator pits, sump pits) if they extend deeper than the dewatering target. Localized dewatering is not considered to be part of this assessment. Dewatering estimates should be reviewed once the pit dimensions are available.

All grading around the perimeter of the Site should be graded away from the shoring the systems. The dewatering assumptions are based on using shoring system without open cuts.

It is noted that the maximum flow estimate equation calculated with a representative K value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering.

Please note that it is the responsibility of the contractor to ensure dry conditions are maintained within the excavation at all times and at all costs.

5.4 Construction MECP Water Taking Permit

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering will be more than 50 m3/day but less than 400 m3/day, application for the Environmental Activity and Sector Registry (EASR) with MECP is required. If groundwater dewatering rates on-Site exceed 400 m3/day, a Category 3 Permit to Take Water (PTTW) would be required from the MECP.

It is recognized that the maximum flow estimate equation calculated with a high K value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering. Based on the dewatering estimate of approximately 220 m^3/day for P2 and 365 m3/day for P3 scenarios, an EASR will be required to facilitate the construction dewatering program for the Site.

6 Sub-Drain Discharge Estimate

6.1 Long-Term Dewatering Rate Assessment

It is our understanding that the development plan includes a permanent foundation sub-drain system that will ultimately discharge to the municipal sewer system if conventional footings are installed.

To estimate the groundwater flow to the future sub-rain, the Dupuit equation for steady linear flow to both sides of a partially-penetrating excavation through an unconfined aquifer resting on a horizontal impervious surface was used to obtain a flow rate estimate. The analytical solution is expressed as follows:

$$Q_w = \left[0.73 + 0.23\left(\frac{P}{H}\right)\right] xK(H^2 - h^2)/Lo$$

Where:

Qw = Rate of pumping (m3/sec)
x = Length of excavation (m)
P = Depth of penetration of drainage (m)
K = Hydraulic conductivity (m/sec)
H = Saturated thickness of water-bearing zone for static water level conditions (m)
h = Saturated thickness above base of the water-bearing zone at the excavation (m)
Lo = Distance of Influence (Ro/2) (m)

The calculation for the estimated flow to the future sub-drain system (with no cut-off walls) is provided in Appendix G.

6.2 Sub-Drain Dewatering Flow Rate Assumptions

Table 6-1 presents the assumptions used to calculate the sub-drain flow rate.

Table 6-1 Sub-drain Estimate Assumptions

Input Parameter		Assumption	Notes
Ground surface elevation		151.32 masl	Highest ground elevation shown on borehole logs (EXP, 2019)
Lowest Slab Elevation	P2	145.2 masl	Based on the geotechnical report (EXP, 2019)
	P3	142.5 masl	
Dewatered elevation target	P2	144.7 masl	Assumed to be approx. 0.5 m below the lowest slab elevation.
	P3	142.0 masl	

Input Parameter		Assumption	Notes
Base of the water-bearing zone	P2	141.10 masl	Based on the geotechnical borehole logs (EXP, 2019)
	P3	133.90 masl	
Excavation Area		125 m x 125 m	Based on the geotechnical report (EXP, 2019), the Site covers a footprint of approximately 15,600 m^2
Groundwater elevation		146.76 masl	The highest representative groundwater elevation measured across the Site at BH/MW 6 (3.93 mbgs on May 13 and 30, 2019)
Hydraulic Conductivity (K)		5.5×10^{-7} m/s	Highest K values estimated for overburden

6.3 Sub-Drain Flow Rate Estimate

Based on the assumptions provided in this report, the results of the sub-drain discharge volume estimate are summarized in Table 6-2. Please note that this estimate is an indication of average discharge volumes. Seasonal and daily fluctuations are expected. These estimates may be affected by hydrogeological conditions beyond those encountered at this time, fluctuations in groundwater regimes, surrounding site alterations, and existing and future infrastructures.

Table 6-2 Summary of Long-Term Discharge Flow Rate

Flow Rate		Long Term Peak Flow Rate with Factor Safety (m3/day)
Flow into Sub-drain without caisson walls	P2	20
	P3	60

Due to the presence of granular material (sand and silt till) below approximate elevation of 143 masl, pressure relief wells may be required for P3 in the post-construction phase. The calculations are provided in Appendix G.

A one hundred and eighty (180) day period is assumed to estimate the highest representative flow rates for the future sub-drain systems. Intermittent cycling of sump pumps and seasonal fluctuation in groundwater regimes should be considered for pump specifications. A safety factor was applied to the flow rate to accommodate the variability in seasonal water level fluctuations.

The sub-drain discharge rate estimate is based on the assumptions outlined in this report, and that any variations in hydrogeological conditions beyond those encountered as part of this investigation may significantly influence the sub-drain discharge volumes. It is recommended that once the sub-drain system is in place, that a flow meter be installed at the sump (s) to record daily discharge volumes to provide more representative estimates during the commissioning stage of the system.

6.4 Post-Development MECP Water Taking Permit

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering will be more than 50 m3/day, application for a Category 3 Permit to Take Water (PTTW) would be required from the MECP.

It is recognized that the maximum flow estimate equation calculated with a high K value, provides a conservative estimate to account for higher than expected flow rates during the post-development dewatering. Based on the dewatering estimate of approximately 60 m3/day for P3 scenario, a Category 3 Permit to Take Water (PTTW) would be required to facilitate the post-development phase. However, since the estimated dewatering rate of 20 m3/day for the P2 scenario is less than 50 m3/day, a water-taking permit will not be required for long-term.

7 Environmental Impact

7.1 Surface Water Features

The Site is located within the Humber River watershed.

No surface water features are located onsite. The nearest surface water feature is one of the tributaries of Humber River named as Emery Creek, approximately located 155 m southwest of the Site boundary. Humber River is about one (1.0) kilometer (km) to the southwest of the Site. Lake Ontario is approximately 10 km from the Site boundary to the southeast.

Due to the limited extent of zone of influence and the distance of the nearest surface water feature, no impacts to surface water features are expected during construction activities.

7.2 Groundwater Sources

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the number of water supply wells present within a 500 m radius of the Site boundaries. Given that the dewatering zone of influence, no dewatering related impact is expected on the water wells in the area.

7.3 Geotechnical Considerations

Under certain conditions, dewatering activities can cause settlements due to an increase in the effective stress in the dewatered soil.

A letter related to geotechnical issues (i.e. settlement) as it pertains to the Site is recommended to be completed under a separate cover.

7.4 Groundwater Quality

It is our understanding that the potential discharge from the dewatering system during the construction will be directed to the municipal sewer system. As such, the quality of groundwater discharge is required to be in compliance with the City of Toronto Sewer Use By-Law.

When compared to the Sanitary Sewer By-Law Limits (Table 1), the laboratory Certificate of Analysis (CofA) showed that all parameters were detected at concentrations below the Sanitary By-Law limits (Table 1).

When compared to the Storm Sewer By-Law Limits (Table 2), the CofA indicated that the concentrations of Total Suspended Solids (TSS) and Total Manganese (Mn) were reported above the Storm Sewer Use By-Law criteria.

For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed the both Sanitary and Storm By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.

For the long-term dewatering discharge to the Sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to discharge without a treatment system.

For the long-term dewatering discharge to the Storm sewer system (post-development phase) and based on the water quality results, it is recommended to implement a suitable pre-treatment as required.

It is noted that the water quality results presented in this report are not representative of the long-term condition of groundwater quality onsite. As such, regular water quality monitoring is recommended for the post-construction phase as required by the City.

An agreement to discharge to the City of Toronto will be required prior to discharging dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

7.5 Well Decommissioning

In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

8 Conclusions and Recommendations

Based on the findings of the Hydrogeological Investigation, the following summary of conclusions and recommendations is provided:

- The laboratory CofA showed that all parameters were detected at concentrations below the Sanitary and Combined Sewer By-Law limits (Table 1 of the By-law).
- When compared to the Storm Sewer By-Law Limits (Table 2), the CofA indicated that the concentrations of Total Suspended Solids (TSS) and Total Manganese (Mn) were reported above the Storm Sewer Use By-Law criteria.
- Based on the dewatering estimate of approximately 220 m3/day for P2 and 365 m3/day for P3 scenarios, an EASR will be required to facilitate the construction dewatering program for the Site.
- The long-term flow rate of the foundation sub-drain for P2 and P3 scenarios are estimated to be approximately 20 m^3/day and 60 m^3/day, respectively. Since the estimated flow volume for P3 scenario exceeds 50 m^3/day, a Category 3 PTTW would be required for post-construction phase; whereas for P2 scenario, no water-taking permit will be required. The exact volume discharged can be confirmed once the system is operational. It is recommended that once the sub-drain system is in place, a flow meter be installed at the sump(s) to record daily discharge volumes to provide more representative estimates during the commissioning stage of the system. Regular maintenance/cleaning of the sub-drain system is recommended to ensure its proper operation.
- The construction dewatering and long-term estimate of sub-drain discharge volumes is based on the assumptions outlined in this report, and that any variations in hydrogeological conditions beyond those encountered as part of this preliminary investigation may significantly influence the discharge volumes.
- Due to the presence of granular material (sand and silt till) below elevation 143 masl, pressure relief wells will be required during for a P3 during construction and may be required in post construction. This should be reviewed once foundation plans are available.
- For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed the both Sanitary and Storm By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.
- For the long-term dewatering discharge to the Sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to discharge without a treatment system.
- For the long-term dewatering discharge to the Storm sewer system (post-development phase) and based on the water quality results, it is recommended to implement a suitable pre-treatment as required.
- It is noted that an agreement to discharge to the City of Toronto will be required prior to discharging dewatering effluent.
- In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

The conclusions and recommendations provided above should be reviewed in conjunction with the entirety of the report where they are based on the assumptions that the present design concept described throughout the report will proceed to construction. This report is solely intended for the construction and long-term dewatering assessments. Any changes to the design concept may result in a modification to the recommendations provided in this report.

9 Limitations

This report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the study area. The conclusions and recommendations presented within this report reflect Site conditions existing at the time of the assessment. EXP must be contacted immediately if any unforeseen Site conditions are experienced during construction activities. This will allow EXP to review the new findings and provide appropriate recommendations to allow the construction to proceed in a timely and cost-effective manner.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the geoscience/engineering profession. No other warranty or representation, either expressed or implied, is included or intended in this report.

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We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

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