

Willow Road Proposed Conditions*Type III 24-hr 100 Year Rainfall=8.10"*

Prepared by The Morin-Cameron Group, Inc.

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Events for Reach DP2:

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
2 Year	1.2	1.2	0.00	0
10 Year	4.8	4.8	0.00	0
25 Year	8.6	8.6	0.00	0
50 Year	13.9	13.9	0.00	0
100 Year	18.8	18.8	0.00	0

comply with the Handbook standards for development projects. The Handbook lists 10 standards covering both mitigation and renovation of stormwater runoff. A full discussion on the project compliance with the standards can be found at the end of this report. However, the following section will summarize the project's compliance with the mitigation standards 1 and 2 of the Handbook relating to reducing peak rates of runoff and creating no adverse down gradient impacts.

To demonstrate that there will be no downstream impacts because of developing the site, a stormwater analysis was performed using the U.S. Soil Conservation Service (S.C.S) method of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service, along with the precipitation values listed in Boxford's Stormwater Management Bylaw. The software application HydroCAD was utilized to analyze the pre and post-development watershed conditions.

The following is a listing of the total pre-and post-development rates of stormwater runoff for the primary Design Points for the 2, 10, 25, 50 and 100-year rainfall events. The dedicated vernal pool Design Points (2A, 3A & 5A) were not individually analyzed because they are tributary to other Design Points (2, 3 & 5) as described previously.

Comparison of Existing and Proposed Rates of Runoff

<u>Design Point</u>	<u>Storm Event</u> (Years)	<u>Existing Conditions</u> (Peak CFS)	<u>Proposed Conditions</u> (Peak CFS)	<u>Change in Peak</u> (CFS)
<u>DP-1</u>	2	1.4	1.2	-0.2
	10	6.6	6.4	-0.2
	25	11.0	10.7	-0.3
	50	14.5	14.3	-0.2
	100	18.5	18.4	-0.1
<u>DP-2</u>	2	1.2	1.2	0.0
	10	6.7	5.0	-1.7
	25	11.2	9.1	-2.1
	50	14.8	14.2	-0.6
	100	19.1	19.0	-0.1
<u>DP-3</u>	2	1.0	0.7	-0.3
	10	5.4	5.3	-0.1
	25	9.1	8.8	-0.3
	50	12.1	11.5	-0.6
	100	15.6	14.6	-1.0

Pipe Sizing Calculation Spreadsheet:

THE MORIN-CAMERON GROUP, INC.

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Name: The Willows at Boxford
Location: Willow Road
Boxford, MA
County: Essex County
Owner: Toll Brothers, Inc.

Proj. No.: 3717
Date: 11/19/2020
Revised: 6/15/2021
Computed by: Daniel J. Powers, P.E.
Checked by: Scott P, Cameron, P.E.

Design Parameters:

IDF Curve

100 Year Storm Boston, MA

k_e= 0.2

DESCRIPTION	LOCATION		AREA (AC.)	C	C x A	SUM C x A	FLOW TIME (MIN)		i*	DESIGN					CAPACITY		PIPE PROFILE				
	FROM	TO					PIPE	CONC. TIME		Q cfs	V fps	n	PIPE SIZE	SLOPE	Q full ft^3/s	V full ft/s	LENGTH ft	FALL ft	RIM	INV UPPER	INV LOWER
CB-1	CB-1	CDS-1	0.21	0.84	0.17	0.17	0.09	6.0	7.0	1.2	3.1	0.012	12	0.006	3.1	4.0	17	0.11	124.85	121.64	121.53
CB-2	CB-2	CDS-1	0.15	0.90	0.13	0.13	0.01	6.0	7.0	0.9	4.2	0.012	12	0.020	5.5	6.9	2	0.04	124.85	121.64	121.60
CDS-1	CDS-1	FES-1	-	-	-	0.31	0.40	6.1	7.0	2.1	3.4	0.012	12	0.005	2.7	3.5	81	0.41	124.84	121.49	121.08
CB-3	CB-3	DMH-1	0.30	0.75	0.22	0.22	0.10	6.0	7.0	1.6	3.9	0.012	12	0.010	3.9	4.9	24	0.24	120.53	117.32	117.08
CB-4	CB-4	DMH-1	0.42	0.59	0.25	0.25	0.09	6.0	7.0	1.7	4.1	0.012	12	0.010	3.9	5.0	23	0.24	120.53	117.32	117.08
DMH-1	DMH-1	DMH-2	-	-	-	0.47	0.16	6.1	7.0	3.3	6.1	0.012	12	0.020	5.5	6.9	58	1.16	120.24	117.00	115.84
DMH-2	DMH-2	DMH-3	-	-	-	0.47	0.35	6.3	6.9	3.2	6.1	0.012	12	0.019	5.4	6.8	126	2.43	118.94	115.74	113.31
CB-5	CB-5	DMH-3	0.29	0.76	0.22	0.22	0.05	6.0	7.0	1.5	3.9	0.012	12	0.010	3.9	4.9	12	0.12	116.77	113.56	113.44
CB-6	CB-6	DMH-3	0.21	0.69	0.14	0.14	0.06	6.0	7.0	1.0	3.4	0.012	12	0.010	3.9	4.9	12	0.12	116.77	113.56	113.44
DMH-3	DMH-3	DMH-7	-	-	-	0.83	0.44	6.1	7.0	5.8	7.7	0.012	12	0.023	5.8	7.4	202	4.60	116.99	113.21	108.61
CB-7	CB-7	DMH-4	0.71	0.52	0.37	0.37	0.13	6.0	7.0	2.6	6.2	0.012	12	0.024	6.0	7.7	49	1.19	120.83	117.59	116.40
CB-8	CB-8	DMH-4	0.04	0.90	0.04	0.04	0.31	6.0	7.0	0.2	2.7	0.012	12	0.023	5.9	7.5	51	1.19	120.83	117.59	116.40
DMH-4	DMH-4	DMH-5	-	-	-	0.40	0.57	6.3	6.9	2.8	4.6	0.012	12	0.010	3.9	4.9	159	1.59	122.24	116.30	114.71
DMH-5	DMH-5	DMH-6	-	-	-	0.40	0.37	6.9	6.8	2.7	4.6	0.012	12	0.010	3.9	4.9	102	1.02	121.29	114.61	113.59
CB-9	CB-9	DMH-6	0.32	0.53	0.17	0.17	0.07	6.0	7.0	1.2	4.6	0.012	12	0.020	5.5	6.9	19	0.38	118.66	115.51	115.13
CB-10	CB-10	DMH-6	0.06	0.90	0.05	0.05	0.06	6.0	7.0	0.4	3.5	0.012	12	0.032	6.9	8.7	12	0.38	118.66	115.51	115.13
DMH-6	DMH-6	DMH-7	-	-	-	0.62	0.17	7.3	6.7	4.2	6.7	0.012	12	0.020	5.5	6.9	70	1.40	118.54	113.49	112.09
DMH-7	DMH-7	FES-2	-	-	-	1.46	0.29	7.4	6.6	9.7	6.0	0.012	18	0.008	10.2	5.8	105	0.84	118.06	108.51	107.67
CB-11	CB-11	DMH-8	0.22	0.79	0.17	0.17	0.05	6.0	7.0	1.2	5.2	0.012	12	0.031	6.8	8.6	15	0.46	116.08	112.87	112.41
CB-12	CB-12	DMH-8	0.36	0.63	0.22	0.22	0.08	6.0	7.0	1.6	5.0	0.012	12	0.020	5.5	6.9	23	0.46	116.08	112.87	112.41
DMH-8	DMH-8	FES-3	-	-	-	0.39	0.13	6.1	7.0	2.8	5.7	0.012	12	0.018	5.2	6.6	45	0.81	116.24	112.31	111.50
CB-16	CB-16	DMH-9	0.31	0.72	0.22	0.22	0.05	6.0	7.0	1.5	5.5	0.012	12	0.026	6.2	7.9	15	0.39	120.22	117.01	116.62
CB-15	CB-15	DMH-9	0.37	0.69	0.25	0.25	0.04	6.0	7.0	1.8	6.0	0.012	12	0.030	6.7	8.5	13	0.39	120.22	117.01	116.62
DMH-9	DMH-9	DMH-10	-	-	-	0.48	0.28	6.0	7.0	3.3	8.6	0.012	12	0.049	8.5	10.9	142	6.93	119.73	116.52	109.59
DMH-10	DMH-10	DMH-11	-	-	-	0.48	0.26	6.3	6.9	3.3	6.6	0.012	12	0.024	6.0	7.6	104	2.49	112.75	109.49	107.00

DESCRIPTION	LOCATION		AREA (AC.)	C	C x A	SUM C x A	FLOW TIME (MIN)		i*	DESIGN					CAPACITY		PIPE PROFILE				
	FROM	TO					PIPE	CONC. TIME		Q cfs	V fps	n	PIPE SIZE	SLOPE	Q full ft^3/s	V full ft/s	LENGTH ft	FALL ft	RIM	INV UPPER	INV LOWER
CB-13	CB-13	DMH-11	0.64	0.73	0.47	0.47	0.04	6.0	7.0	3.3	4.9	0.012	12	0.010	3.9	4.9	12	0.12	110.64	107.43	107.31
CB-14	CB-14	DMH-11	0.69	0.67	0.46	0.46	0.02	6.0	7.0	3.3	5.6	0.012	12	0.015	4.7	6.0	8	0.12	110.64	107.43	107.31
DMH-11	DMH-11	CDS-2	-	-	-	1.41	0.15	6.6	6.9	9.7	6.2	0.012	18	0.009	10.7	6.1	55	0.49	110.84	107.00	106.51
CDS-2	CDS-2	FES-4	-	-	-	1.41	0.66	6.7	6.8	9.6	5.8	0.012	18	0.007	9.8	5.6	229	1.71	111.63	106.51	104.80