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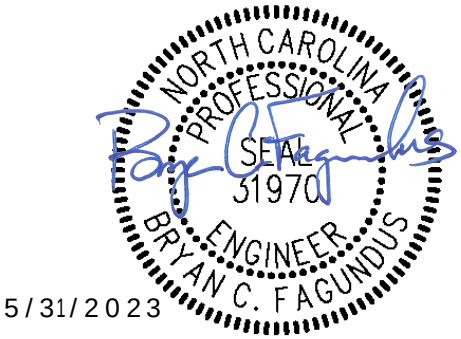
MEMORANDUM



Date: May, 31 2023

To: Wake County, NC; Town of Rolesville, NC

From: Bryan C. Fagundus, PE

Subject: Public Storm Sewer Pipe Network Design – Virginia Water Drive Extension & 7Eleven at Wallbrook – Rolesville, Wake County, NC

Project Summary

The purpose of this memorandum is to present the design calculations for the public storm sewer pipe network for Virginia Water Drive Extension and 7Eleven at Wallbrook. The total development consists of approximately 7.04 acres with approximately 0.32 acres within the public rights-of-way of Virginia Water Drive. The site is located on the North side of Main Street (US 401) in Rolesville, NC. (Reference Wallbrook Preliminary Plat PR21-04, Wallbrook Roadway Improvements – Virginia Water Drive Extension CID23-04, and 7Eleven at Wallbrook – Lot 11 SDP23-04).

Line 7 (DI-106) represents the future drainage area covering approximately half of 3.13 acre Lot 10 as shown on PR 21-04 to the proposed public storm sewer system. Line 1 represents the connection to NCDOT U-6241 30" RCP storm stub serving as the outlet for Lot 11.

Calculation Methodology & Constants

- A minimum time of concentration of 5 minutes was utilized
- A minimum rational C value of 0.85 was utilized
- All pipes are RCP using a Manning's n value of 0.013
- The minimum pipe size used is 15"
- Rainfall data was taken from NOAA Atlas 14 at the Neuse 2 NE station

Analysis

The pipe networks were modeled using Autodesk Civil 3D and the model data was exported to Hydraflow Storm Sewer software for analysis. The attached results show that the drainage network meets Wake County and Town of Rolesville regulations and standards as follows:

- The gutter spread for the 1-year, approximately 4 in/hr storm, does not encroach more than 10' into the adjacent driving lane for the public storm sewer system.
- The total flow (cfs) within the storm sewer system does not exceed the flow capacity (cfs) in the pipe network in the 10-year rain event for storm sewer system.
- The 10-yr rain event HGL is contained within the public storm sewer system.

Drainage Area Map and Supporting Documents

NOAA Atlas 14, Volume 2, Version 3
Location name: Raleigh, North Carolina, USA*
Latitude: 35.9167°, Longitude: -78.5667°
Elevation: 243.35 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.82** (4.42-5.28)	**5.62** (5.15-6.13)	**6.42** (5.89-7.01)	**7.18** (6.56-7.82)	**7.94** (7.24-8.66)	**8.53** (7.74-9.30)	**9.06** (8.16-9.86)	**9.50** (8.53-10.4)	**10.0** (8.90-10.9)	**10.4** (9.20-11.4)
10-min	**3.85** (3.53-4.21)	**4.49** (4.12-4.91)	**5.15** (4.72-5.62)	**5.74** (5.25-6.26)	**6.33** (5.77-6.90)	**6.79** (6.16-7.40)	**7.19** (6.49-7.84)	**7.54** (6.76-8.23)	**7.92** (7.04-8.64)	**8.22** (7.25-8.99)
15-min	**3.21** (2.94-3.51)	**3.76** (3.45-4.11)	**4.34** (3.98-4.74)	**4.84** (4.43-5.28)	**5.35** (4.87-5.83)	**5.74** (5.20-6.25)	**6.06** (5.47-6.60)	**6.34** (5.68-6.92)	**6.64** (5.91-7.25)	**6.88** (6.06-7.52)
30-min	**2.20** (2.02-2.41)	**2.60** (2.38-2.84)	**3.08** (2.83-3.36)	**3.51** (3.21-3.82)	**3.96** (3.61-4.32)	**4.32** (3.92-4.71)	**4.64** (4.19-5.06)	**4.93** (4.42-5.38)	**5.29** (4.70-5.77)	**5.57** (4.91-6.09)
60-min	**1.37** (1.26-1.50)	**1.63** (1.50-1.78)	**1.98** (1.81-2.16)	**2.28** (2.09-2.49)	**2.64** (2.40-2.88)	**2.93** (2.65-3.19)	**3.20** (2.88-3.48)	**3.46** (3.10-3.78)	**3.79** (3.37-4.14)	**4.07** (3.59-4.44)
2-hr	**0.800** (0.728-0.883)	**0.956** (0.872-1.05)	**1.17** (1.06-1.28)	**1.36** (1.24-1.50)	**1.60** (1.44-1.75)	**1.80** (1.61-1.97)	**1.99** (1.77-2.17)	**2.18** (1.93-2.38)	**2.43** (2.13-2.65)	**2.64** (2.30-2.89)
3-hr	**0.565** (0.514-0.625)	**0.675** (0.616-0.744)	**0.829** (0.755-0.913)	**0.974** (0.884-1.07)	**1.15** (1.04-1.26)	**1.31** (1.17-1.43)	**1.46** (1.30-1.60)	**1.62** (1.43-1.77)	**1.83** (1.60-2.00)	**2.01** (1.74-2.21)
6-hr	**0.340** (0.311-0.375)	**0.407** (0.373-0.447)	**0.500** (0.457-0.549)	**0.588** (0.536-0.644)	**0.699** (0.632-0.764)	**0.796** (0.716-0.869)	**0.893** (0.796-0.973)	**0.994** (0.877-1.08)	**1.13** (0.985-1.23)	**1.25** (1.08-1.37)
12-hr	**0.200** (0.183-0.220)	**0.239** (0.220-0.261)	**0.295** (0.270-0.323)	**0.349** (0.318-0.381)	**0.417** (0.378-0.455)	**0.478** (0.431-0.519)	**0.540** (0.481-0.586)	**0.606** (0.534-0.657)	**0.697** (0.604-0.754)	**0.778** (0.664-0.843)
24-hr	**0.119** (0.111-0.128)	**0.144** (0.134-0.154)	**0.180** (0.168-0.193)	**0.209** (0.194-0.224)	**0.248** (0.230-0.266)	**0.279** (0.258-0.299)	**0.310** (0.286-0.333)	**0.343** (0.315-0.368)	**0.387** (0.355-0.415)	**0.422** (0.385-0.454)
2-day	**0.069** (0.064-0.074)	**0.083** (0.078-0.089)	**0.103** (0.096-0.111)	**0.119** (0.111-0.128)	**0.141** (0.131-0.151)	**0.158** (0.146-0.169)	**0.175** (0.162-0.188)	**0.192** (0.177-0.207)	**0.217** (0.199-0.233)	**0.235** (0.215-0.254)
3-day	**0.049** (0.046-0.052)	**0.059** (0.055-0.063)	**0.073** (0.068-0.078)	**0.083** (0.078-0.089)	**0.098** (0.092-0.105)	**0.110** (0.102-0.118)	**0.122** (0.113-0.131)	**0.134** (0.124-0.144)	**0.151** (0.139-0.162)	**0.165** (0.150-0.177)
4-day	**0.039** (0.036-0.041)	**0.046** (0.043-0.049)	**0.057** (0.054-0.061)	**0.066** (0.061-0.070)	**0.077** (0.072-0.082)	**0.086** (0.080-0.092)	**0.096** (0.089-0.102)	**0.105** (0.097-0.113)	**0.119** (0.109-0.127)	**0.129** (0.118-0.138)
7-day	**0.026** (0.024-0.027)	**0.031** (0.029-0.032)	**0.037** (0.035-0.040)	**0.042** (0.040-0.045)	**0.050** (0.046-0.053)	**0.055** (0.052-0.059)	**0.061** (0.057-0.065)	**0.067** (0.062-0.072)	**0.075** (0.069-0.080)	**0.082** (0.075-0.087)
10-day	**0.020** (0.019-0.022)	**0.024** (0.023-0.026)	**0.029** (0.027-0.031)	**0.033** (0.031-0.035)	**0.038** (0.036-0.041)	**0.042** (0.039-0.045)	**0.046** (0.043-0.049)	**0.050** (0.047-0.054)	**0.056** (0.052-0.060)	**0.060** (0.056-0.065)
20-day	**0.014** (0.013-0.015)	**0.016** (0.015-0.017)	**0.019** (0.018-0.020)	**0.021** (0.020-0.023)	**0.024** (0.023-0.026)	**0.027** (0.025-0.029)	**0.029** (0.027-0.031)	**0.032** (0.030-0.034)	**0.035** (0.033-0.038)	**0.038** (0.035-0.041)
30-day	**0.011** (0.011-0.012)	**0.013** (0.013-0.014)	**0.015** (0.015-0.016)	**0.017** (0.016-0.018)	**0.019** (0.018-0.021)	**0.021** (0.020-0.022)	**0.023** (0.021-0.024)	**0.024** (0.023-0.026)	**0.027** (0.025-0.028)	**0.028** (0.026-0.030)
45-day	**0.010** (0.009-0.010)	**0.011** (0.011-0.012)	**0.013** (0.012-0.014)	**0.014** (0.013-0.015)	**0.016** (0.015-0.017)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.022** (0.021-0.023)
60-day	**0.009** (0.008-0.009)	**0.010** (0.010-0.011)	**0.011** (0.011-0.012)	**0.012** (0.012-0.013)	**0.014** (0.013-0.014)	**0.015** (0.014-0.015)	**0.016** (0.015-0.016)	**0.017** (0.016-0.017)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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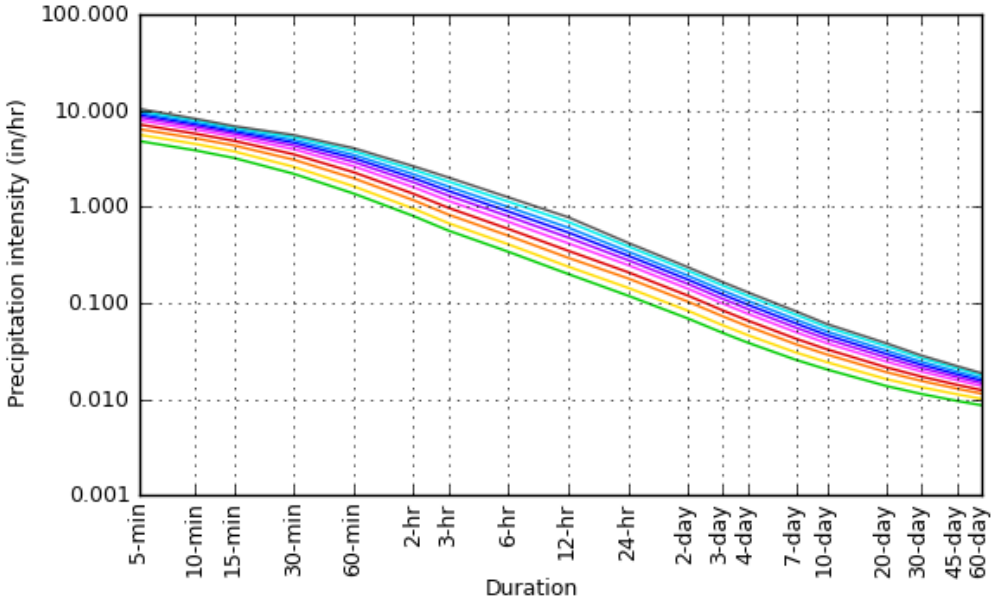
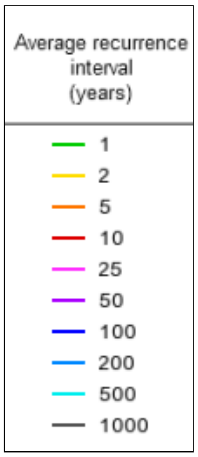
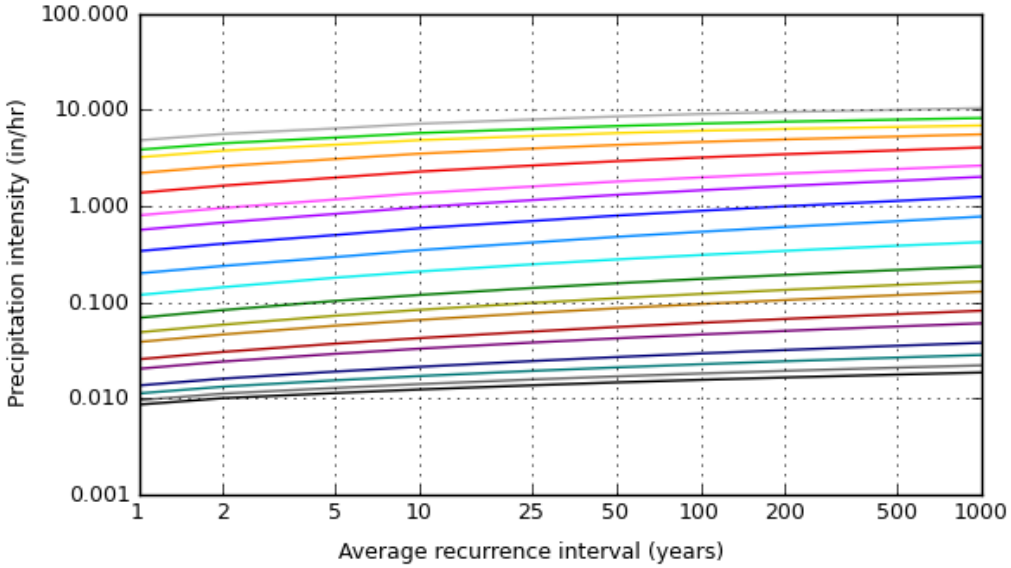
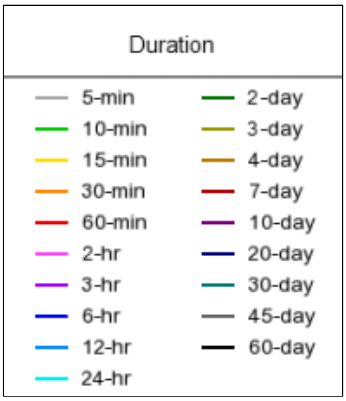
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 35.9167°, Longitude: -78.5667°









NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Fri Jan 6 13:04:06 2023

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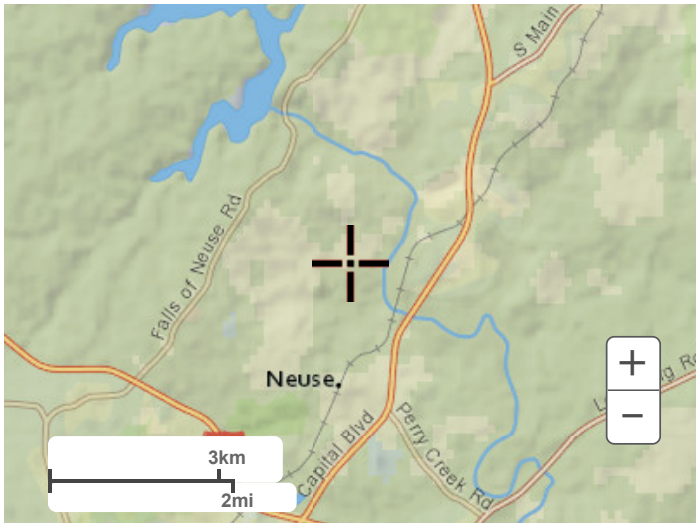
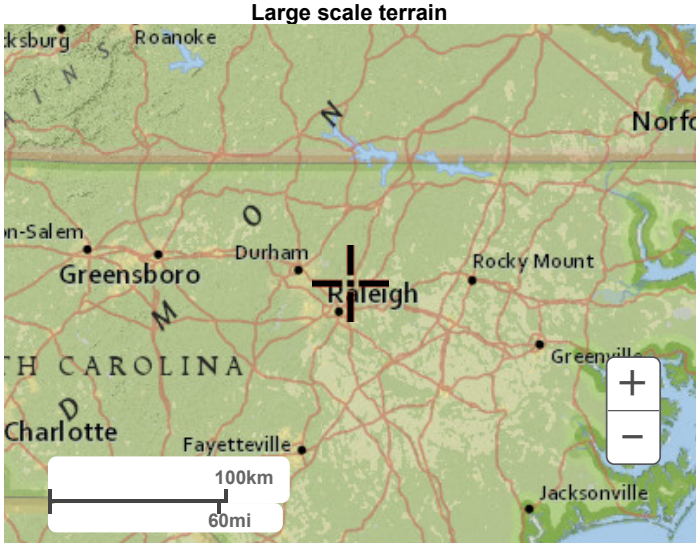
Maps & aerials

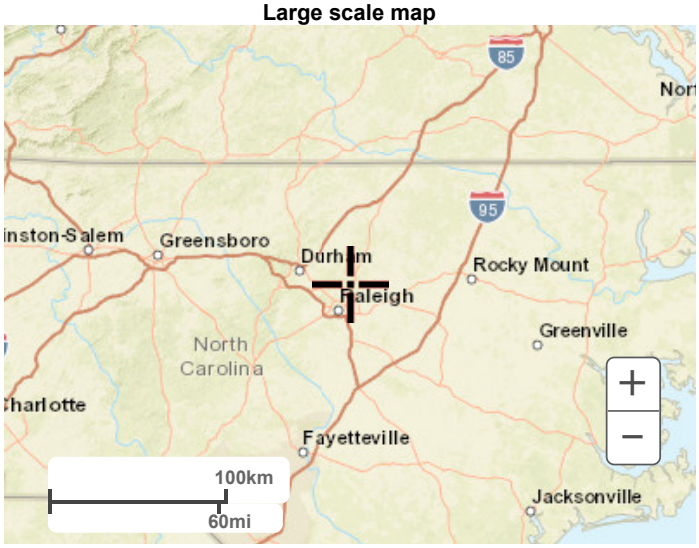
Small scale terrain



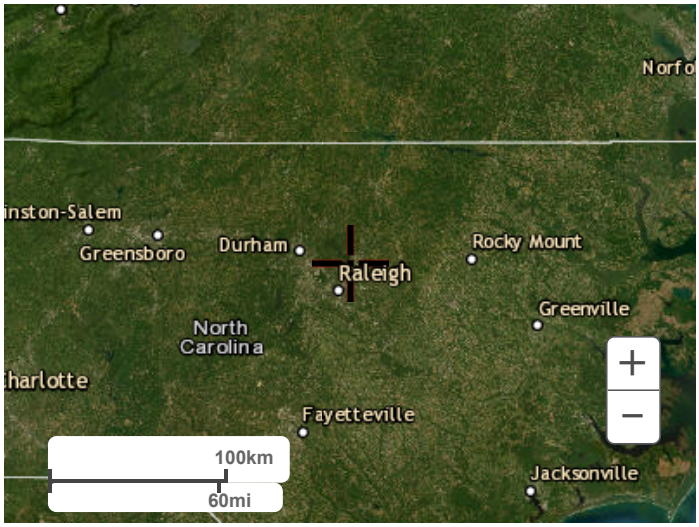
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

NC STATE GRID (NAD83)

DA-106
1.57 ACRES

DA-105
0.20 ACRES

DA-104
0.10 ACRES

DA-103
0.05 ACRES

DA-101
0.47 ACRES

DA-100
0.25 ACRES

DA-100B
0.23 ACRES

DA-100A
0.02 ACRES

DA-0517
0.03 ACRES

DA-0510
0.03 ACRES

DI-106
RIM 397.19
OUT 387.97 (CB-105)

CB-105
RIM 397.04
INV. 387.83 (DI-106)
OUT 387.63 (CB-104)

CB-104
RIM 397.03
INV. 387.42 (CB-105)
OUT 387.22 (CB-103)

CB-103
RIM 397.54
INV. 386.39 (CB-104)
OUT 386.19 (STMH-102)

STMH-102
RIM 397.66
INV. 385.88 (CB-103)
OUT 385.68 (CB-101)

CB-101
RIM 394.02
INV. 384.38 (STMH-102)
OUT 384.18 (CB-100)

CB-100
RIM 394.45
INV. 383.27 (CB-101)
INV. 384.32 (CB-100A)
OUT 383.07 (NCDOT STUB)

CB-100B
RIM 394.38
OUT 385.78 (CB-100A)

CB-100A
RIM 394.09
INV. 385.07 (CB-100B)
OUT 384.87 (CB-100)

NCDOT STUB
INV. 383.00

24" RCP @ 0.75%

15" RCP @ 2.00%

S 51°08'47" E 559.19'(M)

VIRGINIA WATER DRIVE
(60' PUBLIC R/W - 41 B/B)

US 401 BUSINESS - S. MAIN ST.
(VARIABLE WIDTH PUBLIC R/W)

GRAVEL ROAD

GATE

20' 0 10' 20'
SCALE 1 inch = 20 ft

- Final Drawing -
Issued for Permit
Review Purposes Only

REVISIONS:

#	DATE	DESCRIPTION
1	1-MAY-23	ISSUED FOR PERMIT REVIEW
2	1-JUNE-23	REVISED PER TON REVIEW COMMENTS

CROSLAND SOUTHEAST

ELEVEN

DRAINAGE AREAS MAP

7ELEVEN AT WALLBROOK (LOT 11)

Town of Rolesville Project No. SDP 23-04

US 401 Business / S. Main Street & Virginia Water Drive
Wake Forest Township, Town of Rolesville, Wake County, North Carolina

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 037070 BRIAN C. FAGUNDES

PRELIMINARY PLANS NOT FOR CONSTRUCTION OR RECORDATION PURPOSES

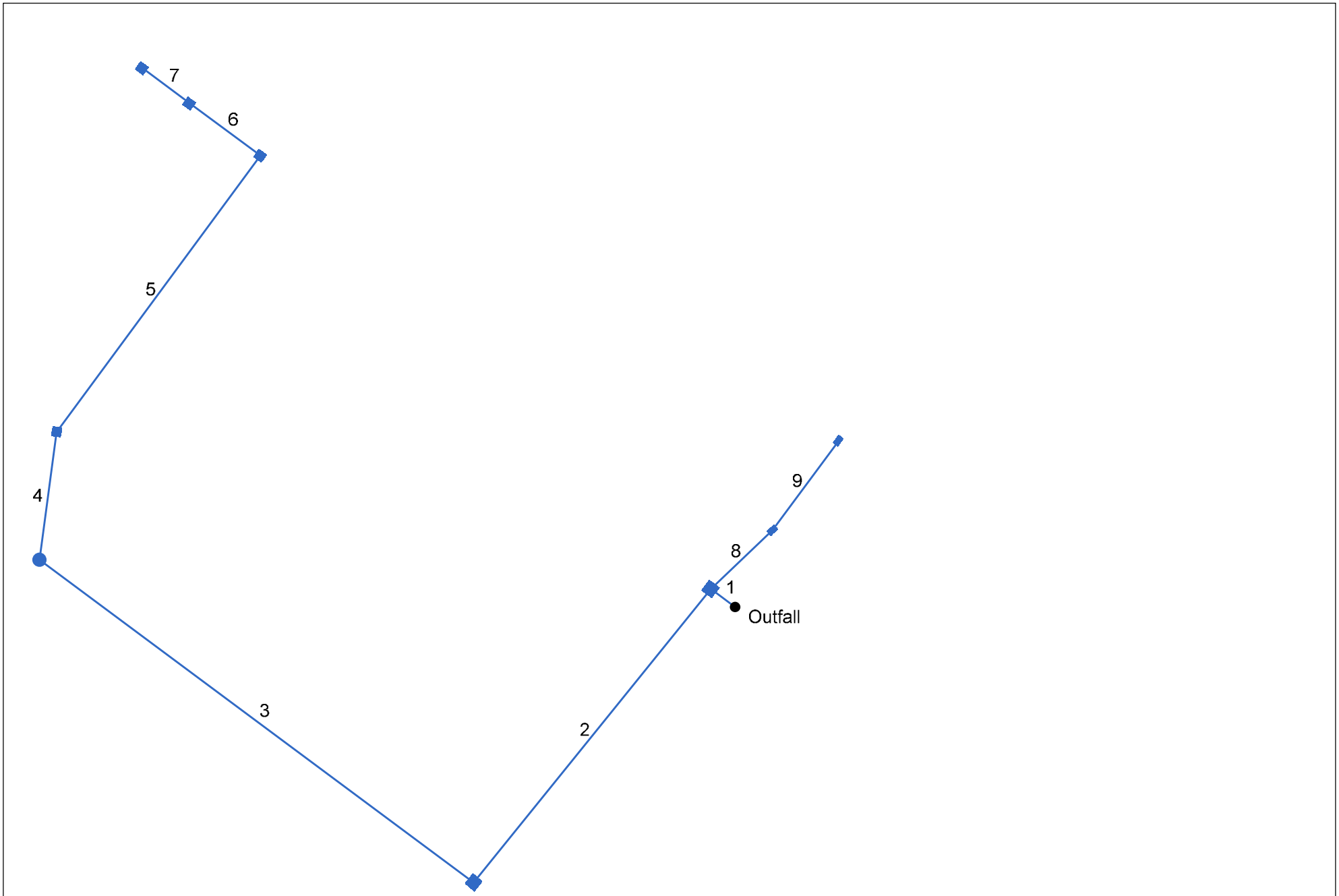
6/1/2023

Project Manager:	BCF
Drawn By:	DLC/TN
Checked By:	TN
Project Number:	22049
Drawing Number:	D-1404-SDP

DA

Date: May 1, 2023

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 2023-05-31 - Wallbrook 7Eleven.stm	Number of lines: 9	Date: 5/31/2023

1-Year Rain Event Results for Gutter Spread

Inlets

Line No.	Inlet ID	Drng Area (ac)	Inlet Time (min)	i Inlet (in/hr)	Runoff Coeff (C)	Flow Rate (cfs)	Line Type	Grate Area (sqft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Local Depr (in)	Gutter Spread (ft)	Gutter Depth (ft)
1	CB-100	0.25	5.0	4.82	0.85	10.15	Cir	3.10	0.056	0.020	2.0	3.06	0.13
2	CB-101	0.47	5.0	4.82	0.85	8.65	Cir	3.10	0.056	0.030	2.0	3.56	0.16
3	STMH-102	0.00	0.0	0.00	0.00	7.34	Cir	....	....	....	....	....	....
4	CB-103	0.05	5.0	4.82	0.85	7.44	Cir	....	0.056	0.020	2.0	1.70	0.10
5	CB-104	0.10	5.0	4.82	0.85	7.52	Cir	3.10	0.056	0.020	2.0	1.42	0.03
6	CB-105	0.20	5.0	4.82	0.85	7.19	Cir	3.10	0.056	0.020	2.0	2.18	0.12
7	DI-106	1.57	5.0	4.82	0.85	6.43	Cir	3.10	0.056	0.020	2.0	17.74	0.43
8	CB-100A	0.02	5.0	4.82	0.85	0.99	Cir	3.10	0.056	0.030	2.0	0.56	-0.09
9	CB-100B	0.23	5.0	4.82	0.85	0.94	Cir	3.10	0.056	0.030	2.0	2.48	0.13

Project File: 2023-05-31 - Wallbrook 7Eleven.stm | Number of lines: 9 | Date: 5/31/2023

NOTES: Intensity = 62.18 / (Inlet time + 12.70) ^ 0.89 -- Return period = 1 Yrs. ; ** Critical depth

10-Year Rain Event Results

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	9.757	0.25	2.89	0.85	0.21	2.46	5.0	7.2	6.5	16.01	34.74	4.93	30	0.72	383.00	383.07	384.93	384.42	0.00	394.45	D-100
2	1	120.987	0.47	2.39	0.85	0.40	2.03	5.0	6.8	6.6	13.50	19.62	6.43	24	0.75	383.27	384.18	384.49	385.50	394.45	394.02	D-101
3	2	173.661	0.00	1.92	0.00	0.00	1.63	0.0	5.9	6.9	11.23	19.57	5.95	24	0.75	384.38	385.68	385.50	386.88	394.02	397.66	D-102
4	3	41.287	0.05	1.92	0.85	0.04	1.63	5.0	5.8	6.9	11.32	19.60	6.09	24	0.75	385.88	386.19	386.97	387.40	397.66	397.54	D-103
5	4	110.121	0.10	1.87	0.85	0.09	1.59	5.0	5.2	7.1	11.28	19.64	6.09	24	0.75	386.39	387.22	387.48	388.42	397.54	397.04	D-104
6	5	28.000	0.20	1.77	0.85	0.17	1.50	5.0	5.1	7.1	10.75	19.59	5.99	24	0.75	387.42	387.63	388.48	388.80	397.04	397.04	D-105
7	6	19.000	1.57	1.57	0.85	1.33	1.33	5.0	5.0	7.2	9.58	19.42	5.77	24	0.74	387.83	387.97	388.82	389.08	397.04	397.19	D-106
8	1	27.270	0.02	0.25	0.85	0.02	0.21	5.0	5.5	7.0	1.49	9.17	4.45	15	2.02	384.32	384.87	384.66	385.35	394.45	394.09	D-100A
9	8	35.670	0.23	0.23	0.85	0.20	0.20	5.0	5.0	7.2	1.40	9.11	4.36	15	1.99	385.07	385.78	385.40	386.25	394.09	394.38	D-100B

Project File: 2023-05-31 - Wallbrook 7Eleven.stm

Number of lines: 9

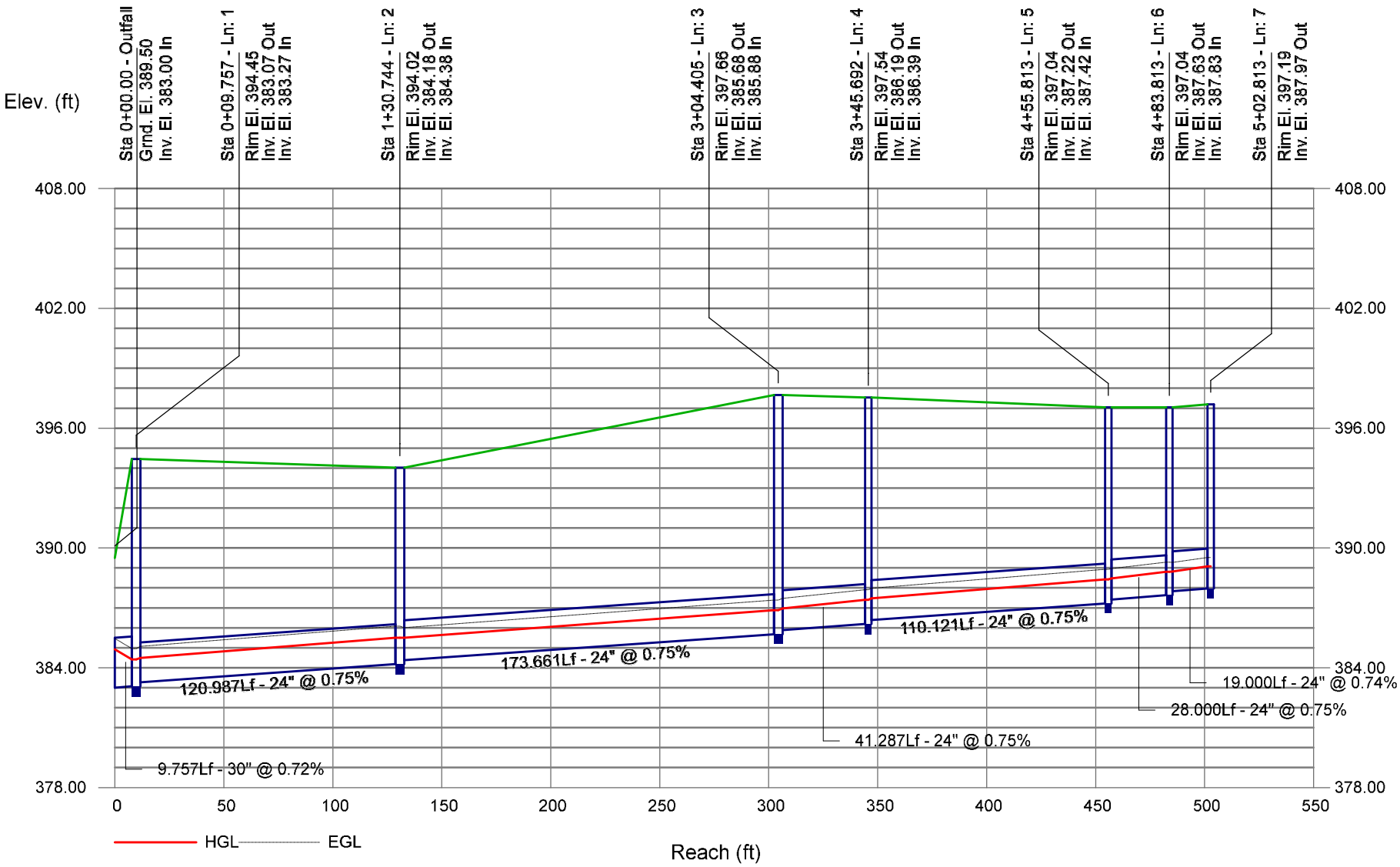
Run Date: 5/31/2023

NOTES:Intensity = 73.11 / (Inlet time + 12.60) ^ 0.81; Return period =Yrs. 10 ; c = cir e = ellip b = box

10-Year Hydraulic Grade Profiles

Storm Sewer Profile

Proj. file: 2023-05-31 - Wallbrook 7Eleven.stm



Storm Sewer Profile