Engineering | Surveying | Planning | Environmental

Stormwater Management Report

Submitted to:
Wake County, NC

Prepared for:
Bullard Restaurant Group
6000 Rogers Road
Rolesville, North Carolina

Sambatek Project Ref.: BUL-2103

VICINITY MAP
NTS

Prepared by:
SAMBATEK NC PC
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Raleigh, North Carolina 27613

Date: 12/10/2024

NORTH CAROLINA PROFESSIONAL SEAL 057014 ENGINEER Q. NEAL SKELTON 12/18/2024

SAMBATEK NC P.C. REGISTERED CORPORATION C-4993 NORTH CAROLINA RALEIGH, NORTH CAROLINA

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Project Narrative

This report has been prepared for the proposed development of a commercial parcel located at 6000 Rogers Road, Rolesville, NC 27571. This project has been designed to meet Wake County stormwater requirements and proposes to drain to an existing wet pond stormwater control measure (SCM) located immediately adjacent to the subject parcel. The property coordinates are 35.923086°, -78.468297°. The development of this 2.07-acre site will result in the development of 1.36 acres of impervious area. The site currently drains to an existing wet pond SCM. The proposed development of this site will maintain pre-development drainage patterns and the wet pond has been evaluated and confirmed to have available capacity to address the increase in runoff resultant from this project. The remaining sections of this report will discuss the details and findings of this analysis.

Adjacent Areas

The adjacent properties are as follows:

- Granite Falls Blvd. runs across the northern property boundary.
- Rogers Rd. runs across the northeast property boundary.
- Commercial development occupies the southeast property boundary.
- Residential townhomes occupy the south and southwest property boundaries.

Existing Conditions

Under the existing conditions, stormwater runoff sheet flows from southeast to northwest into the existing wet pond SCM that was constructed as part of the 2018 Granite Fall Boulevard project (design by John A. Edwards Co). This wet pond facility receives runoff from not only this site, but from a greater 5.89-acre (total) area consisting of mixed use commercial and townhouse developments, as well as a portion of Granite Falls Boulevard. The existing ground cover consists of primarily well-maintained open space/grasses, as well as a wooded area. On-site soils consist of RgC - Rawlings-Rion complex (HSG C) and Ur - Urban land (HSG D). A full accounting of the areas, ground covers, and hydrologic soil groupings within the area of analysis included in this study can be found in the appendices of this report.

Proposed Conditions

The proposed development of this parcel includes the construction of a multi-tenant commercial retail building with two restaurants and the required parking, utilities, landscaping, and stormwater collection infrastructure necessary to tie-in to the existing and surrounding areas. Please see the included construction plan set and appendices of this report for further information.

Stormwater Quality Treatment

This site drains to an existing wet pond SCM which is providing water quality treatment for a total of 5.89 acres of mixed-use commercial, residential, and roadway developments. This wet pond SCM was evaluated to ensure that it has available capacity to provide water quality treatment for this project. Using the Wake County Municipal Stormwater Tool, the wet pond was evaluated under its existing, as-built conditions, and was found to have available capacity to provide water quality treatment for the proposed development with no required revisions. Please see appendix D for a full report of the findings of the Wake County Municipal Stormwater Tool demonstrating this capacity.

Stormwater Quantity Treatment

The Wake County stormwater quantity volume and peak flow control requirements for this proposed development are met by the existing wet pond SCM. The wet pond SCM was modeled digitally and routing calculations were performed under proposed conditions. These calculations indicate that the existing wet pond SCM has available capacity to provide stormwater volume and peak flow control in its existing configuration. Stormwater runoff volume for the first inch of rainfall is retained and drained over a period of 48 - 120 hours and peak flow for the 1-year, 2-year, and 10-year, 24-hour design storms is controlled to below pre-development peak flow rates for the respective design storms. Please see appendix B and C for further information and supporting calculations.

Stormwater SCM Maintenance

Frequent, thorough, and consistent inspections and maintenance are critical to the successful operation of the wet pond SCM. Inspections reveal the operational status of the system and identify necessary maintenance items. The owner of this property is responsible for providing post-construction maintenance and inspections for the wet pond SCM in accordance with Wake County requirements. Please see appendix F for further information.

Calculation Methodology

- The rainfall data was taken from NOAA Atlas 14 for the parcel address and input into the Hydraflows Hydrographs extension of AutoCAD Civil 3D to prepare site specific hydrographs.
- The Storm & Sewer Analysis extension of AutoCAD Civil3D was utilized to prepare hydraulic grade line calculations for the proposed onsite stormwater conveyance infrastructure. Please reference Appendix E within this report for additional information.
- Soils data for the site was taken from the NRCS USDA web soil survey website (http://websoilsurvey.nrcs.usda.gov/). The hydrological soil group classifications assigned by NRCS USDA were utilized as they were listed. SCS Method Curve Numbers were selected based upon visual inspection of the existing ground cover conditions.
- Water quality calculations were performed using the latest copy of the Wake County Municipal Stormwater tool, accessed on December 8, 2024.

Appendix A:

Maps

Map Scale: 1:4,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Wake County, North Carolina
Survey Area Data: Version 26, Sep 9, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 24, 2022—May 9, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HeB	Helena sandy loam, 2 to 6 percent slopes	D	1.4	2.3%
RgB	Rawlings-Rion complex, 2 to 6 percent slopes	C	4.3	7.2%
RgC	Rawlings-Rion complex, 6 to 10 percent slopes	C	15.8	26.4%
Ur	Urban land		32.6	54.4%
WaB	Wake-Rolesville complex, 2 to 6 percent slopes, very rocky	D	0.2	0.4%
WaD	Wake-Rolesville complex, 10 to 15 percent slopes, very rocky	D	4.0	6.7%
WfB	Wedowee-Saw complex, 2 to 6 percent slopes	B	1.6	2.7%
Totals for Area of Interest			**59.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

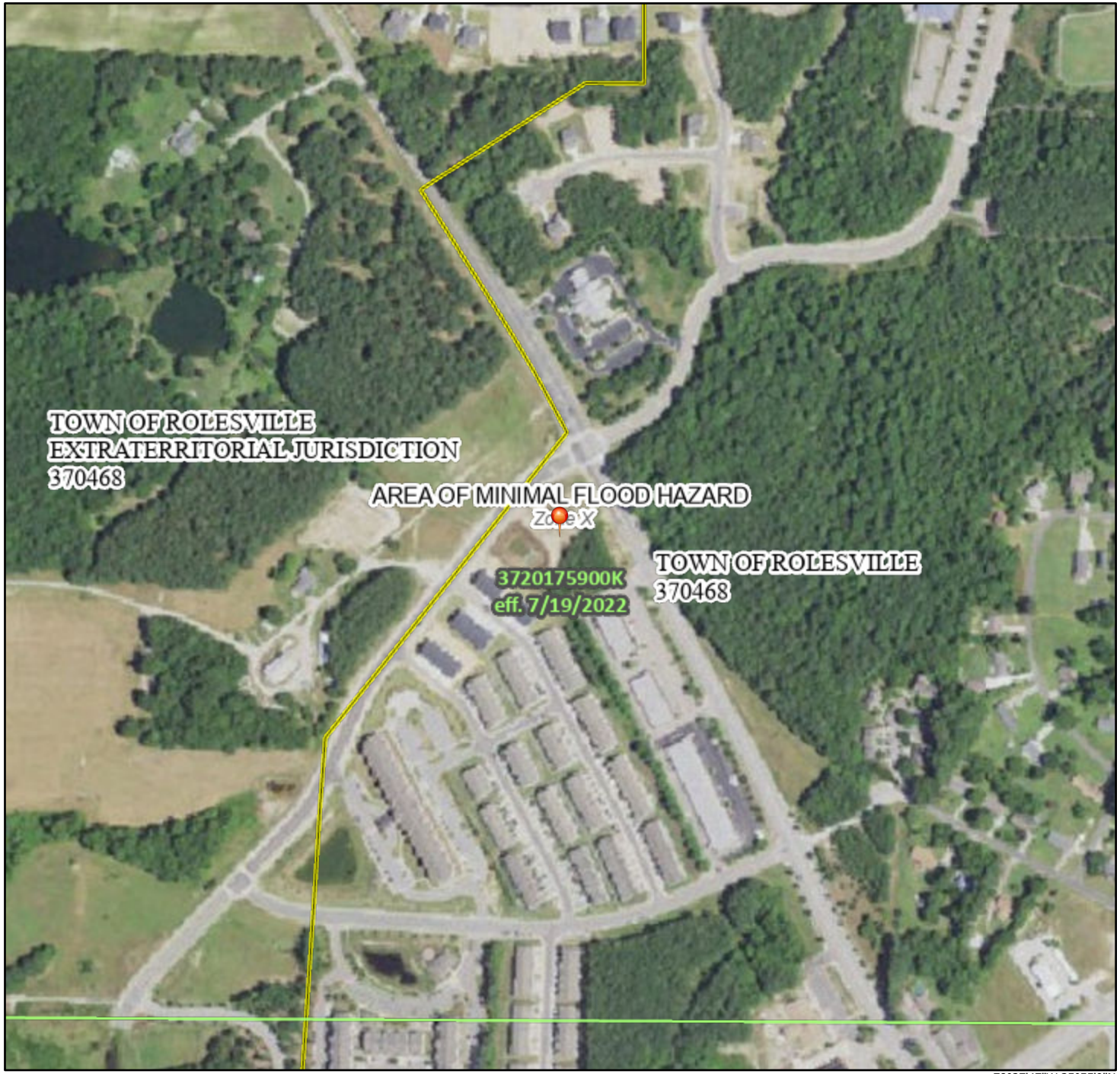
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

78°28'25"W 35°55'38"N



78°27'47"W 35°55'9"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/10/2024 at 7:24 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

ROLESVILLE QUADRANGLE
NORTH CAROLINA
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 17S

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery	NAIP,	July 2020 - July 2020
Roads	U.S. Census Bureau,	2016
Names	GNIS,	1980 - 2022
Hydrography	National Hydrography Dataset,	2001 - 2021
Contours	National Elevation Dataset,	2008
Boundaries	Multiple sources; see metadata file	2019 - 2021
Wetlands	FWS National Wetlands Inventory	Not Available

MN
GN
9°23′
167 MILS
1½°
27 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
QV
Grid Zone Designation
17S

SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

NORTH CAROLINA
QUADRANGLE LOCATION

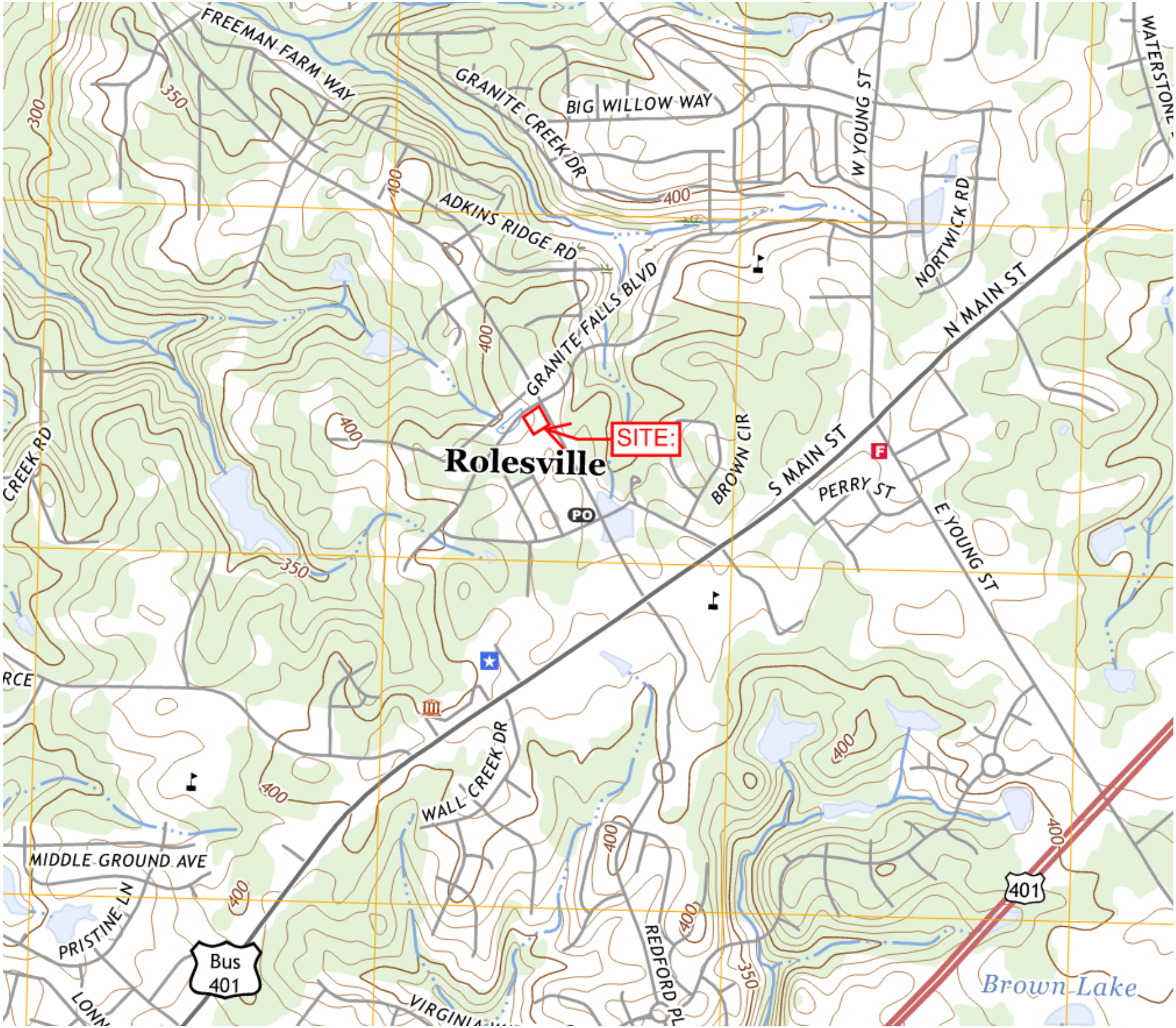
1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Grissom
2 Franklinton
3 Louisburg
4 Wake Forest
5 Bunn West
6 Raleigh East
7 Knightdale
8 Zebulon

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

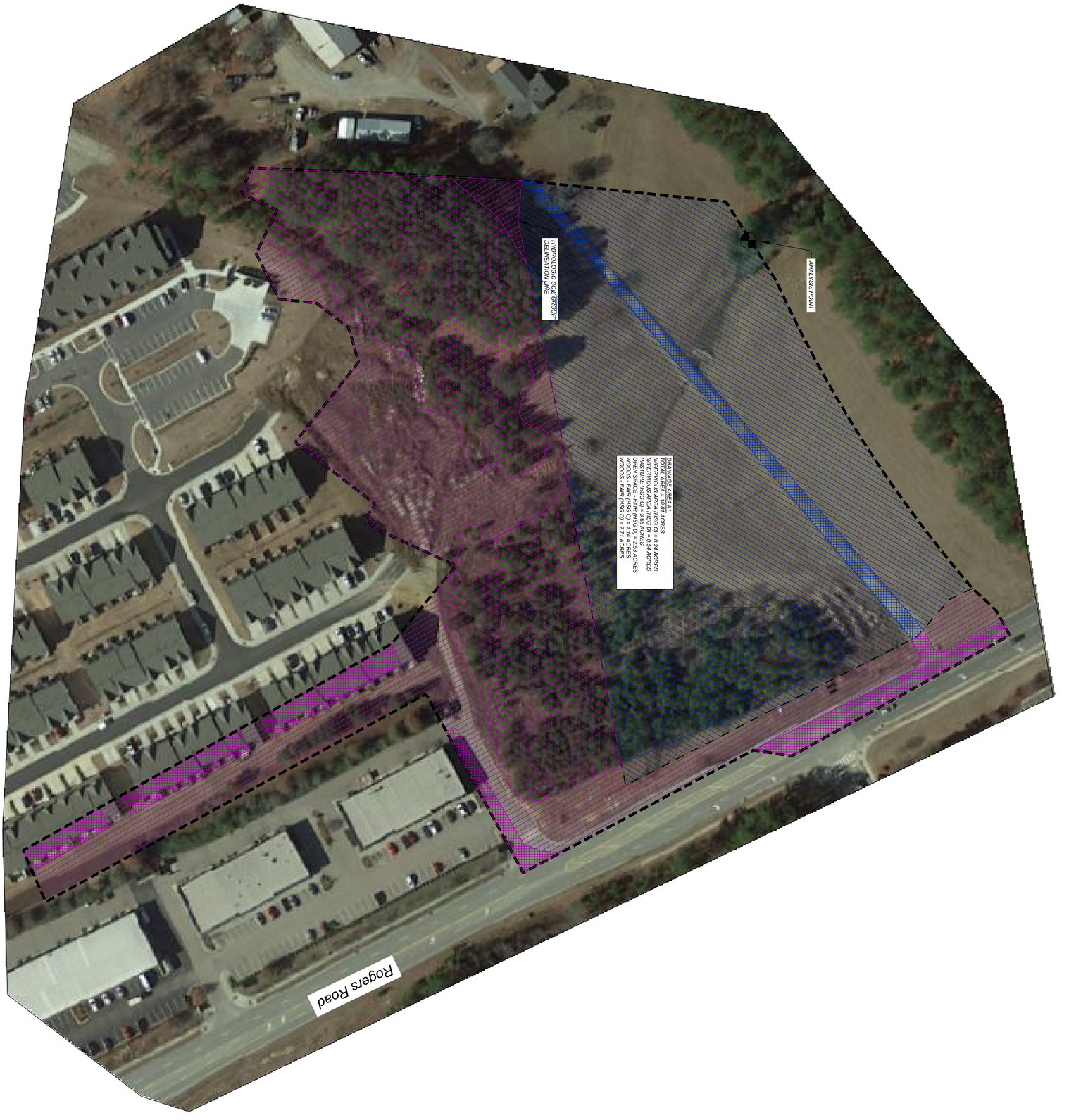
ROLESVILLE, NC
2022

NSN 7643016379170
NGA REF NO. USGSX24K38453


FREEMAN FARM WAY
GRANITE CREEK DR
BIG WILLOW WAY
W YOUNG ST
WATERSTONE
ADKINS RIDGE RD
NORTWICK RD
N MAIN ST
GRANITE FALLS BLVD
SITE:
Rolesville
BROWN CIR
S MAIN ST
PERRY ST
E YOUNG ST
CREEK RD
RCE
WALL CREEK DR
MIDDLE GROUND AVE
PRISTINE LN
Bus 401
REDFORD PL
VIRGINIA
401
Brown Lake
300
350
400

SOILS LEGEND

- HSG C (GRASS AREA)
- HSG C (IMPERVIOUS AREA)
- HSG D (GRASSED AREA)
- HSG D (IMPERVIOUS AREA)
- HSD G (WOODED AREA)



GRAPHIC SCALE
1 inch = 60 ft.
0 30 60 120

PROJECT NO.	BUL-2103
FILENAME	DA-AN-2018
DRAWN BY	STH
SCALE	1"= 20'
DATE	12-10-2024
SHEET NO.	EX-3

PROPOSED RETAIL AND RESTAURANT DEVELOPMENT
6000 ROGERS ROAD
ROLESVILLE, NORTH CAROLINA

OVERALL DRAINAGE EXISTING

CLIENT:
BULLARD RESTAURANT GROUP
9131 ANSON WAY, # 305
RALEIGH, NC 27615

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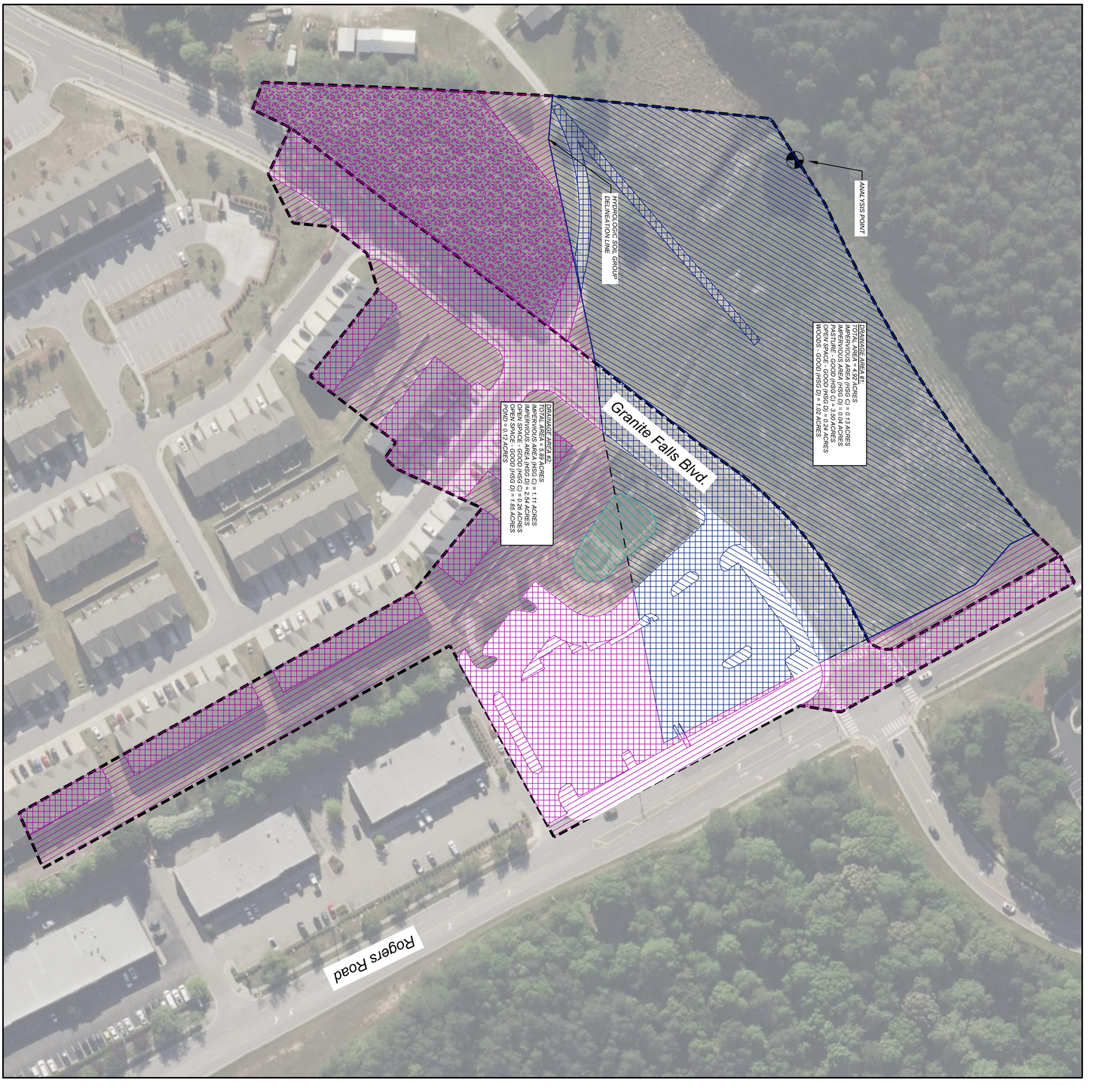
REVISIONS

NO.	DATE	DESCRIPTION	BY
-	-	-	-

SOILS LEGEND

- HSG G (WOODED AREA)
- HSG D (IMPERVIOUS AREA)
- HSG D (GRASSED AREA)
- POND AREA
- HSG-C (IMPERVIOUS AREA)
- HSG-C (GRASS AREA)



GRAPHIC SCALE
1 inch = 60 ft.
0
30
60
120

PROPOSED RETAIL AND RESTAURANT DEVELOPMENT
6000 ROGERS ROAD
ROLESVILLE, NORTH CAROLINA

OVERALL DRAINAGE PROPOSED

CLIENT:
BULLARD RESTAURANT GROUP
9131 ANSON WAY, # 305
RALEIGH, NC 27615

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PROJECT NO.	BUL-2103
FILENAME	DA-MAPPRE
DRAWN BY	STH
SCALE	1"= 20'
DATE	12-10-2024
SHEET NO.	EX-2

REVISIONS

NO.	DATE	DESCRIPTION	BY
-	-	-	-

Appendix B:

Hydrograph Calculations Report

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	14.65	21.63	-------	-------	42.53	-------	-------	-------	Pre-Development
3	SCS Runoff	------	4.262	6.983	-------	-------	15.52	-------	-------	-------	Post-Development Bypass
4	SCS Runoff	------	17.77	22.57	-------	-------	35.42	-------	-------	-------	Post-Development Detained
5	Reservoir	4	2.609	3.895	-------	-------	17.98	-------	-------	-------	Prop. Development Pond
6	Combine	3, 5	5.396	9.702	-------	-------	31.33	-------	-------	-------	Proposed Development

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	14.65	2	720	34,125	------	------	------	Pre-Development
3	SCS Runoff	4.262	2	720	10,666	------	------	------	Post-Development Bypass
4	SCS Runoff	17.77	2	718	41,502	------	------	------	Post-Development Detained
5	Reservoir	2.609	2	734	40,511	4	403.18	21,944	Prop. Development Pond
6	Combine	5.396	2	722	51,177	3, 5	------	------	Proposed Development

Hydrograph Report

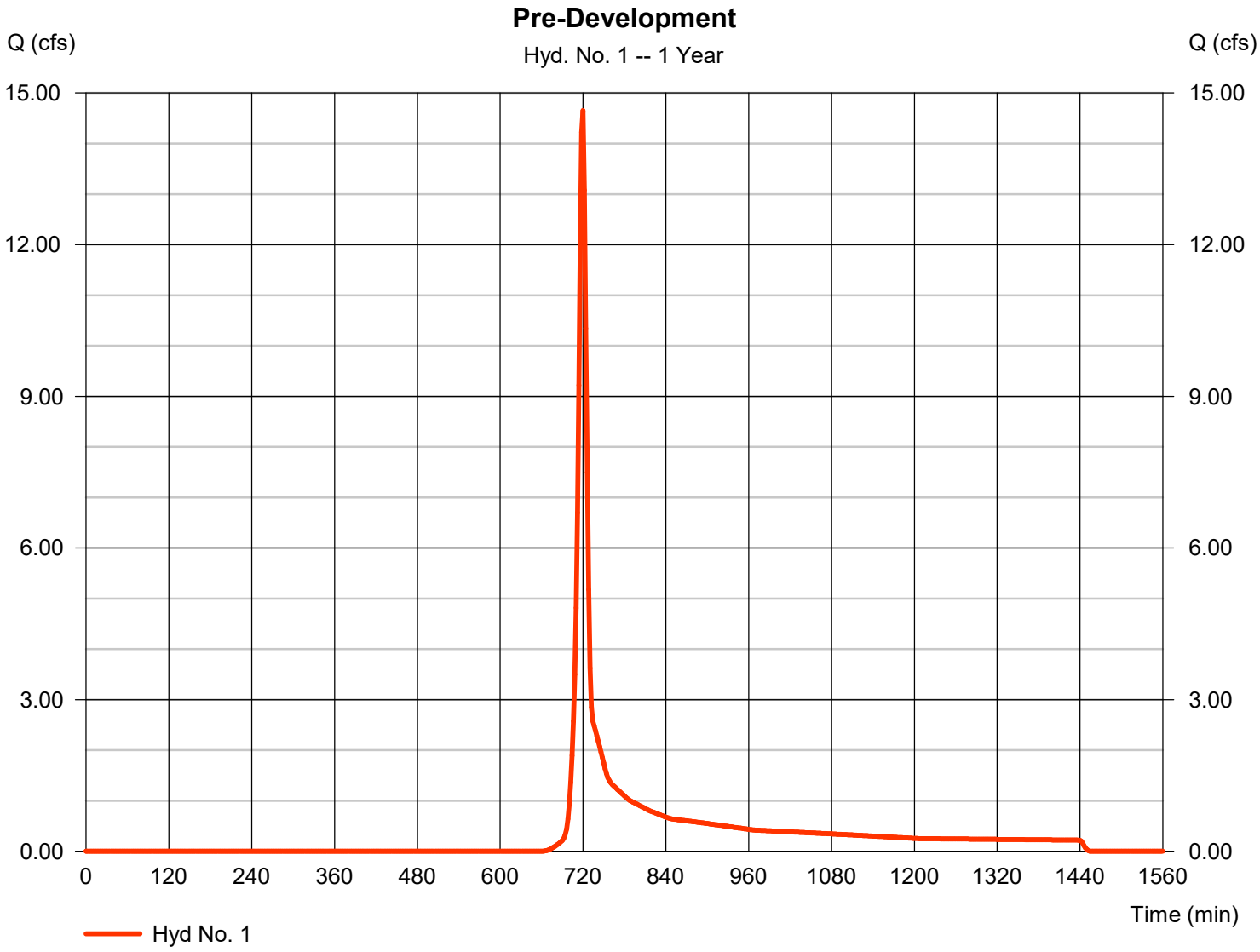
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 14.65 cfs
Storm frequency	= 1 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 34,125 cuft
Drainage area	= 10.800 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 7.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.770 x 98) + (3.650 x 65) + (2.530 x 79) + (1.140 x 73) + (2.710 x 79)] / 10.800



Hydrograph Report

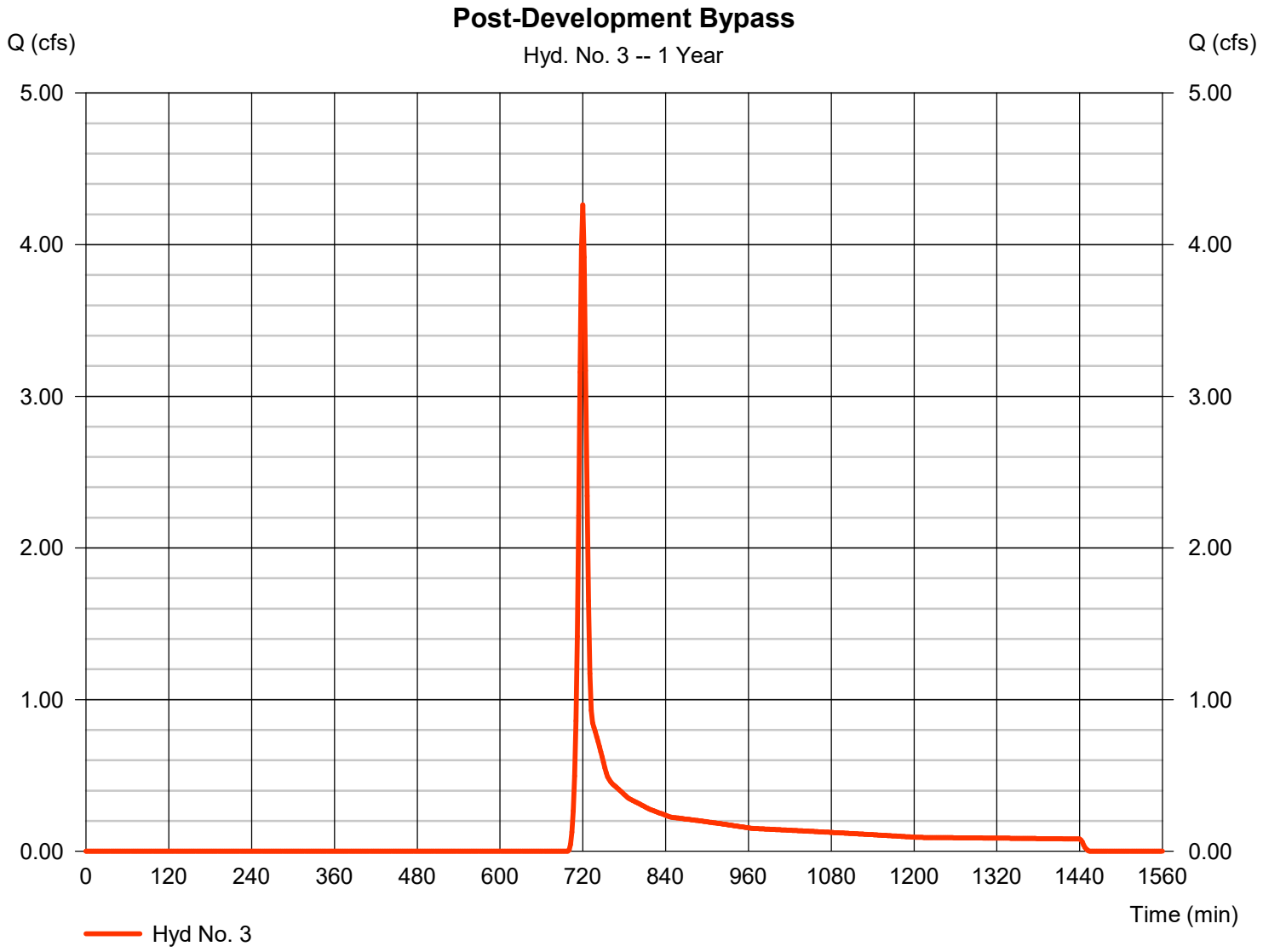
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 3

Post-Development Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.262 cfs
Storm frequency	=	1 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	10,666 cuft
Drainage area	=	4.930 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	7.00 min
Total precip.	=	2.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.170 x 98) + (3.500 x 65) + (0.240 x 80) + (1.020 x 77)] / 4.930



Hydrograph Report

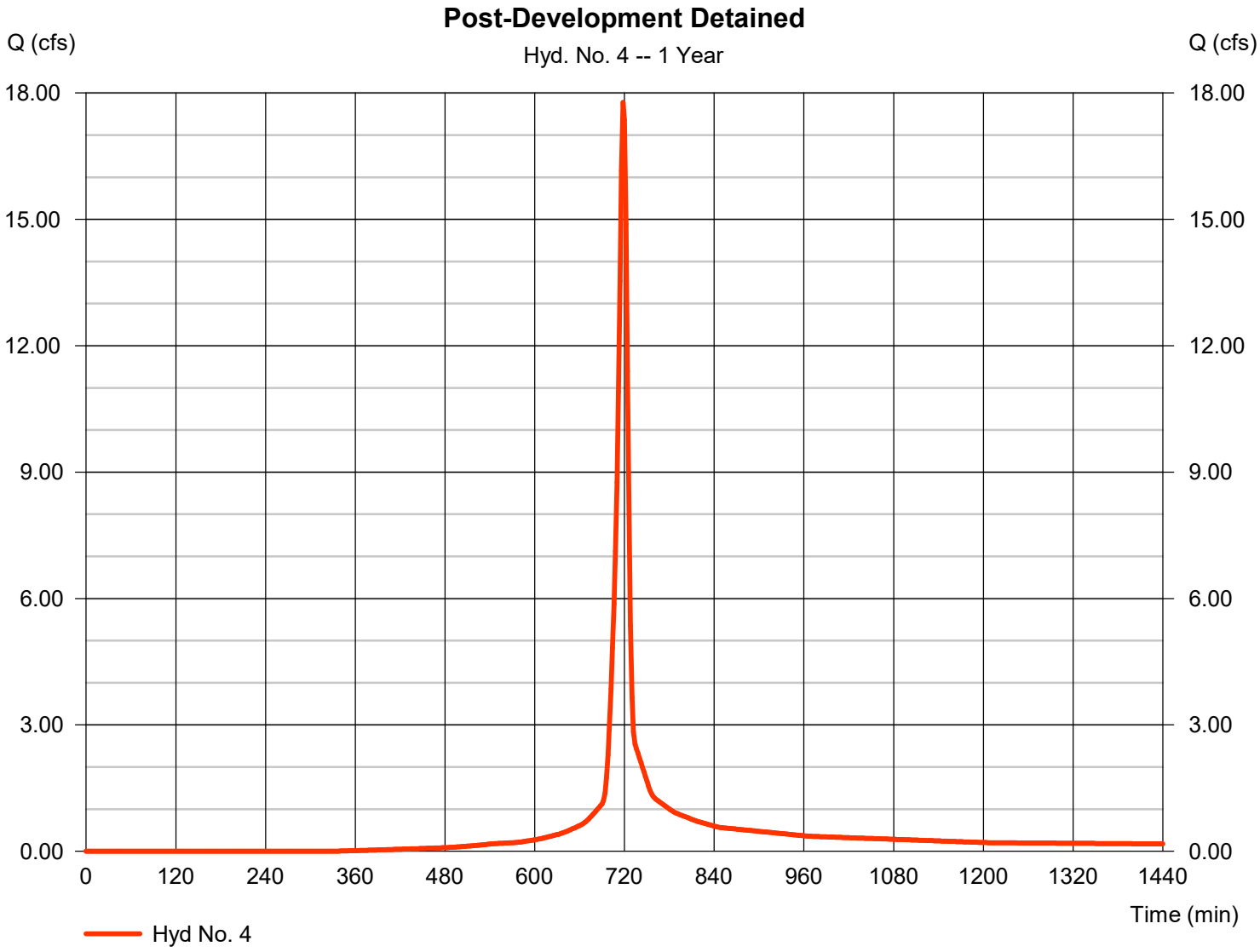
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 4

Post-Development Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 17.77 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 41,502 cuft
Drainage area	= 5.890 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 7.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.660 x 98) + (0.260 x 74) + (1.850 x 80) + (0.120 x 100)] / 5.890



Hydrograph Report

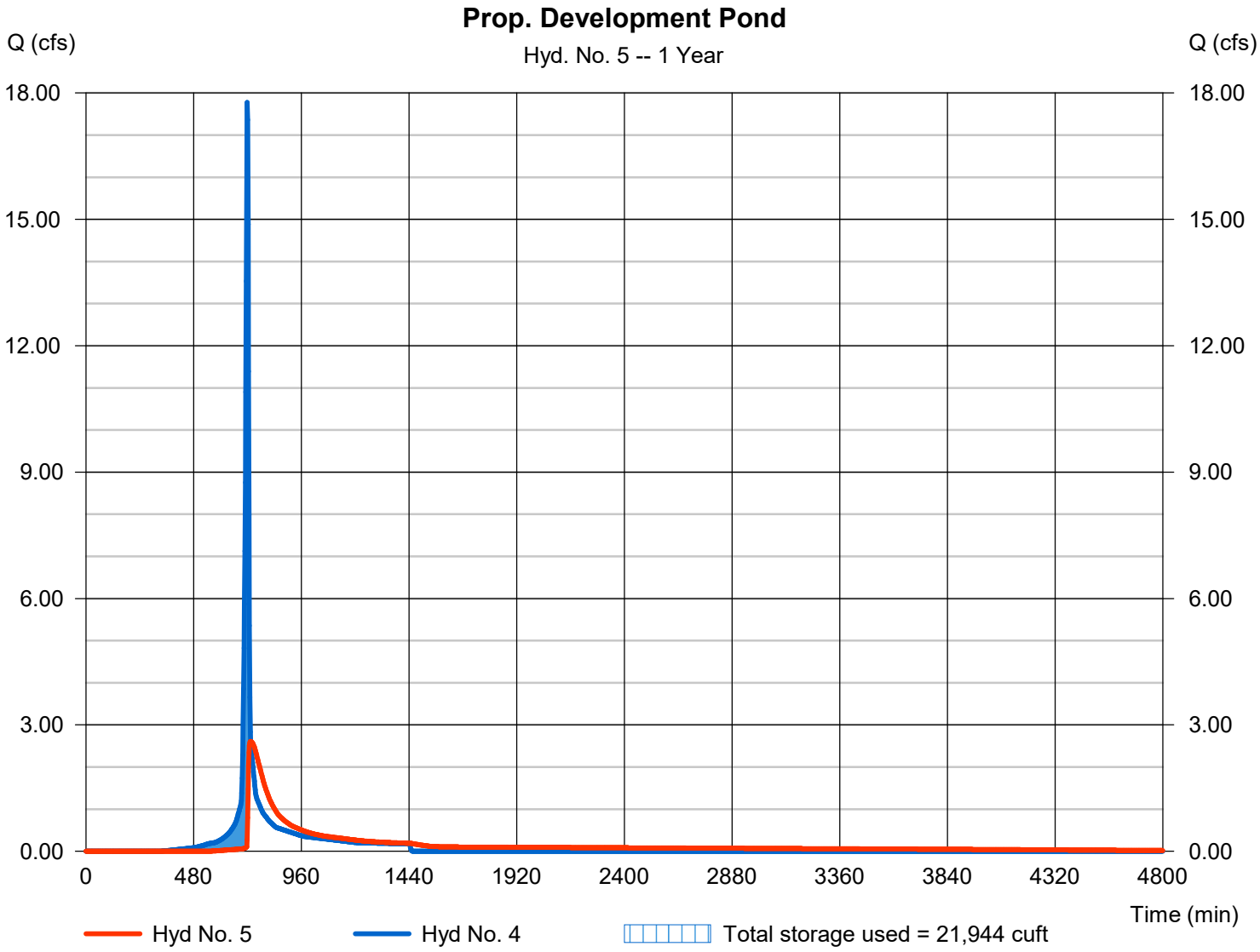
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 5

Prop. Development Pond

Hydrograph type	= Reservoir	Peak discharge	= 2.609 cfs
Storm frequency	= 1 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 40,511 cuft
Inflow hyd. No.	= 4 - Post-Development Detained	Max. Elevation	= 403.18 ft
Reservoir name	= As-Built Pond	Max. Storage	= 21,944 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Pond No. 1 - As-Built Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 400.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	400.50	5,694	0	0
0.50	401.00	7,092	3,197	3,197
1.50	402.00	8,389	7,741	10,937
2.50	403.00	9,757	9,073	20,010
3.50	404.00	11,194	10,476	30,486
4.50	405.00	12,700	11,947	42,433

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	1.75	12.00	0.00
Span (in)	= 18.00	1.75	12.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 398.36	400.61	402.26	0.00
Length (ft)	= 117.40	0.50	0.50	0.00
Slope (%)	= 1.00	0.10	0.10	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	Inactive	Inactive	0.00
Crest El. (ft)	= 404.11	406.00	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= 1	Broad	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	400.50	0.00	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.05	320	400.55	10.03 ic	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.10	639	400.60	10.03 ic	0.00	0.00	---	0.00	0.00	---	---	---	---	0.000
0.15	959	400.65	10.03 ic	0.00 ic	0.00	---	0.00	0.00	---	---	---	---	0.003
0.20	1,279	400.70	10.03 ic	0.01 ic	0.00	---	0.00	0.00	---	---	---	---	0.011
0.25	1,598	400.75	10.03 ic	0.02 ic	0.00	---	0.00	0.00	---	---	---	---	0.021
0.30	1,918	400.80	10.03 ic	0.03 ic	0.00	---	0.00	0.00	---	---	---	---	0.028
0.35	2,238	400.85	10.03 ic	0.03 ic	0.00	---	0.00	0.00	---	---	---	---	0.033
0.40	2,557	400.90	10.03 ic	0.04 ic	0.00	---	0.00	0.00	---	---	---	---	0.037
0.45	2,877	400.95	10.03 ic	0.04 ic	0.00	---	0.00	0.00	---	---	---	---	0.042
0.50	3,197	401.00	10.03 ic	0.05 ic	0.00	---	0.00	0.00	---	---	---	---	0.045
0.60	3,971	401.10	10.03 ic	0.05 ic	0.00	---	0.00	0.00	---	---	---	---	0.052
0.70	4,745	401.20	10.03 ic	0.06 ic	0.00	---	0.00	0.00	---	---	---	---	0.058
0.80	5,519	401.30	10.03 ic	0.06 ic	0.00	---	0.00	0.00	---	---	---	---	0.063
0.90	6,293	401.40	10.03 ic	0.07 ic	0.00	---	0.00	0.00	---	---	---	---	0.068
1.00	7,067	401.50	10.03 ic	0.07 ic	0.00	---	0.00	0.00	---	---	---	---	0.073
1.10	7,841	401.60	10.03 ic	0.08 ic	0.00	---	0.00	0.00	---	---	---	---	0.077
1.20	8,615	401.70	10.03 ic	0.08 ic	0.00	---	0.00	0.00	---	---	---	---	0.081
1.30	9,389	401.80	10.03 ic	0.08 ic	0.00	---	0.00	0.00	---	---	---	---	0.085
1.40	10,163	401.90	10.03 ic	0.09 ic	0.00	---	0.00	0.00	---	---	---	---	0.089
1.50	10,937	402.00	10.03 ic	0.09 ic	0.00	---	0.00	0.00	---	---	---	---	0.092
1.60	11,844	402.10	10.03 ic	0.10 ic	0.00	---	0.00	0.00	---	---	---	---	0.096
1.70	12,752	402.20	10.03 ic	0.10 ic	0.00	---	0.00	0.00	---	---	---	---	0.099
1.80	13,659	402.30	10.03 ic	0.10 ic	0.01 ic	---	0.00	0.00	---	---	---	---	0.110
1.90	14,566	402.40	10.03 ic	0.11 ic	0.09 ic	---	0.00	0.00	---	---	---	---	0.191
2.00	15,474	402.50	10.03 ic	0.11 ic	0.25 ic	---	0.00	0.00	---	---	---	---	0.358
2.10	16,381	402.60	10.03 ic	0.11 ic	0.48 ic	---	0.00	0.00	---	---	---	---	0.589
2.20	17,288	402.70	10.03 ic	0.11 ic	0.76 ic	---	0.00	0.00	---	---	---	---	0.877
2.30	18,195	402.80	10.03 ic	0.12 ic	1.10 ic	---	0.00	0.00	---	---	---	---	1.217
2.40	19,103	402.90	10.03 ic	0.12 ic	1.46 ic	---	0.00	0.00	---	---	---	---	1.584
2.50	20,010	403.00	10.03 ic	0.12 ic	1.83 ic	---	0.00	0.00	---	---	---	---	1.950
2.60	21,058	403.10	10.03 ic	0.13 ic	2.20 ic	---	0.00	0.00	---	---	---	---	2.328
2.70	22,105	403.20	10.03 ic	0.13 ic	2.53 ic	---	0.00	0.00	---	---	---	---	2.660
2.80	23,153	403.30	10.03 ic	0.13 ic	2.78 ic	---	0.00	0.00	---	---	---	---	2.909
2.90	24,200	403.40	10.03 ic	0.13 ic	3.02 ic	---	0.00	0.00	---	---	---	---	3.158
3.00	25,248	403.50	10.03 ic	0.13 ic	3.25 ic	---	0.00	0.00	---	---	---	---	3.388
3.10	26,295	403.60	10.03 ic	0.14 ic	3.47 ic	---	0.00	0.00	---	---	---	---	3.603

Continues on next page...

As-Built Pond

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.20	27,343	403.70	10.03 ic	0.14 ic	3.67 ic	---	0.00	0.00	---	---	---	---	3.806
3.30	28,390	403.80	10.03 ic	0.14 ic	3.86 ic	---	0.00	0.00	---	---	---	---	3.998
3.40	29,438	403.90	10.03 ic	0.14 ic	4.04 ic	---	0.00	0.00	---	---	---	---	4.182
3.50	30,486	404.00	10.03 ic	0.15 ic	4.21 ic	---	0.00	0.00	---	---	---	---	4.357
3.60	31,680	404.10	10.03 ic	0.15 ic	4.38 ic	---	0.00	0.00	---	---	---	---	4.526
3.70	32,875	404.20	10.03 ic	0.15 ic	4.54 ic	---	1.44	0.00	---	---	---	---	6.127
3.80	34,070	404.30	10.03 ic	0.15 ic	4.69 ic	---	4.41	0.00	---	---	---	---	9.259
3.90	35,264	404.40	13.29 oc	0.13 ic	4.84 ic	---	8.32	0.00	---	---	---	---	13.29
4.00	36,459	404.50	16.57 oc	0.07 ic	3.52 ic	---	12.98	0.00	---	---	---	---	16.57
4.10	37,654	404.60	17.72 oc	0.04 ic	1.93 ic	---	15.75 s	0.00	---	---	---	---	17.72
4.20	38,848	404.70	18.03 oc	0.03 ic	1.50 ic	---	16.50 s	0.00	---	---	---	---	18.03
4.30	40,043	404.80	18.27 oc	0.03 ic	1.22 ic	---	17.01 s	0.00	---	---	---	---	18.26
4.40	41,238	404.90	18.46 oc	0.02 ic	1.03 ic	---	17.41 s	0.00	---	---	---	---	18.46
4.50	42,433	405.00	18.64 oc	0.02 ic	0.88 ic	---	17.73 s	0.00	---	---	---	---	18.64

...End

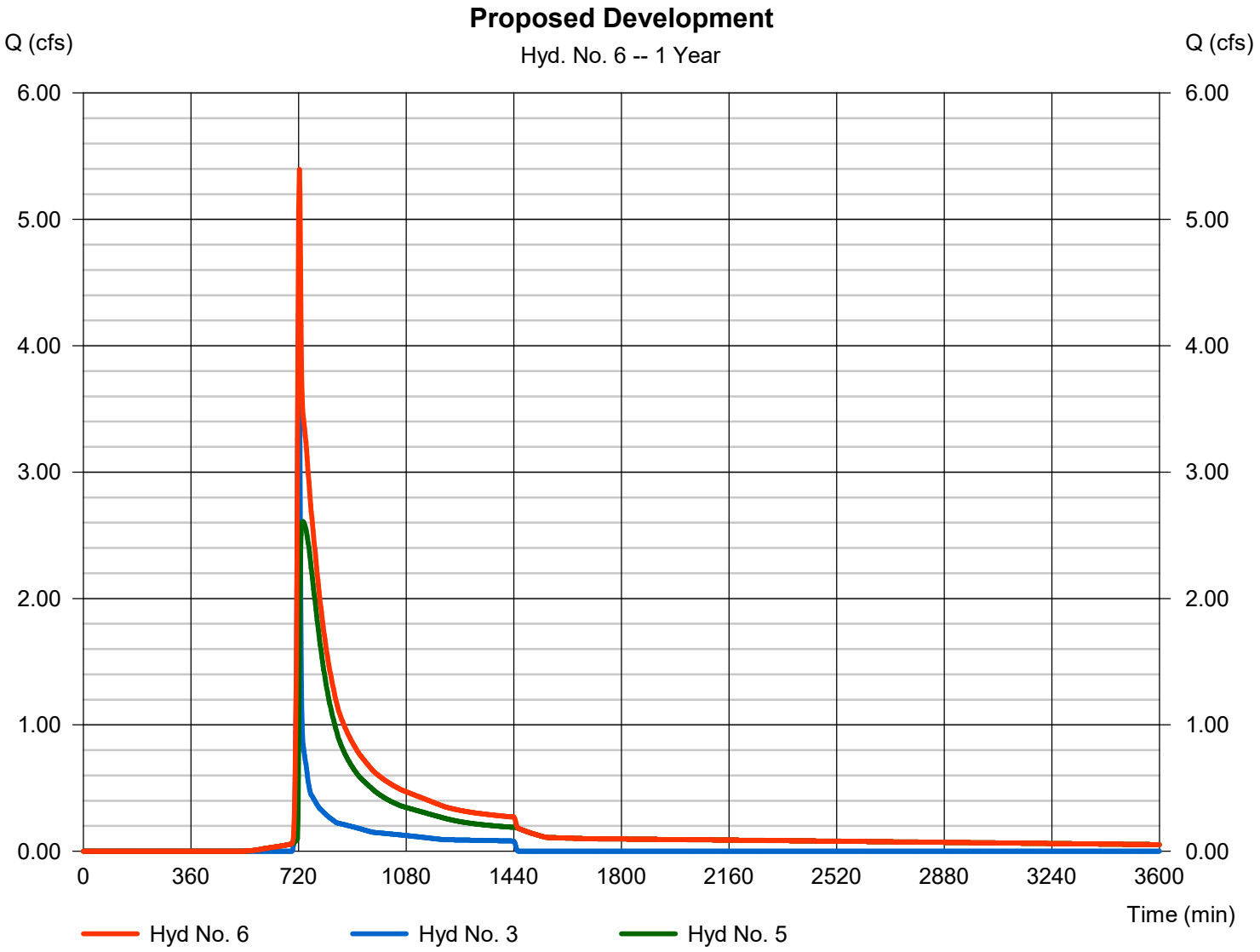
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 6

Proposed Development

Hydrograph type	= Combine	Peak discharge	= 5.396 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 51,177 cuft
Inflow hyds.	= 3, 5	Contrib. drain. area	= 4.930 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	21.63	2	720	49,653	------	------	------	Pre-Development
3	SCS Runoff	6.983	2	720	16,538	------	------	------	Post-Development Bypass
4	SCS Runoff	22.57	2	718	53,320	------	------	------	Post-Development Detained
5	Reservoir	3.895	2	732	52,325	4	403.75	27,831	Prop. Development Pond
6	Combine	9.702	2	720	68,863	3, 5	------	------	Proposed Development

Hydrograph Report

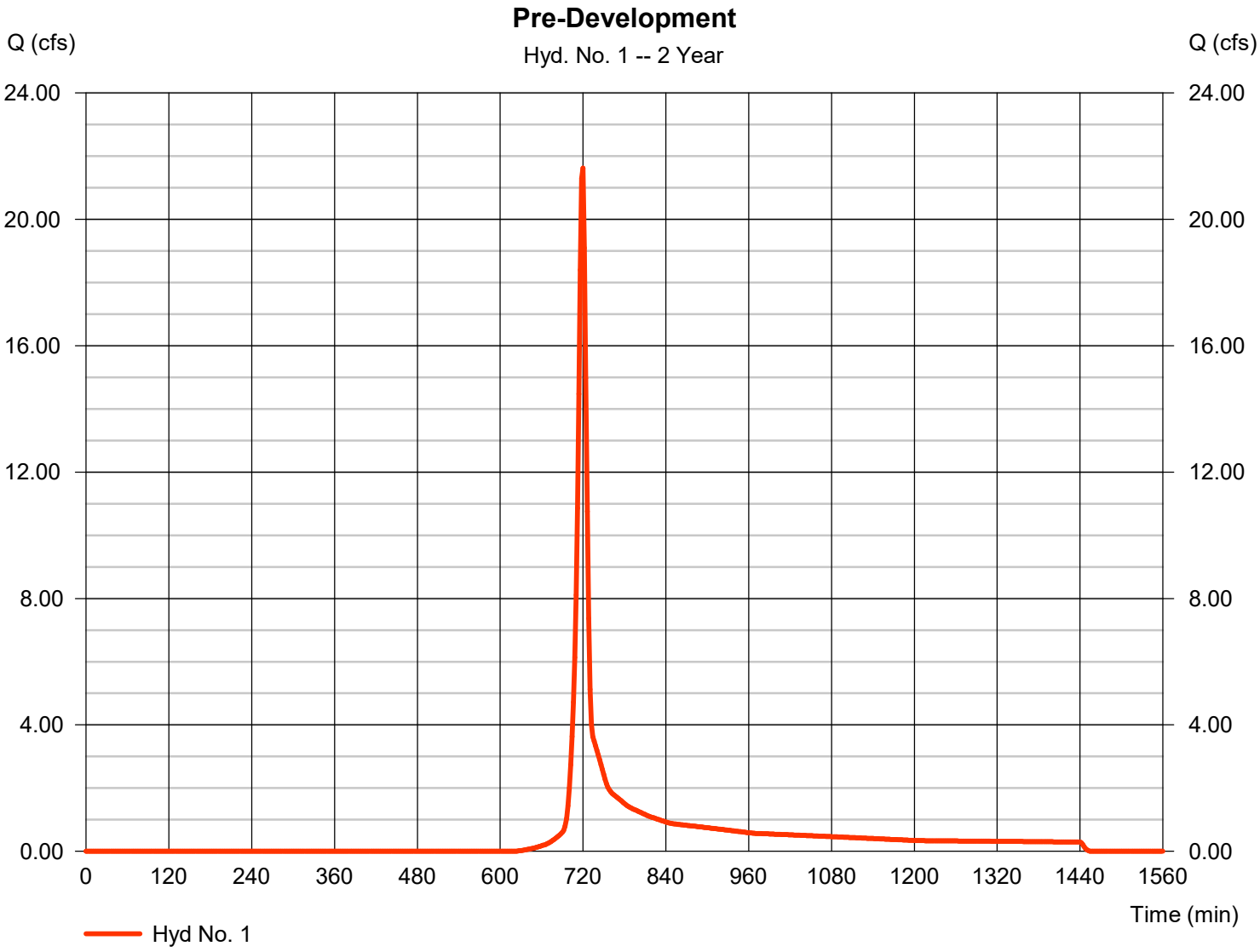
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 21.63 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 49,653 cuft
Drainage area	= 10.800 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 7.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.770 x 98) + (3.650 x 65) + (2.530 x 79) + (1.140 x 73) + (2.710 x 79)] / 10.800



Hydrograph Report

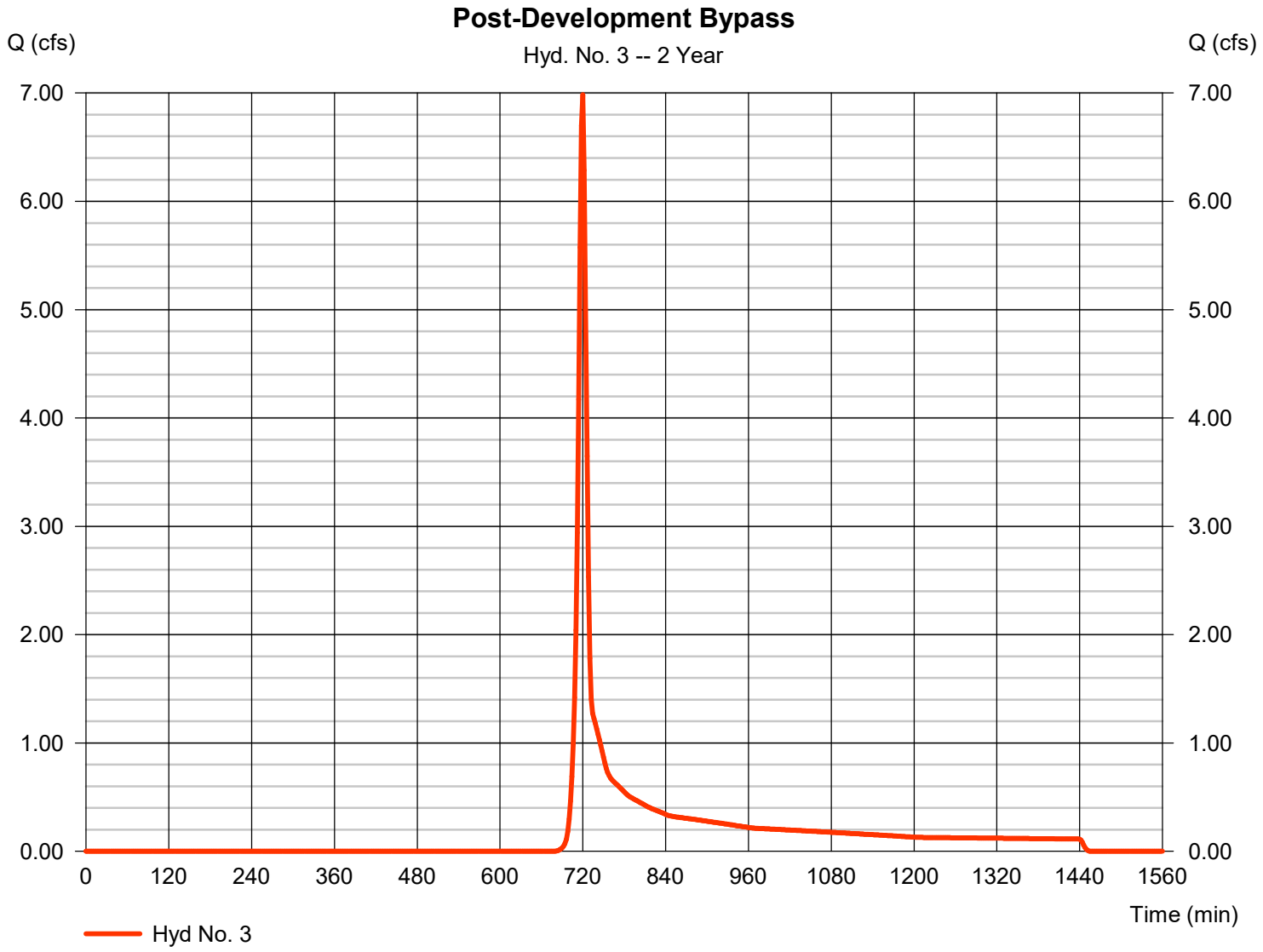
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 3

Post-Development Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.983 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	16,538 cuft
Drainage area	=	4.930 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	7.00 min
Total precip.	=	3.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.170 x 98) + (3.500 x 65) + (0.240 x 80) + (1.020 x 77)] / 4.930



Hydrograph Report

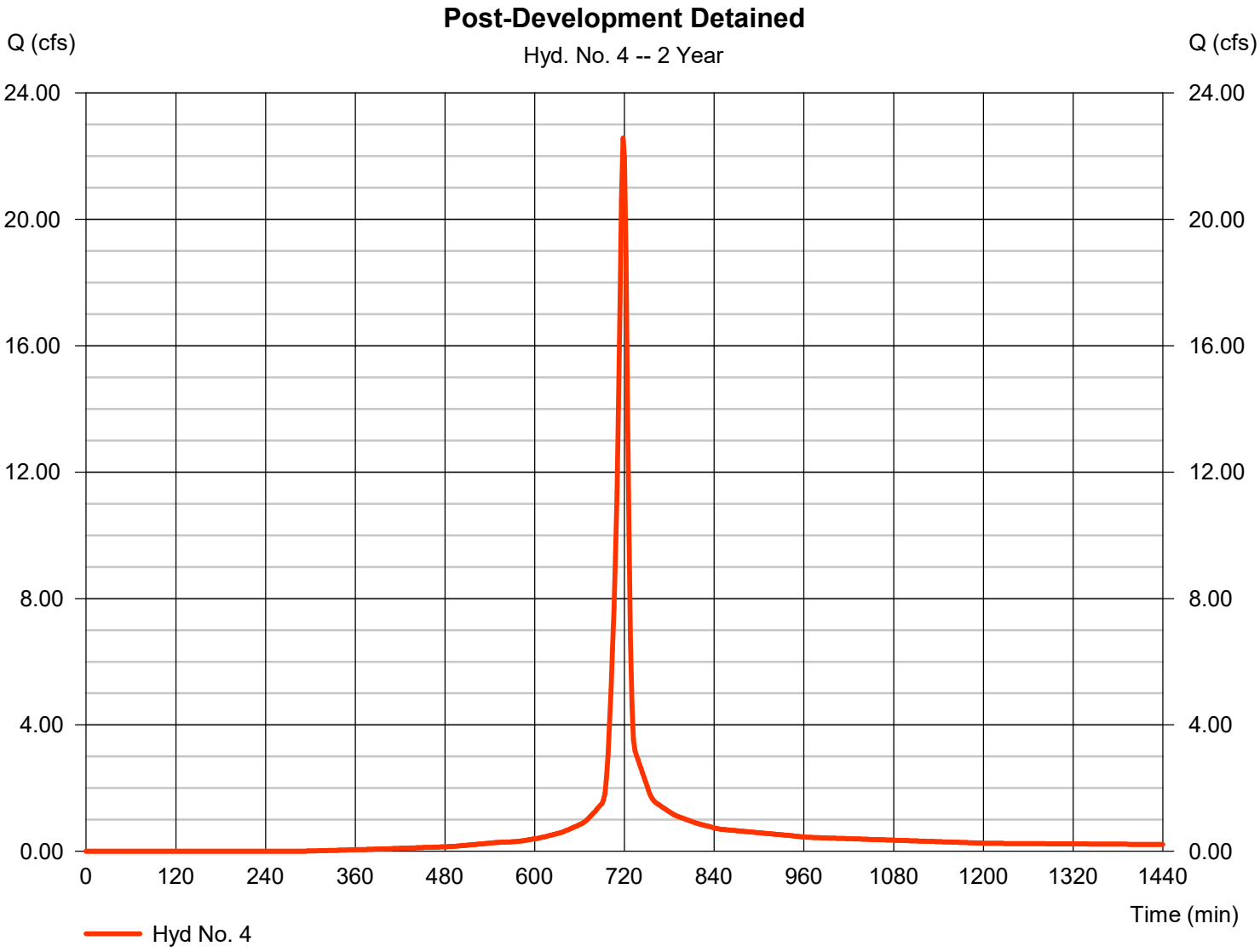
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 4

Post-Development Detained

Hydrograph type	=	SCS Runoff	Peak discharge	=	22.57 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	53,320 cuft
Drainage area	=	5.890 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	7.00 min
Total precip.	=	3.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.660 x 98) + (0.260 x 74) + (1.850 x 80) + (0.120 x 100)] / 5.890



Hydrograph Report

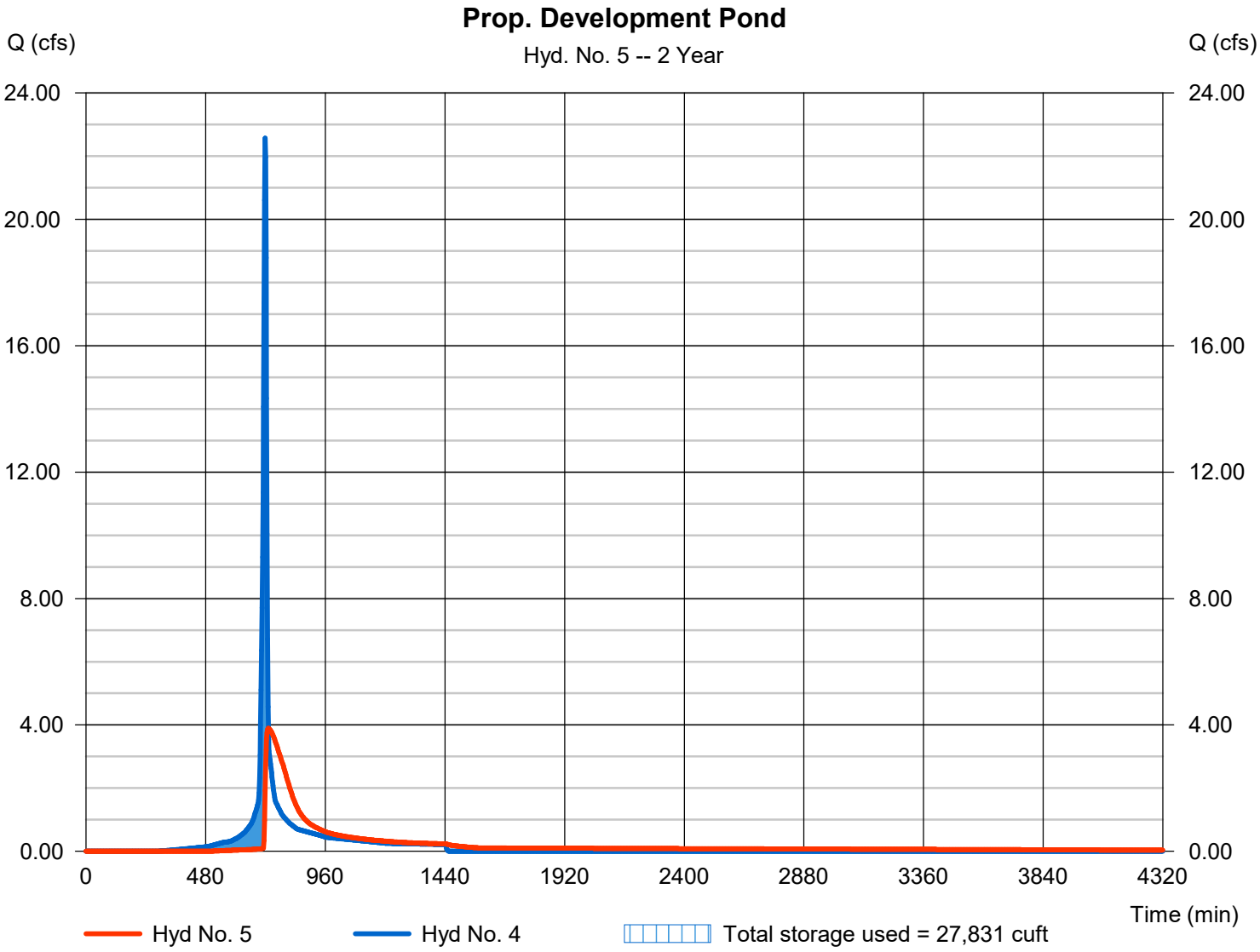
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 5

Prop. Development Pond

Hydrograph type	=	Reservoir	Peak discharge	=	3.895 cfs
Storm frequency	=	2 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	52,325 cuft
Inflow hyd. No.	=	4 - Post-Development Detained	Max. Elevation	=	403.75 ft
Reservoir name	=	As-Built Pond	Max. Storage	=	27,831 cuft

Storage Indication method used.



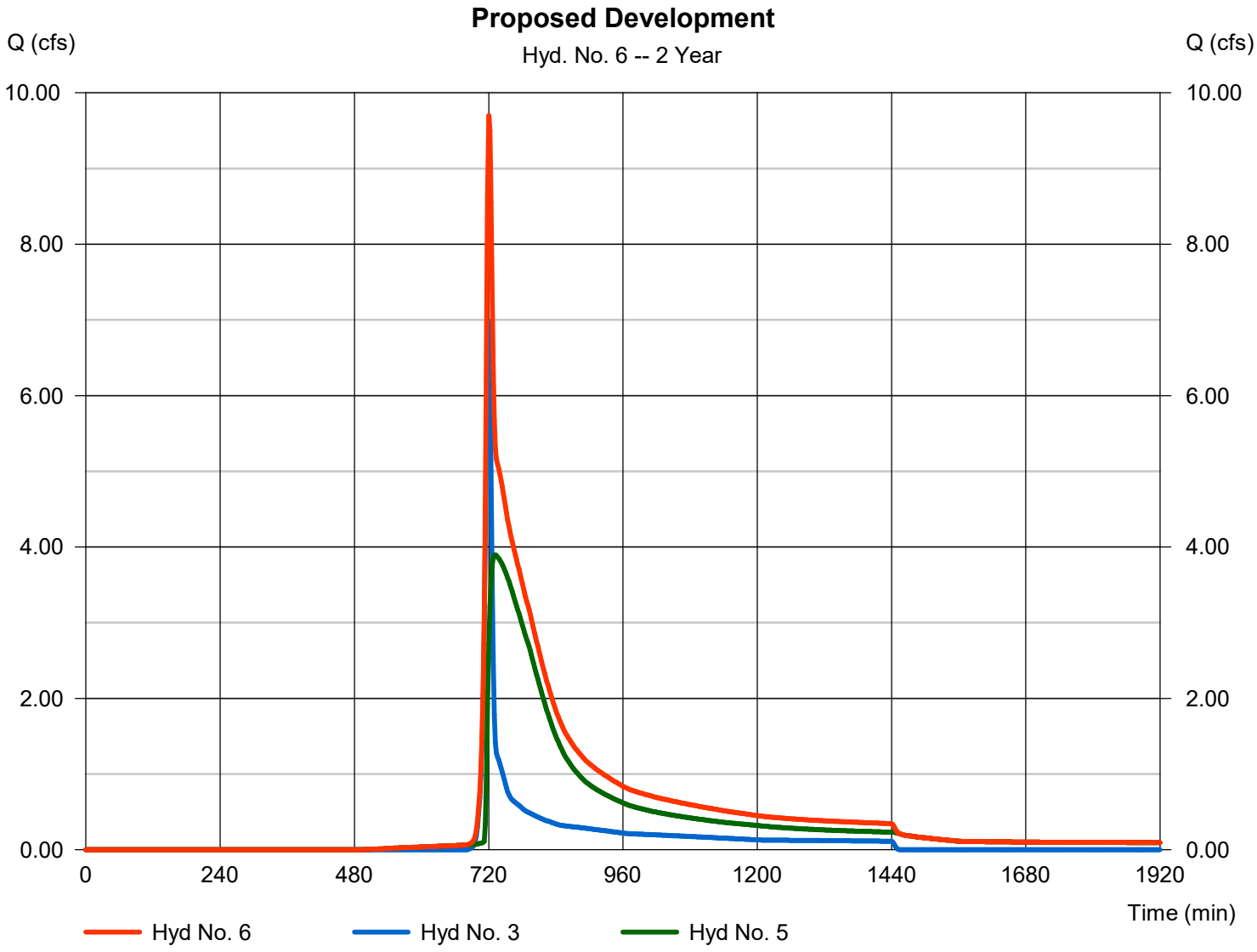
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 6

Proposed Development

Hydrograph type	= Combine	Peak discharge	= 9.702 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 68,863 cuft
Inflow hyds.	= 3, 5	Contrib. drain. area	= 4.930 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	42.53	2	718	97,295	------	------	------	Pre-Development
3	SCS Runoff	15.52	2	720	35,550	------	------	------	Post-Development Bypass
4	SCS Runoff	35.42	2	718	85,970	------	------	------	Post-Development Detained
5	Reservoir	17.98	2	726	84,967	4	404.68	38,665	Prop. Development Pond
6	Combine	31.33	2	722	120,517	3, 5	------	------	Proposed Development

Hydrograph Report

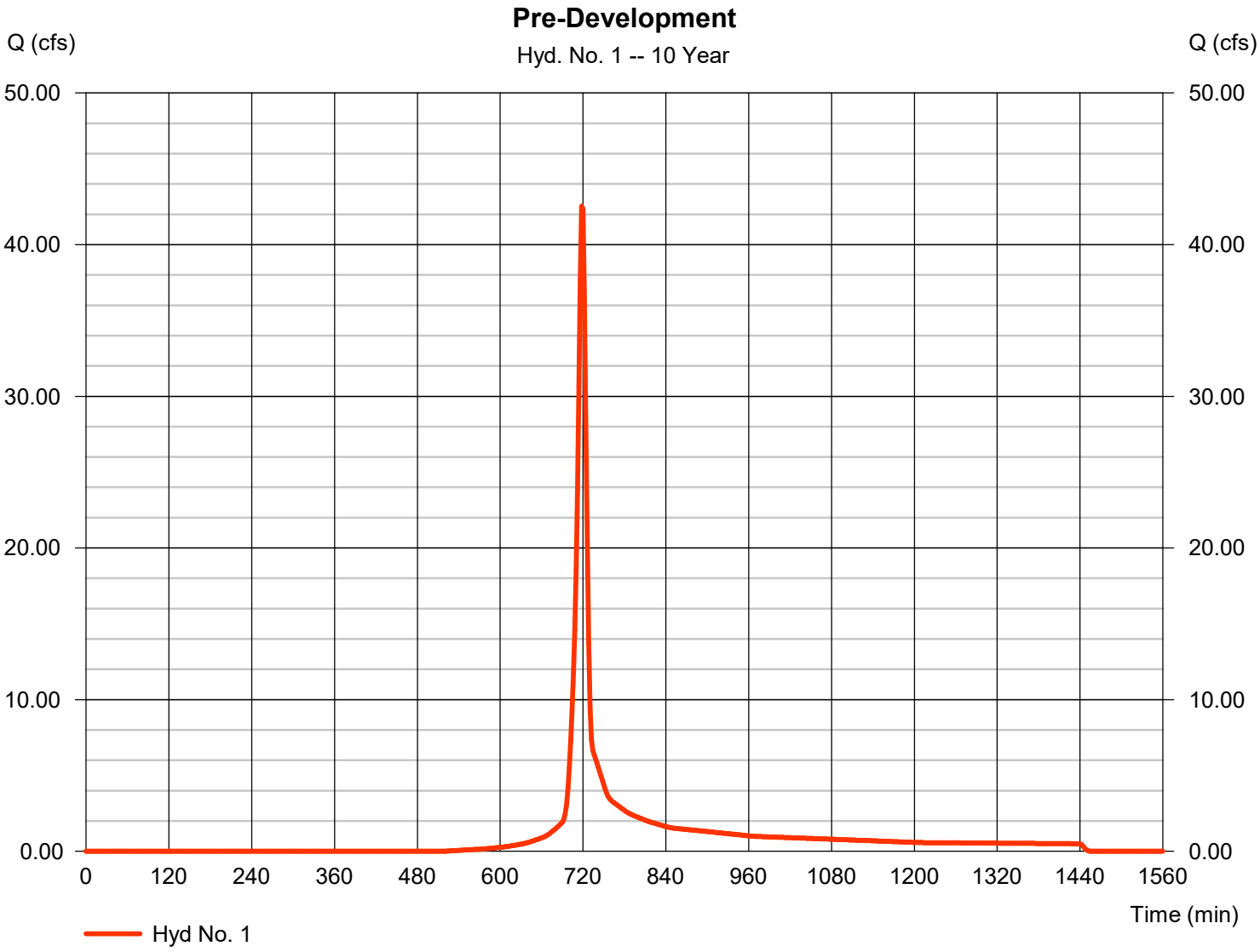
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 42.53 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 97,295 cuft
Drainage area	= 10.800 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 7.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.770 x 98) + (3.650 x 65) + (2.530 x 79) + (1.140 x 73) + (2.710 x 79)] / 10.800



Hydrograph Report

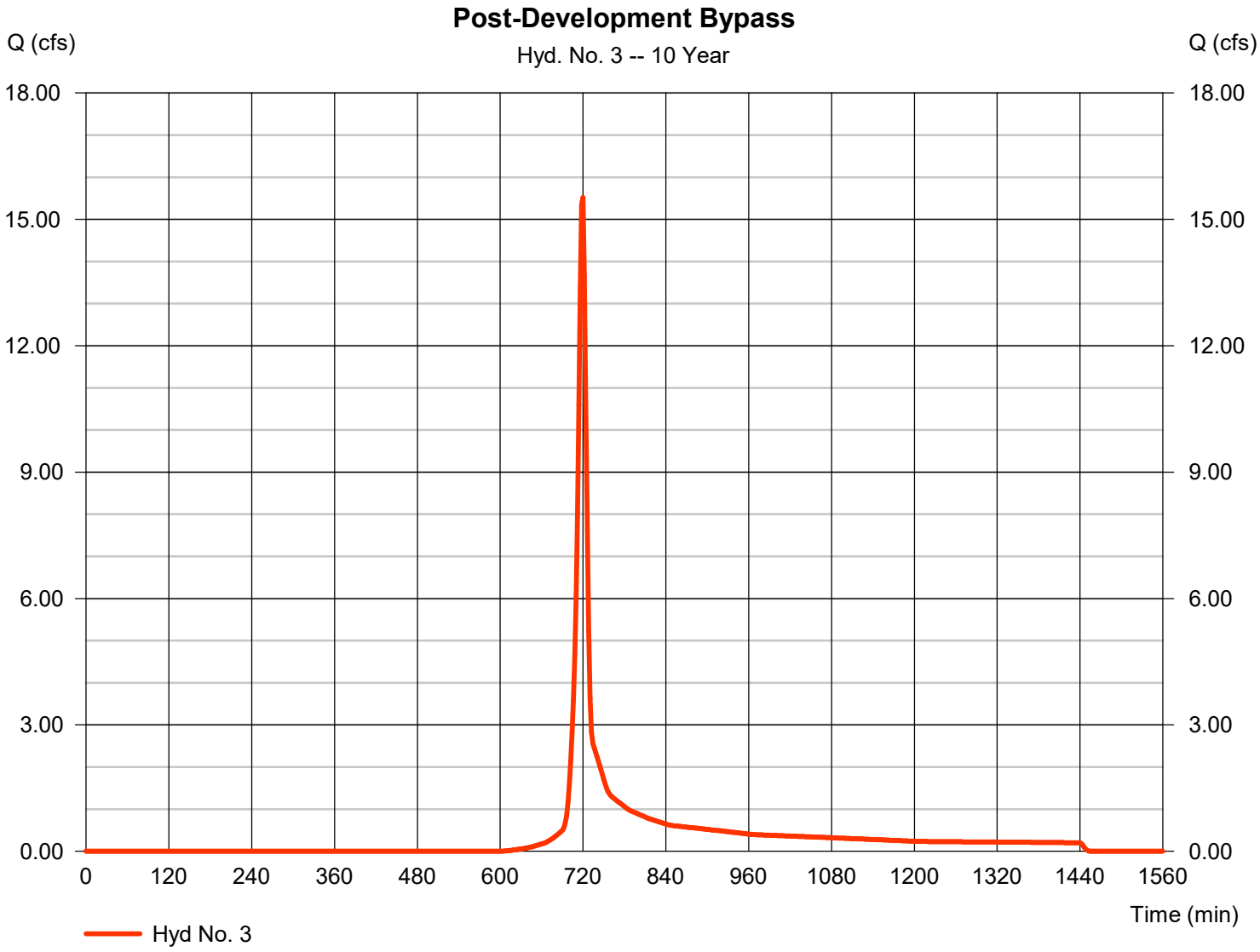
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 3

Post-Development Bypass

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.52 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	35,550 cuft
Drainage area	=	4.930 ac	Curve number	=	69*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	7.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.170 x 98) + (3.500 x 65) + (0.240 x 80) + (1.020 x 77)] / 4.930



Hydrograph Report

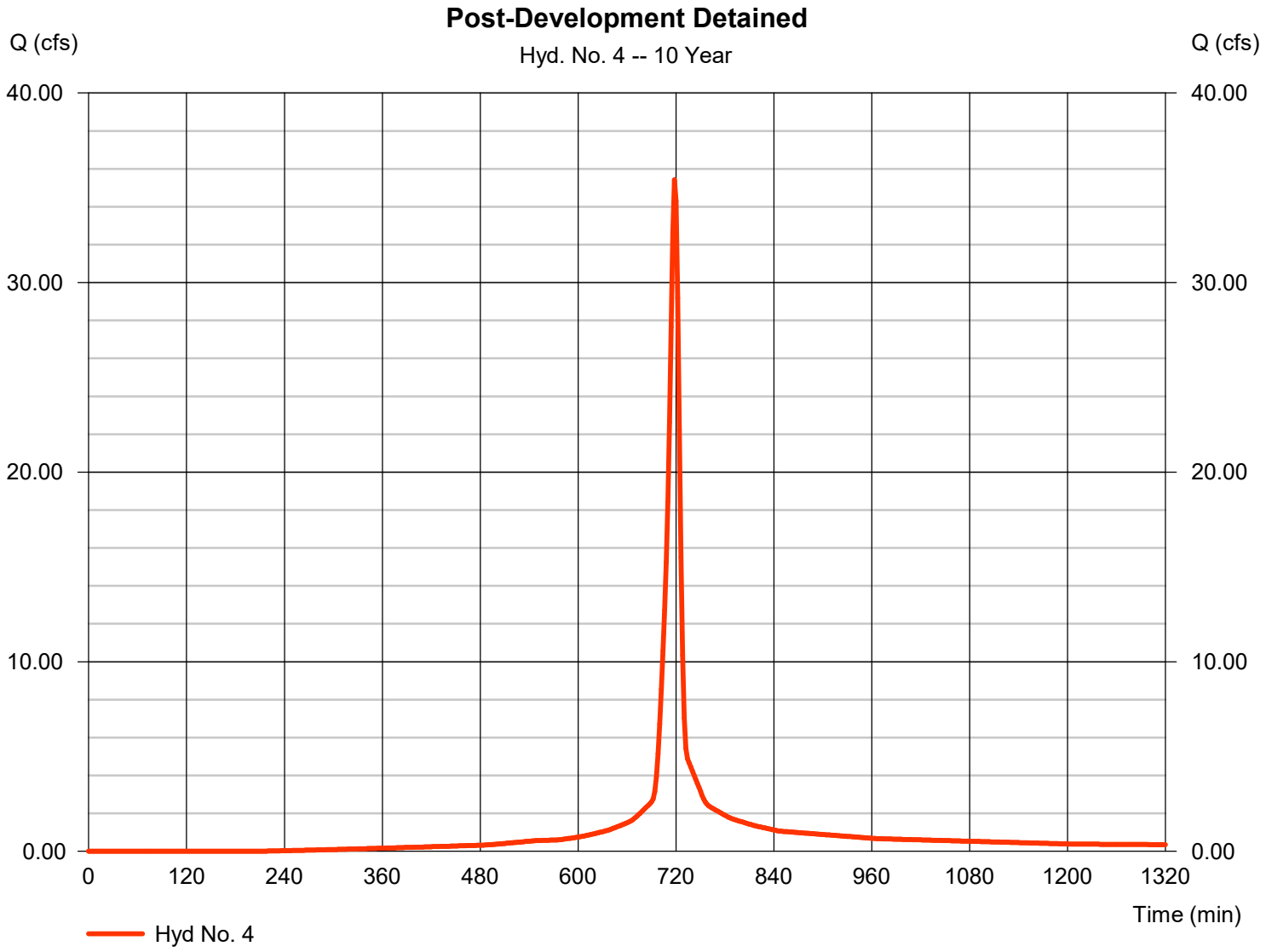
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 4

Post-Development Detained

Hydrograph type	=	SCS Runoff	Peak discharge	=	35.42 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	85,970 cuft
Drainage area	=	5.890 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	7.00 min
Total precip.	=	5.04 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.660 x 98) + (0.260 x 74) + (1.850 x 80) + (0.120 x 100)] / 5.890



Hydrograph Report

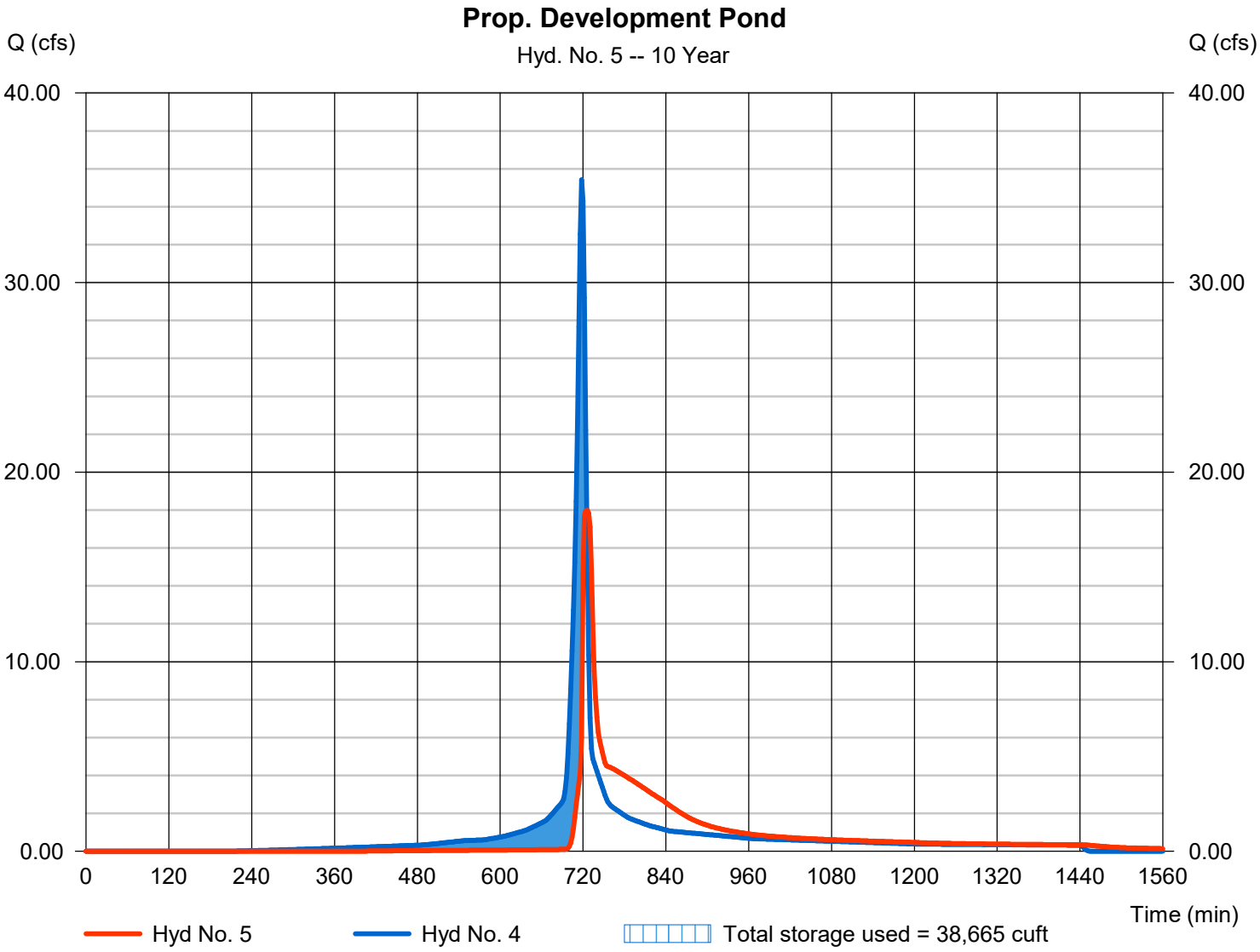
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 5

Prop. Development Pond

Hydrograph type	= Reservoir	Peak discharge	= 17.98 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 84,967 cuft
Inflow hyd. No.	= 4 - Post-Development Detained	Max. Elevation	= 404.68 ft
Reservoir name	= As-Built Pond	Max. Storage	= 38,665 cuft

Storage Indication method used.



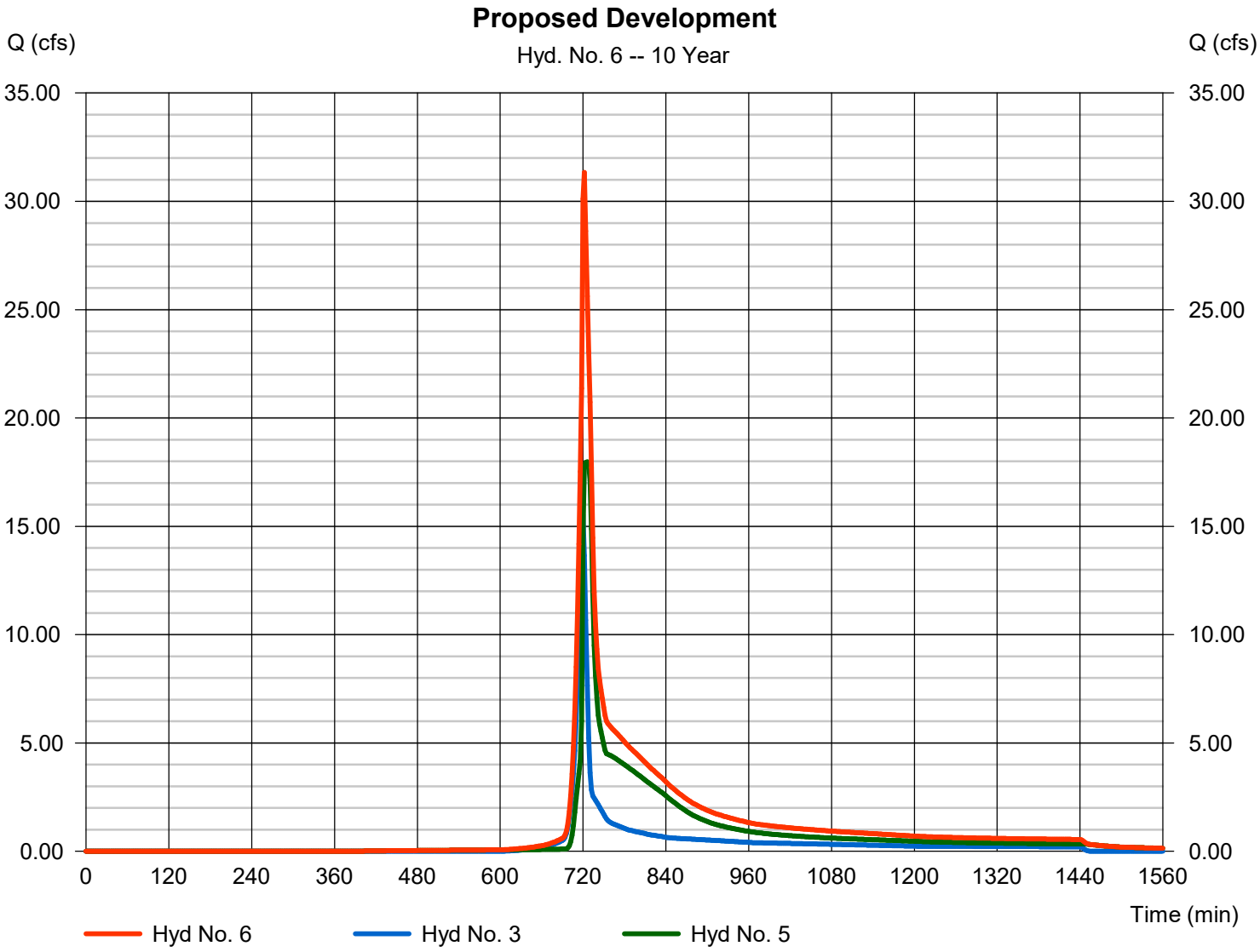
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Hyd. No. 6

Proposed Development

Hydrograph type	= Combine	Peak discharge	= 31.33 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 120,517 cuft
Inflow hyds.	= 3, 5	Contrib. drain. area	= 4.930 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Tuesday, 12 / 10 / 2024

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	59.7930	12.4000	0.8801	--------
2	71.2172	12.9000	0.8806	--------
3	0.0000	0.0000	0.0000	--------
5	69.6789	12.6000	0.8322	--------
10	67.8359	12.0000	0.7923	--------
25	62.7327	11.1000	0.7421	--------
50	56.2745	10.0000	0.6940	--------
100	53.6025	9.4000	0.6625	--------

File name: BUL2103 - 2024 IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	4.84	3.88	3.25	2.80	2.47	2.21	2.00	1.83	1.69	1.57	1.47	1.38
2	5.61	4.52	3.80	3.28	2.90	2.60	2.36	2.16	2.00	1.86	1.74	1.63
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.41	5.20	4.41	3.84	3.41	3.07	2.80	2.58	2.39	2.23	2.09	1.97
10	7.19	5.86	4.98	4.35	3.88	3.51	3.21	2.96	2.76	2.58	2.42	2.29
25	7.98	6.53	5.57	4.89	4.38	3.98	3.65	3.39	3.16	2.97	2.80	2.65
50	8.59	7.04	6.03	5.31	4.77	4.35	4.01	3.73	3.49	3.28	3.11	2.95
100	9.16	7.52	6.46	5.71	5.14	4.70	4.34	4.05	3.80	3.58	3.39	3.23

Tc = time in minutes. Values may exceed 60.

- Rolesville, NC\Engineering\STORMWATER\MODEL\2024-12-03 Verification Modeling\BUL-2103 - 2024 Evt Mgr.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.86	3.45	0.00	4.34	5.04	5.99	6.75	7.53
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix C:

Runoff Volume Control Drawdown Calculation

Project Number:	BUL 2103
Project Name:	Retail and Restaurant Development
Project Location:	6000 Rogers Road, Rolesville, NC
Date:	10-Dec-24

Wet Pond WQv Storage Stage Area & Volume:

Stage:	Elevation (ft AMSL):	Contour Area (sf):	Incremental Storage (cf):	Total Storage (cf):
0	400.5	5,694	--	--
1	401	7,092	3,190	3,190
2	402	8,389	7,731	10,922
3	403	9,757	9,064	19,986
4	404	11,194	10,467	30,453
5	405	12,700	11,939	42,392

Provided Water Quality Treatment Volume:

Required Water Quality Volume Per Wake County Municipal Stormwater Tool =	7,495	cubic feet
Water Quality Volume Provided =	**13,582**	**cubic feet**

Draw Down Calculation:

Q = Cd * A * (2*g * Ho) ^ 0.5
T = WQv / Q / 86400 (sec/day)

Coefficient of Discharge, Cd =	0.6	(unitless)
Diameter of Drawdown Orifice, D =	1.75	inches
Orifice Cross Sectional Area, A =	0.017	square feet
Orifice Invert Elevation =	400.5	ft. AMSL
Stage Elevation of DV =	402.25	ft. AMSL
Average Elevation Head During Drawdown =	0.58	feet
Orifice Flow Rate, Q =	0.06	cfs
Drawdown Time, T =	**2.56**	**days**

Appendix D:

Wake County Municipal Design Tool Report

SITE DATA

Project Information	
Project Name:	**Proposed Retail and Restaurant Development**
Applicant:	Bullard Restaurant Group
Applicant Contact Name:	
Applicant Contact Number:	
Contact Email:	
Municipal Jurisdiction (Select from dropdown menu):	Rolesville
Last Updated:	Monday, December 9, 2024
Site Data:	
Total Site Area (Ac):	10.81
Existing Lake/Pond Area (Ac):	0.12
Proposed Disturbed Area (Ac):	1.80
Impervious Surface Area (acre):	3.83
Type of Development (Select from Dropdown menu):	Non-Residential
Percent Built Upon Area (BUA):	35%
Project Density:	High
Is the proposed project a site expansion?	No
Number of Drainage Areas on Site:	1
NOAA — **1-Year, 24-Hour Storm (inches) (See NOAA Website):**	2.86
2-Year, 24-Hour Storm (inches) (See NOAA Website):	3.45
10-Year, 24-Hour Storm (inches) (See NOAA Website):	5.04
Lot Data (if applicable):	
Total Acreage in Lots:	n/a
Number of Lots:	n/a
Average Lot Size (SF):	n/a
Total Impervious Surface Area on Lots (SF):	n/a
Average Impervious Surface Area Per Lot (SF):	n/a

Stormwater Narrative (limit to 1,200 characters - attach additional pages with submittal if necessary):

This proposed retail and restaurant development is on a parcel of land located immediately adjacent to the Granite Falls Boulevard (to north) and Rogers Road (to east) in Rolesville, NC. This project proposed to retain existing drainage patterns, with the site continuing to drain to an existing wet pond stormwater control measure. This wet pond was evaulated to ensure it has available capacity to address the increase in runoff resulting from this project's proposed impervious area and was found to be in compliance with no required modifications. Please see the stormwater report for further information.

Project Name: Proposed Retail and Restaurant Development

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	10.81				10.81			
Site Acreage within Drainage=	10.69				10.69			
One-year, 24-hour rainfall (in)=	2.86							
Two-year, 24-hour rainfall (in)=	3.45							
Ten-year, 24-hour storm (in)=	5.04							
Total Lake/Pond Area (Acres)=	0.00				0.12			
Lake/Pond Area not in the Tc flow path (Acres)=	0.00				0.00			
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture			3.65				3.50	
Woods, Poor Condition								
Woods, Fair Condition			1.14	2.71				
Woods, Good Condition								1.02
Open Space, Poor Condition								
Open Space, Fair condition								
Open Space, Good Condition				2.53			0.26	2.09
Reforestation (in dedicated OS)								
Connected Impervious								
Disconnected Impervious			0.24	0.54			1.24	2.58
SITE FLOW	**PRE-DEVELOPMENT T_c**				**POST-DEVELOPMENT Tc**			
Sheet Flow								
Length (ft)=								
Slope (ft/ft)=								
Surface Cover:								
n-value=								
T_t (hrs)=								
Shallow Flow								
Length (ft)=	714.00				714.00			
Slope (ft/ft)=	0.022				0.022			
Surface Cover:	Unpaved				Unpaved			
Average Velocity (ft/sec)=	2.39				2.39			
T_t (hrs)=	0.08				0.08			
Channel Flow 1								
Length (ft)=	282.00				282.00			
Slope (ft/ft)=	0.046				0.046			
Cross Sectional Flow Area (ft^2)=	7.57				7.57			
Wetted Perimeter (ft)=	25.76				25.76			
Channel Lining:	Weeds				Weeds			
n-value=	0.040				0.040			
Hydraulic Radius (ft)=	0.29				0.29			
Average Velocity (ft/sec)=	3.53				3.53			
T_t (hrs)=	0.02				0.02			

Project Name: Proposed Retail and Restaurant Development

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

Channel Flow 2		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=	#VALUE!	#VALUE!
T_t (hrs)=	#VALUE!	#VALUE!
Channel Flow 3		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		#VALUE!
T_t (hrs)=		#VALUE!
Tc (hrs)=	0.12	0.12
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Composite Curve Number=	78	84
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =	3.82	
$CN_{adjusted\ (1\text{-}year)}$=	**84**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	14,775	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-}year}$=	1.05	1.40
Volume of runoff (ft^3) =	40,589	54,453
Volume change (ft^3) =	13,864	
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	16.894	22.665
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-}year}$=	1.48	1.90
Volume of runoff (ft^3) =	57,364	73,546
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	23.876	30.611
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.77	3.31
Volume of runoff (ft^3) =	107,523	128,404
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	44.753	53.444

Project Name: Proposed Retail and Restaurant Development

DA SITE SUMMARY
STORMWATER PRE-POST CALCULATIONS

SITE SUMMARY

DRAINAGE AREA SUMMARIES

DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in) = $Q_{pre,1\text{-}year}$ =	1.05									
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	16.894									
Post-Development (1-year, 24-hour storm)										
Proposed Impervious Surface (acre) =	3.82									
Runoff (in)=$Q_{1\text{-}year}$ =	1.40									
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	22.665									
Increase in volume per DA (ft^3)_1-yr storm=	13,864									
Minimum Volume to be Managed for DA HIGH DENSITY REQUIREMENT = (ft^3) =	14,775									

TARGET CURVE NUMBER (TCN)

Site Data

SITE \SOIL COMPOSITION

HYDROLOGIC SOIL GROUP	Site Area	%	Target CN
A	0.00	0%	N/A
B	0.00	0%	N/A
C	5.00	47%	N/A
D	5.69	53%	N/A

Total Site Area (acres) =	10.69
Percent BUA (Includes Existing Lakes/Pond Areas) =	35%
Project Density =	High
Target Curve Number (TCN) =	N/A
$CN_{adjusted\ (1\text{-}year)}$=	
Minimum Volume to be Managed (Total Site) Per TCN Requirement= ft^3 =	

Site Nitrogen Loading Data

HSG	TN export coefficient (lbs/ac/yr)	Site Acreage	N Export
Pasture	1.2	3.50	4.20
Woods, Poor Condition	1.6	0.00	0.00
Woods, Fair Condition	1.2	0.00	0.00
Woods, Good Condition	0.8	1.02	0.82
Open Space, Poor Condition	1.0	0.00	0.00
Open Space, Fair Condition	0.8	0.00	0.00
Open Space, Good Condition	0.6	2.35	1.41
Reforestation (in dedicated OS)	0.6	0.00	0.00
Impervious	21.2	3.82	80.98
SITE NITROGEN LOADING RATE (lbs/ac/yr)=		8.18	
Nitrogen Load (lbs/yr)=		87.41	
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)_Wendell Only=		48.93	

Site Nitrogen Loading Data For Expansions Only

	Existing	New
Impervious(acres)=	NA	NA
"Expansion Area" (acres=)		
Nitrogen Load (lbs/yr)=	NA	NA
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	NA	NA
Total Site loading rate (lbs/ac/yr)		
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)=	NA	

WAKE COUNTY
NORTH CAROLINA

Project Name: Proposed Retail and Restaurant Development

DRAINAGE AREA 1
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA1 Site Acreage=	10.69			
DA1 Off-Site Acreage=	0.12			
Total Required Storage Volume for Site TCN Requirement (ft^3)=				
Total Required Storage Volume for DA1 1" Rainfall for High Density (ft^3)=	14,775			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=	0%	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture			3.50							
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition			1.02							
Open Space, Poor Condition										
Open Space, Fair Condition										
Open Space, Good Condition	2.11		0.24							
Reforestation (in dedicated OS)										
Impervious	3.66		0.17							

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
Wet Pond	Wet Detention Basin	7,495	13,582	25%	78.86	19.71	61.4
				0%	59.14	0.00	
				0%	59.14	0.00	
				0%	59.14	0.00	
				0%	59.14	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):		**59.14**					

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
		1,151	0	0%	8.76	0.00	
				0%	8.76	0.00	
				0%	8.76	0.00	
				0%	8.76	0.00	
				0%	8.76	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):		**8.76**					

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Project Name: Proposed Retail and Restaurant Development

DRAINAGE AREA 1
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
			0	0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA1 BMP SUMMARY	
Total Volume Treated (ft^3)=	13,582
Nitrogen Mitigated(lbs)=	19.71
1-year, 24-hour storm	
Post BMP Volume of Runoff (ft^3)$_{(1\text{-year})}$=	40,871
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	1.05
Post BMP $CN_{(1\text{-year})}$=	78
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	5.396
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff (ft3)$_{(2\text{-year})}$=	59,964
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	1.55
Post BMP $CN_{(2\text{-year})}$=	79
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	9.702
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	114,822
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	2.96
Post BMP $CN_{(10\text{-year})}$=	95
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	31.330

Project Name: Proposed Retail and Restaurant Development

DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY										
DRAINAGE AREA SUMMARIES										
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in)=$Q^*_{1\text{-year}}$ =	1.05									
Peak Flow (cfs)=$Q_{1\text{-year}}$ =	16.894									
Post-Development (1-year, 24-hour storm)										
Target Curve Number (TCN) =	NA									
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	1.05									
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	5.396									
Post BMP $CN_{(1\text{-year})}$=										
Post-BMP Nitrogen Loading										
TOTAL SITE NITROGEN MITIGATED (lbs)=	19.71									
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	6.33									
TOTAL SITE NITROGEN LEFT TO MITIGATE_Wendell Only (lbs)=	**29.21**									

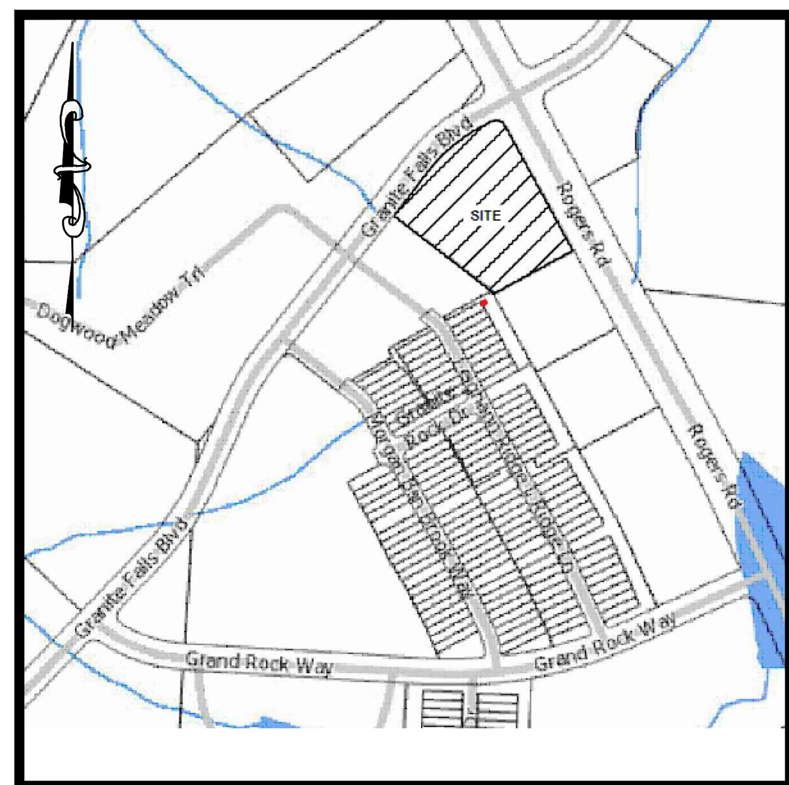
Project Name:	oposed Retail and Restaurant Developme

DOWNSTREAM IMPACT ANALYSIS SITE SUMMARY

DRAINAGE AREA SUMMARIES										
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development										
Peak Discharge (cfs)=$Q_{10\text{-year}}$ =	44.75									
Volume of Runoff (ft^3)$_{(10\text{-year})}$ =	107,523									
Post-Development										
10-year, 24-hour storm (DIA)										
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	31.33									
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	114,822									

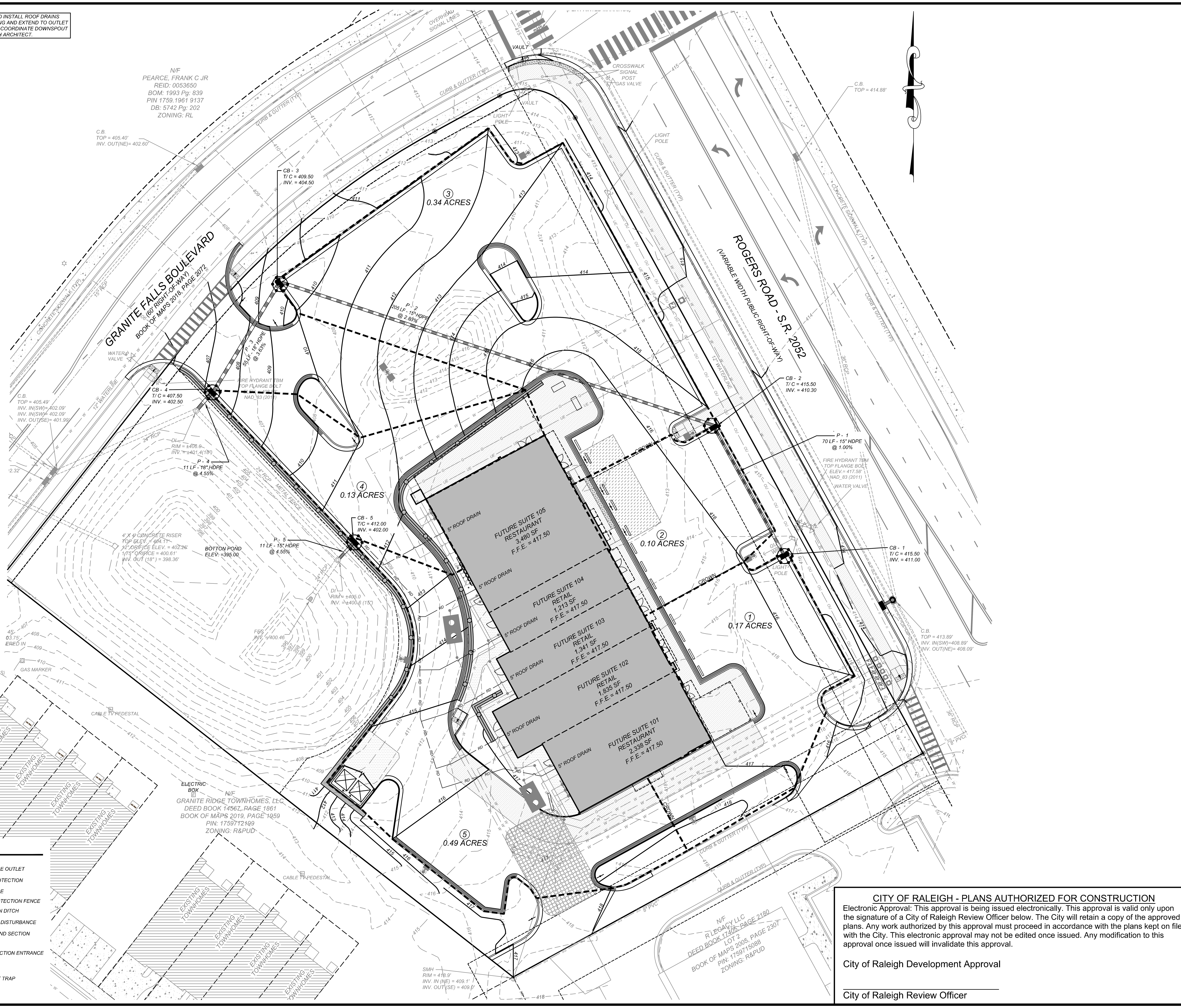
Appendix E:

10-Year HGL Calculations



VICINITY MAP
NTS

CONTRACTOR TO INSTALL ROOF DRAINS AROUND BUILDING AND EXTEND TO OUTLET AT 2% MINIMUM. COORDINATE DOWNSPOUT LOCATIONS WITH ARCHITECT.



Know what's **below.**
Call before you dig.
nc811.org or 1-800-632-4949

GRADING/EROSION CONTROL LEGEND

Symbol	Description	Symbol	Description
■	DROP INLET		SILT FENCE OUTLET
	CURB INLET		INLET PROTECTION
	STORM PIPE	— SF —	SILT FENCE
XXX.XX / XXX.XX	TOP OF CURB / BOTTOM OF CURB	— TP —	TREE PROTECTION FENCE
	HANDICAP AREA (2% MAX. SLOPE)		DIVERSION DITCH
	SPILL CURB	— LD —	LIMITS OF DISTURBANCE
TW=XXX.XX / BW=XXX.XX	GROUND AT TOP OF WALL / GROUND AT BOTTOM OF WALL		FLARED END SECTION
■	INLINE DRAIN		CONSTRUCTION ENTRANCE
---RD---	ROOF DRAIN 8" CORRUGATED PLASTIC 3' MIN. COVER 1% MIN. SLOPE PVC IN TRAFFIC AREAS CLEANOUTS LOCATED @ ALL BENDS		SEDIMENT TRAP

CITY OF RALEIGH - PLANS AUTHORIZED FOR CONSTRUCTION

Electronic Approval: This approval is being issued electronically. This approval is valid only upon the signature of a City of Raleigh Review Officer below. The City will retain a copy of the approved plans. Any work authorized by this approval must proceed in accordance with the plans kept on file with the City. This electronic approval may not be edited once issued. Any modification to this approval once issued will invalidate this approval.

City of Raleigh Development Approval

City of Raleigh Review Officer

REVISIONS

NO.	DATE	DESCRIPTION	BY
1	2023-5-3	ROLESVILLE TRC COMMENTS	KL
2	2024-03-26	WAKE COUNTY COMMENTS	STH
3	2024-10-28	CITY COMMENTS	STH

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Engineering | Surveying | Planning | Environmental

CLIENT:
BULLARD RESTAURANT GROUP
9131 ANSON WAY, # 305
RALEIGH, NC 27615

PROPOSED RETAIL AND RESTAURANT DEVELOPMENT
6000 ROGERS ROAD
ROLESVILLE, NORTH CAROLINA

INLET DRAINAGE AREA MAP

PROJECT NO.	BUL-2103
FILENAME:	BUL2103-GP
DRAWN BY:	RCN
SCALE:	1"= 20'
DATE:	12-06-2022
SHEET NO.	C-4a

X:\BUL - Bullard, Inc\2103 - Rolesville, NC\CAD\BUL2103-Inlet DA Map.dwg, 11/1/2024 12:16:14 PM, THILL

Catchment Report - 10 Yr. Storm Report

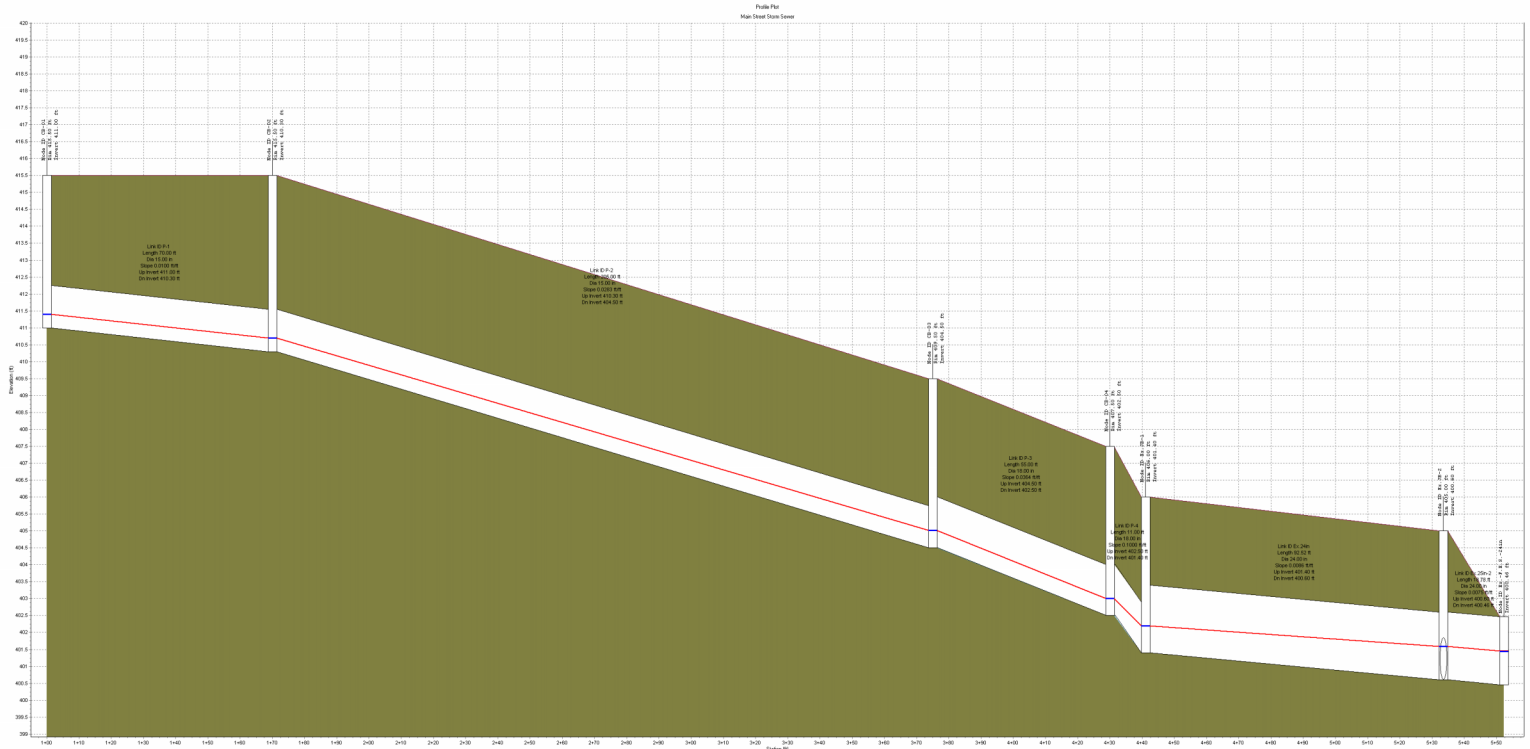
Element ID	Area (acres)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Peak Rate Factor	Total Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
CA-01	0.17	CB-01	92.00	Rolesville	484	5.70	4.77	1.22	0 00:05:00
CA-02	0.10	CB-02	92.00	Rolesville	484	5.70	4.77	0.72	0 00:05:00
CA-03	0.34	CB-03	92.00	Rolesville	484	5.70	4.77	2.40	0 00:05:00
CA-04	0.13	CB-04	92.00	Rolesville	484	5.70	4.77	0.90	0 00:05:00
CA-05	0.49	CB-05	92.00	Rolesville	484	5.70	4.77	3.48	0 00:05:00

Inlet Report - 10 Yr. Storm Event

Element ID	X Coordinate	Y Coordinate	Inlet Location	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Peak Flow (cfs)	Peak Lateral Inflow (cfs)	Peak Flow Intercepted by Inlet (cfs)	Peak Flow Bypassing Inlet (cfs)	Inlet Efficiency during Peak Flow (%)	Max Gutter Spread during Peak Flow (ft)	Max Gutter Water Elev. during Peak Flow (ft)	Max Gutter Water Depth during Peak Flow (ft)
CB-01	2157570.88	791311.41	On Sag	411.00	415.50	N/A	0.0200	0.0160	1.22	1.22	N/A	N/A	N/A	5.76	415.72	0.22
CB-02	2157538.77	791369.19	On Sag	410.30	415.50	N/A	0.0200	0.0160	0.72	0.72	N/A	N/A	N/A	2.56	415.66	0.16
CB-03	2157344.62	791433.72	On Sag	404.50	409.50	N/A	0.0500	0.0160	2.40	2.40	N/A	N/A	N/A	5.06	409.80	0.30
CB-04	2157313.69	791385.14	On Grade	402.50	407.50	0.0400	0.0400	0.0160	2.01	0.90	1.79	0.22	88.98	4.32	407.72	0.22
CB-05	2157377.51	791317.65	On Grade	402.00	412.00	0.0100	0.0200	0.0160	3.48	3.48	2.34	1.14	67.30	10.92	412.30	0.30

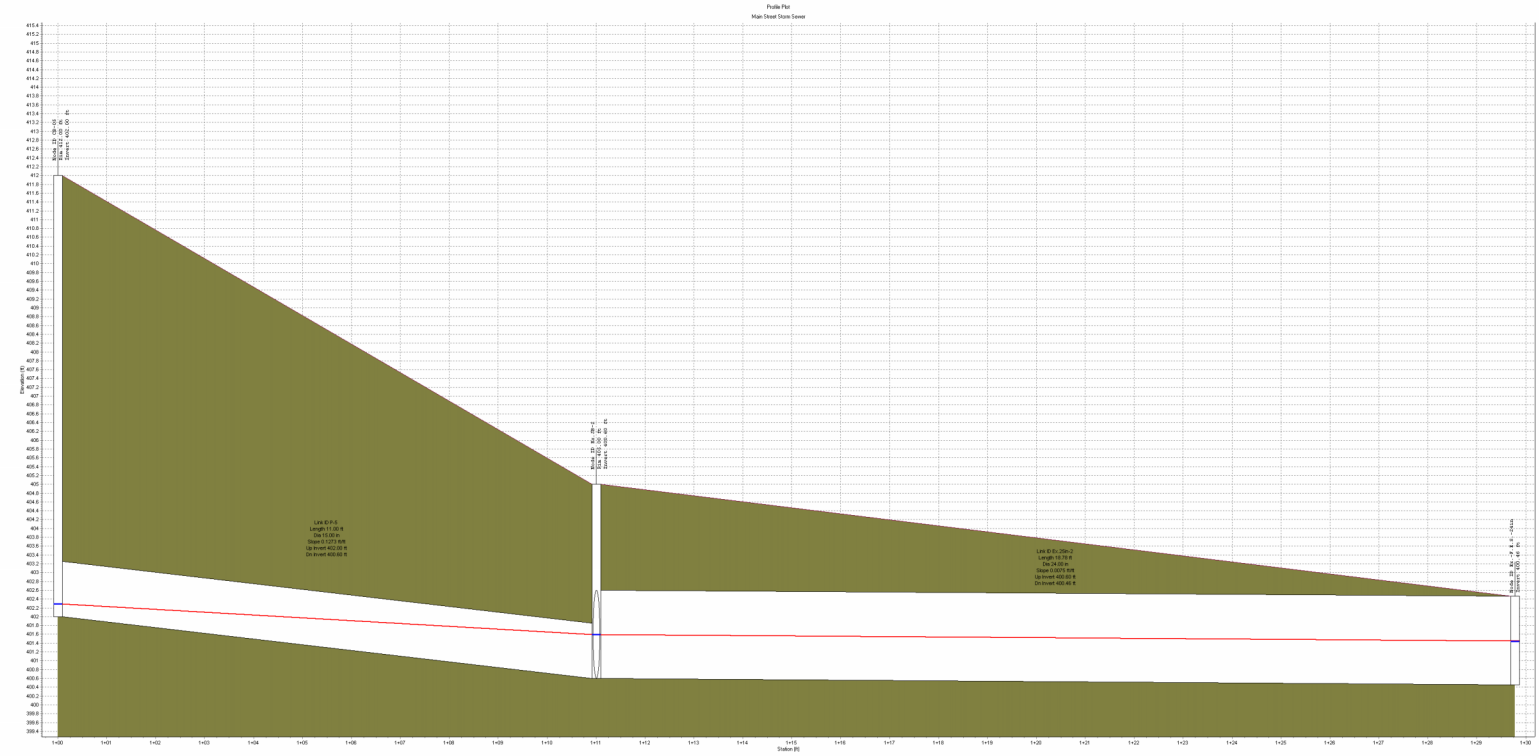
Pipe Report - 10 Yr. Storm Event

Element ID	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Peak Flow	Max Flow Velocity	Travel Time	Design Flow Capacity	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Max Flow Depth
			(ft)	(ft)	(ft)	(ft)	(%)		(inches)	(inches)		(cfs)	(ft/sec)	(min)	(cfs)			(ft)
Ex.24in	Ex.JB-1	Ex.JB-2	92.52	401.40	400.60	0.80	0.8600	CIRCULAR	24.000	24.00	0.0150	6.05	5.22	0.30	18.23	0.33	0.40	0.79
Ex.25in-2	Ex.JB-2	Ex.-F.E.S.-24in	18.78	400.60	400.46	0.14	0.7500	CIRCULAR	24.000	24.00	0.0150	8.32	5.36	0.06	16.93	0.49	0.50	0.99
P-1	CB-01	CB-02	70.00	411.00	410.30	0.70	1.0000	CIRCULAR	15.000	15.00	0.0150	1.21	3.66	0.32	5.60	0.22	0.32	0.39
P-2	CB-02	CB-03	205.00	410.30	404.50	5.80	2.8300	CIRCULAR	15.000	15.00	0.0150	1.92	6.06	0.56	9.42	0.20	0.31	0.38
P-3	CB-03	CB-04	55.00	404.50	402.50	2.00	3.6400	CIRCULAR	18.000	18.00	0.0150	4.28	8.13	0.11	17.36	0.25	0.34	0.50
P-4	CB-04	Ex.JB-1	11.00	402.50	401.40	1.10	10.0000	CIRCULAR	18.000	18.00	0.0150	6.05	12.89	0.01	28.79	0.21	0.31	0.47
P-5	CB-05	Ex.JB-2	11.00	402.00	400.60	1.40	12.7300	CIRCULAR	15.000	15.00	0.0150	2.34	10.88	0.02	19.97	0.12	0.23	0.29



Node ID	CB-01	CB-02	CB-03	CB-04	Ex.I-1	Ex.I5-2	Ex.F.E.S.-24in
Rim (ft)	415.50	415.50	409.50	407.50	406.00	405.00	
Invert (ft)	411.00	410.30	404.50	402.50	401.40	400.60	400.46
Min Pipe Cover (ft)					2.60	2.40	
Max HGL (ft)	411.40	410.70	405.01	403.00	402.19	401.19	401.45

Link ID	P-1	P-2	P-3	P-4	Ex.24in	Ex.25in-2
Length (ft)	70.00	205.00	55.00	11.00	52.52	18.78
Dia (in)	15.00	15.00	18.00	18.00	24.00	24.00
Slope (ft/ft)	0.0100	0.0293	0.0364	0.1000	0.0096	0.0075
Up Invert (ft)	411.00	410.30	404.50	402.50	401.40	400.60
Dn Invert (ft)	410.30	404.50	402.50	401.40	400.60	400.46
Max Q (cfs)	1.21	1.92	4.28	6.05	6.05	8.32
Max Vel (ft/s)	3.06	6.06	6.13	12.69	5.22	5.36
Max Depth (ft)	0.39	0.38	0.50	0.47	0.79	0.99



Node ID	CB-05	Ex.Mh-2	Ex.F.E.S.-24in
Rim (ft)	412.00	409.30	
Invert (ft)	402.00	400.60	400.46
Min Pipe Cover (ft)		2.40	
Max HGL (ft)	402.29	401.59	401.45

Link ID	P-5	Ex.25h-2
Length (ft)	11.00	10.78
Dia (in)	15.00	24.00
Slope (ft/ft)	0.1273	0.0075
Up Invert (ft)	402.00	400.60
Dn Invert (ft)	400.60	400.46
Max Q (cfs)	2.34	8.32
Max Vel (ft/s)	10.88	5.36
Max Depth (ft)	0.29	0.99

Appendix F:

Wet Pond Maintenance Agreement

STORMWATER CONTOL STRUCTURE
WET DETENTION MAINTENANCE AGREEMENT

PROJECT: SEC-098503-2023 - SWF-098498-2023 - Proposed Restaurant and Retail- 6000 Rogers Rd

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS:_____

I. Monthly *or after every runoff producing rainfall, whichever comes first*:

a. Remove debris from trash rack.
b. Check and clear orifice of any obstructions.
c. Check pond side slopes; remove trash, repair eroded areas before next rainfall.

II. Quarterly

a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
c. Check impoundment dam and inlet pipes for undercutting / critter holes. Repair if necessary.
d. Repair any broken pipes.
e. Replace rip rap that is choked with sediment.

III. Semi-Annually

a. Remove accumulated sediment from bottom of outlet structure.
b. Check pond depth at various locations. If depth is reduced to 75% of original design depth, remove sediment to original design depth.
c. Reseed grassed swales twice yearly. Repair eroded areas immediately.

IV. General

a. Mow side slopes according to the season. Once per year sufficient to discourage woody vegetation. Avoid “lawn” type maintenance to reduce geese populations.
b. Wetland plants are encouraged along pond perimeter. Invasive species such as cattails shall be removed.
c. All components of impoundment system to be kept in good working order.
d. In case the ownership of the Impoundment Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.
e. This property and impoundment is also subject to the Operation and Maintenance Manual filed with the register of deeds.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of_____, 2009 and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____ My commission expires: _____