EDEN-MLV-03 STORMWATER CALCULATIONS

1.0 Stormwater Management Design Summary

1.1 Introduction

The EDEN-MLV-03 valve site will be constructed as part of the Southeast Supply Enhancement Project, located in Pittsylvania County, Virginia. The site will be constructed within the limits of Tract SSE31-VA-PI-0216 located off Dry Fork Road, Dry Fork, Virginia 24549. The parcel is composed of approximately 57.4 acres.

The EDEN-MLV-03 valve site consists of the construction of a new valve site. This includes a new gravel access road and pad area with the installation of new aboveground piping and fence. The project will include approximately 0.19 acres of impervious gravel area.

The proposed project must follow the Virginia Code §9VAC25-875 pertaining to Virginia Stormwater Management Program (VSMP) Permit regulations, and the Virginia Erosion and Sediment Control Regulations. Under the technical criteria, the valve site design will have to meet requirements for water quality (§9VAC25-260), channel protection (§9VAC25-875-600.B), and flood protection (§9VAC25-875-600.C) as it relates to post-construction stormwater runoff.

1.2 Existing Site Characteristics

The valve site will only impact Tract SSE31-VA-PI-0216, which is approximately 57.4 acres. Existing conditions of the site include an existing vegetated pipeline right-of-way, as well as mixed open and forested space.

1.2.1 Existing Soil Characteristics

Based on the Soil Survey report for Pittsylvania County, Virginia, the soils consist primarily of Clifford sandy clay loam, 2 to 7 percent slopes, severely eroded (5B3), hydraulic soil group (HSG) B, and Clifford sandy clay loam, 7 to 15 percent slopes, severely eroded (5C3), HSG B.

The USDA Soils Survey map has been included for the entire Southeast Supply Enhancement Project in the appendices of the SWPPP.

1.2.2 Drainage Area Conditions

The valve site is entirely within one drainage area. The drainage area sheets flows to the forested area to the south that consists of a natural drainage swale. Drainage area maps have been included in Attachment 4.

1.2.3 Adjacent Areas

Areas outside of the parcel boundary are not anticipated to be impacted by the valve site. BMPs, as depicted on the plans and described herein, shall be utilized as perimeter controls for the site to prevent sediment laden stormwater from entering downstream channels or properties.

1.3 Methodology and System Description

The valve site was designed in accordance with the Virginia Stormwater Management Act and Regulations. The valve site shall be considered a new development project due to work consisting of construction of a new valve site. A drainage area of 1.20 acres within the projects limits of disturbance was selected as the water quality limits of analysis and the Virginia Runoff Reduction Method was utilized to analyze the pollutant load produced by the site. Water Quality Land Cover Maps have been included in Attachment 2.

1.4 Water Quality

The valve site shall be considered a new development as the site includes the construction of a new natural gas pipeline valve site. In accordance with §9VAC25-260, the required pollutant load removal requirements were calculated utilizing Virginia Runoff Reduction Method (VRRM) and associated spreadsheets for a new development. Table 1.1 illustrates the pre-construction land cover conditions, while Table 1.2 illustrates the post-construction land cover conditions. Please see Attachment 3 for calculations pertaining to water quality and Attachment 2 for land cover maps which illustrate pre- and post-construction cover conditions.

Table 1. 1 Pre-Development Land Cover (acres)					
	A Soils	B Soils	C Soils	D Soils	Totals
Forest (acres)	0.00	0.12	0.00	0.00	0.12
Mixed Open (acres)	0.00	1.05	0.00	0.00	1.05
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00
Impervious Cover (acres)	0.00	0.03	0.00	0.00	0.03
Total					1.20

Table 1. 2 Post-Development Land Cover (acres)					
	A Soils	B Soils	C Soils	D Soils	Totals
Forest (acres)	0.00	0.00	0.00	0.00	0.00
Mixed Open (acres)	0.00	0.99	0.00	0.00	0.99
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00
Impervious Cover (acres)	0.00	0.21	0.00	0.00	0.21
Total					1.20

As aforementioned and as illustrated in Table 1.1 and 1.2, the soils within the property boundary are considered Hydrologic Soil Group B soils. Grading and construction of the valve site will alter the drainage areas from pre- to post-construction and the project will result in a total impervious area of 0.21 acres within the drainage area to the proposed infiltration trench. The proposed infiltration trench was designed as a Level 1 Conventional Infiltration practice. The VRRM spreadsheet indicated the post-construction total phosphorous load reduction required for the site is 0.21 lbs/yr. The post-construction total phosphorous load reduction achieved for the site is 0.32 lbs/yr, and no offsite nutrient credits are required to be purchased for the site. A summary of the VRRM spreadsheets has been provided in Attachment 3. The valve site will satisfy water quality requirements by being in compliance with §9VAC25-260.

1.5 Channel Protection and Flood Protection

Channel and flood protection calculations were completed for the Point of Interest (POI) in accordance with the minimum standards set by §9VAC25-875-600.B and §9VAC25-875-600.C. Because runoff from the site will drain to a natural channel, the site meets conditions set forth by §9VAC25-875-600.B.3 energy balance equation. Flood protection requirements are met because there are no known issues with localized flooding and post-construction peak flow at the infiltration trench outfall decreases from the pre-construction peak flow for the 10-year 24-hour storm event in accordance with §9VAC25-875-600.C.1.

When stormwater from a development is discharged to a natural stormwater conveyance system, the maximum peak flow rate from the one-year 24-hour storm following the land-disturbing activity shall be calculated by using the energy balance equation:

$$Q_{Developed} \leq I.F.*(Q_{Pre\text{-}developed}* RV_{Pre\text{-}Developed})/RV_{Developed}$$

I.F. (Improvement Factor) equals 0.8 for sites > 1 acre or 0.9 for sites ≤ 1 acre.

$Q_{Developed}$ = The allowable peak flow rate of runoff from the developed site.

$RV_{Developed}$ = The volume of runoff from the site in the developed condition.

$Q_{Pre\text{-}Developed}$ = The peak flow rate of runoff from the site in the pre-developed condition.

$RV_{Pre\text{-}Developed}$ = The volume of runoff from the site in pre-developed condition.

Since the one-year 24-hour storm is contained entirely within the infiltration trench, energy balance has been met for the site in accordance with §9VAC25-875-600.B.3.a.

Furthermore, a level spreader has been designed at the outlet of the overflow relief armoring to ensure the 10-year, 24-hour post-development sheet flow depth will be less than 0.1 foot immediately downslope of the level spreader. The level spreader will only receive flow during a 10-year or greater storm event when bypass flows from the infiltration trench exit through the overflow relief armoring. See Attachment 9 for level spreader design calculations.

See Attachment 4 for pre- and post-construction drainage area maps and Attachment 5 for peak flow hydrographs.

1.6 Stormwater Conveyance

Stormwater management for the valve site will consist of the construction of two grass swales and installation of HDPE culverts to convey stormwater to a proposed infiltration trench. See the EDEN-MLV-03 SWM Plan for details on construction of the infiltration trench. An infiltration trench is a “leaky” pipe in a stone filled trench with a level bottom. Level 1 infiltration BMPs require two forms of

pretreatment. Grass swales and 2-foot deep inlet sumps in the proposed manhole and drop inlet are proposed to meet the requirement for pretreatment.

Stormwater analysis was utilized to calculate the peak flow from the drainage area to the infiltration trench. Hydraflow Hydrographs Extensions for Autodesk Civil 3D 2019 (Hydraflow) which utilizes the Manning Formula, was utilized to analyze to analyze the conveyances for the 2-year 24-hour and 10-year 24-hour peak discharge. The discharges were then used to size the proposed grass channels and culverts for the 10-year storm. Please see Attachment 6 for channel sizing and Attachment 7 for culvert sizing.

ATTACHMENT 1
Point Precipitation Frequency Estimates

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NOAA Atlas 14, Volume 2, Version 3
Location name: Danville, Virginia, USA*
Latitude: 36.6302°, Longitude: -79.5479°
Elevation: 681 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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.365 (0.332-0.399)	0.435 (0.397-0.476)	0.515 (0.469-0.564)	0.571 (0.519-0.624)	0.638 (0.578-0.695)	0.682 (0.615-0.743)	0.725 (0.651-0.791)	0.763 (0.682-0.834)	0.807 (0.715-0.884)	0.839 (0.738-0.921)
10-min	0.583 (0.531-0.637)	0.695 (0.635-0.762)	0.825 (0.751-0.903)	0.913 (0.830-0.997)	1.02 (0.921-1.11)	1.09 (0.980-1.18)	1.15 (1.04-1.26)	1.21 (1.08-1.32)	1.28 (1.13-1.40)	1.32 (1.16-1.45)
15-min	0.728 (0.663-0.796)	0.874 (0.798-0.958)	1.04 (0.950-1.14)	1.16 (1.05-1.26)	1.29 (1.17-1.40)	1.38 (1.24-1.50)	1.46 (1.31-1.59)	1.53 (1.36-1.67)	1.61 (1.42-1.76)	1.66 (1.46-1.82)
30-min	0.998 (0.909-1.09)	1.21 (1.10-1.32)	1.48 (1.35-1.62)	1.67 (1.52-1.83)	1.91 (1.73-2.08)	2.07 (1.87-2.26)	2.23 (2.00-2.43)	2.38 (2.12-2.60)	2.56 (2.26-2.80)	2.69 (2.36-2.95)
60-min	1.24 (1.13-1.36)	1.52 (1.38-1.66)	1.90 (1.73-2.08)	2.18 (1.98-2.38)	2.54 (2.30-2.77)	2.81 (2.53-3.06)	3.07 (2.76-3.35)	3.33 (2.98-3.64)	3.67 (3.25-4.02)	3.92 (3.45-4.30)
2-hr	1.47 (1.34-1.62)	1.79 (1.63-1.97)	2.26 (2.05-2.48)	2.62 (2.37-2.87)	3.10 (2.79-3.39)	3.48 (3.11-3.80)	3.86 (3.43-4.22)	4.24 (3.75-4.64)	4.77 (4.17-5.22)	5.18 (4.48-5.67)
3-hr	1.58 (1.44-1.74)	1.93 (1.76-2.12)	2.43 (2.22-2.67)	2.82 (2.56-3.09)	3.34 (3.01-3.65)	3.73 (3.35-4.08)	4.15 (3.70-4.53)	4.56 (4.04-4.98)	5.11 (4.47-5.59)	5.54 (4.80-6.07)
6-hr	1.95 (1.78-2.15)	2.36 (2.16-2.61)	2.97 (2.70-3.28)	3.46 (3.14-3.81)	4.14 (3.72-4.54)	4.69 (4.19-5.14)	5.27 (4.67-5.77)	5.87 (5.15-6.42)	6.72 (5.80-7.34)	7.40 (6.30-8.10)
12-hr	2.35 (2.14-2.59)	2.85 (2.60-3.14)	3.60 (3.28-3.96)	4.23 (3.83-4.64)	5.12 (4.60-5.60)	5.87 (5.23-6.40)	6.68 (5.89-7.26)	7.55 (6.57-8.18)	8.82 (7.52-9.57)	9.86 (8.27-10.7)
24-hr	2.81 (2.60-3.04)	3.40 (3.15-3.68)	4.32 (4.01-4.68)	5.10 (4.71-5.50)	6.23 (5.71-6.70)	7.18 (6.55-7.72)	8.22 (7.44-8.84)	9.36 (8.40-10.1)	11.0 (9.76-11.9)	12.5 (10.9-13.4)
2-day	3.30 (3.07-3.56)	4.00 (3.72-4.31)	5.05 (4.69-5.44)	5.91 (5.47-6.35)	7.14 (6.58-7.67)	8.17 (7.49-8.77)	9.26 (8.44-9.95)	10.4 (9.43-11.2)	12.1 (10.8-13.1)	13.5 (12.0-14.7)
3-day	3.49 (3.24-3.76)	4.22 (3.92-4.56)	5.33 (4.95-5.75)	6.24 (5.78-6.72)	7.53 (6.94-8.11)	8.61 (7.90-9.26)	9.76 (8.89-10.5)	11.0 (9.94-11.9)	12.8 (11.4-13.8)	14.3 (12.6-15.5)
4-day	3.67 (3.42-3.97)	4.44 (4.13-4.80)	5.61 (5.21-6.06)	6.56 (6.08-7.08)	7.92 (7.30-8.55)	9.05 (8.30-9.76)	10.3 (9.34-11.1)	11.6 (10.4-12.5)	13.4 (12.0-14.5)	15.0 (13.3-16.3)
7-day	4.21 (3.94-4.52)	5.06 (4.74-5.42)	6.29 (5.88-6.74)	7.29 (6.80-7.81)	8.72 (8.09-9.33)	9.90 (9.14-10.6)	11.1 (10.2-11.9)	12.5 (11.4-13.4)	14.4 (12.9-15.5)	15.9 (14.2-17.2)
10-day	4.77 (4.48-5.09)	5.70 (5.36-6.10)	7.01 (6.58-7.49)	8.07 (7.55-8.61)	9.54 (8.90-10.2)	10.7 (9.98-11.5)	12.0 (11.1-12.8)	13.3 (12.2-14.2)	15.2 (13.8-16.3)	16.7 (15.0-17.9)
20-day	6.41 (6.05-6.82)	7.64 (7.21-8.12)	9.19 (8.67-9.77)	10.4 (9.80-11.1)	12.1 (11.3-12.8)	13.4 (12.5-14.2)	14.7 (13.7-15.7)	16.1 (14.9-17.1)	17.9 (16.5-19.2)	19.3 (17.7-20.7)
30-day	7.92 (7.51-8.36)	9.37 (8.89-9.89)	11.0 (10.5-11.6)	12.3 (11.7-13.0)	14.0 (13.2-14.8)	15.3 (14.4-16.1)	16.5 (15.5-17.4)	17.7 (16.6-18.7)	19.3 (18.0-20.5)	20.5 (19.0-21.8)
45-day	9.98 (9.47-10.5)	11.8 (11.2-12.4)	13.7 (13.0-14.4)	15.2 (14.4-16.0)	17.0 (16.1-17.9)	18.5 (17.4-19.4)	19.8 (18.6-20.9)	21.1 (19.8-22.3)	22.8 (21.3-24.1)	24.0 (22.3-25.4)
60-day	11.9 (11.4-12.5)	14.0 (13.3-14.7)	16.1 (15.3-16.9)	17.7 (16.8-18.5)	19.7 (18.7-20.6)	21.1 (20.0-22.2)	22.5 (21.3-23.7)	23.9 (22.5-25.1)	25.6 (24.0-26.9)	26.8 (25.1-28.3)

[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

ATTACHMENT 2
Pre- and Post-Construction Water Quality Maps

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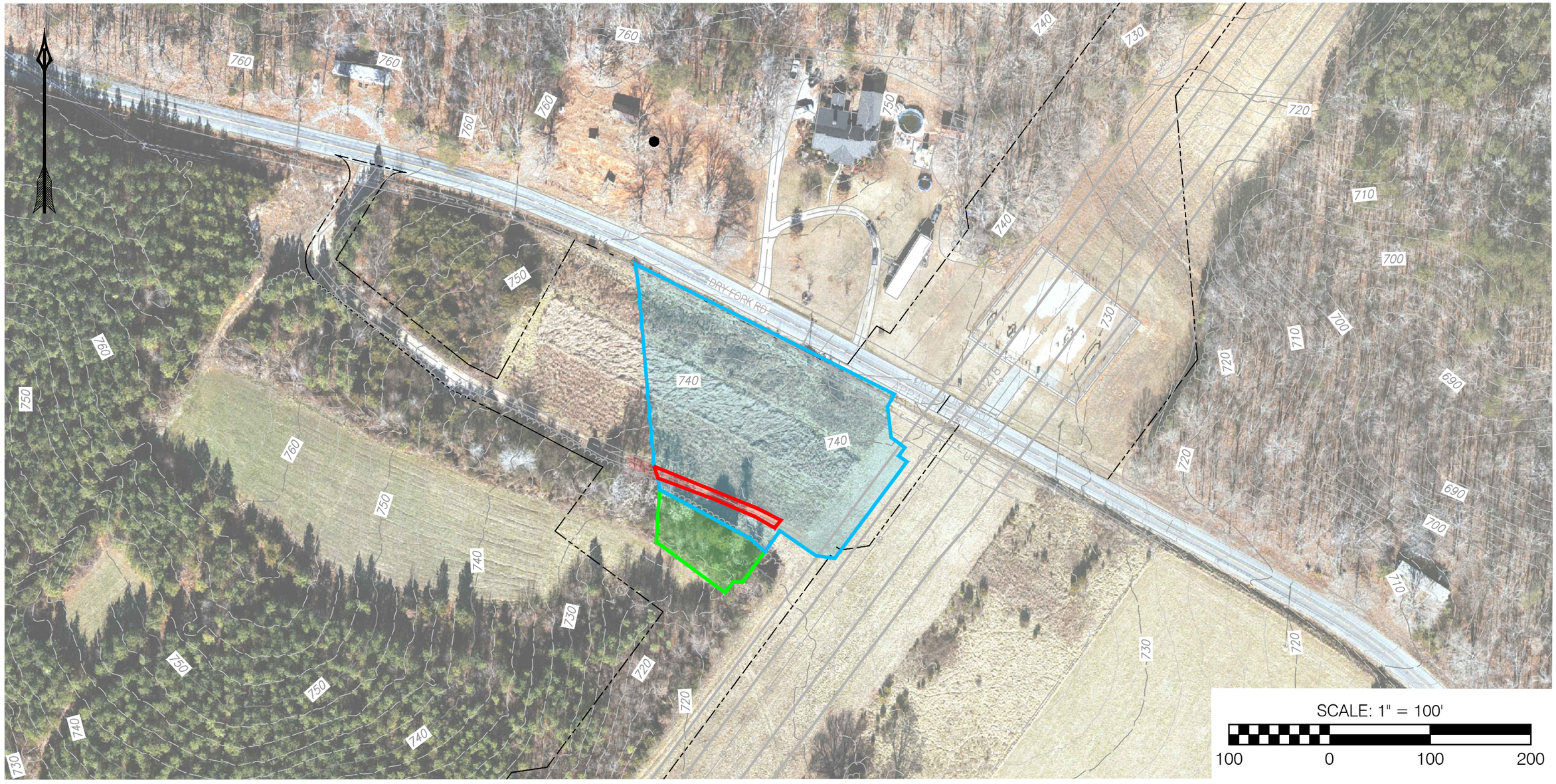

LEGEND

- FOREST
- MIXED OPEN
- IMPERVIOUS
- LIMIT OF DISTURBANCE

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

SOUTHEAST SUPPLY ENHANCEMENT PROJECT

EDEN–MLV–03 PRE–CONSTRUCTION WATER QUALITY MAP

PITTSYLVANIA COUNTY, VIRGINIA

DRAWN BY: JB	DATE: 02/19/2025	ISSUED FOR BID:	SCALE: AS SHOWN
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APPROVED BY: RCM	DATE: 03/20/2025	DRAWING NO.: R230851.01	001 OF 001

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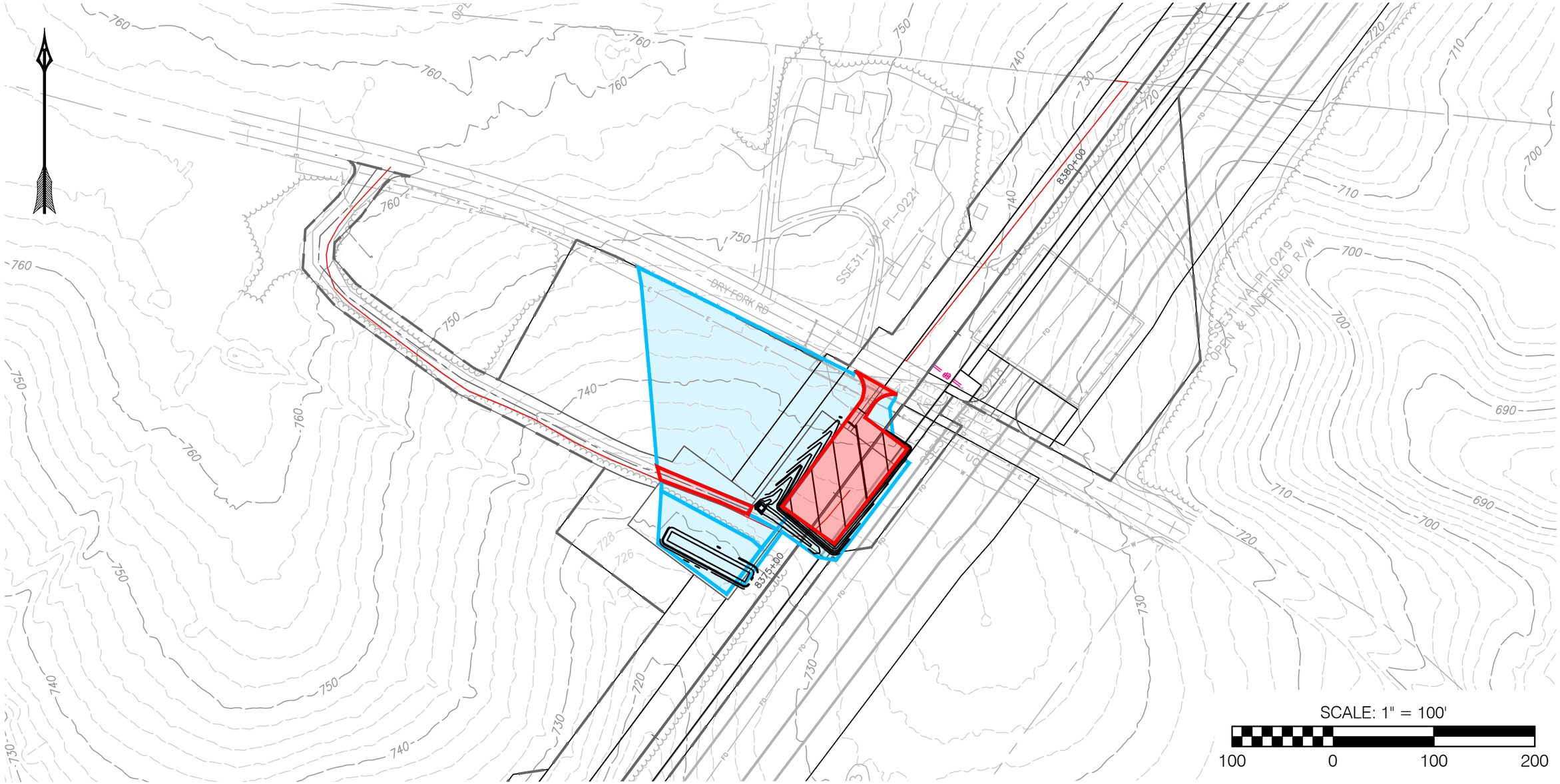

LEGEND

- MIXED OPEN
- IMPERVIOUS
- LIMIT OF DISTURBANCE

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
SOUTHEAST SUPPLY ENHANCEMENT PROJECT
EDEN–MLV–03 POST–CONSTRUCTION WATER QUALITY MAP
PITTSYLVANIA COUNTY, VIRGINIA

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ATTACHMENT 3
VRRM Spreadsheet

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DEQ Virginia Runoff Reduction Method New Development Compliance Spreadsheet - Version 4.1

BMP Design Specifications List: **2024 Stds & Specs**

Site Summary

Project Title: SSE - EDEN-MLV-03

Date: 04/16/2025

Site Land Cover Summary

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0
Mixed Open (acres)	0.00	0.99	0.00	0.00	0.99	83
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0
Impervious Cover (acres)	0.00	0.21	0.00	0.00	0.21	18
					1.20	100

Site Tv and Land Cover Nutrient Loads

Site Rv	0.26
Treatment Volume (ft^3)	1,119
TP Load (lb/yr)	0.52
TN Load (lb/yr)	4.13

Total TP Load Reduction Required (lb/yr)	0.21

Site Compliance Summary

Total Runoff Volume Reduction (ft^3)	560
Total TP Load Reduction Achieved (lb/yr)	0.32
Total TN Load Reduction Achieved (lb/yr)	2.38
Remaining Post Development TP Load (lb/yr)	0.19
Remaining TP Load Reduction (lb/yr) Required	**0.00**

**** TARGET TP REDUCTION EXCEEDED BY 0.12 LB/YEAR ****

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Mixed Open (acres)	0.99	0.00	0.00	0.00	0.00	0.99
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Cover (acres)	0.21	0.00	0.00	0.00	0.00	0.21
Total Area (acres)	**1.20**	**0.00**	**0.00**	**0.00**	**0.00**	**1.20**

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	0.32	0.00	0.00	0.00	0.00	0.32
TN Load Reduced (lb/yr)	2.38	0.00	0.00	0.00	0.00	2.38

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest (acres)	0.00	0.00	0.00	0.00	0.00	0
Mixed Open (acres)	0.00	0.99	0.00	0.00	0.99	83
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0
Impervious Cover (acres)	0.00	0.21	0.00	0.00	0.21	18
					1.20	

BMP Selections

Practice	Mixed Open Credit Area (acres)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed
7.a. Infiltration #1 (P-FIL-04)	**0.98**		**0.22**	**1,149.98**	**0.00**	**0.52**	**0.33**	**0.20**	

Total Impervious Cover Treated (acres)	0.21
Total Mixed Open Treated (acres)	0.99
Total Turf Area Treated (acres)	0.00
Total TP Load Reduction Achieved in D.A. (lb/yr)	0.32
Total TN Load Reduction Achieved in D.A. (lb/yr)	2.38

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	2.80	3.39	5.11

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		66	0	0	0	0
RR (ft^3)		560	0	0	0	0
1-year return period	RV wo RR (ws-in)	0.45	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.32	0.00	0.00	0.00	0.00
	CN adjusted	62	0	0	0	0
2-year return period	RV wo RR (ws-in)	0.74	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.61	0.00	0.00	0.00	0.00
	CN adjusted	63	0	0	0	0
10-year return period	RV wo RR (ws-in)	1.80	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	1.67	0.00	0.00	0.00	0.00
	CN adjusted	64	0	0	0	0

ATTACHMENT 4
Pre- and Post-Construction Drainage Maps

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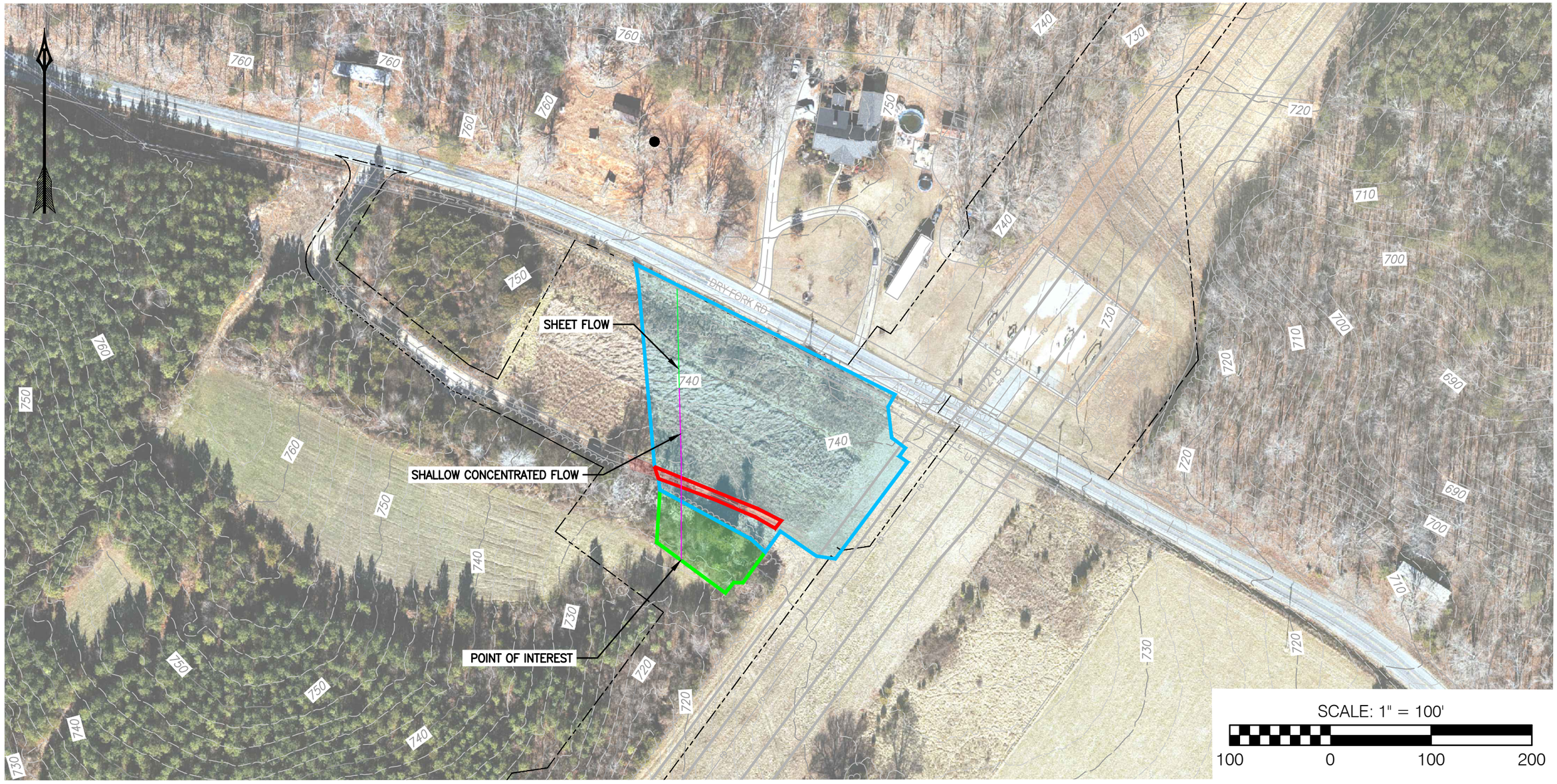

LEGEND

- FOREST
- MEADOW
- IMPERVIOUS
- LIMIT OF DISTURBANCE
- SHEET FLOW
- SHALLOW CONCENTRATED

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
SOUTHEAST SUPPLY ENHANCEMENT PROJECT
EDEN–MLV–03 PRE–CONSTRUCTION DRAINAGE MAP
PITTSYLVANIA COUNTY, VIRGINIA

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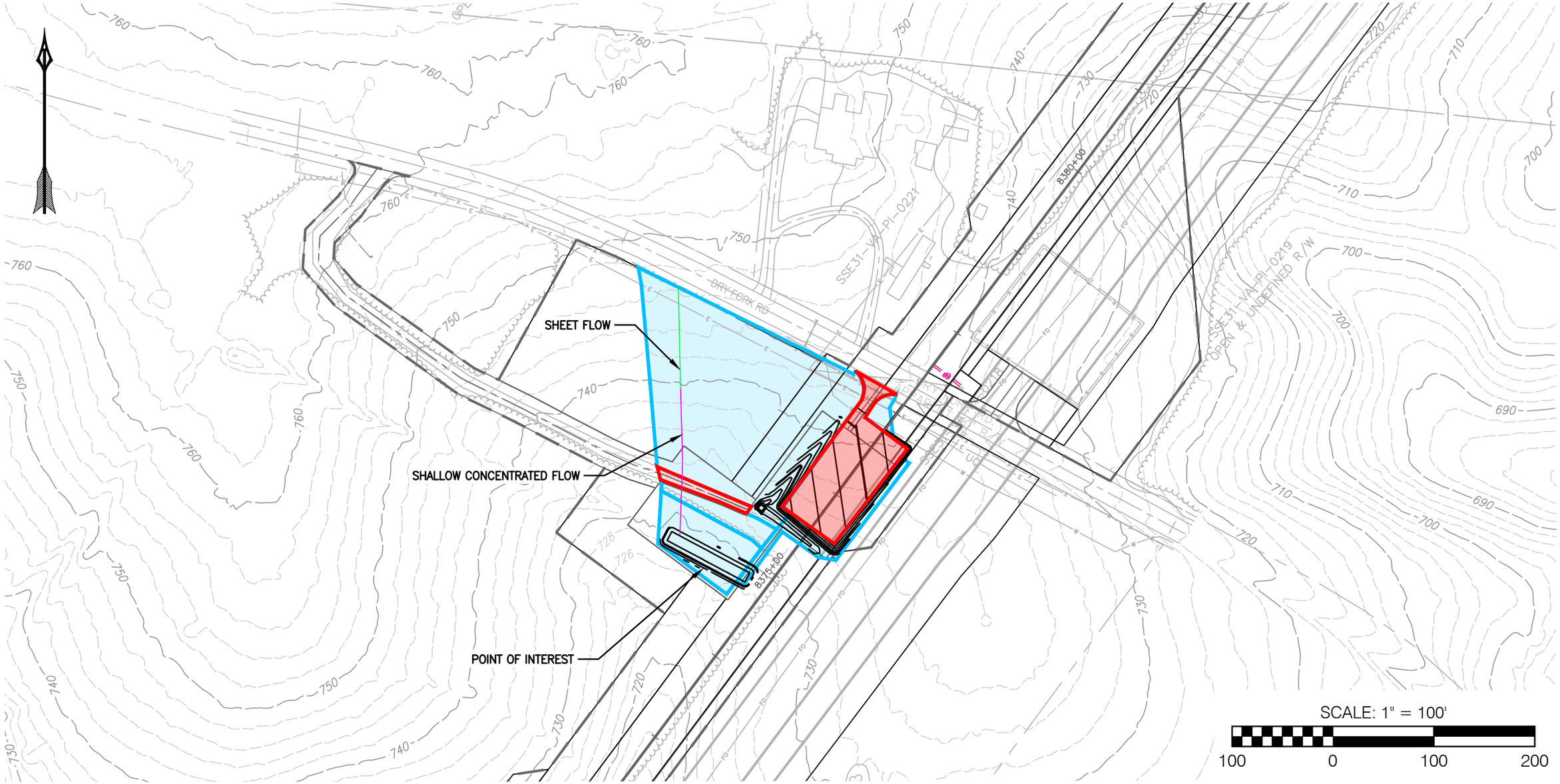


LEGEND

- MEADOW
- IMPERVIOUS
- LIMIT OF DISTURBANCE
- SHEET FLOW
- SHALLOW CONCENTRATED

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
SOUTHEAST SUPPLY ENHANCEMENT PROJECT
EDEN–MLV–03 POST–CONSTRUCTION DRAINAGE MAP
PITTSYLVANIA COUNTY, VIRGINIA

DRAWN BY: JB	DATE: 02/19/2025	ISSUED FOR BID:	SCALE: AS SHOWN
CHECKED BY: JML	DATE: 02/25/2025	ISSUED FOR CONSTRUCTION:	
APPROVED BY: RCM	DATE: 03/20/2025	DRAWING NO.: R230851.01	001 OF 001

Z:\2023\R230851.01 - Williams SE Supply Enhanc\CAD\Worksheets\EDEN-MLV-03 Drainage Maps\Post-Construction Water Quantity Map.dwg 6/4/2025 10:21 AM

ATTACHMENT 5
Peak Flow Hydrographs

gai consultants
transforming ideas into reality

Project:	By:	Date:
R230851.01	HWT	3/28/2025
Location:	Checked:	Date:
Overall Drainage Area - Pre Construction	JAB	4/16/2025

Check: ■ Present ❑ Under Development ❑ Developed

Sheet Flow

Segment ID	A1	
Surface Description	Grass	
Manning's Roughness Coefficient, n	0.24	(TR-55, Table 3-1)
Flow Length, L	100	ft
Two-year 24-hour Rainfall, P_2	3.39	in
Land Slope, s	0.066	ft/ft
Travel Time, $T_t = (0.007*(n*L)^{0.8}) / (P_2^{0.5}*s^{0.4})$	**0.1432**	**hrs**

Shallow Concentrated Flow

Segment ID	B1	B2	B3	B4	
Surface Description (Paved / Unpaved)	Unpaved	Paved	Unpaved	Unpaved	
Surface Description Coefficient, C	16.13	20.23	16.13	16.13	
Flow Length, L	122	10	13	52	ft
Watercourse Slope, s	0.064	0.058	0.053	0.066	ft/ft
Average Velocity, $V = C*s^{0.5}$	4.07	4.87	3.72	4.14	ft/sec
Travel Time, $T_t = (L) / (3600*V)$	**0.008**	**0.001**	**0.001**	**0.003**	**hrs**

Channel Flow

Open Channel Flow

No Open Channel Flow

Pipe Flow

No Pipe Flow

Time of Concentration

Sheet Flow T_t	0.1432	hrs
Shallow Concentrated Flow T_t	0.0134	hrs
Channel Flow Tt	0.0000	hrs
Time of Concentration, T_c	**0.1565**	**hrs**
	9.4	**mins**

Project:	By:	Date:
R230851.01	HWT	3/28/2025
Location:	Checked:	Date:
Overall Drainage Area - Post Construction	JAB	4/16/2025

Check: ❑ Present ❑ Under Development ■ Developed

Sheet Flow

Segment ID	A1	
Surface Description	Grass	
Manning's Roughness Coefficient, n	0.24	(TR-55, Table 3-1)
Flow Length, L	100	ft
Two-year 24-hour Rainfall, P_2	3.39	in
Land Slope, s	0.066	ft/ft
Travel Time, $T_t = (0.007*(n*L)^{0.8}) / (P_2^{0.5}*s^{0.4})$	**0.1432**	**hrs**

Shallow Concentrated Flow

Segment ID	B1	B2	B3	
Surface Description (Paved / Unpaved)	Unpaved	Paved	Unpaved	
Surface Description Coefficient, C	16.13	20.23	16.13	
Flow Length, L	122	10	13	ft
Watercourse Slope, s	0.064	0.058	0.053	ft/ft
Average Velocity, $V = C*s^{0.5}$	4.07	4.87	3.72	ft/sec
Travel Time, $T_t = (L) / (3600*V)$	**0.008**	**0.001**	**0.001**	**hrs**

Channel Flow

Open Channel Flow

No Open Channel Flow

Pipe Flow

No Pipe Flow

Time of Concentration

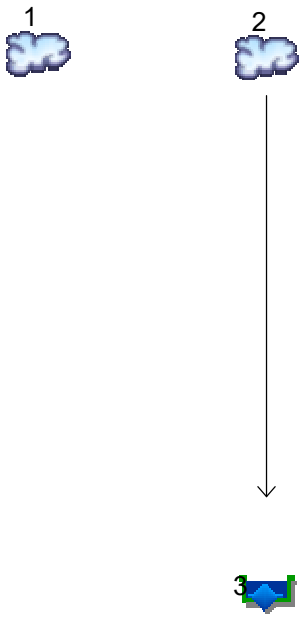
Sheet Flow T_t	0.1432	hrs
Shallow Concentrated Flow T_t	0.0099	hrs
Channel Flow Tt	0.0000	hrs
Time of Concentration, T_c	**0.1530**	**hrs**
	9.2	**mins**

Hydraflow Table of Contents

1405.3.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Wednesday, 06 / 4 / 2025

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Construction
2	SCS Runoff	Post-Construction without BMP's
3	Reservoir	Through Trench

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	------	0.217	-------	-------	-------	2.369	-------	-------	-------	Pre-Construction
2	SCS Runoff	------	0.629	-------	-------	-------	3.286	-------	-------	-------	Post-Construction without BMP's
3	Reservoir	2	0.000	-------	-------	-------	2.144	-------	-------	-------	Through Trench

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	0.217	1	723	1,036	------	------	------	Pre-Construction
2	SCS Runoff	0.629	1	721	1,820	------	------	------	Post-Construction without BMP's
3	Reservoir	0.000	1	n/a	0	2	728.73	1,820	Through Trench

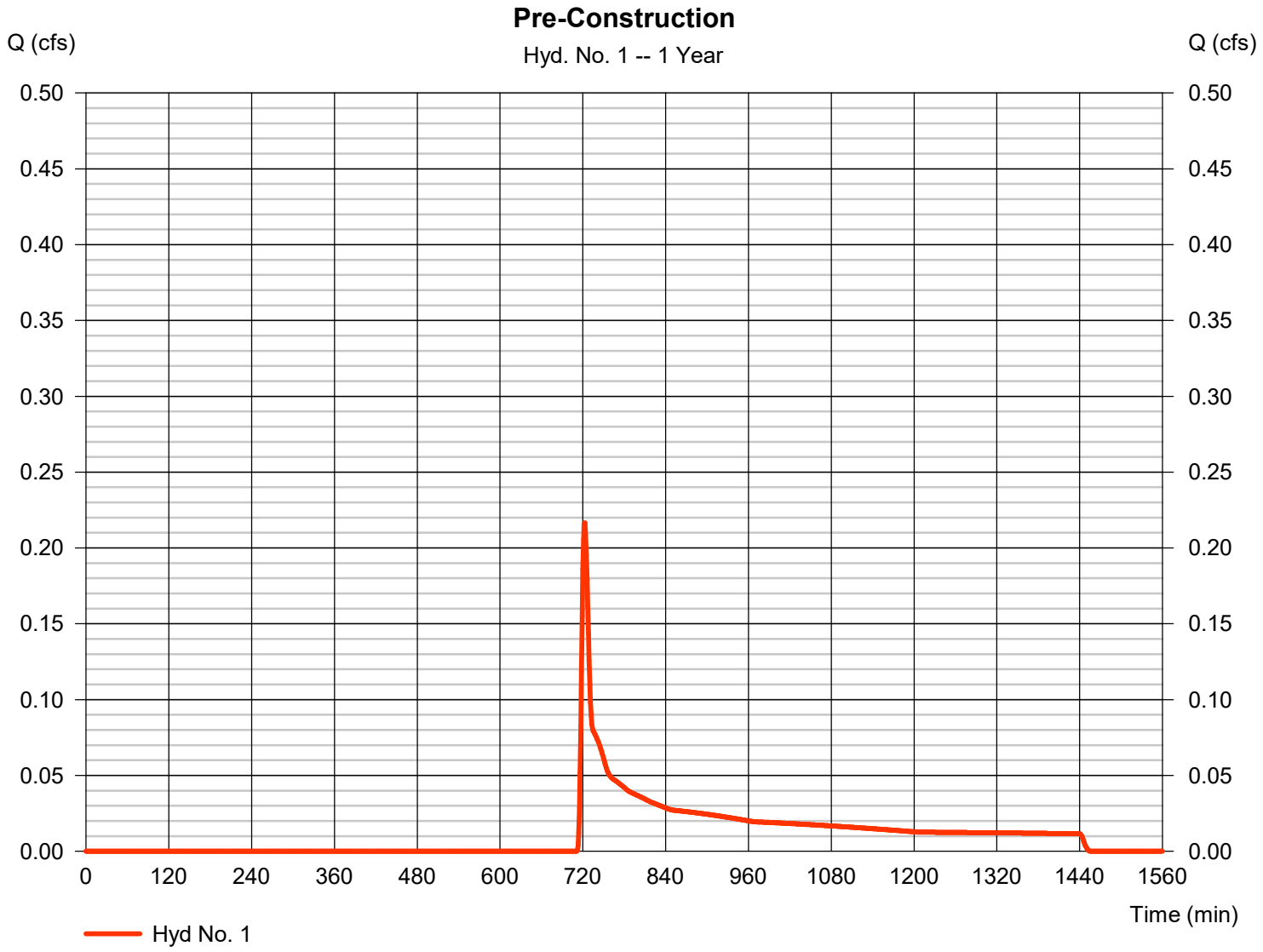
Hydrograph Report

Hyd. No. 1

Pre-Construction

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.217 cfs
Storm frequency	=	1 yrs	Time to peak	=	723 min
Time interval	=	1 min	Hyd. volume	=	1,036 cuft
Drainage area	=	1.200 ac	Curve number	=	59*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.40 min
Total precip.	=	2.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.050 x 58) + (0.120 x 55) + (0.030 x 98)] / 1.200



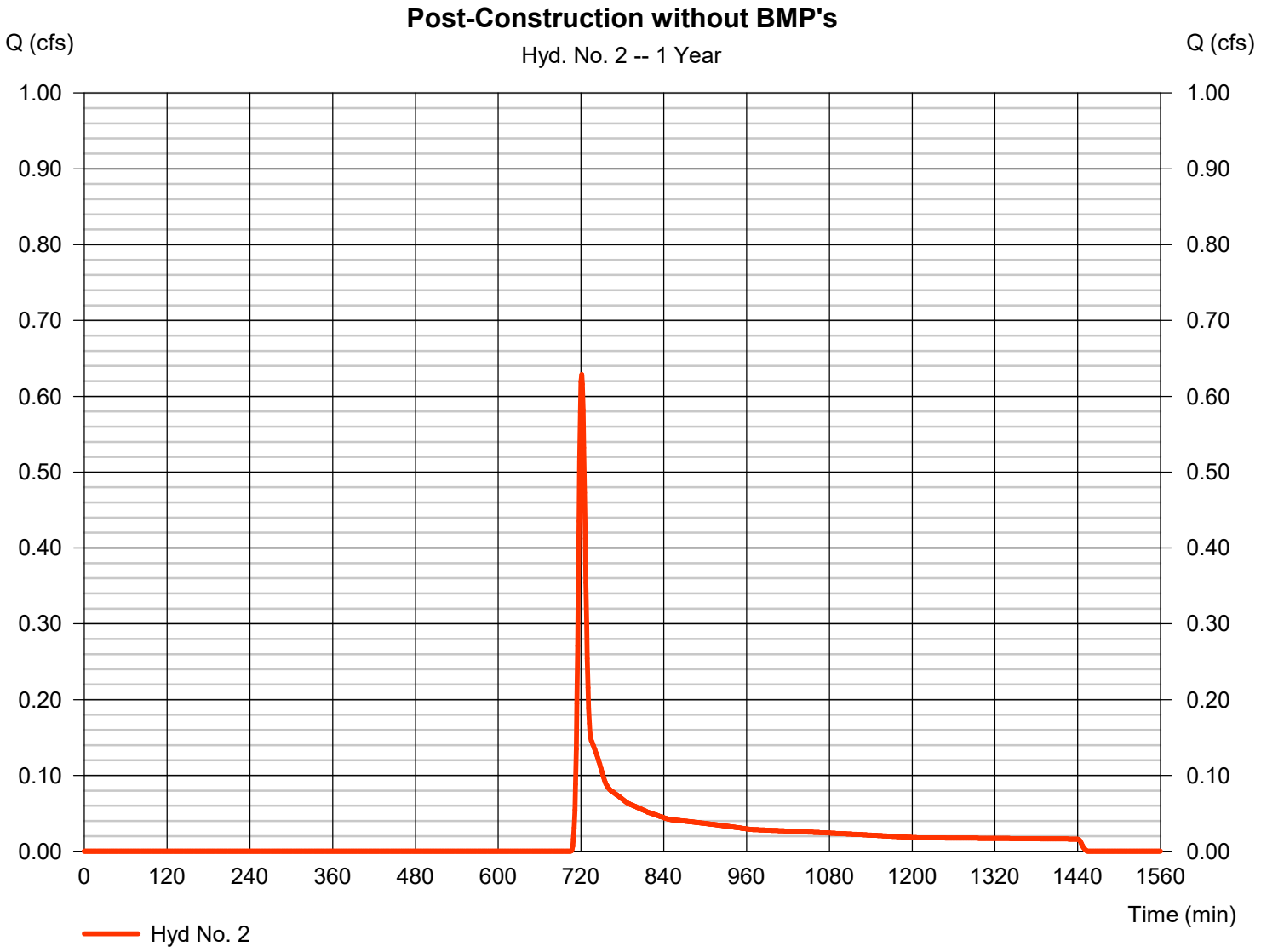
Hydrograph Report

Hyd. No. 2

Post-Construction without BMP's

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.629 cfs
Storm frequency	=	1 yrs	Time to peak	=	721 min
Time interval	=	1 min	Hyd. volume	=	1,820 cuft
Drainage area	=	1.200 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.20 min
Total precip.	=	2.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.990 x 58) + (0.210 x 98)] / 1.200



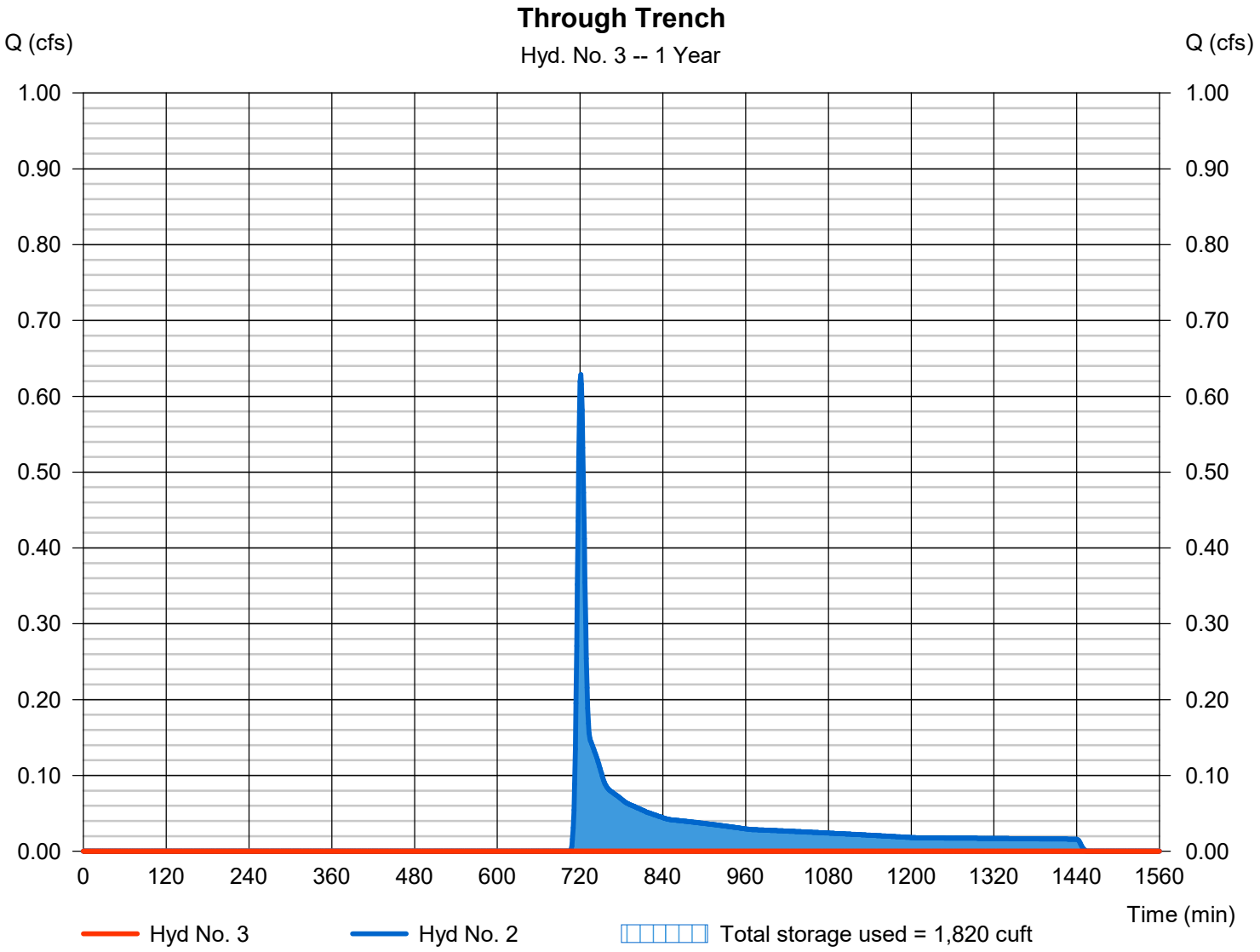
Hydrograph Report

Hyd. No. 3

Through Trench

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	1 yrs	Time to peak	=	n/a
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	2 - Post-Construction without BMP's	Max. Elevation	=	728.73 ft
Reservoir name	=	Infiltration Trench	Max. Storage	=	1,820 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 1 - Infiltration Trench

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	725.00	n/a	0	0
0.50	725.50	n/a	87	87
1.00	726.00	n/a	182	269
1.50	726.50	n/a	182	451
2.00	727.00	n/a	182	634
2.50	727.50	n/a	182	816
3.00	728.00	n/a	182	998
3.25	728.25	n/a	239	1,237
3.50	728.50	n/a	283	1,520
3.75	728.75	n/a	326	1,846
4.00	729.00	n/a	370	2,216
4.25	729.25	n/a	413	2,629
4.50	729.50	n/a	457	3,086

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 5.00	87.00	0.00	0.00
Crest El. (ft)	= 728.80	729.50	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= Ciplti	Broad	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.300 (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	725.00	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.05	9	725.05	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.10	17	725.10	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.15	26	725.15	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.20	35	725.20	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.25	44	725.25	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.30	52	725.30	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.35	61	725.35	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.40	70	725.40	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.45	78	725.45	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.50	87	725.50	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.55	105	725.55	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.60	123	725.60	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.65	142	725.65	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.70	160	725.70	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.75	178	725.75	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.80	196	725.80	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.85	215	725.85	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.90	233	725.90	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
0.95	251	725.95	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.00	269	726.00	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.05	287	726.05	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.10	306	726.10	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.15	324	726.15	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.20	342	726.20	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.25	360	726.25	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.30	379	726.30	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.35	397	726.35	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.40	415	726.40	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.45	433	726.45	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.50	451	726.50	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000

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Infiltration Trench

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
1.55	470	726.55	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.60	488	726.60	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.65	506	726.65	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.70	524	726.70	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.75	542	726.75	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.80	561	726.80	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.85	579	726.85	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.90	597	726.90	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
1.95	615	726.95	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.00	634	727.00	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.05	652	727.05	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.10	670	727.10	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.15	688	727.15	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.20	706	727.20	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.25	725	727.25	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.30	743	727.30	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.35	761	727.35	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.40	779	727.40	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.45	798	727.45	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.50	816	727.50	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.55	834	727.55	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.60	852	727.60	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.65	870	727.65	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.70	889	727.70	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.75	907	727.75	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.80	925	727.80	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.85	943	727.85	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.90	962	727.90	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
2.95	980	727.95	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.00	998	728.00	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.03	1,022	728.03	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.05	1,046	728.05	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.08	1,070	728.08	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.10	1,094	728.10	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.13	1,118	728.13	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.15	1,141	728.15	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.18	1,165	728.18	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.20	1,189	728.20	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.23	1,213	728.23	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.25	1,237	728.25	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.28	1,265	728.28	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.30	1,294	728.30	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.33	1,322	728.33	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.35	1,350	728.35	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.38	1,379	728.38	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.40	1,407	728.40	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.43	1,435	728.43	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.45	1,463	728.45	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.48	1,492	728.48	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.50	1,520	728.50	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.53	1,553	728.53	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.55	1,585	728.55	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.58	1,618	728.58	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.60	1,650	728.60	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.63	1,683	728.63	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.65	1,716	728.65	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.68	1,748	728.68	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.70	1,781	728.70	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.73	1,813	728.73	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.75	1,846	728.75	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.78	1,883	728.78	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.80	1,920	728.80	---	---	---	---	0.00	0.00	---	---	0.000	---	0.000
3.83	1,957	728.83	---	---	---	---	0.07	0.00	---	---	0.000	---	0.066
3.85	1,994	728.85	---	---	---	---	0.19	0.00	---	---	0.000	---	0.187
3.88	2,031	728.88	---	---	---	---	0.34	0.00	---	---	0.000	---	0.343
3.90	2,068	728.90	---	---	---	---	0.53	0.00	---	---	0.000	---	0.528
3.93	2,105	728.93	---	---	---	---	0.74	0.00	---	---	0.000	---	0.737
3.95	2,142	728.95	---	---	---	---	0.97	0.00	---	---	0.000	---	0.969
3.98	2,179	728.98	---	---	---	---	1.22	0.00	---	---	0.000	---	1.221
4.00	2,216	729.00	---	---	---	---	1.49	0.00	---	---	0.000	---	1.489
4.03	2,257	729.03	---	---	---	---	1.78	0.00	---	---	0.000	---	1.777
4.05	2,299	729.05	---	---	---	---	2.08	0.00	---	---	0.000	---	2.082

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Infiltration Trench

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
4.08	2,340	729.08	---	---	---	---	2.40	0.00	---	---	0.000	---	2.402
4.10	2,381	729.10	---	---	---	---	2.74	0.00	---	---	0.000	---	2.737
4.13	2,423	729.13	---	---	---	---	3.09	0.00	---	---	0.000	---	3.087
4.15	2,464	729.15	---	---	---	---	3.45	0.00	---	---	0.000	---	3.450
4.18	2,505	729.18	---	---	---	---	3.83	0.00	---	---	0.000	---	3.826
4.20	2,546	729.20	---	---	---	---	4.22	0.00	---	---	0.000	---	4.215
4.23	2,588	729.23	---	---	---	---	4.62	0.00	---	---	0.000	---	4.617
4.25	2,629	729.25	---	---	---	---	5.03	0.00	---	---	0.000	---	5.026
4.28	2,675	729.28	---	---	---	---	5.45	0.00	---	---	0.000	---	5.451
4.30	2,720	729.30	---	---	---	---	5.89	0.00	---	---	0.000	---	5.888
4.33	2,766	729.33	---	---	---	---	6.34	0.00	---	---	0.000	---	6.335
4.35	2,812	729.35	---	---	---	---	6.79	0.00	---	---	0.000	---	6.793
4.38	2,857	729.38	---	---	---	---	7.26	0.00	---	---	0.000	---	7.262
4.40	2,903	729.40	---	---	---	---	7.74	0.00	---	---	0.000	---	7.741
4.43	2,949	729.43	---	---	---	---	8.23	0.00	---	---	0.000	---	8.230
4.45	2,995	729.45	---	---	---	---	8.73	0.00	---	---	0.000	---	8.730
4.48	3,040	729.48	---	---	---	---	9.24	0.00	---	---	0.000	---	9.238
4.50	3,086	729.50	---	---	---	---	9.75	0.00	---	---	0.000	---	9.752

...End

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	2.369	1	720	5,650	------	------	------	Pre-Construction
2	SCS Runoff	3.286	1	720	7,523	------	------	------	Post-Construction without BMP's
3	Reservoir	2.144	1	725	5,603	2	729.05	2,307	Through Trench

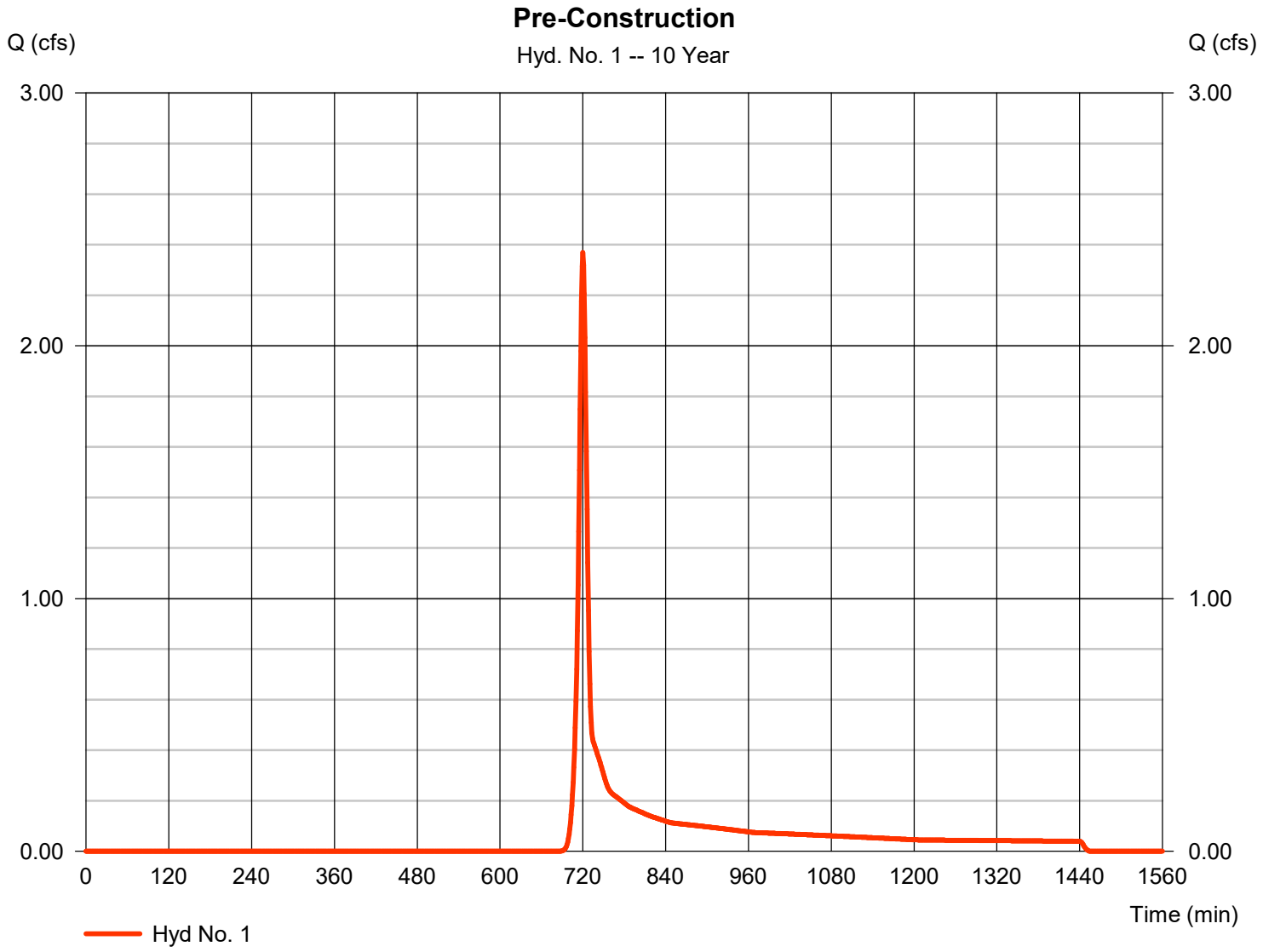
Hydrograph Report

Hyd. No. 1

Pre-Construction

Hydrograph type	= SCS Runoff	Peak discharge	= 2.369 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 5,650 cuft
Drainage area	= 1.200 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.40 min
Total precip.	= 5.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.050 x 58) + (0.120 x 55) + (0.030 x 98)] / 1.200



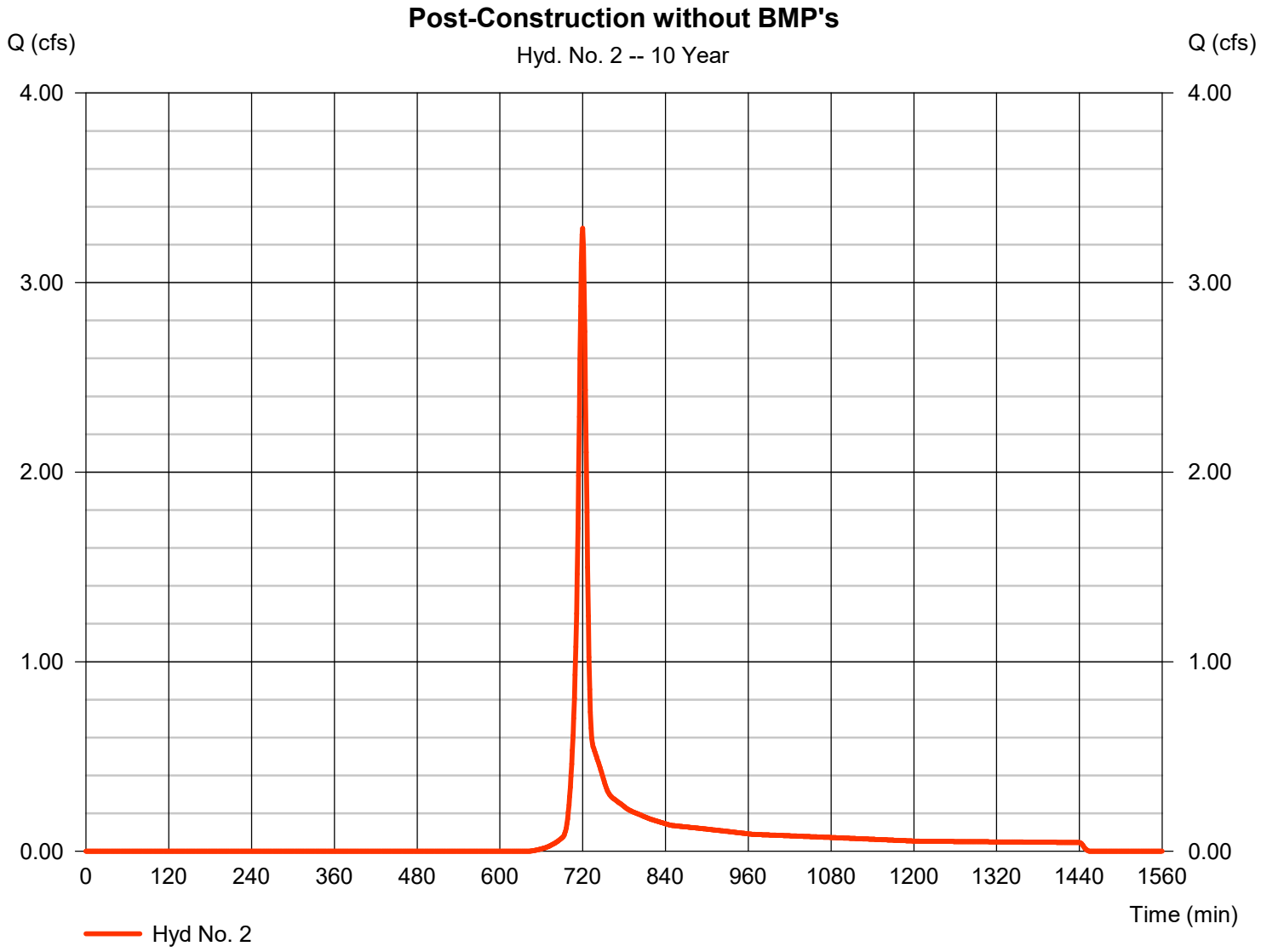
Hydrograph Report

Hyd. No. 2

Post-Construction without BMP's

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.286 cfs
Storm frequency	=	10 yrs	Time to peak	=	720 min
Time interval	=	1 min	Hyd. volume	=	7,523 cuft
Drainage area	=	1.200 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.20 min
Total precip.	=	5.11 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.990 x 58) + (0.210 x 98)] / 1.200



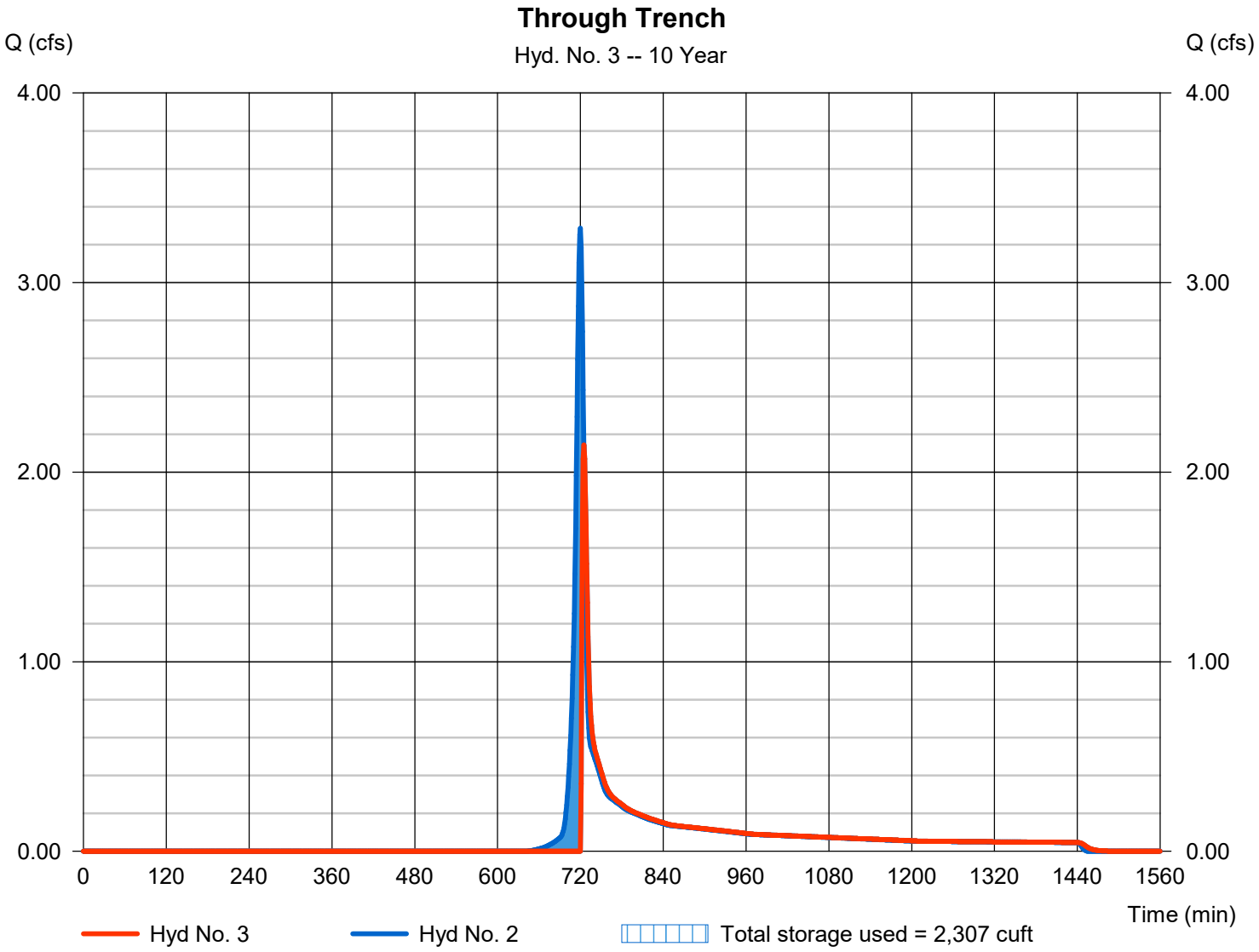
Hydrograph Report

Hyd. No. 3

Through Trench

Hydrograph type	=	Reservoir	Peak discharge	=	2.144 cfs
Storm frequency	=	10 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	5,603 cuft
Inflow hyd. No.	=	2 - Post-Construction without BMP's	Max. Elevation	=	729.05 ft
Reservoir name	=	Infiltration Trench	Max. Storage	=	2,307 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



ATTACHMENT 6
Channel Design Worksheets

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CHANNEL DESIGN WORKSHEET

Channel Design Data

PROJECT NAME: WILLIAMS SSE
LOCATION: VIRGINIA
PREPARED BY: BOWERJG DATE: 2/19/2025
CHECKED BY: BARCLJA DATE: 4/16/2025

		MAX SLOPE (SHEAR)		MIN SLOPE (DEPTH)	
		6.40%	6.40%	6.40%	6.40%
CHANNEL OR CHANNEL SECTION	Units	Grass Channel 1	Grass Channel 1	Grass Channel 1	Grass Channel 1
Temporary or Permanent		Temporary	Permanent	Temporary	Permanent
Design Storm	INCHES/HR	6.82	6.82	6.82	6.82
Acres	ACRE	0.33	0.33	0.33	0.33
C-VALUE (ASSUMED 0.90)		0.90	0.90	0.90	0.90
Qr (REQUIRED CAPACITY)	CFS	2.03	2.03	2.03	2.03
Q (CALCULATED AT FLOW DEPTH d)	CFS	2.03	2.03	2.03	2.03
PROTECTIVE LINING[1]		North American Green SC 250	Vegetated	North American Green SC 250	Vegetated
n (MANNING'S COEFFICIENT)[1]		0.040	0.051	0.040	0.051
Va (ALLOWABLE VELOCITY)	FPS	9.50	15.00	9.50	15.00
V (CALCULATED AT FLOW DEPTH d)	FPS	3.07	2.61	3.07	2.61
τ_a (MAX ALLOWABLE SHEAR STRESS)	LB/FT^2	3.00	8.00	3.00	8.00
τ_d (SHEAR STRESS @ FLOW DEPTH d)	LB/FT^2	0.97	1.10	0.97	1.10
CHANNEL BOTTOM WIDTH	FT	2.00	2.00	2.00	2.00
CHANNEL SIDE SLOPES (X:1)	H:V	3.00	3.00	3.00	3.00
D (TOTAL DEPTH)	FT	0.74	0.78	0.74	0.78
CHANNEL TOP WIDTH @ D	FT	6.45	6.65	6.45	6.65
d (CALCULATED FLOW DEPTH)	FT	0.24	0.28	0.24	0.28
CHANNEL TOP WIDTH @ FLOW DEPTH d	FT	3.45	3.65	3.45	3.65
BOTTOM WIDTH: FLOW DEPTH RATIO		8.27	7.27	8.27	7.27
d_{50} STONE SIZE	IN	N/A	N/A	N/A	N/A
A (CROSS SECTIONAL AREA)	SQ FT	0.66	0.78	0.66	0.78
R (HYDRAULIC RADIUS)		0.19	0.21	0.19	0.21
S (BED SLOPE)[4]	FT/FT	0.064	0.064	0.064	0.064
S_c (CRITICAL SLOPE)	FT/FT	0.04	0.06	0.04	0.06
.7*S_c	FT/FT	0.03	0.05	0.03	0.05
1.3*S_c	FT/FT	0.05	0.08	0.05	0.08
STABLE FLOW (Y/N)		YES	NO	YES	NO
MINIMUM REQUIRED FREEBOARD[3]	FT	0.50	0.50	0.50	0.50
DESIGN METHOD FOR PROTECTIVE LINING[4] (V OR S)		V	V	V	V

1. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.

2.. Slopes may not be averaged.

3. Minimum Freeboard is 0.5 ft.

4. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Proposed Channel Dimensions & Linings		
Base	2.0	
Required Depth	0.78	
Design Depth	1.0	
Z = H:V	3.0	
Top Width	8.0	
Lining	North American Green	SC 250
Lining Longevity	Permanent	

CHANNEL DESIGN WORKSHEET

Channel Design Data

PROJECT NAME: WILLIAMS SSE
LOCATION: VIRGINIA
PREPARED BY: BOWERJG DATE: 2/19/2025
CHECKED BY: BARCLJA DATE: 4/16/2025

		MAX SLOPE (SHEAR)		MIN SLOPE (DEPTH)	
		2.00%	2.00%	2.00%	2.00%
CHANNEL OR CHANNEL SECTION	**Units**	**Grass Channel 2**	**Grass Channel 2**	**Grass Channel 2**	**Grass Channel 2**
Temporary or Permanent		**Temporary**	**Permanent**	**Temporary**	**Permanent**
Design Storm	**INCHES/HR**	**6.82**	**6.82**	**6.82**	**6.82**
Acres	**ACRE**	**0.08**	**0.08**	**0.08**	**0.08**
C-VALUE(ASSUMED 0.90)		**0.90**	**0.90**	**0.90**	**0.90**
Qr (REQUIRED CAPACITY)	**CFS**	**0.49**	**0.49**	**0.49**	**0.49**
Q (CALCULATED AT FLOW DEPTH d)	**CFS**	**0.49**	**0.49**	**0.49**	**0.49**
PROTECTIVE LINING[1]		**North American Green SC 250**	**Vegetated**	**North American Green SC 250**	**Vegetated**
n (MANNING'S COEFFICIENT)[1]		**0.040**	**0.085**	**0.040**	**0.085**
Va (ALLOWABLE VELOCITY)	**FPS**	**9.50**	**15.00**	**9.50**	**15.00**
V (CALCULATED AT FLOW DEPTH d)	**FPS**	**1.32**	**0.79**	**1.32**	**0.79**
τ_a (MAX ALLOWABLE SHEAR STRESS)	**LB/FT^2**	**3.00**	**8.00**	**3.00**	**8.00**
τ_d (SHEAR STRESS @ FLOW DEPTH d)	**LB/FT^2**	**0.19**	**0.29**	**0.19**	**0.29**
CHANNEL BOTTOM WIDTH	**FT**	**2.00**	**2.00**	**2.00**	**2.00**
CHANNEL SIDE SLOPES (X:1)	**H:V**	**3.00**	**3.00**	**3.00**	**3.00**
D (TOTAL DEPTH)	**FT**	**0.65**	**0.73**	**0.65**	**0.73**
CHANNEL TOP WIDTH @ D	**FT**	**5.91**	**6.39**	**5.91**	**6.39**
d (CALCULATED FLOW DEPTH)	**FT**	**0.15**	**0.23**	**0.15**	**0.23**
CHANNEL TOP WIDTH @ FLOW DEPTH d	**FT**	**2.91**	**3.39**	**2.91**	**3.39**
BOTTOM WIDTH: FLOW DEPTH RATIO		**13.19**	**8.63**	**13.19**	**8.63**
d_{50} STONE SIZE	**IN**	**N/A**	**N/A**	**N/A**	**N/A**
A (CROSS SECTIONAL AREA)	**SQ FT**	**0.37**	**0.62**	**0.37**	**0.62**
R (HYDRAULIC RADIUS)		**0.13**	**0.18**	**0.13**	**0.18**
S (BED SLOPE)[4]	**FT/FT**	**0.020**	**0.020**	**0.020**	**0.020**
S_c (CRITICAL SLOPE)	**FT/FT**	**0.05**	**0.19**	**0.05**	**0.19**
.7*S_c	**FT/FT**	**0.03**	**0.13**	**0.03**	**0.13**
1.3*S_c	**FT/FT**	**0.06**	**0.25**	**0.06**	**0.25**
STABLE FLOW (Y/N)		**YES**	**YES**	**YES**	**YES**
MINIMUM REQUIRED FREEBOARD[3]	**FT**	**0.50**	**0.50**	**0.50**	**0.50**
DESIGN METHOD FOR PROTECTIVE LINING[4] (V OR S)		**V**	**V**	**V**	**V**

1. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.

2.. Slopes may not be averaged.

3. Minimum Freeboard is 0.5 ft.

4. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

Proposed Channel Dimensions & Linings		
Base	**2.0**	
Required Depth	**0.73**	
Design Depth	**1.0**	
Z = H:V	**3.0**	
Top Width	**8.0**	
Lining	**North American Green**	**SC 250**
Lining Longevity	**Permanent**	

ATTACHMENT 7
Culvert Design Worksheets

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Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 22 2025

Culvert 1

Invert Elev Dn (ft)	=	738.34
Pipe Length (ft)	=	42.00
Slope (%)	=	1.21
Invert Elev Up (ft)	=	738.85
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Culvert
Culvert Entrance	=	Smooth tapered inlet throat
Coeff. K,M,c,Y,k	=	0.534, 0.555, 0.0196, 0.9, 0.2

Embankment

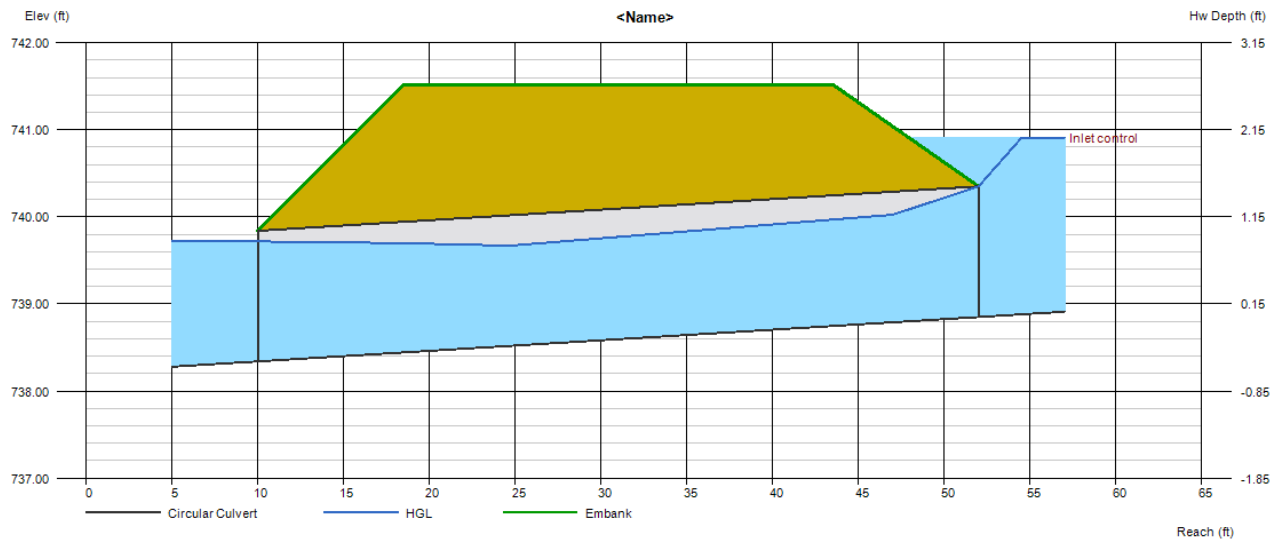
Top Elevation (ft)	=	741.52
Top Width (ft)	=	25.00
Crest Width (ft)	=	25.00

Calculations

Qmin (cfs)	=	10.69
Qmax (cfs)	=	10.69
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	10.69
Qpipe (cfs)	=	10.69
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.29
Veloc Up (ft/s)	=	6.77
HGL Dn (ft)	=	739.72
HGL Up (ft)	=	740.10
Hw Elev (ft)	=	740.91
Hw/D (ft)	=	1.37
Flow Regime	=	Inlet Control



Channel Report

Culvert 2

Circular

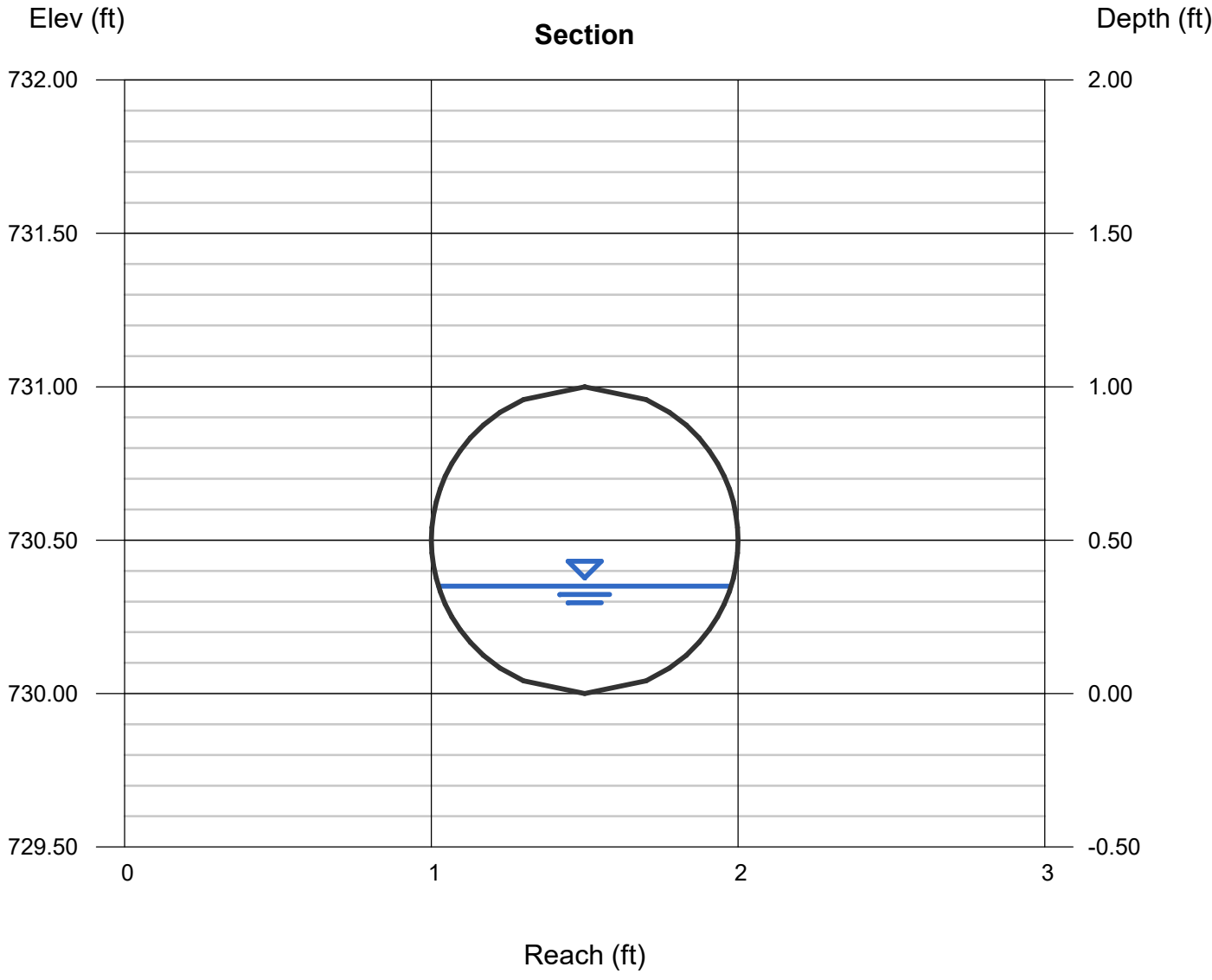
Diameter (ft)	= 1.00
Invert Elev (ft)	= 730.00
Slope (%)	= 6.58
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.52

Highlighted

Depth (ft)	= 0.35
Q (cfs)	= 2.520
Area (sqft)	= 0.25
Velocity (ft/s)	= 10.21
Wetted Perim (ft)	= 1.27
Crit Depth, Yc (ft)	= 0.68
Top Width (ft)	= 0.96
EGL (ft)	= 1.97



Channel Report

Culvert 3

Circular

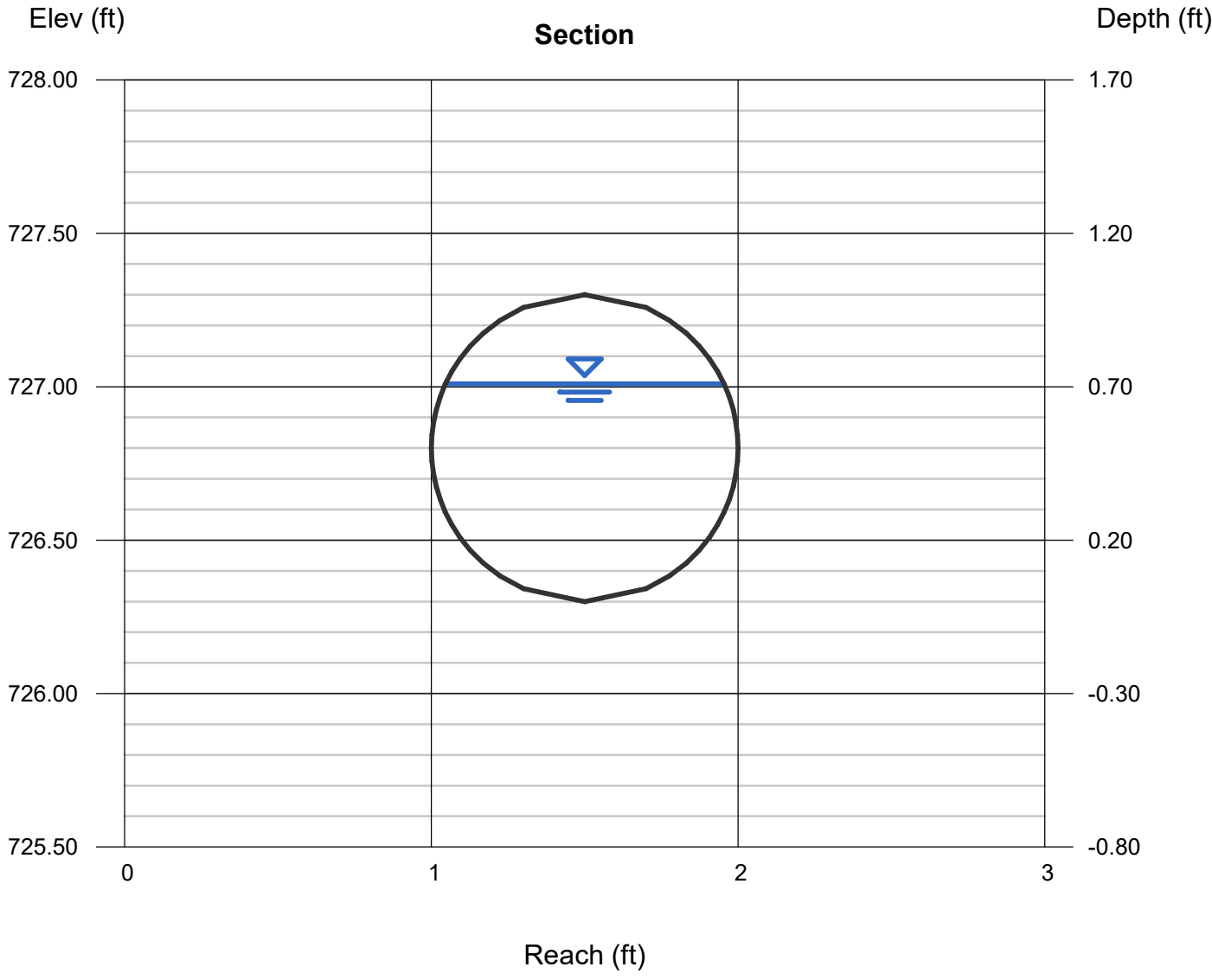
Diameter (ft)	= 1.00
Invert Elev (ft)	= 726.30
Slope (%)	= 0.59
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.52

Highlighted

Depth (ft)	= 0.71
Q (cfs)	= 2.520
Area (sqft)	= 0.60
Velocity (ft/s)	= 4.22
Wetted Perim (ft)	= 2.00
Crit Depth, Yc (ft)	= 0.68
Top Width (ft)	= 0.91
EGL (ft)	= 0.99



ATTACHMENT 8
Infiltration Trench Calculations

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Infiltration Trench with Infiltration Berm (Level 1 Design)

Trench Dimensions			
Depth (ft)	2.5	Area/Linear Foot of Trench (ft^2/LF)[1]	10.47
Width (ft)	10	Length (ft)	87
Pipe Diameter (in)	12		

1. Using 40% void space in aggregate

Berm Dimensions			
Berm Length (ft)	87	Impoundment Area Depth (ft)	1.5
Berm Side Slopes (Upslope)	4	Impoundment Area Top Width (ft)	22
Slope of Existing Grade (%)	10%	Calculated Impoundment (ft^2/LF)	24
Impoundment Area Bottom Width (ft)	10		

Trench Storage (cf)	911.0
Berm Storage (cf)	2088.0
Sand Storage (cf)[1]	87

1. Using 20% void space

Total Storage Volume (cf)	**3086**

Infiltration Test Field Data

SUBJECT: Southeast Supply Enhancement Project (EDEN-MLV-03)
BY: JAB Date: 4/16/2025
CHECKED: _____ Date: _____

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Test Hole #2					
Reading	delta T (min)	Delta (in)	Perc Rate (in/hr)	Elevation (ft)	Depth (ft)
1	30	0.250	0.500	726.00	2
2	30	0.250	0.500	726.00	2
3	30	0.125	0.250	726.00	2
4	30	0.063	0.125	726.00	2
	Final Value	0.172	0.344		

Test Hole #6					
Reading	delta T (min)	Delta (in)	Perc Rate (in/hr)	Elevation (ft)	Depth (ft)
1	30	0.625	1.250	725.0	2
2	30	0.500	1.000	725.0	2
3	30	0.500	1.000	725.0	2
4	30	0.500	1.000	725.0	2
	Final Value	0.531	1.063		

Infiltration Rate:	0.60	in/hr
Factor of Safety:	2	
Infiltration Rate:	0.30	in/hr

Project:	By:	Date:
	JAB	4/16/2025
Southeast Supply Enhancement Project (EDEN-MLV-03)	Checked:	Date:
Description:		
Drawdown of Infiltration BMP		

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Introduction:

The VADEQ Stormwater Management Handbook specifies that infiltration BMP's must be designed such that the treatment volume infiltrates within 36 to 48 hours, and must completely drain within 72 hours.

Calculations:

Infiltration area determined by using the infiltration bottom surface area.

Dewatering Time (hr) = (12*Treatment volume)/(Infiltration area X infiltration design rate)

Infiltration Trench

Surface storage volume at overflow elevation =	1,009	cf
Infiltration Area =	870	sq.ft.
Infiltration design rate =	0.30	in/hr
Dewatering Time =	46	hrs (calculated)

ATTACHMENT 9
Level Spreader Design

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Level Spreader Design

Weir Equation: $Q = C_w L H^{3/2}$

Solving for L: $L = \frac{Q}{CwH^{3/2}}$

Q =	2.14	cfs	Outflow of diversion berm plus during 10-year storm
C_w=	2.6		Weir coefficient
H =	0.1	ft	Max flow depth immediately below level spreader
L =	26.0	ft	

Round to 26 feet length; flow depth H < 0.1 ft

H =	0.10	ft

ATTACHMENT 10
Channel Drainage Maps

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CHANNEL 1 DRAINAGE AREA (0.33 ACRES)

CHANNEL 1

CHANNEL 2

CHANNEL 2 DRAINAGE AREA (0.08 ACRES)

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
SOUTHEAST SUPPLY ENHANCEMENT PROJECT – EDEN LOOP
CHANNEL DRAINAGE MAP
PITTSYLVANIA COUNTY, VIRGINIA

DRAWN BY: JAB	DATE: 05/22/2025	ISSUED FOR BID:	SCALE: AS SHOWN
CHECKED BY: JAB	DATE:	ISSUED FOR CONSTRUCTION:	
APPROVED BY: RCM	DATE:	DRAWING NO.: R230851.01	001 OF 001

ATTACHMENT 11
Infiltration Testing Report

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SUBJECT Williams SSE Project – EDEN-MLV-03

Infiltration Testing Results and Calculations

DESIGNED BY: BAC DATE 10/04/2024 PROJ. NO. R230851.01

CHECKED BY: RRC DATE 10/08/2024 SECTION NO. 1 OF 5

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Introduction

This package determines the effective infiltration rates for the Williams SSE Project (Project) EDEN-MLV-03 proposed Post Construction Stormwater Management (PCSM) Best Management Practices (BMP). The proposed BMPs must completely drain within 72 hours of the end of a rainfall according to the Virginia Stormwater Management Handbook (Version 1.1).

Procedure

Prepare the testing area by levelling the ground and scraping any shrubs from the surface. Place outer ring on the testing area and drive the ring into the ground using a flat wooden board and a hammer. Drive the ring to a minimum depth of 2 inches. Next, place the inner ring and repeat the process. The bottom rim of both rings should be at the same level. Presoak the test area immediately prior to testing by filling both rings with water until the rim at every 30-minute intervals for an hour. The minimum water depth should be 4 inches. Depending on the drop-in water level after presoak period, the measurement intervals are determined. If water level drop was 2 inches or more, 10-minute intervals are used; and if water level drop was less than 2 inches, then 30-minute intervals are used. Note down the reading at each interval, after which the ring should be filled with water until the rim. Measure water level at each interval until a stabilized reading is obtained, which means a difference of 0.25 inch or less between the highest and lowest reading.

Method

In accordance with Appendix C of the Virginia Stormwater Management Handbook, double ring infiltrometer tests were conducted on site at the proposed locations of the infiltration BMPs as shown on the map in this package. The testing was conducted at the surface elevation of the proposed BMPs and completed on September 9, 2024. The existing condition of the site included woodland area and brush area. The soil test pits were machine and hand excavated.

Test No. IT #1

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil and subsoil consists of two feet of dry sand with some gravel, some silt, cobbles, and boulders. One infiltration test was conducted within the test pit at a depth of 2 feet.

Test No. IT #2

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil and subsoil consists of two feet of dry sand with some gravel and a little silt. Roots were present throughout the pit. One infiltration test was conducted within the test pit at a depth of 2 feet.

Test No. IT #3

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil consists of three feet of dry sand with some gravel, trace silt, and trace clay. The subsoil consists of dry to damp sand with some silt and some clay. One infiltration test was conducted within the test pit at a depth of 0.5 feet.

Test No. IT #4

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil consists of three feet of dry sand with some gravel and trace silt. The subsoil consists of dry to damp sand with some silt and trace gravel. One infiltration test was conducted within the test pit at a depth of 0.5 feet.

Test No. IT #5

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil consists of 0.8 feet of dry to damp sand with some gravel some silt, boulders, and cobbles. The subsoil from depths 0.8 feet to 2 feet consists of damp sand with some gravel, some silt, boulders, and cobbles. The subsoil from depths 2 feet to 7 feet consists of damp sand with some silt, and a little clay. The subsoil from depths 7 feet to 7.8 feet consists of dry sand and gravel. One infiltration test was conducted within the test pit at a depth of 0.5 feet.

Test No. IT #6

Based on visual observation of the ground surface and from shallow excavations made to the test area during infiltration testing on September 9, 2024, the near surface soil and subsoil consists of 1 foot of dry sand and gravel. One infiltration test was conducted within the test pit at a depth of 1 foot.

Geologic Test Results

Test Pits of approximately 1-ft to 7.8-ft deep were dug in the infiltration BMP locations to observe the soil horizon and the overall soil conditions both horizontally and vertically.

Test No. TP #1

Based on visual observation of the ground surface and from test pit dug 2 feet deep on September 9, 2024, the near surface soil and subsoil consists of two feet of dull yellow orange (10YR 6/4) sand with some gravel, some silt, cobbles, and boulders, heterogeneous, non-plastic fines, flat to angular, and colluvium. Roots were present from surface to a depth of 1.5 feet. No bedrock or groundwater was encountered.

Test No. TP #2

Based on visual observation of the ground surface and from test pit dug 2 feet deep on September 9, 2024, the near surface soil and subsoil consists of two feet of dull orange (7.5YR 6/4) dry sand with some gravel, a little silt, homogeneous, flat to angular, non-plastic fines, and residuum. Roots were present from surface to a depth of two feet. No bedrock or groundwater was encountered.

Test No. TP #3

Based on visual observation of the ground surface and from test pit dug 6 feet deep on September 9, 2024, the near surface soil consists of three feet of orange (5YR 6/8) dry sand with some gravel, trace silt, trace clay, blocky, heterogeneous, angular to flat, non-plastic fines, and colluvium. The subsoil consists of orange (5YR 6/8) dry to damp sand with some silt, some clay, homogeneous, rounded, low plastic fines, and residuum. No bedrock or groundwater was encountered.

Test No. TP #4

Based on visual observation of the ground surface and from test pit dug 6 feet deep on September 9, 2024, the near surface soil consists of three feet of yellow brown (10YR 7/6) dry sand with some gravel, trace silt, blocky, heterogeneous, non-plastic fines, and colluvium. The subsoil consists of orange (5YR 6/8) dry to damp sand with some silt, trace gravel, homogeneous, rounded, low plastic fines, and residuum. No bedrock or groundwater was encountered.

Test No. TP #5

Based on visual observation of the ground surface and from test pit dug 7.8 feet deep on September 9, 2024, the near surface soil consists of 0.8 feet of yellow brown (10YR 7/6) dry to damp sand with some gravel, some silt, boulders, and cobbles, blocky, heterogeneous, non-plastic fines, and colluvium. The subsoil from depths 0.8 feet to 2 feet consists of bright brown (10YR 6/6) damp sand with some gravel,

some silt, boulders, and cobbles, non-plastic fines, and colluvium. The subsoil from depths 2 feet to 7 feet consists of bright brown (10YR 6/6) damp sand with some silt, a little clay, homogeneous, rounded, low plastic fines, and residuum. The subsoil from depths 7 feet to 7.8 feet consists of bright brown (10YR 6/6) dry sand and gravel, rounded, heterogeneous, non-plastic fines, and colluvium. No bedrock or groundwater was encountered.

Test No. TP #6

Based on visual observation of the ground surface and from test pit dug 1 foot deep on September 9, 2024, the near surface soil and subsoil consists of 1 foot of bright brown (10YR 6/6) dry sand and gravel, rounded, heterogeneous, non-plastic fines, and colluvium. No bedrock or groundwater was encountered.

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Infiltration Testing Worksheets

Double Ring Infiltrometer Field Test

Test Pit Number: 1	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 2 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	12:12 PM	N/A	0.5	12:42 PM
2	12:42 PM	N/A	0.25	1:12 PM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	1:12 PM	N/A	0.25	1:42 PM
2	1:42 PM	N/A	0.25	2:12 PM
3	2:12 PM	N/A	0.25	2:42 PM
4	2:42 PM	N/A	0.125	3:12 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =	0.44	in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =		in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

Double Ring Infiltrometer Field Test

Test Pit Number: 2	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 2 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	12:07 PM	N/A	0.25	12:37 PM
2	12:37 PM	N/A	0.25	1:07 PM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	1:07 PM	N/A	0.25	1:37 PM
2	1:37 PM	N/A	0.25	2:07 PM
3	2:07 PM	N/A	0.125	2:37 PM
4	2:37 PM	N/A	0.0625	3:07 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =	0.34	in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =		in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

Double Ring Infiltrometer Field Test

Test Pit Number: 3	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 0.5 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	11:12 AM	N/A	0.25	11:42 AM
2	11:42 AM	N/A	0.25	12:12 PM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	12:12 PM	N/A	0.125	12:42 PM
2	12:42 PM	N/A	0.25	1:12 PM
3	1:12 PM	N/A	0.25	1:42 PM
4	1:42 PM	N/A	0.125	2:12 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =	0.38	in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =		in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

Double Ring Infiltrometer Field Test

Test Pit Number: 4	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 0.5 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	10:48 AM	N/A	3.625	11:18 AM
2	11:18 AM	N/A	2.375	11:48 AM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	11:48 AM	N/A	0.375	11:58 AM
2	11:58 AM	N/A	0.375	12:08 PM
3	12:08 PM	N/A	0.375	12:18 PM
4	12:18 PM	N/A	0.25	12:28 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =		in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =	2.06	in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

Double Ring Infiltrometer Field Test

Test Pit Number: 5	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 0.5 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	10:30 AM	N/A	3.875	11:00 AM
2	11:00 AM	N/A	2.875	11:30 AM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	11:30 AM	N/A	0.625	11:40 AM
2	11:40 AM	N/A	0.625	11:50 AM
3	11:50 AM	N/A	0.5	12:00 PM
4	12:00 PM	N/A	0.75	12:10 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =		in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =	3.75	in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

Double Ring Infiltrometer Field Test

Test Pit Number: 6	Project Name: Williams SSE - MP 1405.25	Project #R230851.01

Depth of Excavation (ft.): 2 Depth of Topsoil (in.): See Soil Test Pit Log Depth of Watertable (ft): See Soil Test Pit Log	Soil Conditions: See Soil Test Pit Log

1-hour Pre-soak

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	2:00 PM	N/A	0.625	2:30 PM
2	2:30 PM	N/A	0.625	3:00 PM

Less than 2-inches of drop, Use 30 minute measurement intervals
More than 2-inches of drop, Use 10-minute measurement intervals

Infiltration Testing

	Start Time	Fill Mark from Bottom (inches)	Drop in Water Level (inches)	Measured Time
1	3:00 PM	N/A	0.625	3:30 PM
2	3:30 PM	N/A	0.5	4:00 PM
3	4:00 PM	N/A	0.5	4:30 PM
4	4:30 PM	N/A	0.5	5:00 PM

Stop test if there is a stabilized rate of drop, meaning a difference of 1/4 inch or less of drop between the highest and lowest readings of the top four readings

5				
6				
7				
8				

Infiltration Rate:(Average Drop in Water Level/30 minutes) x 60 minutes/1 hour =	1.06	in/hr
Infiltration Rate:(Average Drop in Water Level/10 minutes) x 60 minutes/1 hour =		in/hr
		in/hr

Test Performed: 9-9-2024
Test By: Ryan Connell and Brandon Clark

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Soil Test Pit Logs

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 731ft Lat/Long (36°44'51". -79°25'44") BORING NO. **TP-1**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET/ % RECOVERY	DESCRIPTION			REMARKS*
		PROFILE	COLOR	MATERIAL CLASSIFICATION	
	1.0	1.0	Dull yellow orange	Sand, some Gravel, some Silt, cobbles and boulders encountered, heterogeneous	
1.0	100%		10YR 6/4	non-plastic fines, flat to angular, colluvium, roots 0.0' - 1.5' a-1-b/sp, (0.0' - 2.0')	**No presence of seasonal high**
	1.0	2.0			**groundwater table within**
2.0	100%			Pit terminated at 2.0 ft	**the test pit.**

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 732ft Lat/Long (36°44'52". -79°25'46") BORING NO. **TP-2**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET / % RECOVERY	DESCRIPTION: PROFILE	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	REMARKS*
	1.0	1.0	Dull orange	Sand, some Gravel, litte Silt, dry,	
1.0	100%		7.5YR 6/4	homogeneous, flat to angular, non-plastic fines, residuum, a-1-b/sp, (0.0' - 2.0')	**No presence of seasonal high**
	1.0	2.0		Roots 0.0' - 2.0'	**groundwater table**
2.0	100%			Pit terminated at 2.0 ft	**present.**

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 734ft Lat/Long (36°44'52". -79°25'44") BORING NO. **TP-3**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET / % RECOVERY	DESCRIPTION			REMARKS*
		PROFILE	COLOR	MATERIAL CLASSIFICATION	
	1.0		Orange	Sand, some Gravel, trace Silt, trace Clay, blocky, heterogeneous, dry, angular to flat,	
1.0	100%		5YR 6/8	non plastic fines, colluvium, a-1-b/sm (0.0' - 3.0')	
	1.0				
2.0	100%				
	1.0				**No presence of seasonal high**
3.0	100%				**groundwater table within**
	1.0	6.0	5YR 6/8	Sand, some Silt, some Clay, dry to damp, homogeneous, rounded, residuum,	**the test pit.**
4.0	100%		Orange	low plastic fines, a-2-4/sm (3.0' - 6.0')	
	1.0				
5.0	100%				
	1.0				
6.0	100%			Pit terminated at 6.0 ft	

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 736ft Lat/Long (36°44'52". -79°25'44") BORING NO. **TP-4**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET/ % RECOVERY	DESCRIPTION: PROFILE	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	REMARKS*
	1.0	1.0	Yellow brown	Sand, some Gravel, trace Silt, blocky, heterogeneous, dry,	
1.0	100%		10YR 7/6	non-plastic fines, colluvium, a-1-b/sp (0.0' - 3.0')	
	1.0				
2.0	100%				
	1.0				**No presence of seasonal high**
3.0	100%				**groundwater table within**
	1.0	6.0	5YR 6/8	Sand, some Silt, trace Gravel, homogeneous, dry to damp, rounded, low plastic fines,	**the test pit.**
4.0	100%		Orange	residuum, a-1-b/sm (3.0' - 6.0')	
	1.0				
5.0	100%				
	1.0				
6.0	100%			Pit terminated at 6.0 ft	

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 739ft Lat/Long (36°44'53". -79°25'44") BORING NO. **TP-5**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET/ % RECOVERY	DESCRIPTION: PROFILE	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	REMARKS*
	1.0	1.0	Yellow brown	Sand, some Gravel, some Silt, Boulders and Cobbles encountered, blocky,	
1.0	100%		10YR 7/6	heterogeneous, dry to damp,non-plastic fines, colluvium, a-1-b/sp (0.0' - 0.8')	
	1.0				
2.0	100%		10YR 6/6	Sand, some Gravel, some Silt, Boulders and Cobbles encountered, damp, non-plastic,	
	1.0		Bright Brown	colluvium, a-1-b/sm (0.8' - 2.0')	**No presence of seasonal high**
3.0	100%				**groundwater table within**
	1.0	6.0	10YR 6/6	Sand, some Silt, little Clay, homogeneous, damp, rounded, low plastic fines,	**the test pit.**
4.0	100%		Bright Brown	residuum, a-2-4/sc (2.0' - 7.0')	
	1.0				
5.0	100%				
	1.0				
6.0	100%				
	1.0		10YR 6/6	Sand and gravel, rounded, heterogeneous, dry, non-plastic fines, colluvium,	
7.0	100%	7.8	Bright Brown	a-1-b/sm, (7.0' - 7.8')	
	1.0			Pit terminated at 7.8 ft	

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.

PROJECT **Williams SSE Project – MP 1405.25**

ELEVATION 727ft Lat/Long (36°44'52". -79°25'46") BORING NO. **TP-6**

ELEVATION GW **Dry** PROJECT NO. **R210356.01**

DATE **09/09/24** CLASSIFIED BY **Konstantin Kasamias** PAGE **1** OF **1**

DEPTH (FEET)	RECOVERY IN FEET/ % RECOVERY	DESCRIPTION			REMARKS*
		PROFILE	COLOR	MATERIAL CLASSIFICATION	
	1.0	1.0	Bright brown	Sand and Gravel, rounded, heterogeneous, dry, non-plastic fines,	
1.0	100%	6.0	10YR 6/6	colluvium, a-1-b/sp (0.0' - 0.8')	

Test pits were completed by Southeast Connections, LLC . using a Cat 305E2 CR Mini Excavator with a 2 ft bucket on 9/9/24.