

TECHNICAL MEMORANDUM

Date: February 1, 2021
Subject: All Mac Trailer Facility Stormwater Management
Prepared For: All Mac, Inc.
Prepared By: Kent Brander, PE

A. INTRODUCTION

Civil Methods, Inc. (CMI) performed a hydrologic and hydraulic analysis to verify that runoff rate control requirements are met for the All Mac Trailer Facility project at 5580 Stacy Trail in Stacy, MN. The project consists of the construction of a gravel parking area, bituminous asphalt parking lot, building, utilities, and associated site grading.

B. EXISTING SITE CONDITIONS

The site currently consists of undeveloped area with grass and some trees, with runoff discharging to the northeast as well as to the west, toward the Hwy I35E ramp (see Attachment 1). The site is underlain by high-permeability soils (HSG A). The soil survey data for the site is provided in Attachment 2.

C. PROPOSED SITE CONDITIONS

Proposed conditions are shown in Attachment 1. Under proposed conditions, runoff continues to discharge in the same general directions, but with more area (the impervious area) directed to the northeast, to the proposed infiltration basin. This is the only discharge location with impervious area being added under proposed conditions.

D. STORMWATER TREATMENT REQUIREMENTS

Permanent stormwater treatment is not required by the MPCA for this project, because less than 1 acre of impervious area is being added. However, the City of Stacy requires that the existing peak runoff rates must not be exceeded under proposed conditions, for the 2-, 10-, and 100-year, 24-hour storms. To meet this requirement, an infiltration basin will be constructed in the northeast corner of the property as shown on project plans. The infiltration basin will receive the runoff from all the additional impervious area via sheet flow.

E. STORMWATER BMP DETAILS

The proposed infiltration basin is described in the project plans. Discharge will be controlled with an outlet control structure, including an orifice installed within an internal weir. The bottom 4 feet of the basin volume (below the orifice invert) will be used to hold and infiltrate runoff, with additional live storage provided above the orifice invert. Based on the soil data, a conservative infiltration rate of 1.0 in/hr was assumed, providing for the recommended 48-hour drawdown time. The OCS will discharge via a 12" RCP and connect to the existing storm sewer.

F. RESULTS

Peak stormwater runoff results are provided in the following table. Detailed model output is provided in Attachment 3.

	Northeast (R1X and R1P) (CFS)			Northwest (A3X and A3P) (CFS)			Southwest (A2X and A2P) (CFS)		
	2-yr	10-yr	100-yr	2-yr	10-yr	100-yr	2-yr	10-yr	100-yr
Existing Conditions	0.0	0.0	0.27	0.0	0.0	0.13	0.0	0.0	0.21
Proposed Conditions	0.0	0.0	0.27	0.0	0.0	0.03	0.0	0.0	0.10

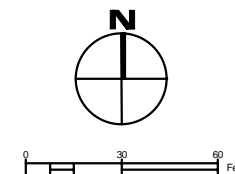
As indicated in the table, the peak runoff rate for all storms is maintained or reduced for all discharge locations.

G. CONCLUSION








Based on the results of this analysis, the proposed design meets the applicable stormwater management requirements.

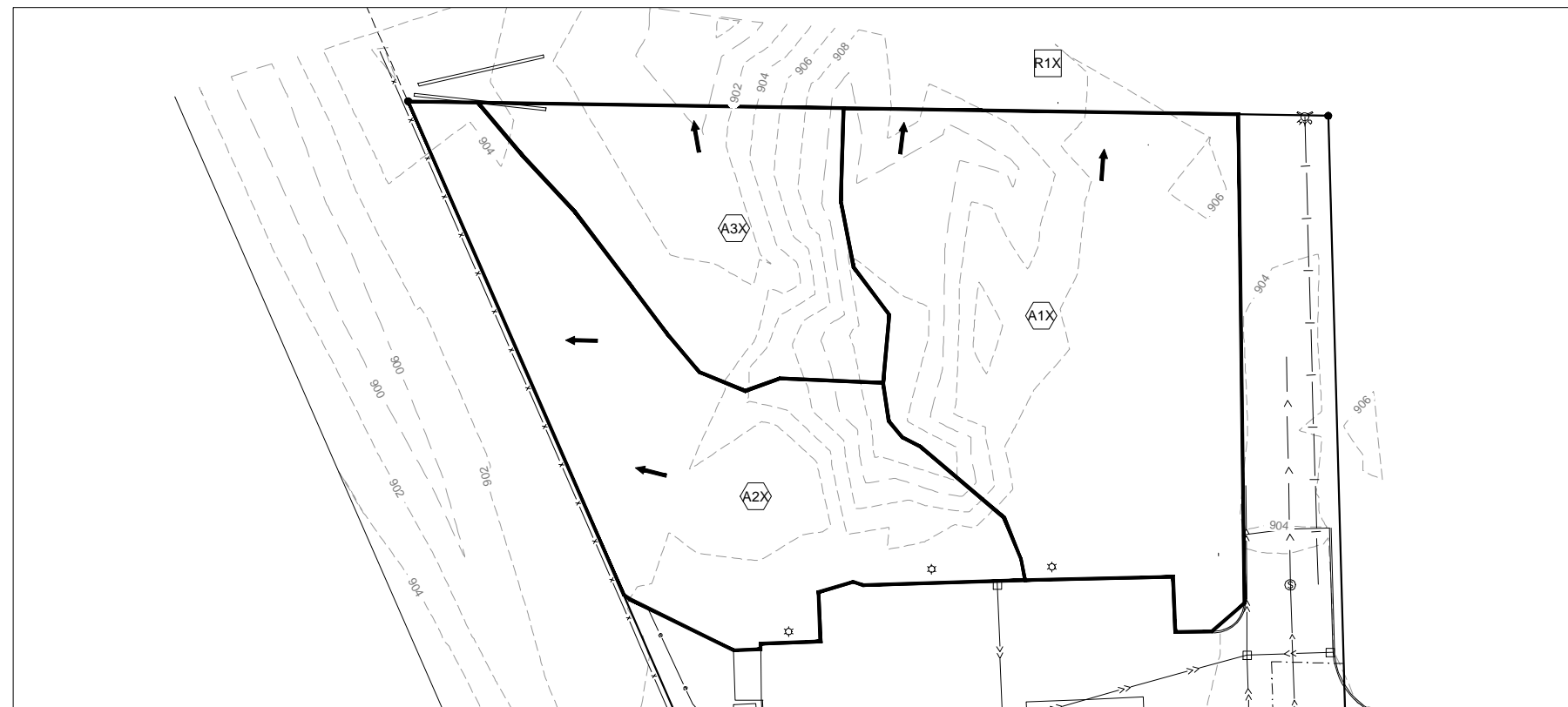
Attachment 1: Drainage Figure

BENCHMARK
See Survey Documentation

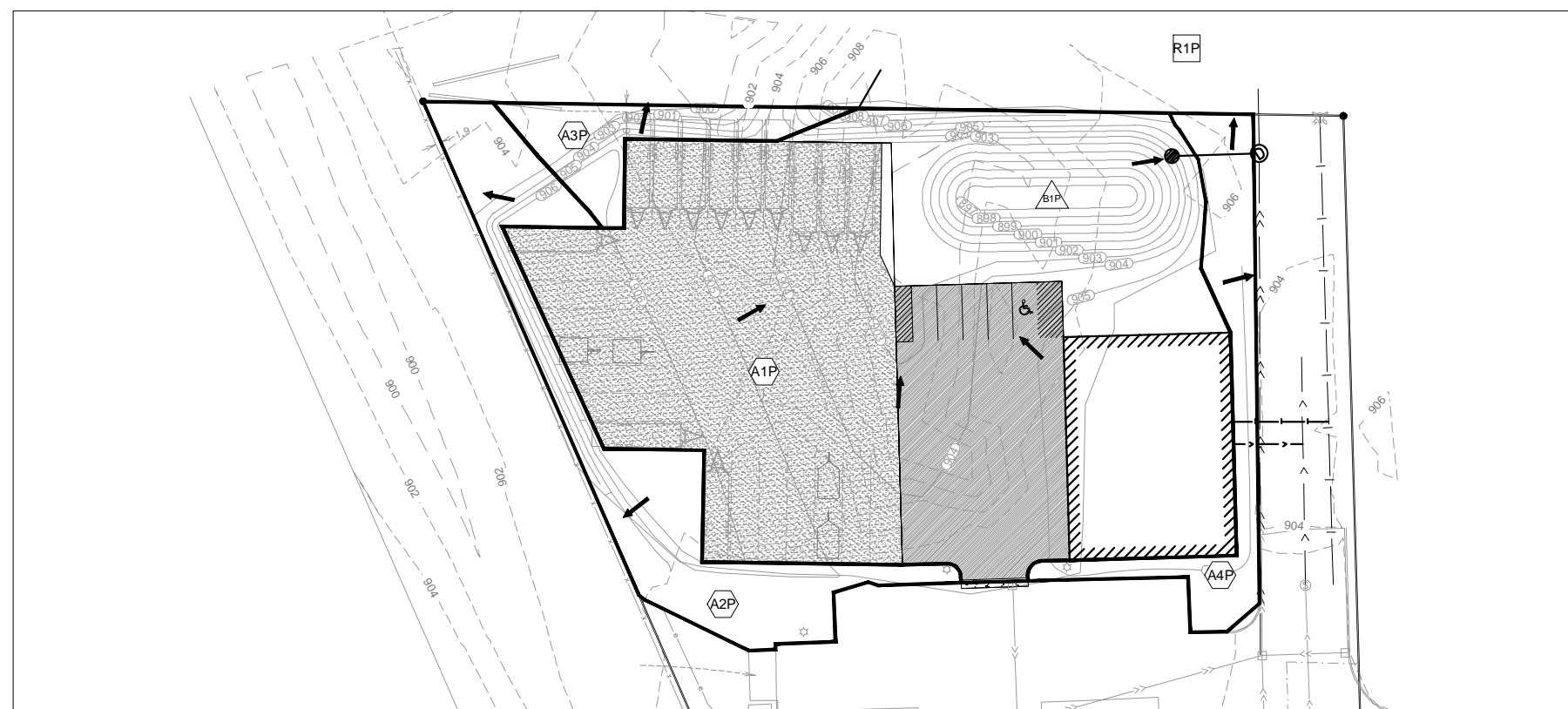


LEGEND:

-  SUBCATCHMENT NODE ID
-  BASIN NODE ID
-  REACH NODE ID
-  DRAINAGE AREA BOUNDARY
-  DRAINAGE DIRECTION
-  EXISTING CONTOUR
-  PROPOSED CONTOUR




EXISTING CONDITION



PROPOSED CONDITION

Print Date: 1/30/2021 4:33 PM
File Loc: C:\CIVIL\METHODS, INC\CM\Documents\7\Projects\0663_All Mac Trailer Facility\08_DRAWINGS AND SPECIFICATIONS\03\DWG\Basin\0663_WR.dwg

CIVIL METHODS, INC.
P.O. Box 28038
St. Paul, MN 55128
o: 763.210.5713 | www.civilmethods.com

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

KENT E. BRANDER
DATE: 02-01-2021
LIC. NO.: 44578

DESIGNED: KEB
DRAWN: KEB
CHECKED: DMP
DATE / REVISION:
02-01-2021 Stormwater Management Plan

OWNER:

ALL MAC, INC.
23773 Johnson St NE
East Bethel, MN 55005

TITLE:

DRAINAGE FIGURE
ALL MAC TRAILER FACILITY
STACY, MN

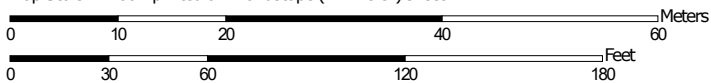
FIG1

Attachment 2: Soil HSG Data

Hydrologic Soil Group—Chisago County, Minnesota



Map Scale: 1:700 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N 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 1:15,800.

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: Chisago County, Minnesota
 Survey Area Data: Version 17, Jun 4, 2020

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

Date(s) aerial images were photographed: Apr 3, 2015—Sep 13, 2016

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
158B	Zimmerman fine sand, 1 to 6 percent slopes	A	1.7	100.0%
Totals for Area of Interest			1.7	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.

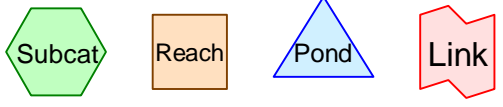
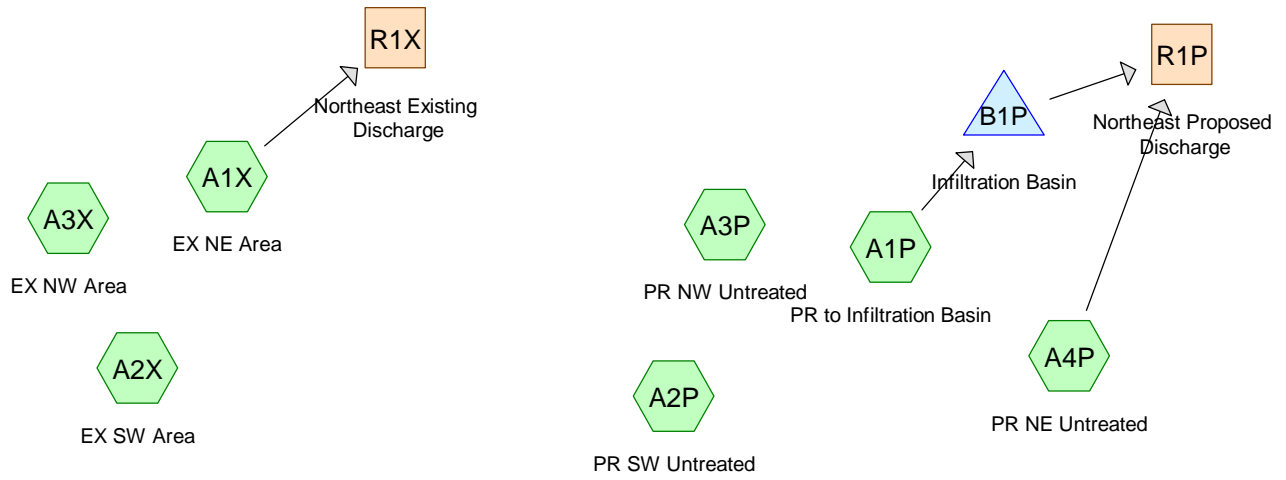
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Attachment 3: HydroCAD Results



0663_All Mac Trailer Facility

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	MSE 24-hr	3	Default	24.00	1	2.80	2
2	10-Year	MSE 24-hr	3	Default	24.00	1	4.11	2
3	100-Year	MSE 24-hr	3	Default	24.00	1	6.63	2

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MSE 24-hr 3 2-Year Rainfall=2.80"

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Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment A1P: PR to Infiltration Basin Runoff Area=34,589 sf 38.27% Impervious Runoff Depth=1.57"
Tc=5.0 min CN=87 Runoff=2.41 cfs 0.104 af

Subcatchment A1X: EX NE Area Runoff Area=20,939 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=132' Slope=0.0606 '/ Tc=8.4 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A2P: PR SW Untreated Runoff Area=6,127 sf 0.00% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A2X: EX SW Area Runoff Area=15,683 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=129' Slope=0.0736 '/ Tc=7.6 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A3P: PR NW Untreated Runoff Area=2,081 sf 0.00% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A3X: EX NW Area Runoff Area=9,353 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=129' Slope=0.0930 '/ Tc=6.9 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A4P: PR NE Untreated Runoff Area=3,178 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=75' Slope=0.0100 '/ Tc=11.0 min CN=39 Runoff=0.00 cfs 0.000 af

Reach R1P: Northeast Proposed Discharge Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach R1X: Northeast Existing Discharge Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond B1P: Infiltration Basin Peak Elev=899.56' Storage=3,273 cf Inflow=2.41 cfs 0.104 af
Discarded=0.04 cfs 0.104 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.104 af

Total Runoff Area = 2.111 ac Runoff Volume = 0.104 af Average Runoff Depth = 0.59"
85.60% Pervious = 1.807 ac 14.40% Impervious = 0.304 ac

Summary for Subcatchment A1P: PR to Infiltration Basin

Runoff = 2.41 cfs @ 12.13 hrs, Volume= 0.104 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
*	13,237	98	Impervious Area
	5,697	39	>75% Grass cover, Good, HSG A
*	15,655	96	Gravel
	34,589	87	Weighted Average
	21,352	81	61.73% Pervious Area
	13,237	98	38.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A1X: EX NE Area

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
	20,939	39	>75% Grass cover, Good, HSG A
	20,939	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	132	0.0606	0.26		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A2P: PR SW Untreated

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

	Area (sf)	CN	Description
	6,127	39	>75% Grass cover, Good, HSG A
	6,127	39	100.00% Pervious Area

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MSE 24-hr 3 2-Year Rainfall=2.80"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A2X: EX SW Area

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

Area (sf)	CN	Description
15,683	39	>75% Grass cover, Good, HSG A
15,683	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	129	0.0736	0.28		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A3P: PR NW Untreated

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

Area (sf)	CN	Description
2,081	39	>75% Grass cover, Good, HSG A
2,081	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A3X: EX NW Area

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

Area (sf)	CN	Description
9,353	39	>75% Grass cover, Good, HSG A
9,353	39	100.00% Pervious Area

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MSE 24-hr 3 2-Year Rainfall=2.80"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	129	0.0930	0.31		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A4P: PR NE Untreated

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-Year Rainfall=2.80"

Area (sf)	CN	Description
3,178	39	>75% Grass cover, Good, HSG A
3,178	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	75	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Reach R1P: Northeast Proposed Discharge

Inflow Area = 0.867 ac, 35.05% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Reach R1X: Northeast Existing Discharge

Inflow Area = 0.481 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond B1P: Infiltration Basin

Inflow Area = 0.794 ac, 38.27% Impervious, Inflow Depth = 1.57" for 2-Year event
 Inflow = 2.41 cfs @ 12.13 hrs, Volume= 0.104 af
 Outflow = 0.04 cfs @ 15.15 hrs, Volume= 0.104 af, Atten= 98%, Lag= 181.4 min
 Discarded = 0.04 cfs @ 15.15 hrs, Volume= 0.104 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
 Peak Elev= 899.56' @ 15.15 hrs Surf.Area= 1,687 sf Storage= 3,273 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 930.8 min (1,731.3 - 800.6)

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MSE 24-hr 3 2-Year Rainfall=2.80"

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Volume	Invert	Avail.Storage	Storage Description
#1	897.00'	10,211 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
897.00	636	0	0
898.00	1,374	1,005	1,005
899.00	1,418	1,396	2,401
900.00	1,897	1,658	4,059
901.00	2,432	2,165	6,223
902.00	3,024	2,728	8,951
902.40	3,277	1,260	10,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	897.00'	1.000 in/hr Exfiltration over Surface area
#2	Primary	900.00'	12.0" Round Culvert L= 31.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 900.00' / 899.00' S= 0.0323 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	901.00'	3.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.04 cfs @ 15.15 hrs HW=899.56' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=897.00' TW=0.00' (Dynamic Tailwater)

↑ **2=Culvert** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

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MSE 24-hr 3 10-Year Rainfall=4.11"

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Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment A1P: PR to Infiltration Basin Runoff Area=34,589 sf 38.27% Impervious Runoff Depth=2.74"
Tc=5.0 min CN=87 Runoff=4.11 cfs 0.181 af

Subcatchment A1X: EX NE Area Runoff Area=20,939 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=132' Slope=0.0606 '/ Tc=8.4 min CN=39 Runoff=0.00 cfs 0.002 af

Subcatchment A2P: PR SW Untreated Runoff Area=6,127 sf 0.00% Impervious Runoff Depth=0.06"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.001 af

Subcatchment A2X: EX SW Area Runoff Area=15,683 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=129' Slope=0.0736 '/ Tc=7.6 min CN=39 Runoff=0.00 cfs 0.002 af

Subcatchment A3P: PR NW Untreated Runoff Area=2,081 sf 0.00% Impervious Runoff Depth=0.06"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment A3X: EX NW Area Runoff Area=9,353 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=129' Slope=0.0930 '/ Tc=6.9 min CN=39 Runoff=0.00 cfs 0.001 af

Subcatchment A4P: PR NE Untreated Runoff Area=3,178 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=75' Slope=0.0100 '/ Tc=11.0 min CN=39 Runoff=0.00 cfs 0.000 af

Reach R1P: Northeast Proposed Discharge Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach R1X: Northeast Existing Discharge Inflow=0.00 cfs 0.002 af
Outflow=0.00 cfs 0.002 af

Pond B1P: Infiltration Basin Peak Elev=900.90' Storage=5,990 cf Inflow=4.11 cfs 0.181 af
Discarded=0.06 cfs 0.181 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.181 af

Total Runoff Area = 2.111 ac Runoff Volume = 0.188 af Average Runoff Depth = 1.07"
85.60% Pervious = 1.807 ac 14.40% Impervious = 0.304 ac

Summary for Subcatchment A1P: PR to Infiltration Basin

Runoff = 4.11 cfs @ 12.12 hrs, Volume= 0.181 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

	Area (sf)	CN	Description
*	13,237	98	Impervious Area
	5,697	39	>75% Grass cover, Good, HSG A
*	15,655	96	Gravel
	34,589	87	Weighted Average
	21,352	81	61.73% Pervious Area
	13,237	98	38.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A1X: EX NE Area

Runoff = 0.00 cfs @ 13.37 hrs, Volume= 0.002 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

	Area (sf)	CN	Description
	20,939	39	>75% Grass cover, Good, HSG A
	20,939	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	132	0.0606	0.26		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A2P: PR SW Untreated

Runoff = 0.00 cfs @ 13.34 hrs, Volume= 0.001 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

	Area (sf)	CN	Description
	6,127	39	>75% Grass cover, Good, HSG A
	6,127	39	100.00% Pervious Area

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MSE 24-hr 3 10-Year Rainfall=4.11"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A2X: EX SW Area

Runoff = 0.00 cfs @ 13.37 hrs, Volume= 0.002 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

Area (sf)	CN	Description
15,683	39	>75% Grass cover, Good, HSG A
15,683	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	129	0.0736	0.28		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A3P: PR NW Untreated

Runoff = 0.00 cfs @ 13.34 hrs, Volume= 0.000 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

Area (sf)	CN	Description
2,081	39	>75% Grass cover, Good, HSG A
2,081	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A3X: EX NW Area

Runoff = 0.00 cfs @ 13.35 hrs, Volume= 0.001 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

Area (sf)	CN	Description
9,353	39	>75% Grass cover, Good, HSG A
9,353	39	100.00% Pervious Area

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MSE 24-hr 3 10-Year Rainfall=4.11"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	129	0.0930	0.31		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A4P: PR NE Untreated

Runoff = 0.00 cfs @ 13.43 hrs, Volume= 0.000 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-Year Rainfall=4.11"

Area (sf)	CN	Description
3,178	39	>75% Grass cover, Good, HSG A
3,178	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	75	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Reach R1P: Northeast Proposed Discharge

Inflow Area = 0.867 ac, 35.05% Impervious, Inflow Depth = 0.00" for 10-Year event
 Inflow = 0.00 cfs @ 13.43 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 13.43 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Reach R1X: Northeast Existing Discharge

Inflow Area = 0.481 ac, 0.00% Impervious, Inflow Depth = 0.06" for 10-Year event
 Inflow = 0.00 cfs @ 13.37 hrs, Volume= 0.002 af
 Outflow = 0.00 cfs @ 13.37 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond B1P: Infiltration Basin

Inflow Area = 0.794 ac, 38.27% Impervious, Inflow Depth = 2.74" for 10-Year event
 Inflow = 4.11 cfs @ 12.12 hrs, Volume= 0.181 af
 Outflow = 0.06 cfs @ 16.06 hrs, Volume= 0.181 af, Atten= 99%, Lag= 236.0 min
 Discarded = 0.06 cfs @ 16.06 hrs, Volume= 0.181 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
 Peak Elev= 900.90' @ 16.06 hrs Surf.Area= 2,380 sf Storage= 5,990 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 1,278.4 min (2,067.8 - 789.4)

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MSE 24-hr 3 10-Year Rainfall=4.11"

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Volume	Invert	Avail.Storage	Storage Description
#1	897.00'	10,211 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
897.00	636	0	0
898.00	1,374	1,005	1,005
899.00	1,418	1,396	2,401
900.00	1,897	1,658	4,059
901.00	2,432	2,165	6,223
902.00	3,024	2,728	8,951
902.40	3,277	1,260	10,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	897.00'	1.000 in/hr Exfiltration over Surface area
#2	Primary	900.00'	12.0" Round Culvert L= 31.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 900.00' / 899.00' S= 0.0323 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	901.00'	3.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 16.06 hrs HW=900.90' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=897.00' TW=0.00' (Dynamic Tailwater)

↑ **2=Culvert** (Controls 0.00 cfs)

↑ **3=Orifice/Grate** (Controls 0.00 cfs)

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MSE 24-hr 3 100-Year Rainfall=6.63"

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Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment A1P: PR to Infiltration Basin Runoff Area=34,589 sf 38.27% Impervious Runoff Depth=5.12"
Tc=5.0 min CN=87 Runoff=7.39 cfs 0.339 af

Subcatchment A1X: EX NE Area Runoff Area=20,939 sf 0.00% Impervious Runoff Depth=0.64"
Flow Length=132' Slope=0.0606 1/100 Tc=8.4 min CN=39 Runoff=0.27 cfs 0.026 af

Subcatchment A2P: PR SW Untreated Runoff Area=6,127 sf 0.00% Impervious Runoff Depth=0.64"
Tc=5.0 min CN=39 Runoff=0.10 cfs 0.008 af

Subcatchment A2X: EX SW Area Runoff Area=15,683 sf 0.00% Impervious Runoff Depth=0.64"
Flow Length=129' Slope=0.0736 1/100 Tc=7.6 min CN=39 Runoff=0.21 cfs 0.019 af

Subcatchment A3P: PR NW Untreated Runoff Area=2,081 sf 0.00% Impervious Runoff Depth=0.64"
Tc=5.0 min CN=39 Runoff=0.03 cfs 0.003 af

Subcatchment A3X: EX NW Area Runoff Area=9,353 sf 0.00% Impervious Runoff Depth=0.64"
Flow Length=129' Slope=0.0930 1/100 Tc=6.9 min CN=39 Runoff=0.13 cfs 0.011 af

Subcatchment A4P: PR NE Untreated Runoff Area=3,178 sf 0.00% Impervious Runoff Depth=0.64"
Flow Length=75' Slope=0.0100 1/100 Tc=11.0 min CN=39 Runoff=0.04 cfs 0.004 af

Reach R1P: Northeast Proposed Discharge Inflow=0.27 cfs 0.129 af
Outflow=0.27 cfs 0.129 af

Reach R1X: Northeast Existing Discharge Inflow=0.27 cfs 0.026 af
Outflow=0.27 cfs 0.026 af

Pond B1P: Infiltration Basin Peak Elev=902.30' Storage=9,892 cf Inflow=7.39 cfs 0.339 af
Discarded=0.07 cfs 0.214 af Primary=0.26 cfs 0.125 af Outflow=0.33 cfs 0.339 af

Total Runoff Area = 2.111 ac Runoff Volume = 0.409 af Average Runoff Depth = 2.33"
85.60% Pervious = 1.807 ac 14.40% Impervious = 0.304 ac

Summary for Subcatchment A1P: PR to Infiltration Basin

Runoff = 7.39 cfs @ 12.12 hrs, Volume= 0.339 af, Depth= 5.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

	Area (sf)	CN	Description
*	13,237	98	Impervious Area
	5,697	39	>75% Grass cover, Good, HSG A
*	15,655	96	Gravel
	34,589	87	Weighted Average
	21,352	81	61.73% Pervious Area
	13,237	98	38.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A1X: EX NE Area

Runoff = 0.27 cfs @ 12.20 hrs, Volume= 0.026 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

	Area (sf)	CN	Description
	20,939	39	>75% Grass cover, Good, HSG A
	20,939	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	132	0.0606	0.26		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A2P: PR SW Untreated

Runoff = 0.10 cfs @ 12.15 hrs, Volume= 0.008 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

	Area (sf)	CN	Description
	6,127	39	>75% Grass cover, Good, HSG A
	6,127	39	100.00% Pervious Area

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MSE 24-hr 3 100-Year Rainfall=6.63"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A2X: EX SW Area

Runoff = 0.21 cfs @ 12.19 hrs, Volume= 0.019 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

Area (sf)	CN	Description
15,683	39	>75% Grass cover, Good, HSG A
15,683	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	129	0.0736	0.28		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A3P: PR NW Untreated

Runoff = 0.03 cfs @ 12.15 hrs, Volume= 0.003 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

Area (sf)	CN	Description
2,081	39	>75% Grass cover, Good, HSG A
2,081	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

Summary for Subcatchment A3X: EX NW Area

Runoff = 0.13 cfs @ 12.17 hrs, Volume= 0.011 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

Area (sf)	CN	Description
9,353	39	>75% Grass cover, Good, HSG A
9,353	39	100.00% Pervious Area

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MSE 24-hr 3 100-Year Rainfall=6.63"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	129	0.0930	0.31		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment A4P: PR NE Untreated

Runoff = 0.04 cfs @ 12.25 hrs, Volume= 0.004 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-Year Rainfall=6.63"

Area (sf)	CN	Description
3,178	39	>75% Grass cover, Good, HSG A
3,178	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	75	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.80"

Summary for Reach R1P: Northeast Proposed Discharge

Inflow Area = 0.867 ac, 35.05% Impervious, Inflow Depth = 1.79" for 100-Year event
Inflow = 0.27 cfs @ 13.28 hrs, Volume= 0.129 af
Outflow = 0.27 cfs @ 13.28 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Reach R1X: Northeast Existing Discharge

Inflow Area = 0.481 ac, 0.00% Impervious, Inflow Depth = 0.64" for 100-Year event
Inflow = 0.27 cfs @ 12.20 hrs, Volume= 0.026 af
Outflow = 0.27 cfs @ 12.20 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

Summary for Pond B1P: Infiltration Basin

Inflow Area = 0.794 ac, 38.27% Impervious, Inflow Depth = 5.12" for 100-Year event
Inflow = 7.39 cfs @ 12.12 hrs, Volume= 0.339 af
Outflow = 0.33 cfs @ 13.43 hrs, Volume= 0.339 af, Atten= 96%, Lag= 78.3 min
Discarded = 0.07 cfs @ 13.43 hrs, Volume= 0.214 af
Primary = 0.26 cfs @ 13.43 hrs, Volume= 0.125 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 902.30' @ 13.43 hrs Surf.Area= 3,215 sf Storage= 9,892 cf

Plug-Flow detention time= 882.2 min calculated for 0.339 af (100% of inflow)
Center-of-Mass det. time= 882.4 min (1,659.4 - 777.0)

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MSE 24-hr 3 100-Year Rainfall=6.63"

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Volume	Invert	Avail.Storage	Storage Description
#1	897.00'	10,211 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
897.00	636	0	0
898.00	1,374	1,005	1,005
899.00	1,418	1,396	2,401
900.00	1,897	1,658	4,059
901.00	2,432	2,165	6,223
902.00	3,024	2,728	8,951
902.40	3,277	1,260	10,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	897.00'	1.000 in/hr Exfiltration over Surface area
#2	Primary	900.00'	12.0" Round Culvert L= 31.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 900.00' / 899.00' S= 0.0323 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	901.00'	3.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.07 cfs @ 13.43 hrs HW=902.30' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.26 cfs @ 13.43 hrs HW=902.30' TW=0.00' (Dynamic Tailwater)

↑ **2=Culvert** (Passes 0.26 cfs of 5.08 cfs potential flow)

↑ **3=Orifice/Grate** (Orifice Controls 0.26 cfs @ 5.22 fps)