



## STORMWATER MANAGEMENT REPORT – Carvana (CC-19432)

Columbus, Ohio

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Prepared on: December 2021



1/6/2022

Registered Engineer

Date

**Kimley»»Horn**

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## 1. PROJECT DESCRIPTION

The proposed development is located off of Lyra Drive. The site drains predominately from east to west and is comprised of one watershed tributary to existing storm sewer infrastructure which ultimately drains to an unnamed tributary of Alum Creek. The project site is currently considered to be developed land with asphalt pavement parking lot and Magic Mountain Fun Center. The proposed redevelopment consists of a car vending machine, utilities, and parking lot on 7.77 acres. An underground detention facility will be provided to control runoff from the development.

This report evaluates the pre- and post-development runoff characteristics of the development and addresses the stormwater requirements of the City of Columbus Stormwater Drainage Manual and the Ohio EPA. The analysis of the proposed underground stormwater detention facility was completed with the assistance of HydroCAD Version 10.00.

### 1.1. Pre-Development Conditions

A study of the pre-development stormwater runoff was completed to determine the peak rate of discharge for the project site. For both pre- and post-development calculations, one point of analysis has been identified: an existing, off-site storm sewer network, specifically manhole “T0139”, located on the south west side of the site. The existing site utilizes ponding within the existing parking lot for detention storage. The client does not want ponding in the parking lot. To determine the pre-developed calculations, a CN of 94 was used for the site.

The pre-development tributary map and calculations are provided in Appendices 1 and 6. A summary of the watershed characteristics is provided below.

**EXISTING WATERSHED A SUMMARY  
TRIBUTARY TO EXISTING STORM MANHOLE T0139**

Watershed	Area (acres)	CN	Tc (min)
A	6.96	94	21.6

### 1.2. Post Development Conditions

A study of the post-development stormwater runoff was completed to determine the peak rate of discharge for the proposed, developed project site. The post-development site has the same point of analysis as identified in the pre-development conditions. The post-development drainage area consists of a car vending machine, parking lot and grass-covered area. An onsite underground detention facility is proposed to detain tributary stormwater and release at a controlled rate to the existing off-site storm sewer network.

Runoff from storm events less than or equal to the critical storm event shall be released from the site at a rate no greater than the peak runoff during a 1-year storm event under pre-developed conditions. Additionally, the peak runoff rate during the 100-year storm event shall be released at a rate less than or equal to the peak runoff rate during the 10-year storm event under pre-developed conditions (where the critical storm is more frequent than a 100-year storm).

The post-developed watershed consists of two subareas: 'A' and 'B', both of which are areas tributary to the underground detention facility, ultimately to existing manhole T0139. Subarea 'B', the area to the north of the building, is not being developed. It was assumed to be impervious area with a CN of 98 for the calculations of future development. The post-development tributary map and calculations are provided in Appendices 4 and 6. A summary of watershed characteristics is provided below.

Critical Storm Determination for Watershed A:

- 1-Year Pre-Developed Runoff Volume = 0.919 ac-ft
- 1-Year Post-Developed Runoff Volume = 0.971 ac-ft
- Volume % Increase = 5.7%
- Critical Storm = 1-year storm

**PROPOSED WATERSHED A SUMMARY  
 TRIBUTARY TO EXSTING STORM SEWER MANHOLE T0139**

Watershed	Area (acres)	CN	Tc (min)
A	6.96	95	8.4

## 2. DETENTION FACILITY DESIGN SUMMARY

The proposed underground detention facility was designed using HydroCAD software to accomplish the detention requirements for the proposed development. The layout and stormwater management features were design per the standards and recommendations detailed in the City of Columbus Stormwater Drainage Manual. The proposed site disturbance is expected to be over an acre; therefore, water quality is required and will be provided.

### 2.1. Rate Attenuation Summary

#### Allowable Release Rates - Watershed A

Storm Event (yr)	Pre-Developed Onsite Peak Flow Rates (cfs)	Total Allowable Release Rates (cfs)	Proposed Site Release Rates (cfs)	Und. Detention WSEL (ft)
1	11.19	11.19	2.42	888.15
2	11.31	11.31	4.57	888.84
5	11.44	11.44	6.78	890.01
10	11.53	11.53	8.05	890.88
25	11.64	11.53	9.19	891.78
50	11.73	11.53	9.96	892.47
100	11.80	11.53	11.48	893.98

### 2.2. Storm Sewer Design

A storm sewer network will be constructed to convey runoff to the proposed underground detention facility. The storm sewer design will be in accordance with the City of Columbus Stormwater Drainage Manual. The storm sewer is designed to convey the 2-year storm and checked using the 5-year hydraulic grade line. Refer to Appendix 5 for storm sewer design sheets.

### 2.3. Water Quality

The site has been designed to adhere to water quality regulations set forward by both the City of Columbus and the OEPA's Current Construction General Permit. Per the General Permit, water quality is required should the development disturb greater than 1 acre of land.

The OEPA stipulates that the amount of runoff to be treated shall be in direct relation to precipitation depth, the volumetric runoff coefficient, and the area draining into the BMP. Please see below for calculations.

Treatment has been provided through the use of a Contech 60" wet extended retention system. This system utilizes solid rows with a water quality weir plate to allow water to slowly release to the perforated rows in the underground system.

**Water Quality**

BMP Tributary Acreage (total) = 6.960-acres

Acreage (pervious) = 0.807-acres

Acreage (impervious) = 6.153-acres

P = 0.90 inches precipitation depth

$I = \text{Acreage (impervious)} / \text{Acreage (total)} = 0.884$

$R_v = \text{Volumetric runoff coefficient} = 0.05 + 0.9i = 0.846$

Required WQv = Water quality volume =  $R_v * P * (\text{acreage (total)} / 12) = 0.441\text{-acre-feet}$

The water quality weir plate was designed to have a 1" orifice at 887.44 to allow for the water quality volume to release 50% of the volume in the first 8 hours, and 100% of the volume in the first 24 hours per the Ohio EPA general construction permit requirements. The top weir was placed at the water quality elevation of 891.44 to allow overflow into the perforate systems once it hits the WQv. The water quality calculations can be seen in **Appendix 3**.

**3. CONCLUSION**

Kimley-Horn has designed the proposed underground detention facility to meet the requirements of the City of Columbus Stormwater Drainage Manual and the Ohio EPA for the proposed development. For each storm event, Kimley-Horn is proposing a release rate that is less than or equal to the calculated allowable release rate. The existing storm sewer infrastructure has the capacity to handle the site's release rate. The proposed stormwater management system should not pose a threat to property and public safety downstream of the proposed development.

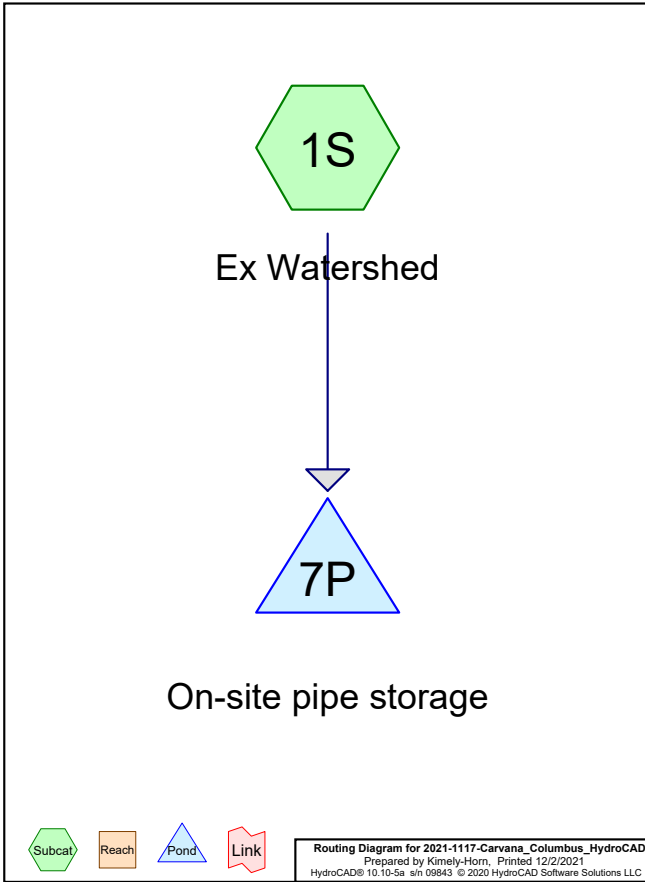


# Appendix 1 – Pre-Development HydroCAD Model



Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	Type II 24-hr		Default	24.00	1	2.20	2
2	2-Year	Type II 24-hr		Default	24.00	1	2.63	2
3	5-Year	Type II 24-hr		Default	24.00	1	3.24	2
4	10-Year	Type II 24-hr		Default	24.00	1	3.74	2
5	25-Year	Type II 24-hr		Default	24.00	1	4.44	2
6	50-Year	Type II 24-hr		Default	24.00	1	5.02	2
7	100-Year	Type II 24-hr		Default	24.00	1	5.63	2



2021-1117-Carvana\_Columbus\_HydroCAD

Type II 24-hr 1-Year Rainfall=2.20"

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Summary for Subcatchment 1S: Ex Watershed

Runoff = 11.50 cfs @ 12.14 hrs, Volume= 0.919 af, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-Year Rainfall=2.20"

Area (ac)	CN	Description
* 4.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302		18.71% Pervious Area
5.658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		Sheet Flow, Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

2021-1117-Carvana\_Columbus\_HydroCAD

Type II 24-hr 1-Year Rainfall=2.20"

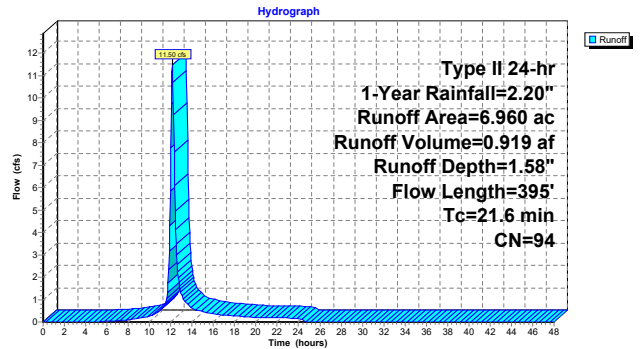
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Subcatchment 1S: Ex Watershed





**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 1.58" for 1-Year event  
 Inflow = 11.50 cfs @ 12.14 hrs, Volume= 0.919 af  
 Outflow = 11.19 cfs @ 12.15 hrs, Volume= 0.919 af, Atten= 3%, Lag= 0.6 min  
 Primary = 11.19 cfs @ 12.15 hrs, Volume= 0.919 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.09' @ 12.15 hrs Surf.Area= 5,464 sf Storage= 2,231 cf

Plug-Flow detention time= 1.4 min calculated for 0.918 af (100% of inflow)  
 Center-of-Mass det. time= 1.4 min ( 812.9 - 811.5 )

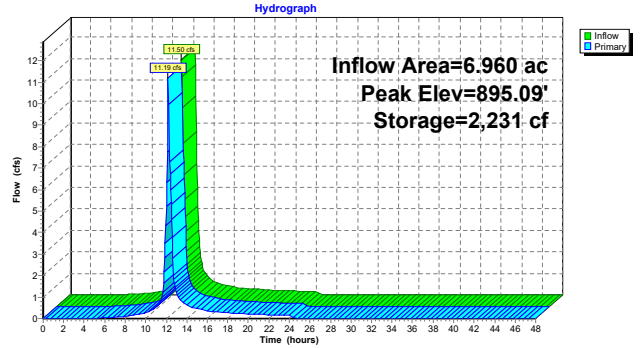
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 ' /
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 ' /
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 ' /
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 ' /
		31,982 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 ' / Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.19 cfs @ 12.15 hrs HW=895.09' (Free Discharge)  
 2=Culvert (Passes 11.19 cfs of 40.02 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.19 cfs @ 12.93 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

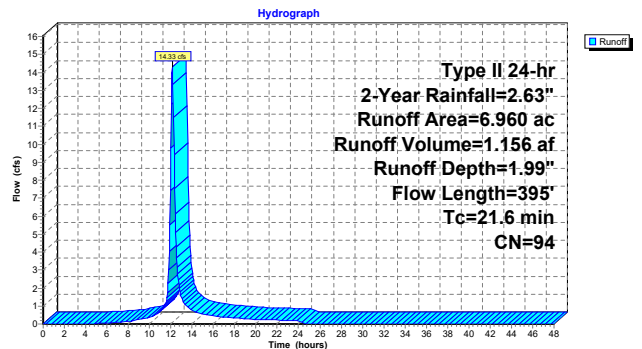
Runoff = 14.33 cfs @ 12.14 hrs, Volume= 1.156 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-Year Rainfall=2.63"

Area (ac)	CN	Description
* 4.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302		18.71% Pervious Area
5.658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 1.99" for 2-Year event  
 Inflow = 14.33 cfs @ 12.14 hrs, Volume= 1.156 af  
 Outflow = 11.31 cfs @ 12.25 hrs, Volume= 1.156 af, Atten= 21%, Lag= 6.9 min  
 Primary = 11.31 cfs @ 12.25 hrs, Volume= 1.156 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 3  
 Peak Elev= 895.24' @ 12.25 hrs Surf.Area= 14,486 sf Storage= 3,731 cf

Plug-Flow detention time= 1.9 min calculated for 1.156 af (100% of inflow)  
 Center-of-Mass det. time= 1.9 min ( 806.9 - 805.0 )

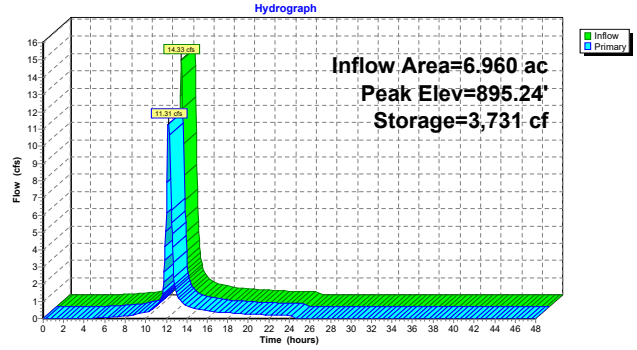
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 1'
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 1'
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 1'
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 1'
		31,982 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 1' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.31 cfs @ 12.25 hrs HW=895.24' (Free Discharge)  
 2=Culvert (Passes 11.31 cfs of 40.45 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.31 cfs @ 13.06 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

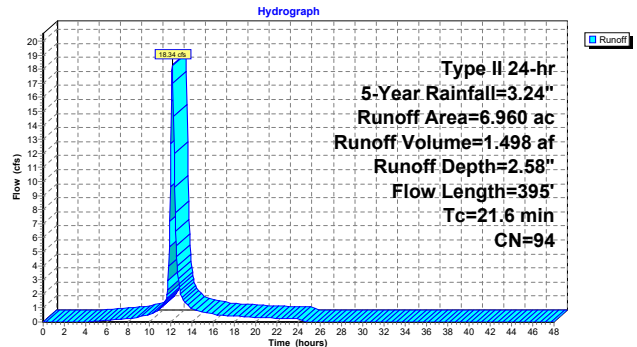
Runoff = 18.34 cfs @ 12.14 hrs, Volume= 1.498 af, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 5-Year Rainfall=3.24"

Area (ac)	CN	Description
* 4.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302		18.71% Pervious Area
5.658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 2.58" for 5-Year event  
 Inflow = 18.34 cfs @ 12.14 hrs, Volume= 1,498 af  
 Outflow = 11.44 cfs @ 12.31 hrs, Volume= 1,498 af, Atten= 38%, Lag= 10.5 min  
 Primary = 11.44 cfs @ 12.31 hrs, Volume= 1,498 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.42' @ 12.31 hrs Surf.Area= 25,100 sf Storage= 7,232 cf

Plug-Flow detention time= 3.2 min calculated for 1,498 af (100% of inflow)  
 Center-of-Mass det. time= 3.2 min ( 801.1 - 797.9 )

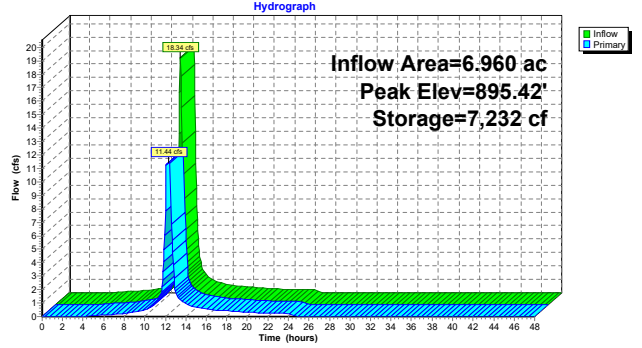
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	Custom Stage Data (Prismatic), Listed below (Recalc)
#2	887.80'	751 cf	24.0" Round 24" RCP Pipe L= 239.0' S= 0.0020 1'
#3	888.39'	746 cf	18.0" Round 18" RCP Pipe L= 422.0' S= 0.0050 1'
#4	888.35'	295 cf	15.0" Round 15" RCP Pipe L= 240.0' S= 0.0100 1'
#5	889.72'	191 cf	12.0" Round 12" RCP Pipe L= 243.0' S= 0.0050 1'
31,982 cf			Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	12.6" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	24.0" Round Culvert L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 1' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.44 cfs @ 12.31 hrs HW=895.42' (Free Discharge)  
 2=Culvert (Passes 11.44 cfs of 40.94 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.44 cfs @ 13.21 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

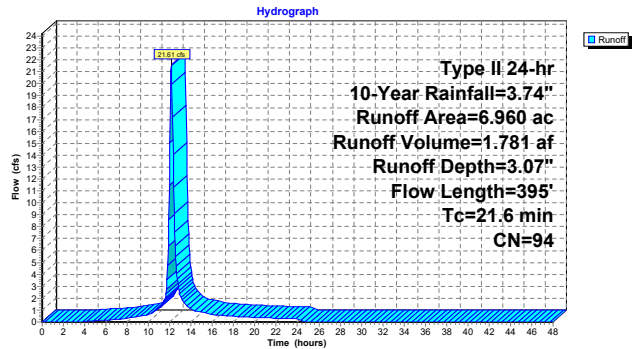
Runoff = 21.61 cfs @ 12.14 hrs, Volume= 1,781 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-Year Rainfall=3.74"

Area (ac)	CN	Description
* 1,302	74	>75% Grass cover, Good, HSG C
* 5,658	98	Impervious/pavement
6,960	94	Weighted Average
1,302		18.71% Pervious Area
5,658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		Sheet Flow, Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	Pipe Channel, 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 3.07" for 10-Year event  
 Inflow = 21.61 cfs @ 12.14 hrs, Volume= 1.781 af  
 Outflow = 11.53 cfs @ 12.35 hrs, Volume= 1.781 af, Atten= 47%, Lag= 12.7 min  
 Primary = 11.53 cfs @ 12.35 hrs, Volume= 1.781 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.53' @ 12.35 hrs Surf.Area= 32,088 sf Storage= 10,562 cf

Plug-Flow detention time= 4.6 min calculated for 1.781 af (100% of inflow)  
 Center-of-Mass det. time= 4.6 min ( 797.8 - 793.2 )

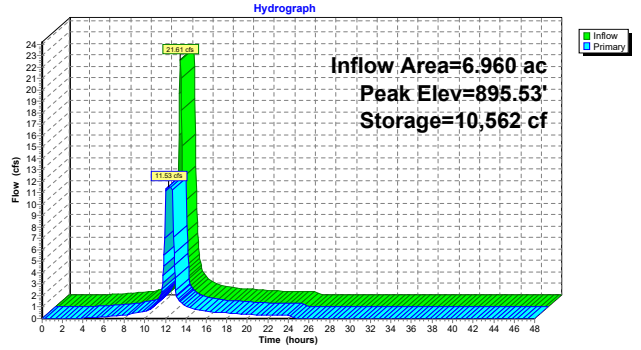
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 1'
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 1'
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 1'
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 1'
		31,982 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 1' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.53 cfs @ 12.35 hrs HW=895.53' (Free Discharge)  
 2=Culvert (Passes 11.53 cfs of 41.27 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.53 cfs @ 13.32 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

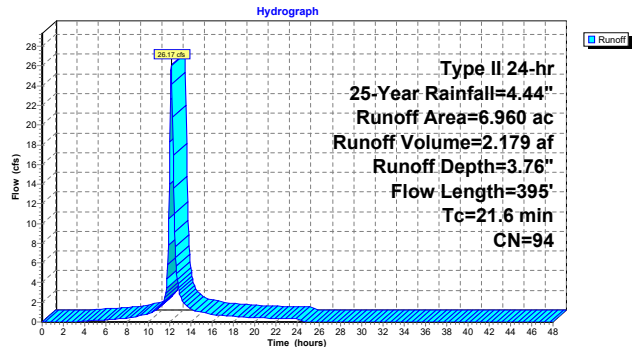
Runoff = 26.17 cfs @ 12.14 hrs, Volume= 2.179 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=4.44"

Area (ac)	CN	Description
* 4.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302	18.71%	Pervious Area
5.658	81.29%	Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 3.76" for 25-Year event  
 Inflow = 26.17 cfs @ 12.14 hrs, Volume= 2.179 af  
 Outflow = 11.64 cfs @ 12.39 hrs, Volume= 2.179 af, Atten= 56%, Lag= 15.3 min  
 Primary = 11.64 cfs @ 12.39 hrs, Volume= 2.179 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.68' @ 12.39 hrs Surf.Area= 40,853 sf Storage= 15,890 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 6.9 min ( 794.8 - 787.9 )

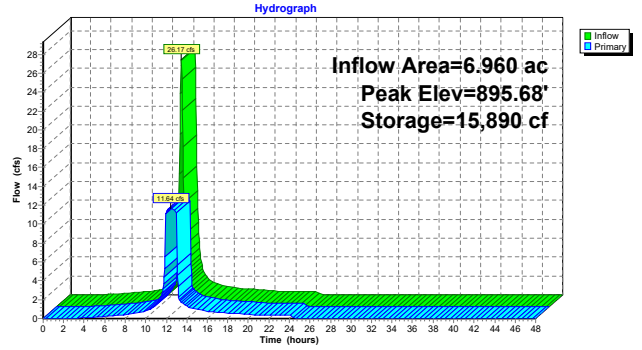
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 1'
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 1'
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 1'
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 1'
		31,982 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 1' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.64 cfs @ 12.39 hrs HW=895.68' (Free Discharge)  
 2=Culvert (Passes 11.64 cfs of 41.67 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.64 cfs @ 13.44 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

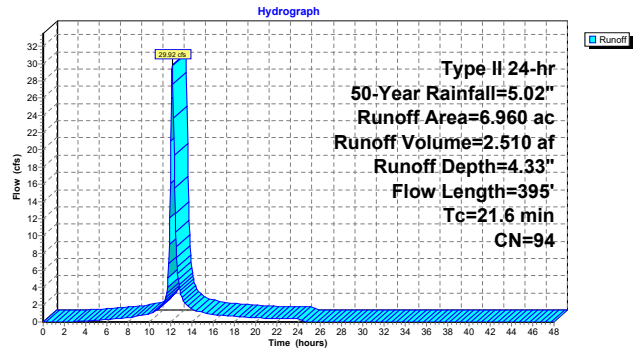
Runoff = 29.92 cfs @ 12.13 hrs, Volume= 2.510 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 50-Year Rainfall=5.02"

Area (ac)	CN	Description
* 1.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302		18.71% Pervious Area
5.658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 4.33" for 50-Year event  
 Inflow = 29.92 cfs @ 12.13 hrs, Volume= 2,510 af  
 Outflow = 11.73 cfs @ 12.42 hrs, Volume= 2,510 af, Atten= 61%, Lag= 17.1 min  
 Primary = 11.73 cfs @ 12.42 hrs, Volume= 2,510 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.80' @ 12.42 hrs Surf.Area= 47,916 sf Storage= 21,115 cf

Plug-Flow detention time= 9.4 min calculated for 2,507 af (100% of inflow)  
 Center-of-Mass det. time= 9.4 min ( 793.7 - 784.3 )

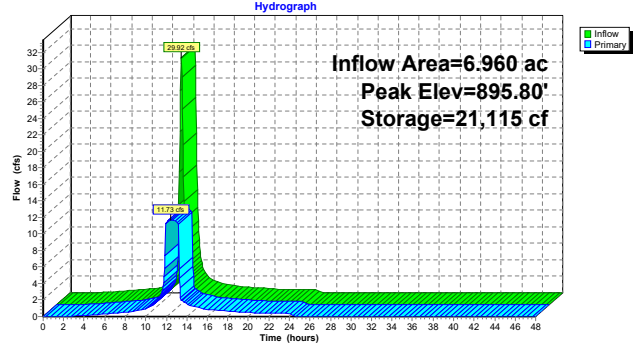
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 ' /
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 ' /
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 ' /
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 ' /
31,982 cf			Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 ' / Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.73 cfs @ 12.42 hrs HW=895.80' (Free Discharge)  
 2=Culvert (Passes 11.73 cfs of 42.00 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.73 cfs @ 13.54 fps)

**Pond 7P: On-site pipe storage**



**Summary for Subcatchment 1S: Ex Watershed**

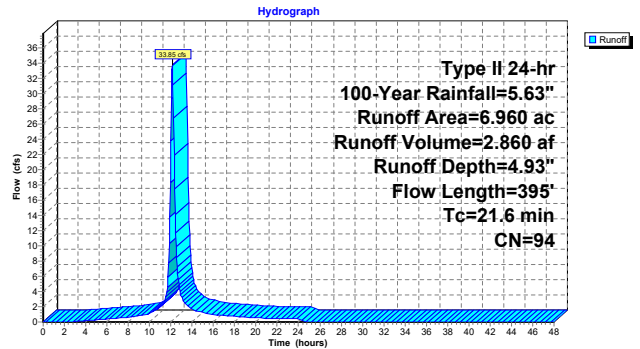
Runoff = 33.85 cfs @ 12.13 hrs, Volume= 2.860 af, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-Year Rainfall=5.63"

Area (ac)	CN	Description
* 4.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302	18.71%	Pervious Area
5.658	81.29%	Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

**Subcatchment 1S: Ex Watershed**



**Summary for Pond 7P: On-site pipe storage**

Inflow Area = 6.960 ac, 81.29% Impervious, Inflow Depth = 4.93" for 100-Year event  
 Inflow = 33.85 cfs @ 12.13 hrs, Volume= 2,860 af  
 Outflow = 11.80 cfs @ 12.45 hrs, Volume= 2,860 af, Atten= 65%, Lag= 19.0 min  
 Primary = 11.80 cfs @ 12.45 hrs, Volume= 2,860 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 895.90' @ 12.45 hrs Surf.Area= 54,079 sf Storage= 26,353 cf

Plug-Flow detention time= 11.8 min calculated for 2,860 af (100% of inflow)  
 Center-of-Mass det. time= 11.8 min ( 792.9 - 781.1 )

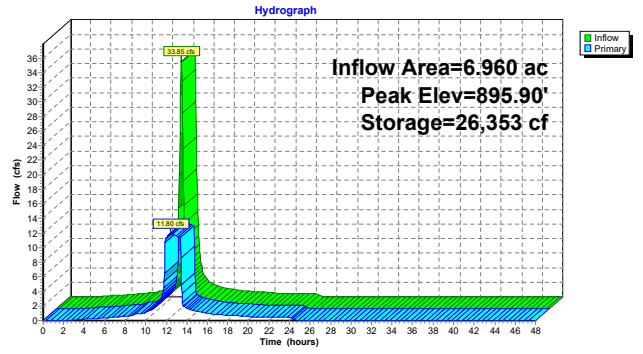
Volume	Invert	Avail.Storage	Storage Description
#1	895.00'	30,000 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
#2	887.80'	751 cf	<b>24.0" Round 24" RCP Pipe</b> L= 239.0' S= 0.0020 1'
#3	888.39'	746 cf	<b>18.0" Round 18" RCP Pipe</b> L= 422.0' S= 0.0050 1'
#4	888.35'	295 cf	<b>15.0" Round 15" RCP Pipe</b> L= 240.0' S= 0.0100 1'
#5	889.72'	191 cf	<b>12.0" Round 12" RCP Pipe</b> L= 243.0' S= 0.0050 1'
		31,982 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
895.00	0	0	0
896.00	60,000	30,000	30,000

Device	Routing	Invert	Outlet Devices
#1	Device 2	887.36'	<b>12.6" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	887.09'	<b>24.0" Round Culvert</b> L= 24.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 887.09' / 887.07' S= 0.0008 1' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=11.80 cfs @ 12.45 hrs HW=895.90' (Free Discharge)  
 2=Culvert (Passes 11.80 cfs of 42.28 cfs potential flow)  
 1=Orifice/Grate (Orifice Controls 11.80 cfs @ 13.63 fps)

**Pond 7P: On-site pipe storage**





## Appendix 2 – Critical Storm Calculations





### Critical Storm Calculation

1-Year Pre-Developed Runoff Volume= 0.919 AC-FT

1-Year Post-Developed Runoff Volume = 0.971 AC-FT

Volume % Increase= 5.7%

Critical Storm = 1-Year <- Reference Below Chart

**Table 3-1  
Critical Storm Determination**

If the percent of increase in runoff volume is		The critical storm runoff rate will be limited to:
Equal to or greater than	And less than	
--	10	1-year
10	20	2-year
20	50	5-year
50	100	10-year
100	250	25-year
250	500	50-year
500	--	100-year

Runoff from storm events less than or equal to the critical storm event shall be released from the site at a rate no greater than the peak runoff during a 1-year storm event under pre-developed conditions<sup>1</sup>. Additionally, the peak runoff rate during the 100-year storm event shall be released at a rate less than or equal to the peak runoff rate during the 10-year storm event under pre-developed conditions (where the critical storm is more frequent than a 100-year storm).

**Summary for Subcatchment 1S: Ex Watershed**

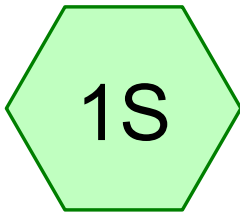
Runoff = 11.50 cfs @ 12.14 hrs, Volume= 0.919 af, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1-Year Rainfall=2.20"

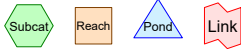
Area (ac)	CN	Description
* 1.302	74	>75% Grass cover, Good, HSG C
* 5.658	98	Impervious/pavement
6.960	94	Weighted Average
1.302		18.71% Pervious Area
5.658		81.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	150	0.0100	0.13		<b>Sheet Flow</b> , Grass: Short n= 0.150 P2= 2.63"
0.3	45	0.1000	2.21		<b>Shallow Concentrated Flow</b> , Short Grass Pasture Kv= 7.0 fps
0.4	125	0.0100	5.26	6.46	<b>Pipe Channel</b> , 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	75	0.0002	1.02	3.20	<b>Pipe Channel</b> , 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
21.6	395	Total			

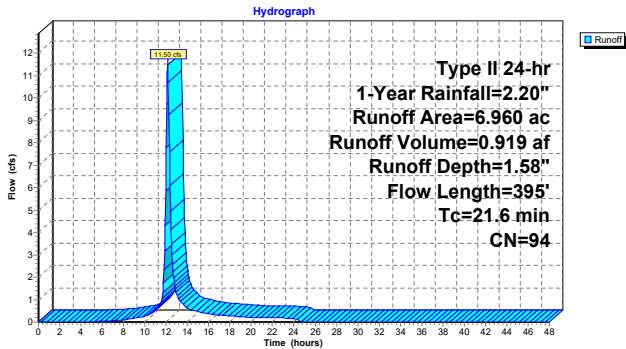


# Ex Watershed



Routing Diagram for 2021-1117-Carvana\_Columbus\_HydroCAD  
 Prepared by Kimely-Horn, Printed 12/2/2021  
 HydroCAD® 10.10-5a s/n 09843 © 2020 HydroCAD Software Solutions LLC

**Subcatchment 1S: Ex Watershed**



**Summary for Subcatchment 2S: Prop Watershed**

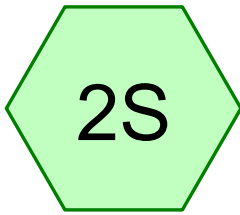
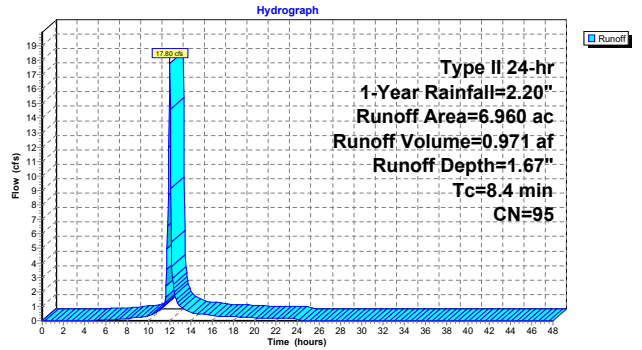
Runoff = 17.80 cfs @ 11.99 hrs, Volume= 0.971 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1-Year Rainfall=2.20"

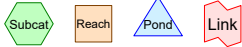
Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
* 3.753	98	Impervious
* 2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



# Prop Watershed





## Appendix 3 – Water Quality



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 5.04" for 100-Year event  
 Inflow = 50.09 cfs @ 11.99 hrs, Volume= 2,926 af  
 Outflow = 50.76 cfs @ 11.99 hrs, Volume= 2,575 af, Atten= 0%, Lag= 0.1 min  
 Primary = 50.76 cfs @ 11.99 hrs, Volume= 2,575 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 893.71' @ 11.99 hrs Storage= 0.519 af

Plug-Flow detention time= 160.6 min calculated for 2,575 af (88% of inflow)  
 Center-of-Mass det. time= 101.7 min ( 865.4 - 763.7 )

Volume	Invert	Avail Storage	Storage Description
#1	887.44'	0.519 af	<b>60.0" Round Pipe Storage</b> L= 1,151.7'

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	891.44'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

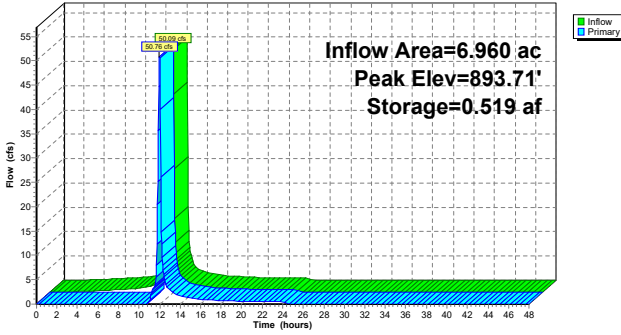
**Primary OutFlow** Max=49.72 cfs @ 11.99 hrs HW=893.67' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.07 cfs @ 11.98 fps)  
 2=Sharp-Crested Rectangular Weir (Weir Controls 49.65 cfs @ 4.89 fps)

**Hydrograph for Pond 3P: Solid Pipe**

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	887.44	0.00
1.00	0.00	0.000	887.44	0.00
2.00	0.02	0.000	887.45	0.00
3.00	0.12	0.006	887.61	0.01
4.00	0.22	0.019	887.83	0.02
5.00	0.33	0.040	888.09	0.02
6.00	0.44	0.070	888.40	0.03
7.00	0.55	0.108	888.75	0.03
8.00	0.66	0.155	889.14	0.03
9.00	0.99	0.219	889.63	0.04
10.00	1.29	0.306	890.29	0.04
11.00	2.38	0.447	891.45	0.10
12.00	49.88	0.519	893.70	50.58
13.00	2.64	0.476	891.75	2.81
14.00	1.55	0.467	891.65	1.63
15.00	1.21	0.463	891.61	1.24
16.00	0.94	0.460	891.59	0.97
17.00	0.82	0.459	891.57	0.83
18.00	0.72	0.458	891.56	0.73
19.00	0.62	0.456	891.55	0.63
20.00	0.52	0.455	891.54	0.54
21.00	0.49	0.454	891.53	0.50
22.00	0.47	0.454	891.53	0.48
23.00	0.45	0.454	891.52	0.46
24.00	0.43	0.454	891.52	0.44
25.00	0.00	0.444	891.43	0.05
26.00	0.00	0.440	891.39	0.05
27.00	0.00	0.436	891.35	0.05
28.00	0.00	0.431	891.31	0.05
29.00	0.00	0.427	891.27	0.05
30.00	0.00	0.423	891.24	0.05
31.00	0.00	0.419	891.20	0.05
32.00	0.00	0.415	891.16	0.05
33.00	0.00	0.410	891.13	0.05
34.00	0.00	0.406	891.09	0.05
35.00	0.00	0.402	891.06	0.05
36.00	0.00	0.398	891.02	0.05
37.00	0.00	0.394	890.99	0.05
38.00	0.00	0.390	890.96	0.05
39.00	0.00	0.386	890.92	0.05
40.00	0.00	0.382	890.89	0.05
41.00	0.00	0.378	890.86	0.05
42.00	0.00	0.374	890.82	0.05
43.00	0.00	0.370	890.79	0.05
44.00	0.00	0.366	890.76	0.05
45.00	0.00	0.362	890.73	0.05
46.00	0.00	0.358	890.70	0.05
47.00	0.00	0.354	890.67	0.05
48.00	0.00	0.350	890.64	0.05

**Pond 3P: Solid Pipe**

Hydrograph



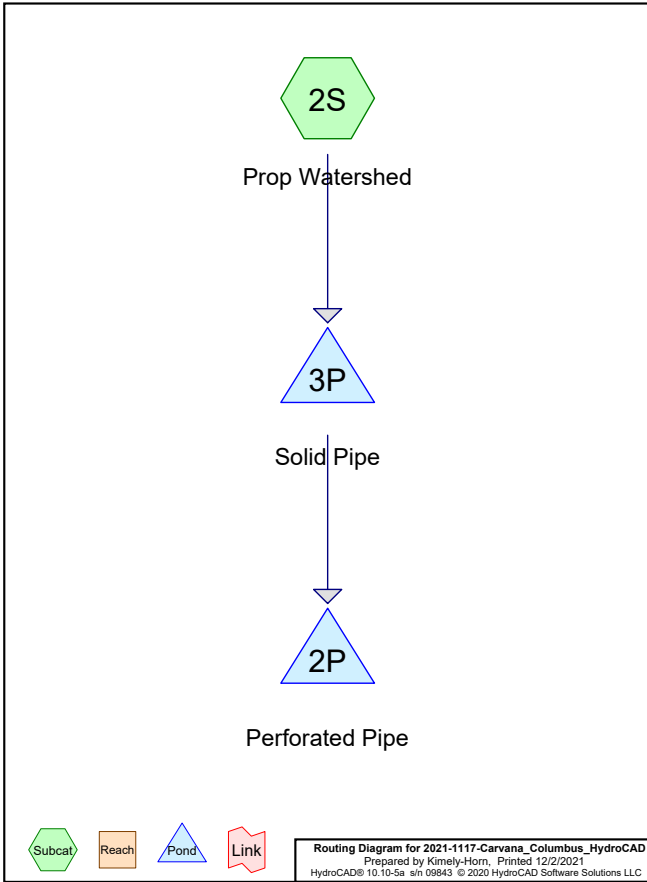


# Appendix 4 – Post-Development HydroCAD Model



**Rainfall Events Listing**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year	Type II 24-hr		Default	24.00	1	2.20	2
2	2-Year	Type II 24-hr		Default	24.00	1	2.63	2
3	5-Year	Type II 24-hr		Default	24.00	1	3.24	2
4	10-Year	Type II 24-hr		Default	24.00	1	3.74	2
5	25-Year	Type II 24-hr		Default	24.00	1	4.44	2
6	50-Year	Type II 24-hr		Default	24.00	1	5.02	2
7	100-Year	Type II 24-hr		Default	24.00	1	5.63	2



**2021-1117-Carvana\_Columbus\_HydroCAD**

Type II 24-hr 1-Year Rainfall=2.20"

Prepared by Kimely-Horn

Printed 12/2/2021

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**Summary for Subcatchment 2S: Prop Watershed**

Runoff = 17.80 cfs @ 11.99 hrs, Volume= 0.971 af, Depth= 1.67"

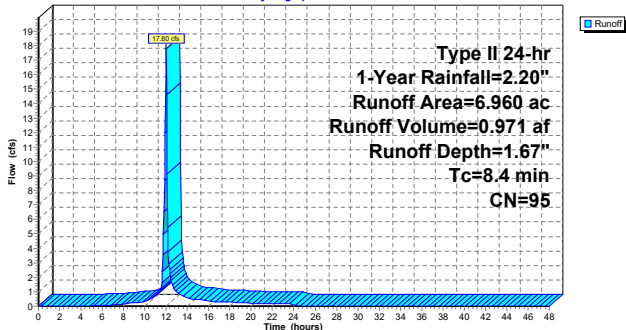
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1-Year Rainfall=2.20"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
* 3.753	98	Impervious
* 2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**

Hydrograph



**2021-1117-Carvana\_Columbus\_HydroCAD**

Type II 24-hr 1-Year Rainfall=2.20"

Prepared by Kimely-Horn

Printed 12/2/2021

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**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 1.04" for 1-Year event  
Inflow = 4.57 cfs @ 12.18 hrs, Volume= 0.604 af  
Outflow = 2.42 cfs @ 12.51 hrs, Volume= 0.581 af, Atten= 47%, Lag= 19.8 min  
Primary = 2.42 cfs @ 12.51 hrs, Volume= 0.581 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
Peak Elev= 888.15' @ 12.51 hrs Surf.Area= 7,178 sf Storage= 3,744 cf

Plug-Flow detention time= 100.4 min calculated for 0.581 af (96% of inflow)  
Center-of-Mass det. time= 36.4 min ( 1,114.0 - 1,077.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	<b>97.00'W x 74.00'L x 6.00'H Field A</b> 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	<b>CMP Round 60</b> x 13 Inside #1 Effective Size= 60.0'W x 60.0'H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0'W x 60.0'H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	<b>Stone above CMP system (Prismatic)</b> listed below (Recalc) 28,653 cf Overall x 30.0% Voids
			34,381 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	<b>24.0" Round Culvert</b> L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085' / Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	<b>13.3" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.42 cfs @ 12.51 hrs HW=888.15' (Free Discharge)

- 1=Culvert (Passes 2.42 cfs of 3.54 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 2.42 cfs @ 3.11 fps)

**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = **CMP Round 60 (Round Corrugated Metal Pipe)**

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf

Overall Size= 60.0"W x 60.0"H x 20.00'L

Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length

13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width  
 6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf Stone x 30.0% Voids = 7,406.9 cf Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

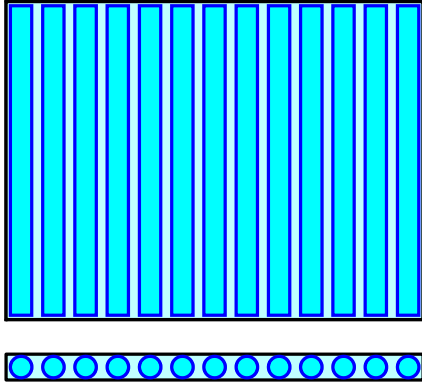
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

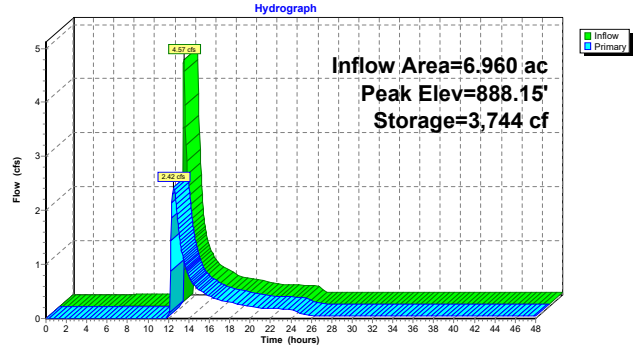
13 Chambers

1,595.1 cy Field

914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 1.67" for 1-Year event  
 Inflow = 17.80 cfs @ 11.99 hrs, Volume= 0.971 af  
 Outflow = 4.57 cfs @ 12.18 hrs, Volume= 0.604 af, Atten= 74%, Lag= 11.1 min  
 Primary = 4.57 cfs @ 12.18 hrs, Volume= 0.604 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 890.67' @ 12.18 hrs Surf.Area= 0.172 ac Storage= 0.522 af

Plug-Flow detention time= 388.8 min calculated for 0.604 af (62% of inflow)  
 Center-of-Mass det. time= 285.3 min ( 1,077.6 - 792.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Cotech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1/'
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1/'
#5	887.44'	0.002 af	<b>4.00"D x 6.94"H Vertical Cone/Cylinder</b>
		0.746 af	Total Available Storage

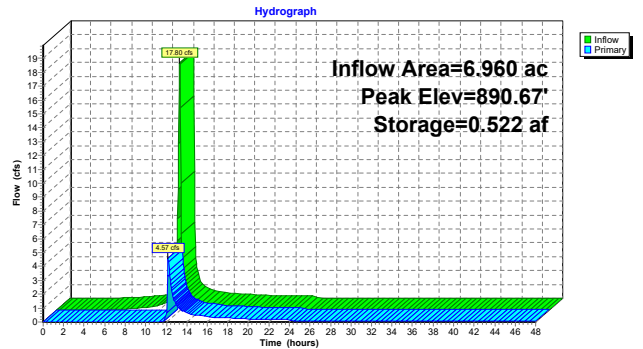
Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contractions

Primary OutFlow Max=4.52 cfs @ 12.18 hrs HW=890.67' TW=887.70' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 0.05 cfs @ 8.30 fps)

2=Sharp-Crested Rectangular Weir (Weir Controls 4.48 cfs @ 2.14 fps)

**Pond 3P: Solid Pipe**





**Summary for Subcatchment 2S: Prop Watershed**

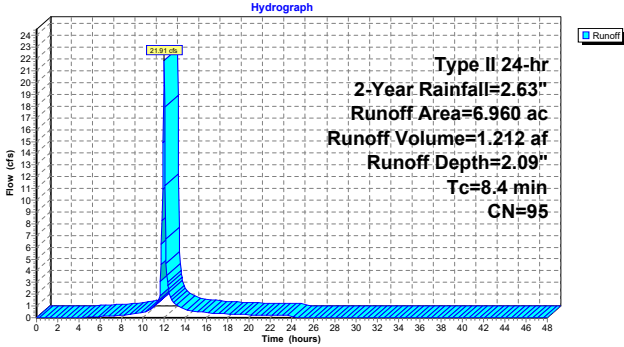
Runoff = 21.91 cfs @ 11.99 hrs, Volume= 1.212 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-Year Rainfall=2.63"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
3.753	98	Impervious
2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 1.46" for 2-Year event  
 Inflow = 11.43 cfs @ 12.11 hrs, Volume= 0.845 af  
 Outflow = 4.57 cfs @ 12.36 hrs, Volume= 0.821 af, Atten= 60%, Lag= 15.3 min  
 Primary = 4.57 cfs @ 12.36 hrs, Volume= 0.821 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 888.84' @ 12.36 hrs Surf.Area= 7,178 sf Storage= 7,047 cf

Plug-Flow detention time= 77.9 min calculated for 0.821 af (97% of inflow)  
 Center-of-Mass det. time= 30.5 min ( 1,031.2 - 1,000.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	97.00'W x 74.00'L x 6.00'H Field A 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	CMP Round 60 x 13 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	Stone above CMP system (Prismatic) Listed below (Recalc) 28,653 cf Overall x 30.0% Voids
		34,381 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	24.0" Round Culvert L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085' / Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	13.3" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.56 cfs @ 12.36 hrs HW=888.84' (Free Discharge)  
 1=Culvert (Passes 4.56 cfs of 8.99 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 4.56 cfs @ 4.73 fps)

**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf  
 Overall Size= 60.0"W x 60.0"H x 20.00'L  
 Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length  
 13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width  
 6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

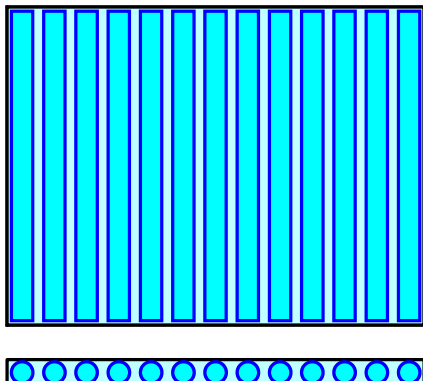
43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf of Stone x 30.0% Voids = 7,406.9 cf of Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

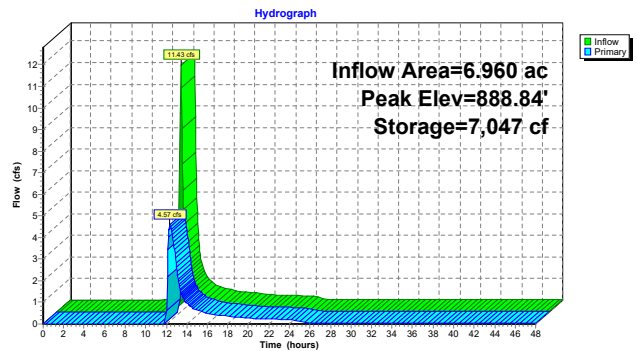
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

13 Chambers  
 1,595.1 cy Field  
 914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 2.09" for 2-Year event  
 Inflow = 21.91 cfs @ 11.99 hrs, Volume= 1.212 af  
 Outflow = 11.43 cfs @ 12.11 hrs, Volume= 0.845 af, Atten= 48%, Lag= 7.0 min  
 Primary = 11.43 cfs @ 12.11 hrs, Volume= 0.845 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 891.04' @ 12.11 hrs Surf.Area= 0.161 ac Storage= 0.584 af

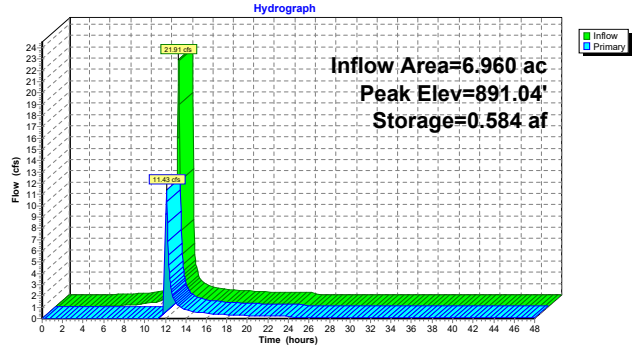
Plug-Flow detention time= 308.6 min calculated for 0.844 af (70% of inflow)  
 Center-of-Mass det. time= 214.5 min ( 1,000.7 - 786.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Contech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1'
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1'
#5	887.44'	0.002 af	<b>4.00'D x 6.94'H Vertical Cone/Cylinder</b>
			0.746 af Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=11.19 cfs @ 12.11 hrs HW=891.03' TW=888.16' (Dynamic Tailwater)  
 1=Orifice/Grate (Orifice Controls 0.04 cfs @ 8.16 fps)  
 2=Sharp-Crested Rectangular Weir (Weir Controls 11.15 cfs @ 2.91 fps)

**Pond 3P: Solid Pipe**



**Summary for Subcatchment 2S: Prop Watershed**

Runoff = 27.70 cfs @ 11.99 hrs, Volume= 1.557 af, Depth= 2.68"

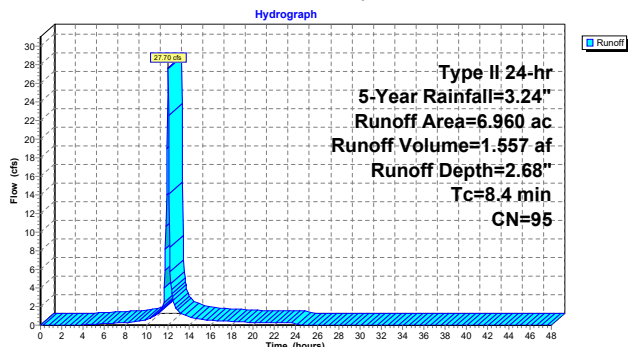
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 5-Year Rainfall=3.24"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
3.753	98	Impervious
2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 2.05" for 5-Year event  
 Inflow = 20.70 cfs @ 12.07 hrs, Volume= 1.189 af  
 Outflow = 6.78 cfs @ 12.32 hrs, Volume= 1.166 af, Atten= 67%, Lag= 15.2 min  
 Primary = 6.78 cfs @ 12.32 hrs, Volume= 1.166 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 890.01' @ 12.32 hrs Surf.Area= 7,178 sf Storage= 13,247 cf

Plug-Flow detention time= 63.7 min calculated for 1.165 af (98% of inflow)  
 Center-of-Mass det. time= 29.6 min ( 973.0 - 943.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	<b>97.00'W x 74.00'L x 6.00'H Field A</b> 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	<b>CMP Round 60 x 13 Inside #1</b> Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	<b>Stone above CMP system (Prismatic)</b> listed below (Recalc) 28,653 cf Overall x 30.0% Voids
			34,381 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	<b>24.0" Round Culvert</b> L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085 1' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	<b>13.3" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=6.77 cfs @ 12.32 hrs HW=890.00' (Free Discharge)  
 1=Culvert (Passes 6.77 cfs of 18.22 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 6.77 cfs @ 7.02 fps)

**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = **CMP Round 60 (Round Corrugated Metal Pipe)**

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf

Overall Size= 60.0"W x 60.0"H x 20.00'L

Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length

13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width

6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf Stone x 30.0% Voids = 7,406.9 cf Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

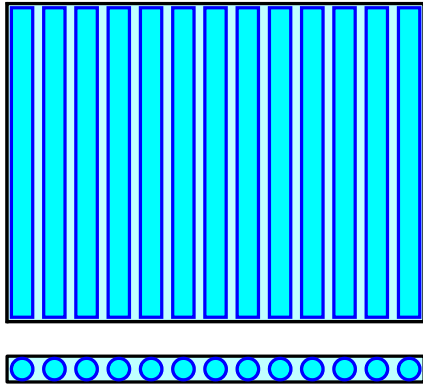
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

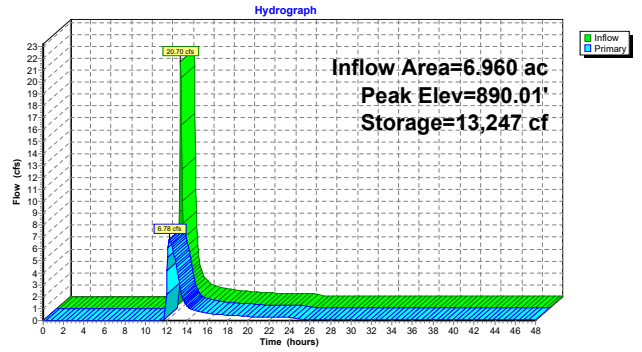
13 Chambers

1,595.1 cy Field

914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 2.68" for 5-Year event  
 Inflow = 27.70 cfs @ 11.99 hrs, Volume= 1.557 af  
 Outflow = 20.70 cfs @ 12.07 hrs, Volume= 1.189 af, Atten= 25%, Lag= 4.4 min  
 Primary = 20.70 cfs @ 12.07 hrs, Volume= 1.189 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 891.45' @ 12.07 hrs Surf.Area= 0.143 ac Storage= 0.646 af

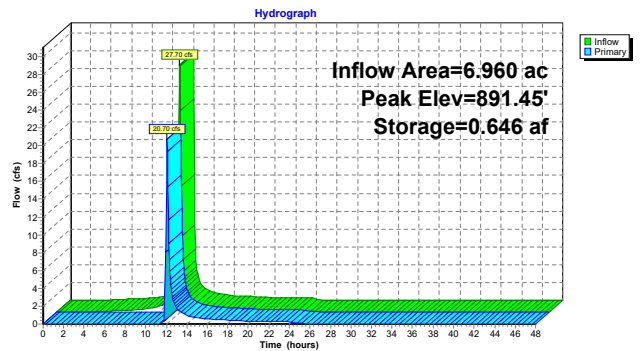
Plug-Flow detention time= 248.6 min calculated for 1.188 af (76% of inflow)  
 Center-of-Mass det. time= 164.0 min ( 943.4 - 779.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Contech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1/'
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1/'
#5	887.44'	0.002 af	<b>4.00'D x 6.94'H Vertical Cone/Cylinder</b>
		0.746 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

Primary OutFlow Max=20.09 cfs @ 12.07 hrs HW=891.42' TW=888.84' (Dynamic Tailwater)  
 1=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.75 fps)  
 2=Sharp-Crested Rectangular Weir (Weir Controls 20.05 cfs @ 3.56 fps)

**Pond 3P: Solid Pipe**



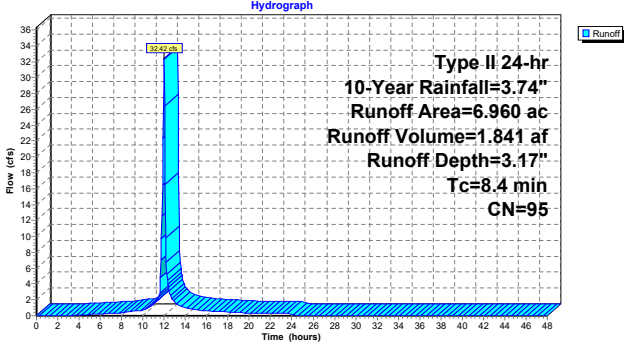
**Summary for Subcatchment 2S: Prop Watershed**

Runoff = 32.42 cfs @ 11.99 hrs, Volume= 1.841 af, Depth= 3.17"  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-Year Rainfall=3.74"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
3.753	98	Impervious
2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 2.54" for 10-Year event  
 Inflow = 27.02 cfs @ 12.05 hrs, Volume= 1.474 af  
 Outflow = 8.05 cfs @ 12.26 hrs, Volume= 1.450 af, Atten= 70%, Lag= 12.9 min  
 Primary = 8.05 cfs @ 12.26 hrs, Volume= 1.450 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 890.88' @ 12.26 hrs Surf.Area= 7,178 sf Storage= 17,902 cf

Plug-Flow detention time= 58.6 min calculated for 1.450 af (98% of inflow)  
 Center-of-Mass det. time= 30.5 min ( 946.7 - 916.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	97.00'W x 74.00'L x 6.00'H Field A 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	CMP Round 60 x 13 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	Stone above CMP system (Prismatic) Listed below (Recalc) 28,653 cf Overall x 30.0% Voids
		34,381 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	24.0" Round Culvert L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085' /' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	13.3" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.04 cfs @ 12.26 hrs HW=890.87' (Free Discharge)  
 1=Culvert (Passes 8.04 cfs of 22.98 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 8.04 cfs @ 8.33 fps)

**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf  
 Overall Size= 60.0"W x 60.0"H x 20.00'L  
 Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length  
 13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width  
 6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

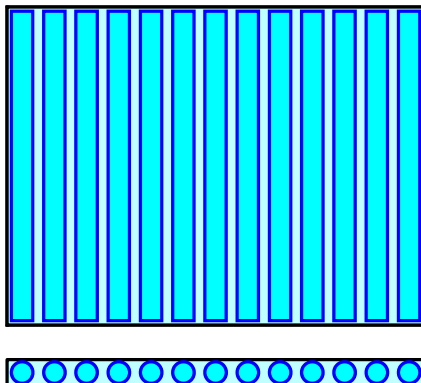
43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf of Stone x 30.0% Voids = 7,406.9 cf of Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

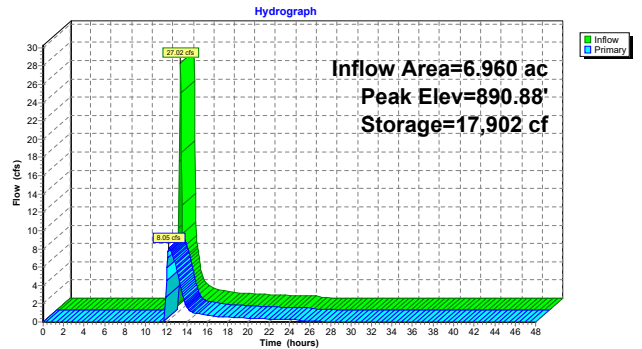
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

13 Chambers  
 1,595.1 cy Field  
 914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 3.17" for 10-Year event  
 Inflow = 32.42 cfs @ 11.99 hrs, Volume= 1.841 af  
 Outflow = 27.02 cfs @ 12.05 hrs, Volume= 1.474 af, Atten= 17%, Lag= 3.5 min  
 Primary = 27.02 cfs @ 12.05 hrs, Volume= 1.474 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 891.69' @ 12.05 hrs Surf.Area= 0.128 ac Storage= 0.680 af

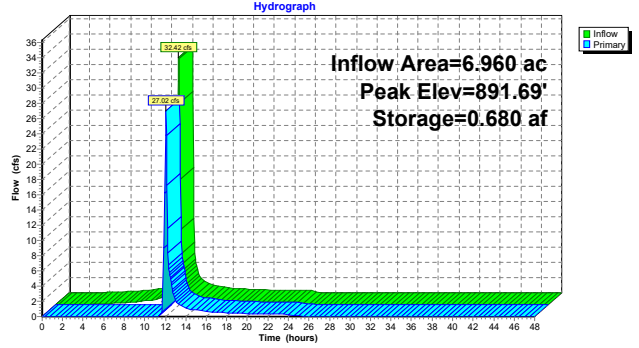
Plug-Flow detention time= 219.0 min calculated for 1.472 af (80% of inflow)  
 Center-of-Mass det. time= 141.1 min ( 916.1 - 775.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Contech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1/
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1/
#5	887.44'	0.002 af	<b>4.00'D x 6.94'H Vertical Cone/Cylinder</b>
			0.746 af Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=27.01 cfs @ 12.05 hrs HW=891.69' TW=889.51' (Dynamic Tailwater)  
 1=Orifice/Grate (Orifice Controls 0.04 cfs @ 7.11 fps)  
 2=Sharp-Crested Rectangular Weir (Weir Controls 26.97 cfs @ 3.94 fps)

**Pond 3P: Solid Pipe**



**Summary for Subcatchment 2S: Prop Watershed**

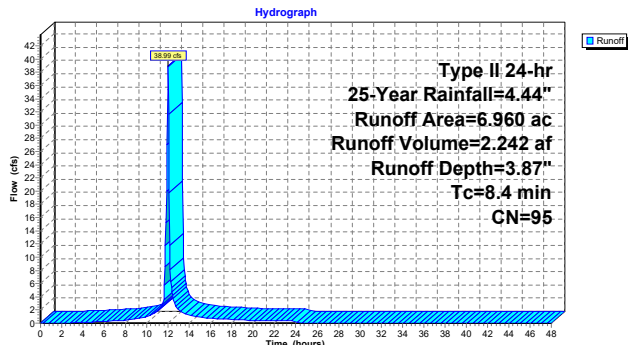
Runoff = 38.99 cfs @ 11.99 hrs, Volume= 2.242 af, Depth= 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=4.44"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
3.753	98	Impervious
2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 3.23" for 25-Year event  
 Inflow = 34.02 cfs @ 12.03 hrs, Volume= 1.874 af  
 Outflow = 9.19 cfs @ 12.20 hrs, Volume= 1.851 af, Atten= 73%, Lag= 10.4 min  
 Primary = 9.19 cfs @ 12.20 hrs, Volume= 1.851 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 891.78' @ 12.20 hrs Surf.Area= 7,178 sf Storage= 22,300 cf

Plug-Flow detention time= 54.2 min calculated for 1.851 af (99% of inflow)  
 Center-of-Mass det. time= 32.0 min ( 924.8 - 892.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	<b>97.00'W x 74.00'L x 6.00'H Field A</b> 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	<b>CMP Round 60 x 13 Inside #1</b> Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	<b>Stone above CMP system (Prismatic)</b> listed below (Recalc) 28,653 cf Overall x 30.0% Voids
			34,381 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	<b>24.0" Round Culvert</b> L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085 1/ Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	<b>13.3" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=9.18 cfs @ 12.20 hrs HW=891.78' (Free Discharge)  
 1=Culvert (Passes 9.18 cfs of 26.69 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 9.18 cfs @ 9.52 fps)

**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = **CMP Round 60 (Round Corrugated Metal Pipe)**

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf

Overall Size= 60.0"W x 60.0"H x 20.00'L

Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length

13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width

6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf Stone x 30.0% Voids = 7,406.9 cf Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

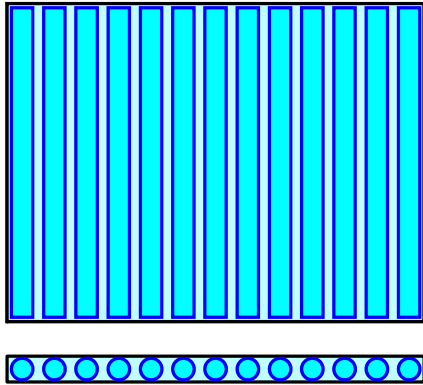
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

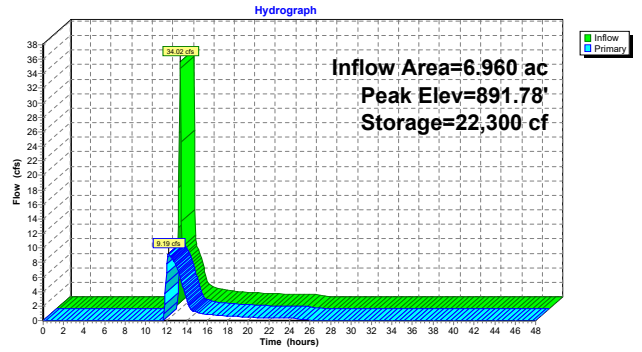
13 Chambers

1,595.1 cy Field

914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 3.87" for 25-Year event  
 Inflow = 38.99 cfs @ 11.99 hrs, Volume= 2.242 af  
 Outflow = 34.02 cfs @ 12.03 hrs, Volume= 1.874 af, Atten= 13%, Lag= 2.2 min  
 Primary = 34.02 cfs @ 12.03 hrs, Volume= 1.874 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 891.98' @ 12.05 hrs Surf.Area= 0.104 ac Storage= 0.713 af

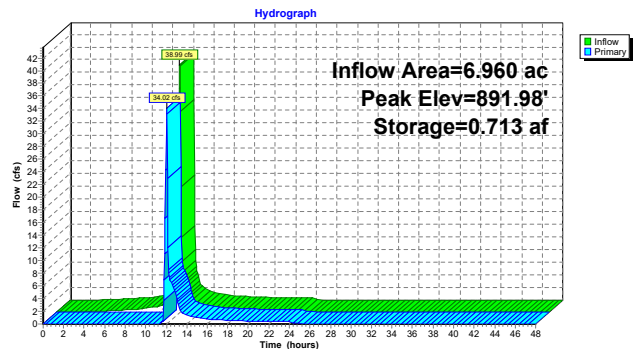
Plug-Flow detention time= 192.6 min calculated for 1.872 af (84% of inflow)  
 Center-of-Mass det. time= 122.8 min ( 892.9 - 770.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Contech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1/'
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1/'
#5	887.44'	0.002 af	<b>4.00'D x 6.94'H Vertical Cone/Cylinder</b>
		0.746 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

Primary OutFlow Max=33.60 cfs @ 12.03 hrs HW=891.94' TW=890.35' (Dynamic Tailwater)  
 1=Orifice/Grate (Orifice Controls 0.03 cfs @ 6.07 fps)  
 2=Sharp-Crested Rectangular Weir (Weir Controls 33.57 cfs @ 4.24 fps)

**Pond 3P: Solid Pipe**



**Summary for Subcatchment 2S: Prop Watershed**

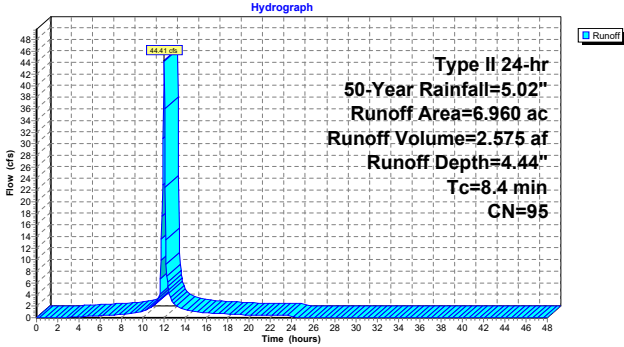
Runoff = 44.41 cfs @ 11.99 hrs, Volume= 2.575 af, Depth= 4.44"  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 50-Year Rainfall=5.02"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
3.753	98	Impervious
2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

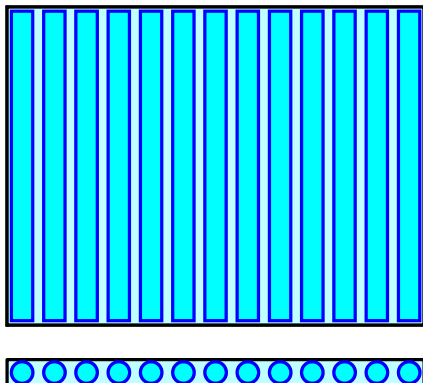
**Subcatchment 2S: Prop Watershed**



**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

**Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)**  
 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf  
 Overall Size= 60.0"W x 60.0"H x 20.00'L  
 Row Length Adjustment= +52.00' x 19.63 sf x 13 rows  
 60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing  
 1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length  
 13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width  
 6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height  
 13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage  
 43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf of Stone x 30.0% Voids = 7,406.9 cf of Stone Storage  
 Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af  
 Overall Storage Efficiency = 59.9%  
 Overall System Size = 74.00' x 97.00' x 6.00'

13 Chambers  
 1,595.1 cy Field  
 914.4 cy Stone



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 3.80" for 50-Year event  
 Inflow = 37.82 cfs @ 12.01 hrs, Volume= 2.207 af  
 Outflow = 9.96 cfs @ 12.20 hrs, Volume= 2.183 af, Atten= 74%, Lag= 11.1 min  
 Primary = 9.96 cfs @ 12.20 hrs, Volume= 2.183 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 892.47' @ 12.20 hrs Surf.Area= 18,241 sf Storage= 26,841 cf

Plug-Flow detention time= 51.8 min calculated for 2.181 af (99% of inflow)  
 Center-of-Mass det. time= 33.3 min ( 913.2 - 879.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	<b>97.00'W x 74.00'L x 6.00'H Field A</b> 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	<b>CMP Round 60</b> x 13 Inside #1 Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	<b>Stone above CMP system (Prismatic)</b> Listed below (Recalc) 28,653 cf Overall x 30.0% Voids
		34,381 cf	Total Available Storage

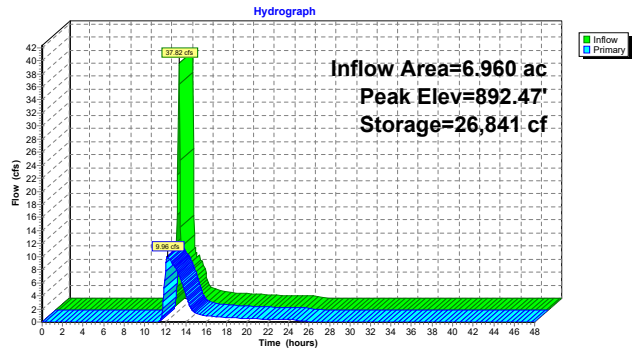
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	<b>24.0" Round Culvert</b> L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085' /' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	<b>13.3" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.96 cfs @ 12.20 hrs HW=892.47' (Free Discharge)  
 1=Culvert (Passes 9.96 cfs of 29.16 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 9.96 cfs @ 10.32 fps)

**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 4.44" for 50-Year event  
 Inflow = 44.41 cfs @ 11.99 hrs, Volume= 2.575 af  
 Outflow = 37.82 cfs @ 12.01 hrs, Volume= 2.207 af, Atten= 15%, Lag= 1.2 min  
 Primary = 37.82 cfs @ 12.01 hrs, Volume= 2.207 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 892.50' @ 12.19 hrs Surf.Area= 0.000 ac Storage= 0.746 af

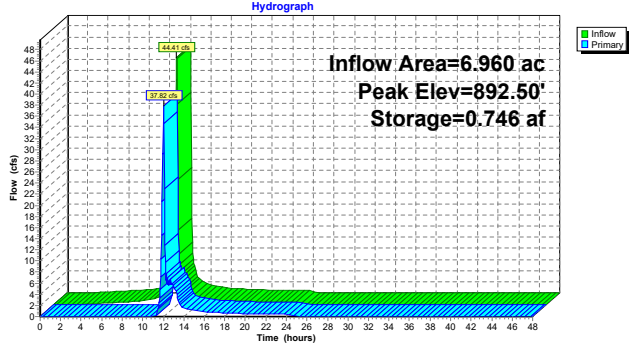
Plug-Flow detention time= 177.4 min calculated for 2.205 af (86% of inflow)  
 Center-of-Mass det. time= 113.2 min ( 879.9 - 766.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	<b>60.0" Round Solid Contech CMP Pipe Storage</b> L= 1,561.7'
#2	887.82'	0.022 af	<b>24.0" Round 24" Pipe Storage</b> L= 300.0' S= 0.0025 1'
#3	888.87'	0.011 af	<b>18.0" Round 18" Pipe Storage</b> L= 280.0'
#4	887.82'	0.007 af	<b>12.0" Round 12" Pipe Storage</b> L= 405.0' S= 0.0025 1'
#5	887.44'	0.002 af	<b>4.00'D x 6.94'H Vertical Cone/Cylinder</b>
			0.746 af Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	<b>1.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	<b>5.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=37.59 cfs @ 12.01 hrs HW=892.18' TW=890.88' (Dynamic Tailwater)  
 1=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.49 fps)  
 2=Sharp-Crested Rectangular Weir(Weir Controls 37.56 cfs @ 4.20 fps)

**Pond 3P: Solid Pipe**



**Summary for Subcatchment 2S: Prop Watershed**

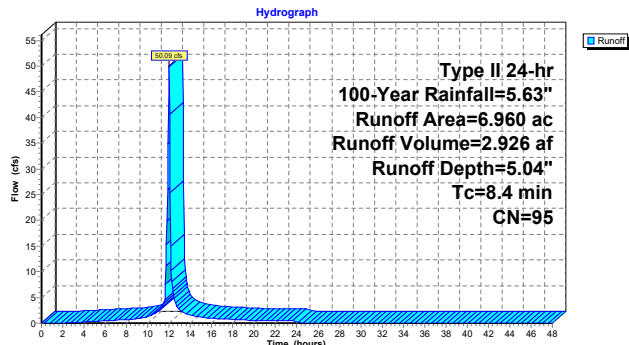
Runoff = 50.09 cfs @ 11.99 hrs, Volume= 2.926 af, Depth= 5.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-Year Rainfall=5.63"

Area (ac)	CN	Description
0.297	74	>75% Grass cover, Good, HSG C
* 3.753	98	Impervious
* 2.400	98	Pavement
0.510	74	>75% Grass cover, Good, HSG C
6.960	95	Weighted Average
0.807		11.59% Pervious Area
6.153		88.41% Impervious Area

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

**Subcatchment 2S: Prop Watershed**



**Summary for Pond 2P: Perforated Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth > 4.41" for 100-Year event  
 Inflow = 48.84 cfs @ 12.03 hrs, Volume= 2.558 af  
 Outflow = 11.48 cfs @ 12.19 hrs, Volume= 2.534 af, Atten= 76%, Lag= 9.8 min  
 Primary = 11.48 cfs @ 12.19 hrs, Volume= 2.534 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 893.98' @ 12.19 hrs Surf.Area= 18,241 sf Storage= 32,871 cf

Plug-Flow detention time= 50.8 min calculated for 2.534 af (99% of inflow)  
 Center-of-Mass det. time= 34.4 min ( 903.1 - 868.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	886.94'	7,407 cf	<b>97.00"W x 74.00"L x 6.00"H Field A</b> 43,068 cf Overall - 18,378 cf Embedded = 24,690 cf x 30.0% Voids
#2A	887.44'	18,378 cf	<b>CMP Round 60 x 13 Inside #1</b> Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf Overall Size= 60.0"W x 60.0"H x 20.00'L Row Length Adjustment= +52.00' x 19.63 sf x 13 rows
#3	891.85'	8,596 cf	<b>Stone above CMP system (Prismatic)</b> listed below (Recalc) 28,653 cf Overall x 30.0% Voids
			34,381 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
891.85	11,063	0	0
894.44	11,063	28,653	28,653

Device	Routing	Invert	Outlet Devices
#1	Primary	887.24'	<b>24.0" Round Culvert</b> L= 20.0' Ke= 0.600 Inlet / Outlet Invert= 887.24' / 887.07' S= 0.0085 1' Cc= 0.900 n= 0.011, Flow Area= 3.14 sf
#2	Device 1	887.32'	<b>13.3" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=11.47 cfs @ 12.19 hrs HW=893.97' (Free Discharge)  
 1=Culvert (Passes 11.47 cfs of 33.95 cfs potential flow)  
 2=Orifice/Grate (Orifice Controls 11.47 cfs @ 11.89 fps)



**Pond 2P: Perforated Pipe - Chamber Wizard Field A**

Chamber Model = CMP Round 60 (Round Corrugated Metal Pipe)

Effective Size= 60.0"W x 60.0"H => 19.63 sf x 20.00'L = 392.7 cf

Overall Size= 60.0"W x 60.0"H x 20.00'L

Row Length Adjustment= +52.00' x 19.63 sf x 13 rows

60.0" Wide + 30.0" Spacing = 90.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +52.00' Row Adjustment = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length

13 Rows x 60.0" Wide + 30.0" Spacing x 12 + 12.0" Side Stone x 2 = 97.00' Base Width

6.0" Stone Base + 60.0" Chamber Height + 6.0" Stone Cover = 6.00' Field Height

13 Chambers x 392.7 cf +52.00' Row Adjustment x 19.63 sf x 13 Rows = 18,378.3 cf of Chamber Storage

43,068.0 cf of Field - 18,378.3 cf of Chambers = 24,689.7 cf Stone x 30.0% Voids = 7,406.9 cf Stone Storage

Chamber Storage + Stone Storage = 25,785.2 cf = 0.592 af

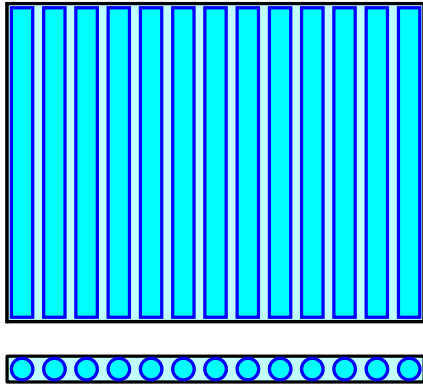
Overall Storage Efficiency = 59.9%

Overall System Size = 74.00' x 97.00' x 6.00'

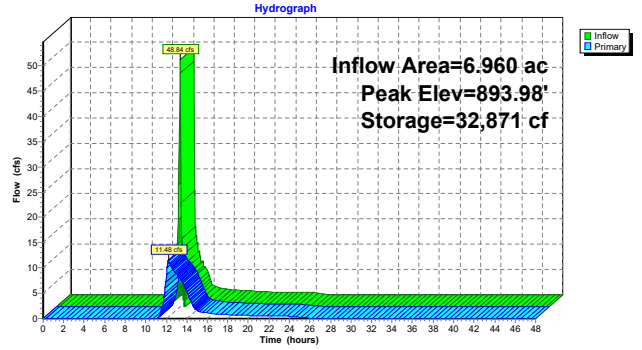
13 Chambers

1,595.1 cy Field

914.4 cy Stone



**Pond 2P: Perforated Pipe**



**Summary for Pond 3P: Solid Pipe**

Inflow Area = 6.960 ac, 88.41% Impervious, Inflow Depth = 5.04" for 100-Year event  
 Inflow = 50.09 cfs @ 11.99 hrs, Volume= 2,926 af  
 Outflow = 48.84 cfs @ 12.03 hrs, Volume= 2,558 af, Atten= 3%, Lag= 2.2 min  
 Primary = 48.84 cfs @ 12.03 hrs, Volume= 2,558 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs / 9  
 Peak Elev= 893.99' @ 12.18 hrs Surf.Area= 0.000 ac Storage= 0.746 af

Plug-Flow detention time= 165.8 min calculated for 2,558 af (87% of inflow)  
 Center-of-Mass det. time= 104.9 min ( 868.7 - 763.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	887.44'	0.704 af	60.0" Round Solid Contech CMP Pipe Storage L= 1,561.7'
#2	887.82'	0.022 af	24.0" Round 24" Pipe Storage L= 300.0' S= 0.0025 1'
#3	888.87'	0.011 af	18.0" Round 18" Pipe Storage L= 280.0'
#4	887.82'	0.007 af	12.0" Round 12" Pipe Storage L= 405.0' S= 0.0025 1'
#5	887.44'	0.002 af	4.00'D x 6.94'H Vertical Cone/Cylinder
		0.746 af	Total Available Storage

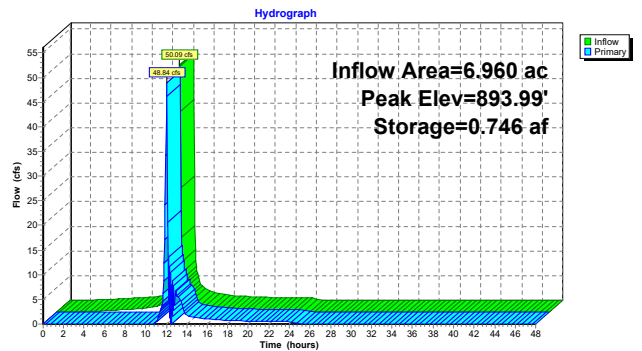
Device	Routing	Invert	Outlet Devices
#1	Primary	887.44'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	890.24'	5.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=46.50 cfs @ 12.03 hrs HW=892.90' TW=892.03' (Dynamic Tailwater)

1=Orifice/Grate (Orifice Controls 0.02 cfs @ 4.49 fps)

2=Sharp-Crested Rectangular Weir (Weir Controls 46.47 cfs @ 3.91 fps)

**Pond 3P: Solid Pipe**





# Appendix 5 – Storm Sewer Calculations



5-Year Storm Event  
 0.013 Manning's n

## Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
7	CB	577.00	0.45	5.98		0.00	0.00		5.00				0.35%				889.80	895.03
					<b>0.00</b>					0.00	15	132.00	0.35%	3.12	3.83			
6	CB	445.00	0.45	5.79		0.00	0.00	0.70	5.70				0.25%			889.34	889.24	894.89
					<b>0.00</b>					0.00	24	148.00	0.25%	3.61	11.34			
5	CB	297.00	0.45	5.61		0.00	0.00	0.68	6.39				0.25%			888.87	888.77	895.64
										0.00	24	161.00	0.25%	3.61	11.34			
4	CB	136.00	0.45	5.42		0.00	0.00	0.74	7.13				0.25%			888.37	888.27	894.90
										0.00	24	77.00	0.25%	3.61	11.34			
3	CB	59.00	0.45	5.32		0.00	0.00	0.36	7.49				0.25%			888.07	887.96	894.83
										0.00	24	59.00	0.25%	3.61	11.34			
A2	MH	0.00	0.45	5.24	0.00	0.00	0.00	0.27	7.76							887.82	887.72	894.68



5-Year Storm Event  
 0.013 Manning's n

**Hydraulic Grade Line and Energy Loss**

Structures			Tributary Area				Flow Data					Hydraulic Grade Check				
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
7	CB	577.00	0.45	5.98	0.00	5.00									890.84	895.03
							0.00	15	132.00	0.35%	3.12	0.000	0.00	890.84	890.80	PASS
6	CB	445.00	0.45	5.79	0.00	5.70									890.84	894.89
							0.00	24	148.00	0.25%	3.61	0.000	0.00	890.37	890.84	PASS
5	CB	297.00	0.45	5.61	0.00	6.39									890.37	895.64
							0.00	24	161.00	0.25%	3.61	0.000	0.00	889.87	890.37	PASS
4	CB	136.00	0.45	5.42	0.00	7.13									889.87	894.90
							0.00	24	77.00	0.25%	3.61	0.000	0.00	889.56	889.87	PASS
3	CB	59.00	0.45	5.32	0.00	7.49									889.56	894.83
							0.00	24	59.00	0.25%	3.61	0.000	0.00	889.32	889.56	PASS
A2	MH	0.00	0.45	5.24	0.00	7.76									889.32	894.68

5-Year Storm Event  
 0.013 Manning's n

## Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
10	CB	384.00	0.45	5.98		0.00	0.00		5.00				0.50%				889.94	894.53
										0.00	12	212.00	0.50%	3.22	2.53			
9	MH	172.00	0.45	5.69	0.00	0.00	0.00	1.10	6.10				0.50%			888.88	888.78	894.71
										0.00	12	74.00	0.50%	3.22	2.53			
8	MH	98.00	0.45	5.58	0.00	0.00	0.00	0.38	6.48				0.50%			888.41	888.31	896.88
										0.00	12	98.00	0.50%	3.22	2.53			
B1	X	0.00	0.45	5.45		0.00	0.00	0.51	6.99							887.82	887.72	894.44

5-Year Storm Event  
 0.013 Manning's n

## Hydraulic Grade Line and Energy Loss

Structures			Tributary Area				Flow Data					Hydraulic Grade Check				
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
10	CB	384.00	0.45	5.98	0.00	5.00									890.74	894.53
							0.00	12	212.00	0.50%	3.22	0.000	0.00	889.58	890.74	PASS
9	MH	172.00	0.45	5.69	0.00	6.10									889.58	894.71
							0.00	12	74.00	0.50%	3.22	0.000	0.00	889.11	889.58	PASS
8	MH	98.00	0.45	5.58	0.00	6.48									889.11	896.88
							0.00	12	98.00	0.50%	3.22	0.000	0.00	888.52	889.11	PASS
B1	X	0.00	0.45	5.45	0.00	6.99									888.52	894.44

5-Year Storm Event  
 0.013 Manning's n

## Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
11	CI	19.00	0.45	5.98	0.31	0.31	0.14		5.00				0.45%				887.91	894.23
										0.83	12	19.00	0.45%	3.05	2.40			
C1	MH	0.00	0.45	5.95	0.00	0.31	0.14	0.10	5.10							887.82	887.72	894.80

5	-Year Storm Event
0.013	Manning's n

## Hydraulic Grade Line and Energy Loss

Structures			Tributary Area			Flow Data					Hydraulic Grade Check					
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
11	CI	19.00	0.45	5.98	0.31	5.00									888.71	893.73
							0.83	12	19.00	0.45%	3.05	0.055	0.01	888.53	888.71	PASS
C1	MH	0.00	0.45	5.95	0.31	5.10									888.52	894.80



5-Year Storm Event  
 0.013 Manning's n

## Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
12	CI	55.00	0.45	5.98	0.76	0.76	0.34		5.00				0.45%				888.07	893.09
D1	MH	0.00	0.45	5.90	0.00	0.76	0.34	0.30	5.30	2.05	12	55.00	0.45%	3.05	2.40	887.82	887.72	894.11

5	-Year Storm Event
0.013	Manning's n

## Hydraulic Grade Line and Energy Loss

Structures			Tributary Area				Flow Data					Hydraulic Grade Check				
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
12	CI	55.00	0.45	5.98	0.76	5.00									888.87	892.59
							2.05	12	55.00	0.45%	3.05	0.330	0.18	888.70	888.87	PASS
D1	MH	0.00	0.45	5.90	0.76	5.30									888.52	894.11

5-Year Storm Event  
 0.013 Manning's n

## Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
13	CI	34.00	0.45	5.98		0.00	0.00		5.00				0.45%				889.49	897.04
6	MH	0.00	0.45	5.93	0.00	0.00	0.00	0.19	5.19	0.00	12	34.00	0.45%	3.05	2.40	889.34	889.24	896.60

5-Year Storm Event  
 0.013 Manning's n

## Hydraulic Grade Line and Energy Loss

Structures			Tributary Area			Flow Data					Hydraulic Grade Check					
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
13	CI	34.00	0.45	5.98	0.00	5.00									890.29	896.54
							0.00	12	34.00	0.45%	3.05	0.000	0.00	890.04	890.29	PASS
6	MH	0.00	0.45	5.93	0.00	5.19									890.04	896.60

5-Year Storm Event  
 0.013 Manning's n

### Storm Sewer Design

Structures			Tributary Area					Time		Flow Data						Structure Data		
Name	Type	Station	C	I	Area (acres)	Total Area (acres)	Σ CA	Δ t (min)	Σ t (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	Capacity (cfs)	Inlet	Outlet	T.C.
14	CI	20.00	0.45	5.98		0.00	0.00		5.00				0.45%				888.96	896.62
										0.00	12	20.00	0.45%	3.05	2.40			
5	MH	0.00	0.45	5.95	0.00	0.00	0.00	0.11	5.11							888.87	888.77	895.29

5-Year Storm Event  
 0.013 Manning's n

## Hydraulic Grade Line and Energy Loss

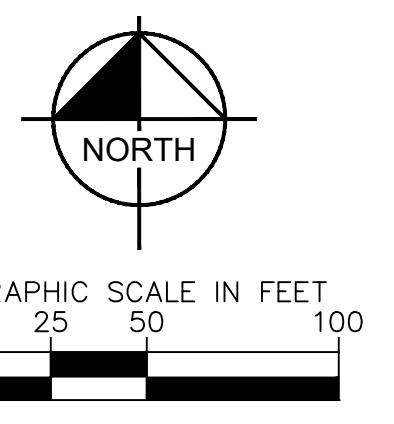
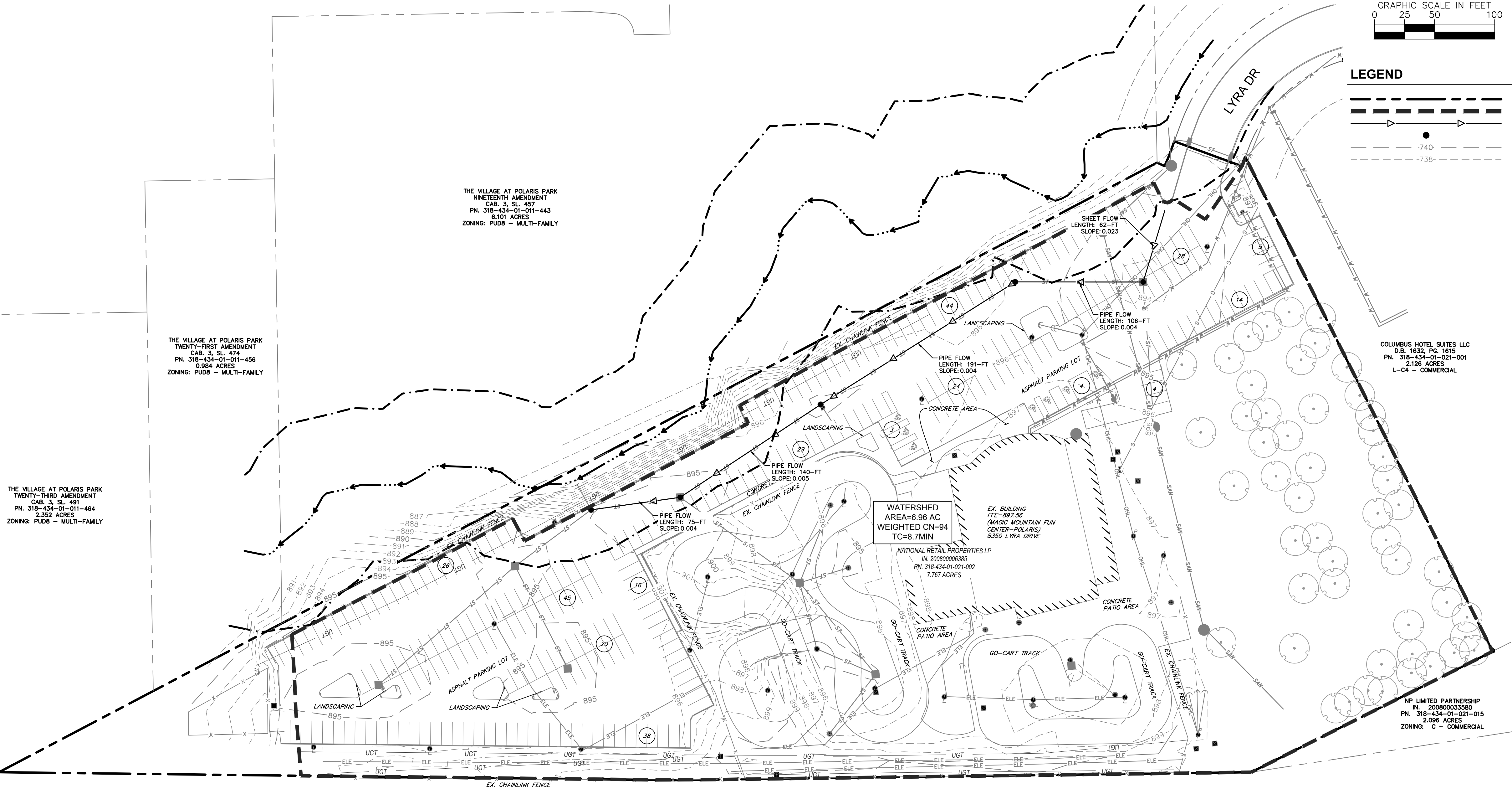
Structures			Tributary Area			Flow Data					Hydraulic Grade Check					
Name	Type	Station	C	I	Total Area (acres)	$\sum t$ (min)	Q (cfs)	Pipe Dia. (in)	Pipe Length (ft)	Pipe Slope (%)	V (fps)	S <sub>f</sub> %	S <sub>f</sub> L (ft)	T <sub>w</sub> or D <sub>c</sub>	HW Elev	TC Elev
14	CI	20.00	0.45	5.98	0.00	5.00									889.76	896.12
							0.00	12	20.00	0.45%	3.05	0.000	0.00	889.57	889.76	PASS
5	MH	0.00	0.45	5.95	0.00	5.11									889.57	895.29



## Appendix 6 – Maps



Drawing name: K:\CBE\_LBE\190014021\_Carvana\_Columbus\_Lyr\_01\2\_Design\CAD\Exhibits\Drainage\Pre-DevelopedTribMap.dwg Layout1 Jan 05, 2022 10:02am by: Sarah Strick  
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**LEGEND**

	EXISTING SITE BOUNDARY
	EXISTING WATERSHED BOUNDARY
	EXISTING FLOW PATH
	CHANGE IN SURFACE FLOW CONDITIONS
	EXISTING INDEX CONTOUR
	EXISTING INTERMEDIATE CONTOUR

INTERSTATE 71  
(PUBLIC) (LIMITED ACCESS)

SCALE: AS NOTED		DESIGNED BY: SRS		DRAWN BY: DUG		CHECKED BY: DDL	
 © 2021 KIMLEY-HORN AND ASSOCIATES, INC. 7965 COLUMBUS, OH 43235 PHONE: 614-454-6699 WWW.KIMLEY-HORN.COM		<b>PRE-DEVELOPED TRIBUTARY MAP</b>		<b>CARVANA</b> 8850 LYRA DRIVE COLUMBUS, OH 43240		ORIGINAL ISSUE: 12/20/2021 KHA PROJECT NO. 190014021 SHEET NUMBER <b>EX-1</b>	
No.	REVISIONS	DATE	BY	APR	DATE	APR	BY

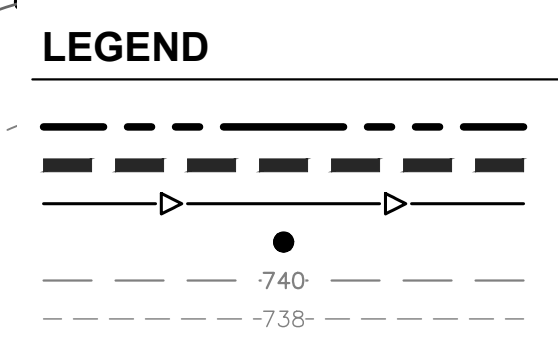
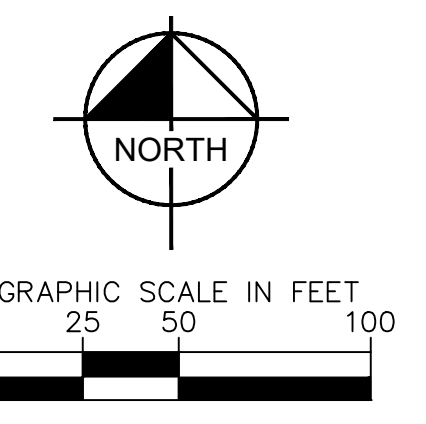


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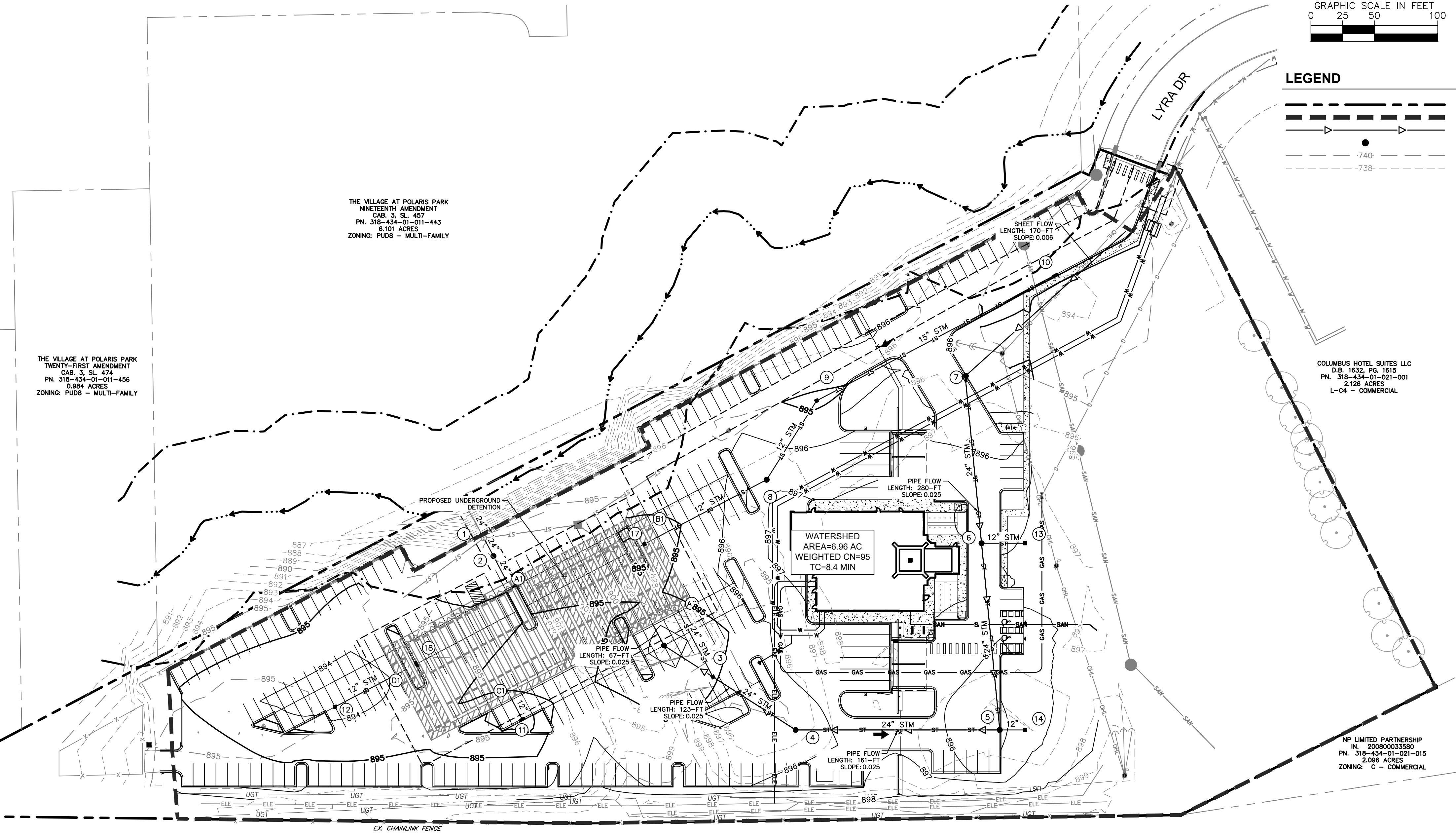
THE VILLAGE AT POLARIS PARK  
 TWENTY-THIRD AMENDMENT  
 CAB. 3, SL. 491  
 PN. 318-434-01-011-464  
 2.352 ACRES  
 ZONING: PUD8 - MULTI-FAMILY

THE VILLAGE AT POLARIS PARK  
 TWENTY-FIRST AMENDMENT  
 CAB. 3, SL. 474  
 PN. 318-434-01-011-456  
 0.984 ACRES  
 ZONING: PUD8 - MULTI-FAMILY

THE VILLAGE AT POLARIS PARK  
 NINETEENTH AMENDMENT  
 CAB. 3, SL. 457  
 PN. 318-434-01-011-443  
 8.101 ACRES  
 ZONING: PUD8 - MULTI-FAMILY



EXISTING SITE BOUNDARY  
 PROPOSED WATERSHED BOUNDARY  
 PROPOSED FLOW PATH  
 CHANGE IN SURFACE FLOW CONDITIONS  
 EXISTING INDEX CONTOUR  
 EXISTING INTERMEDIATE CONTOUR



INTERSTATE 71  
 (PUBLIC) ( LIMITED ACCESS)

COLUMBUS HOTEL SUITES LLC  
 D.B. 1632, PG. 1015  
 PN. 318-434-01-021-001  
 2.128 ACRES  
 L-C4 - COMMERCIAL

NP LIMITED PARTNERSHIP  
 IN. 20080033580  
 PN. 318-434-01-021-015  
 2.096 ACRES  
 ZONING: C - COMMERCIAL

No.	REVISIONS	DATE	BY	APR DATE	APR BY

**Kimley»Horn**  
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 7965 KIMLEY-HORN DRIVE, SUITE 200  
 COLUMBUS, OH 43235  
 PHONE: 614-454-6699  
 WWW.KIMLEY-HORN.COM

SCALE: AS NOTED  
 DESIGNED BY: SRS  
 DRAWN BY: DUG  
 CHECKED BY: DDL

## POST-DEVELOPED TRIBUTARY MAP

**CARVANA**  
 8850 LYRA DRIVE  
 COLUMBUS, OH 43240

ORIGINAL ISSUE:  
 12/20/2021  
 KHA PROJECT NO.  
 190014021

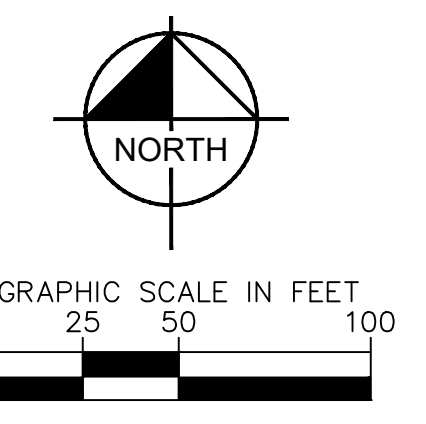
SHEET NUMBER  
**EX-2**

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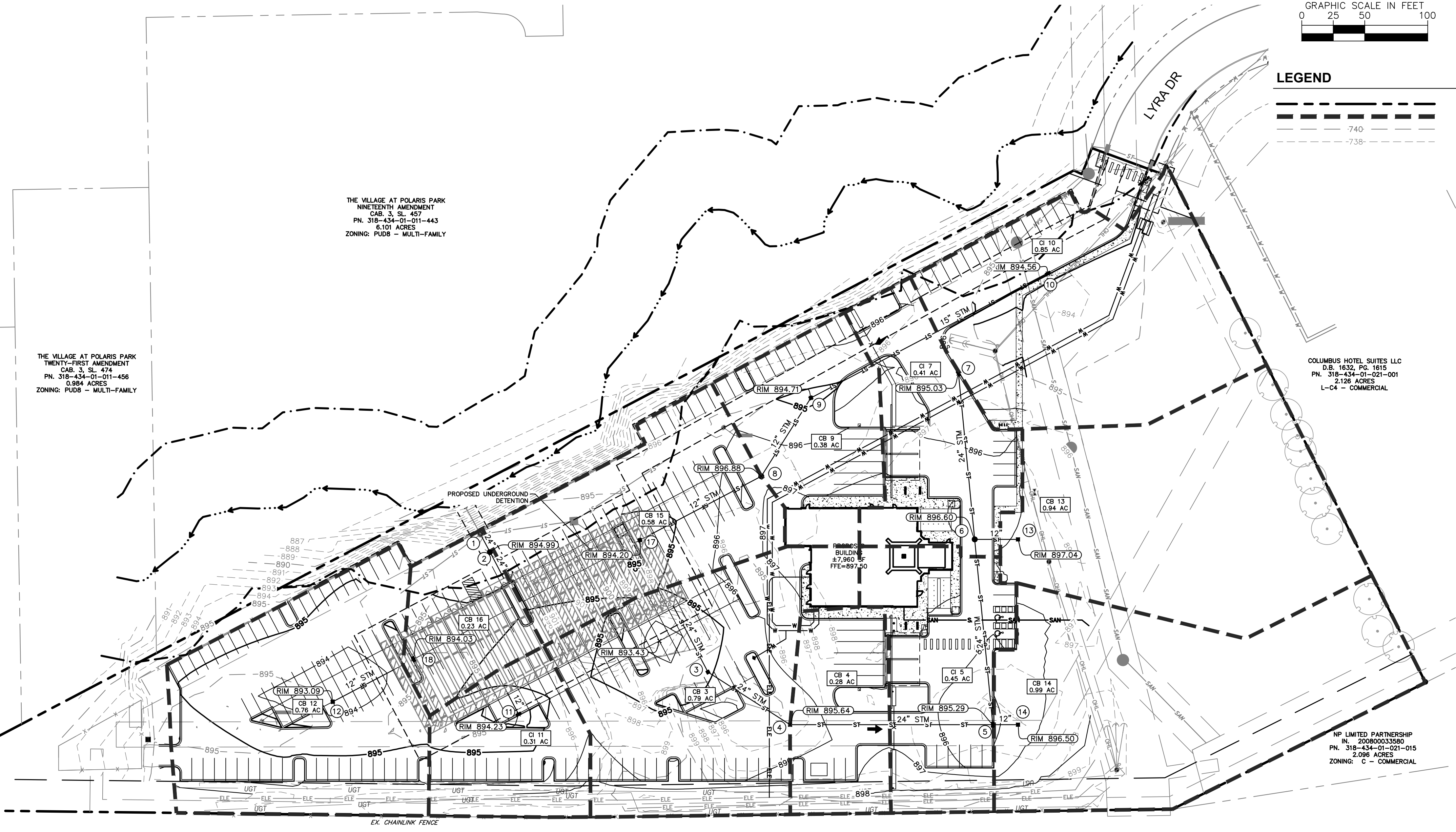
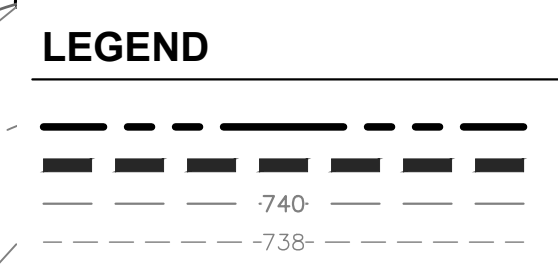
THE VILLAGE AT POLARIS PARK  
 TWENTY-THIRD AMENDMENT  
 CAB. 3, SL. 491  
 PN. 318-434-01-011-464  
 2.352 ACRES  
 ZONING: PUD8 - MULTI-FAMILY

THE VILLAGE AT POLARIS PARK  
 TWENTY-FIRST AMENDMENT  
 CAB. 3, SL. 474  
 PN. 318-434-01-011-456  
 0.984 ACRES  
 ZONING: PUD8 - MULTI-FAMILY

THE VILLAGE AT POLARIS PARK  
 NINETEENTH AMENDMENT  
 CAB. 3, SL. 457  
 PN. 318-434-01-011-443  
 8.101 ACRES  
 ZONING: PUD8 - MULTI-FAMILY



**OHIO**  
**Utilities Protection**  
**SERVICE**  
 Click, Call or Tap Before You Dig



INTERSTATE 71  
 (PUBLIC) ( LIMITED ACCESS)

COLUMBUS HOTEL SUITES LLC  
 D.B. 1632, PG. 1015  
 PN. 318-434-01-021-001  
 2.128 ACRES  
 L-C4 - COMMERCIAL

NP LIMITED PARTNERSHIP  
 IN. 20080033580  
 PN. 318-434-01-021-015  
 2.096 ACRES  
 ZONING: C - COMMERCIAL

No.	REVISIONS	DATE	BY	APR DATE	APR BY

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 COLUMBUS, OH 43235  
 PHONE: 614-454-6899  
 WWW.KIMLEY-HORN.COM

SCALE: AS NOTED  
 DESIGNED BY: SRS  
 DRAWN BY: DUG  
 CHECKED BY: DDL

**LOCAL  
 TRIBUTARY MAP**

**CARVANA**  
 8850 LYRA DRIVE  
 COLUMBUS, OH 43240

ORIGINAL ISSUE:  
 12/20/2021  
 KHA PROJECT NO.  
 190014021

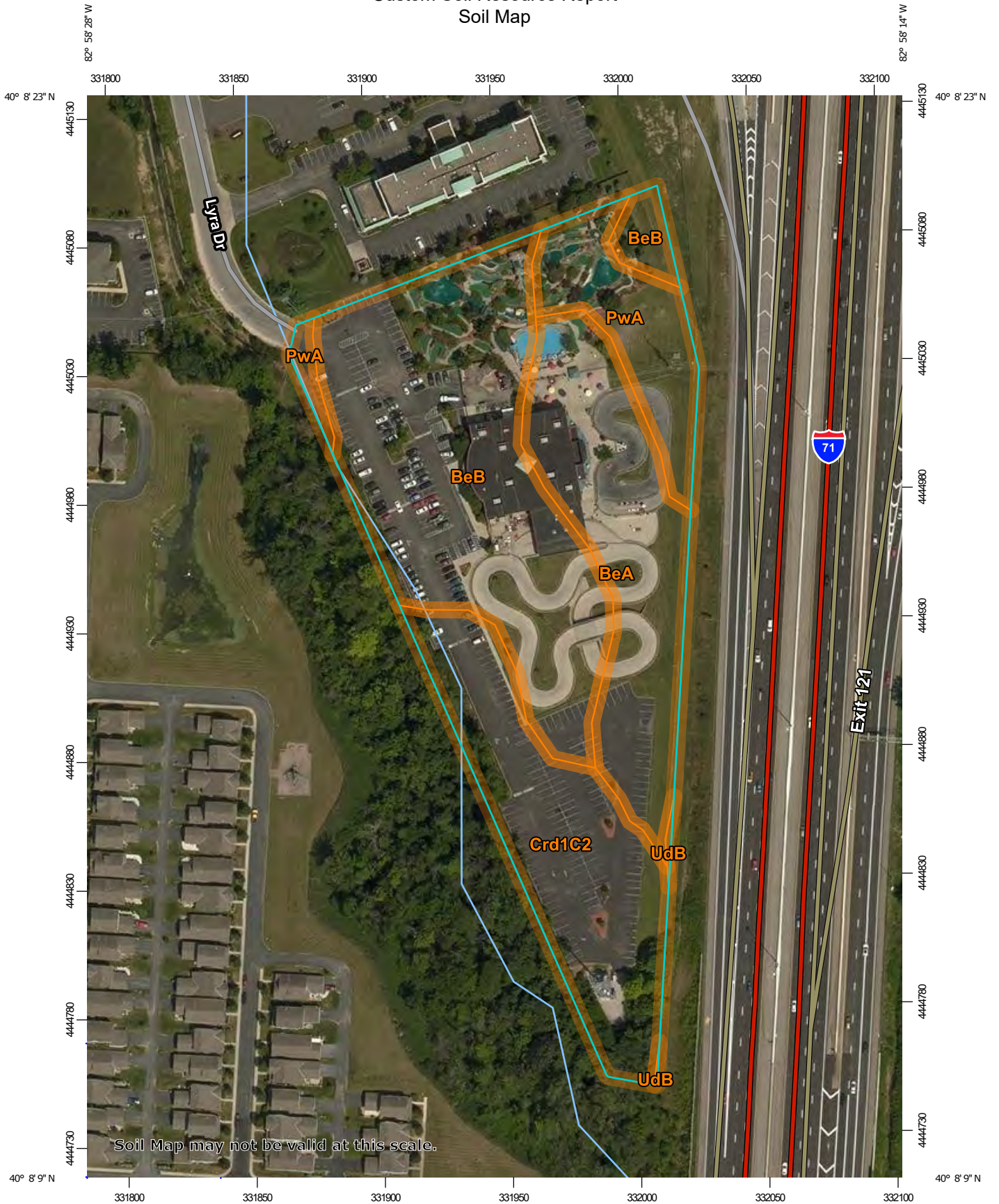
SHEET NUMBER  
**EX-3**



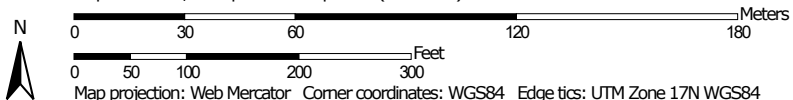
## Appendix 7 – Soils Map/Additional Information



# Custom Soil Resource Report Soil Map



Map Scale: 1:2,050 if printed on A portrait (8.5" x 11") sheet.



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

### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)


**Soils**


 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

**Special Point Features**

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit

 Gravelly Spot


 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip


 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

**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 1:12,000.

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

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

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

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

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

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

Soil Survey Area: Delaware County, Ohio  
 Survey Area Data: Version 20, Sep 7, 2021

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

Date(s) aerial images were photographed: Aug 4, 2014—Aug 27, 2014

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
BeA	Bennington silt loam, 0 to 2 percent slopes	C/D	1.8	22.8%
BeB	Bennington silt loam, 2 to 6 percent slopes	C/D	3.3	42.1%
Crd1C2	Cardington silt loam, 6 to 12 percent slopes, eroded	C/D	1.8	23.7%
PwA	Pewamo silty clay loam, 0 to 1 percent slopes	C/D	0.9	11.2%
UdB	Udorthents, clayey-Urban land complex, undulating		0.0	0.2%
<b>Totals for Area of Interest</b>			<b>7.7</b>	<b>100.0%</b>

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BeA	Bennington silt loam, 0 to 2 percent slopes	1.8	22.8%
BeB	Bennington silt loam, 2 to 6 percent slopes	3.3	42.1%
Crd1C2	Cardington silt loam, 6 to 12 percent slopes, eroded	1.8	23.7%
PwA	Pewamo silty clay loam, 0 to 1 percent slopes	0.9	11.2%
UdB	Udorthents, clayey-Urban land complex, undulating	0.0	0.2%
<b>Totals for Area of Interest</b>		<b>7.7</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

## Custom Soil Resource Report

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.



## Delaware County, Ohio

### BeA—Bennington silt loam, 0 to 2 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2t6m9  
*Elevation:* 800 to 1,000 feet  
*Mean annual precipitation:* 34 to 42 inches  
*Mean annual air temperature:* 48 to 54 degrees F  
*Frost-free period:* 145 to 180 days  
*Farmland classification:* Prime farmland if drained

#### Map Unit Composition

*Bennington and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Bennington

##### Setting

*Landform:* Ground moraines, end moraines  
*Landform position (two-dimensional):* Summit, footslope, backslope  
*Landform position (three-dimensional):* Interfluve  
*Down-slope shape:* Linear, concave  
*Across-slope shape:* Linear  
*Parent material:* Wisconsin loamy till derived from sandstone and shale

##### Typical profile

*Ap - 0 to 10 inches:* silt loam  
*Bt - 10 to 29 inches:* silty clay loam  
*BCt - 29 to 42 inches:* silty clay loam  
*C - 42 to 79 inches:* clay loam

##### Properties and qualities

*Slope:* 0 to 2 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Somewhat poorly drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 6 to 12 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 22 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Moderate (about 8.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2w  
*Hydrologic Soil Group:* C/D  
*Ecological site:* F111EY502OH - Wet Till Ridge  
*Hydric soil rating:* No

## Minor Components

### Cardington

*Percent of map unit:* 7 percent  
*Landform:* End moraines, ground moraines  
*Landform position (two-dimensional):* Shoulder, backslope, summit  
*Landform position (three-dimensional):* Crest, side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Ecological site:* F111EY503OH - Till Ridge  
*Hydric soil rating:* No

### Condit

*Percent of map unit:* 5 percent  
*Landform:* Drainageways, depressions  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear, concave  
*Across-slope shape:* Concave  
*Ecological site:* F111EY501OH - Till Depression  
*Hydric soil rating:* Yes

### Pewamo, low carbonate till

*Percent of map unit:* 3 percent  
*Landform:* Drainageways, depressions  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear, concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

## BeB—Bennington silt loam, 2 to 6 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t6mb  
*Elevation:* 800 to 1,120 feet  
*Mean annual precipitation:* 34 to 42 inches  
*Mean annual air temperature:* 48 to 54 degrees F  
*Frost-free period:* 145 to 175 days  
*Farmland classification:* Prime farmland if drained

### Map Unit Composition

*Bennington and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Bennington

#### Setting

*Landform:* End moraines, ground moraines

## Custom Soil Resource Report

*Landform position (two-dimensional):* Footslope, backslope, summit  
*Landform position (three-dimensional):* Interfluve  
*Down-slope shape:* Concave, linear  
*Across-slope shape:* Linear  
*Parent material:* Wisconsin loamy till derived from sandstone and shale

### Typical profile

*Ap - 0 to 9 inches:* silt loam  
*Bt - 9 to 29 inches:* silty clay loam  
*BCt - 29 to 40 inches:* silty clay loam  
*C - 40 to 79 inches:* clay loam

### Properties and qualities

*Slope:* 2 to 6 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Somewhat poorly drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 6 to 12 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 22 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Moderate (about 8.0 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C/D  
*Ecological site:* F111EY502OH - Wet Till Ridge  
*Hydric soil rating:* No

## Minor Components

### Cardington

*Percent of map unit:* 9 percent  
*Landform:* End moraines, ground moraines  
*Landform position (two-dimensional):* Shoulder, backslope, summit  
*Landform position (three-dimensional):* Crest, side slope  
*Down-slope shape:* Convex, linear  
*Across-slope shape:* Convex  
*Ecological site:* F111EY503OH - Till Ridge  
*Hydric soil rating:* No

### Pewamo, low carbonate till

*Percent of map unit:* 3 percent  
*Landform:* Drainageways, depressions  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Linear, concave  
*Across-slope shape:* Concave  
*Hydric soil rating:* Yes

### Condit

*Percent of map unit:* 3 percent  
*Landform:* Depressions, drainageways

## Custom Soil Resource Report

*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave, linear  
*Across-slope shape:* Concave  
*Ecological site:* F111EY501OH - Till Depression  
*Hydric soil rating:* Yes

### **Crd1C2—Cardington silt loam, 6 to 12 percent slopes, eroded**

#### **Map Unit Setting**

*National map unit symbol:* 2wp1z  
*Elevation:* 700 to 1,400 feet  
*Mean annual precipitation:* 34 to 42 inches  
*Mean annual air temperature:* 48 to 55 degrees F  
*Frost-free period:* 150 to 180 days  
*Farmland classification:* Not prime farmland

#### **Map Unit Composition**

*Cardington, eroded, and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### **Description of Cardington, Eroded**

##### **Setting**

*Landform:* End moraines, ground moraines  
*Landform position (two-dimensional):* Backslope, shoulder  
*Landform position (three-dimensional):* Crest, side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Linear  
*Parent material:* Wisconsin loamy till derived from limestone, sandstone, and shale

##### **Typical profile**

*Ap - 0 to 7 inches:* silt loam  
*Bt - 7 to 27 inches:* silty clay loam  
*BC - 27 to 32 inches:* silty clay loam  
*C - 32 to 79 inches:* clay loam

##### **Properties and qualities**

*Slope:* 6 to 12 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Moderately well drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)  
*Depth to water table:* About 12 to 24 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 22 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

## Custom Soil Resource Report

*Available water supply, 0 to 60 inches:* Moderate (about 7.3 inches)

### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3e

*Hydrologic Soil Group:* C/D

*Ecological site:* F111EY503OH - Till Ridge

*Hydric soil rating:* No

### Minor Components

#### Alexandria, severely eroded

*Percent of map unit:* 6 percent

*Landform:* End moraines, ground moraines

*Landform position (two-dimensional):* Shoulder, backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex

*Across-slope shape:* Linear

*Ecological site:* F111EY503OH - Till Ridge

*Hydric soil rating:* No

#### Bennington

*Percent of map unit:* 5 percent

*Landform:* End moraines, ground moraines

*Landform position (two-dimensional):* Footslope, backslope

*Landform position (three-dimensional):* Interfluvium

*Down-slope shape:* Concave

*Across-slope shape:* Linear

*Ecological site:* F111EY502OH - Wet Till Ridge

*Hydric soil rating:* No

#### Condit

*Percent of map unit:* 4 percent

*Landform:* Depressions, drainageways

*Landform position (two-dimensional):* Toeslope

*Landform position (three-dimensional):* Base slope

*Down-slope shape:* Concave, linear

*Across-slope shape:* Concave

*Ecological site:* F111EY501OH - Till Depression

*Hydric soil rating:* Yes

## PwA—Pewamo silty clay loam, 0 to 1 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t6lv

*Elevation:* 700 to 1,300 feet

*Mean annual precipitation:* 32 to 42 inches

*Mean annual air temperature:* 48 to 54 degrees F

*Frost-free period:* 140 to 180 days

*Farmland classification:* Prime farmland if drained

### Map Unit Composition

*Pewamo and similar soils: 85 percent*

*Minor components: 15 percent*

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Pewamo

#### Setting

*Landform: Drainageways on till plains, depressions on till plains*

*Landform position (two-dimensional): Toeslope*

*Landform position (three-dimensional): Base slope*

*Down-slope shape: Linear, concave*

*Across-slope shape: Concave*

*Parent material: Wisconsin till derived from limestone and shale*

#### Typical profile

*Ap - 0 to 11 inches: silty clay loam*

*Btg1 - 11 to 34 inches: silty clay*

*Btg2 - 34 to 47 inches: silty clay*

*BCg - 47 to 57 inches: clay loam*

*Cg - 57 to 79 inches: clay loam*

#### Properties and qualities

*Slope: 0 to 1 percent*

*Depth to restrictive feature: More than 80 inches*

*Drainage class: Very poorly drained*

*Runoff class: Negligible*

*Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)*

*Depth to water table: About 0 to 12 inches*

*Frequency of flooding: None*

*Frequency of ponding: Frequent*

*Calcium carbonate, maximum content: 30 percent*

*Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)*

*Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)*

#### Interpretive groups

*Land capability classification (irrigated): None specified*

*Land capability classification (nonirrigated): 2w*

*Hydrologic Soil Group: C/D*

*Ecological site: F111BY501IN - Till Depression*

*Hydric soil rating: Yes*

### Minor Components

#### Blount

*Percent of map unit: 9 percent*

*Landform: End moraines on till plains, ground moraines on till plains*

*Landform position (two-dimensional): Footslope*

*Landform position (three-dimensional): Interfluvium*

*Down-slope shape: Linear*

*Across-slope shape: Linear*

*Ecological site: F111BY502IN - Wet Till Ridge*

*Hydric soil rating: No*

**Minster**

*Percent of map unit:* 6 percent  
*Landform:* Depressions on till plains  
*Landform position (two-dimensional):* Toeslope  
*Landform position (three-dimensional):* Base slope  
*Down-slope shape:* Concave  
*Across-slope shape:* Concave  
*Ecological site:* F111BY101IN - Lacustrine Flatwood  
*Hydric soil rating:* Yes

**UdB—Udorthents, clayey-Urban land complex, undulating**

**Map Unit Setting**

*National map unit symbol:* 5s2j  
*Elevation:* 750 to 1,020 feet  
*Mean annual precipitation:* 34 to 42 inches  
*Mean annual air temperature:* 48 to 55 degrees F  
*Frost-free period:* 140 to 180 days  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Udorthents and similar soils:* 45 percent  
*Urban land:* 40 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Udorthents**

**Properties and qualities**

*Slope:* 0 to 6 percent  
*Depth to restrictive feature:* More than 80 inches  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None

**Minor Components**

**Pewamo**

*Percent of map unit:* 5 percent  
*Landform:* Drainageways on ground moraines, drainageways on end moraines, drainageways on outwash terraces  
*Ecological site:* F111BY501IN - Till Depression  
*Hydric soil rating:* Yes

**Bennington**

*Percent of map unit:* 3 percent  
*Landform:* Rises on end moraines, rises on ground moraines, flats on end moraines, flats on ground moraines  
*Landform position (two-dimensional):* Shoulder, summit  
*Down-slope shape:* Linear

Custom Soil Resource Report

*Across-slope shape:* Linear

**Cardington**

*Percent of map unit:* 3 percent

*Landform:* End moraines, ground moraines

*Landform position (two-dimensional):* Summit, shoulder, backslope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

**Blount**

*Percent of map unit:* 2 percent

*Landform:* Rises on end moraines, rises on ground moraines, flats on end moraines, flats on ground moraines

*Landform position (two-dimensional):* Summit, shoulder

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* F111BY502IN - Wet Till Ridge

**Glynwood**

*Percent of map unit:* 2 percent

*Landform:* End moraines, ground moraines

*Ecological site:* F111BY503IN - Till Ridge





# Appendix 8 – Stream Corridor Protection Zone Calculations



## **STREAM CORRIDOR PROTECTION ZONE DETERMINATION**

The Stream Corridor Protection Zone for streams shall be established based on the City of Columbus Stormwater Drainage Manual. The Drainage Manual stipulates that the

The City of Columbus Stormwater Drainage Manual stipulates that the width of the Stream Corridor Protection Zone (SCPZ) for streams shall be established based on the following criteria:

1. The area within the FEMA designated 100-year floodway
2. The area calculated based on the following equation:

$$\text{Stream Corridor Protection Zone, in feet of width} = 147(\text{DA})^{0.38},$$

Where DA = drainage area of the stream in square miles (50' min or 250' max)

3. 50 feet from the top of each bank for fourth order streams or larger

The drainage area was determined, using StreamStats from USGS, to be 0.68 square miles.

$$\text{Stream Corridor Protection Zone, in feet of width} = 147(0.68)^{0.38} = 126.96 = 127 \text{ feet}$$

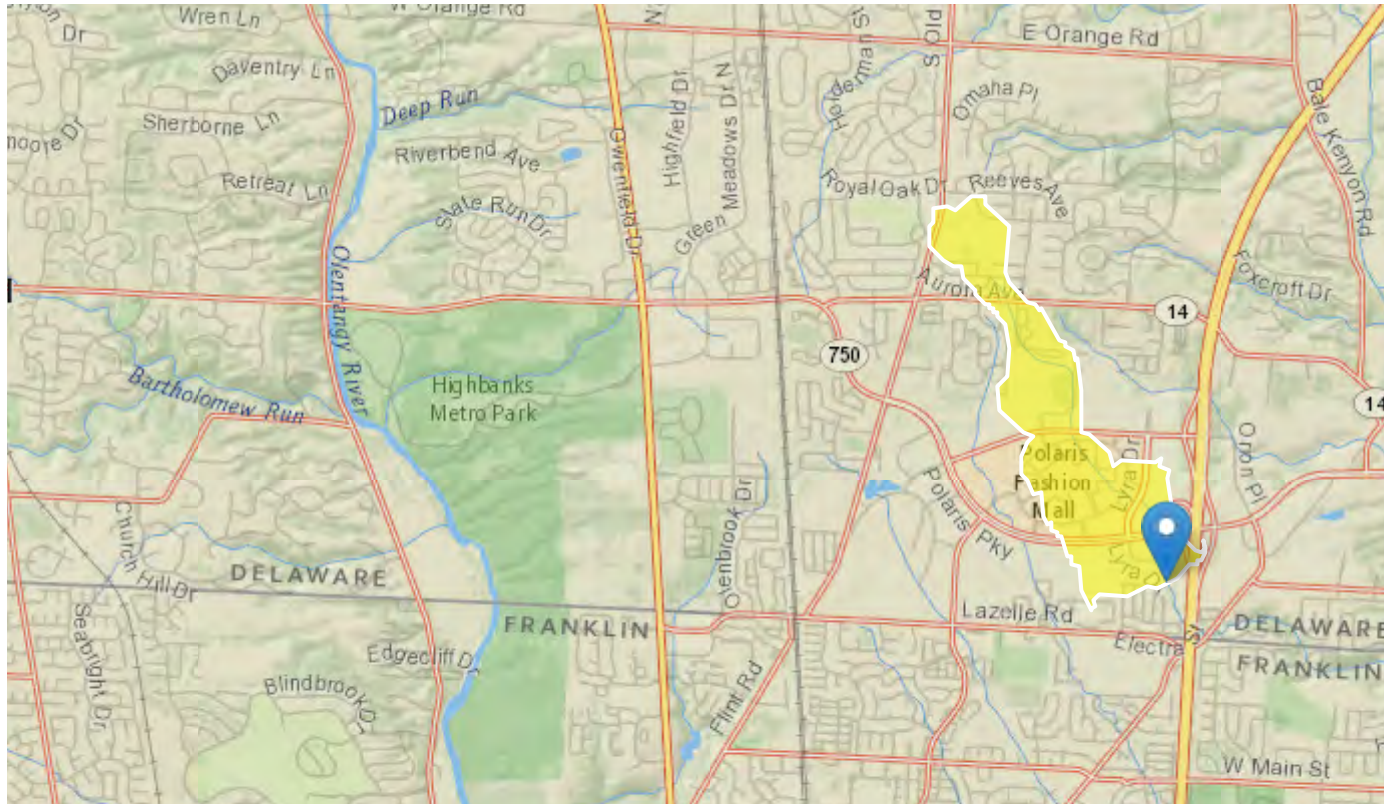
# StreamStats Report

**Region ID:** OH

**Workspace ID:** OH20210818214745197000

**Clicked Point (Latitude, Longitude):** 40.13856, -82.97343

**Time:** 2021-08-18 17:48:04 -0400



## Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.68	square miles

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Application Version: 4.6.2

StreamStats Services Version: 1.2.22

NSS Services Version: 2.1.2