

# PIG ATE MY PIZZA

Bloomington, Minnesota

## STORMWATER MANAGEMENT REPORT

City Review

ARC24021

MAY 1, 2024





## Introduction & Project Overview

The proposed project consists of the northeast corner of the existing retail center located at 10700 Bloomington Ferry Rd. The 3,200 square foot building was previously a gas station and is being converted to a restaurant with a 1,291 square foot addition, an outdoor dining patio and a play area. The overall retail center is 4.559 acres, 0.412 acres are within the construction limits, and the redevelopment results in 0.162 acres of disturbed/reconstructed impervious surface. A portion of the parking/drive lot will be milled and overlaid with slight grade adjustment for ADA compliance at accessible stalls. Overall, the impervious area within the observed drainage area will be reduced from 2.342 acres to 2.300 acres, this is illustrated in the Existing & Proposed Drainage maps included for reference in the attachments of the report.

## Information

|                    |                                                   |                 |                  |
|--------------------|---------------------------------------------------|-----------------|------------------|
| Owner/Developer    | Pig Ate My Pizza                                  |                 |                  |
| Site Address       | 10700 Bloomington Ferry Rd, Bloomington, MN 55438 |                 |                  |
| Site PID #         | 3111621420070                                     |                 |                  |
| Rainfall Intensity | 2 yr. – 24 hr.                                    | 10 yr. – 24 hr. | 100 yr. – 24 hr. |
|                    | 2.85                                              | 4.24            | 7.44             |

## Regulatory Requirements

The primary regulatory agency for this redevelopment is Riley-Purgatory-Bluff Creek Watershed District (RPBCWD). Since the project doesn't increase the amount of impervious or disturb over 50% of the parcel, the primary requirement for stormwater management is to provide abstraction of 1.1 in of the disturbed impervious surface. RPBCWD also requires a chloride management plan for any land disturbing activity. The disturbed area doesn't exceed 1 acre, so a SWPPP is not required.

## Soils

The soils onsite are categorized as Kasota silty clay loam per the USDA Web Soil Survey. It is categorized as HSG C, but in the profile description it is likely to be underlaid by sand & coarse sands. A geotechnical investigation is pending to confirm soil and groundwater conditions are conducive to infiltration.



## Design Overview

The site area is split into three subcatchments as illustrated in the drainage maps. 1E and 1P represent the central area including the building and surrounding area. 2E and 2P are on the outskirts of the site and run off to the adjacent streets, Landau Circle and Bloomington Ferry Rd. 3E and 3P are the large parking area in the center of the plat south of the building. 4E and 4P make up the southernmost end of the parking area. To manage the required abstraction of 1.1 inches of runoff from the 0.162 acres of disturbed/reconstructed impervious area, a small underground infiltration basin is proposed. The basin will be two rows of 20 ft long 3 ft diameter corrugated metal pipe with a 3' diameter 9' long connecting header. The system will be installed over a 6" bed of stone with 30" of stone on each side, 12" of stone on one end, 24" on the other end, and 6" of stone cover over the pipe. The volume the system must provide is 647 cubic ft or 0.015, as calculated below.

$$\left(0.162 \text{ acres} * 43,560 \frac{\text{square ft}}{\text{acre}}\right) * \left(1.1 \text{ in} * \frac{1 \text{ ft}}{12 \text{ in}}\right) = 647 \text{ cubic ft}$$

This underground system will be connected to the existing manhole located in the corner of the parking area just west of the building. This manhole is the primary outfall of subcatchment 1, and is also directly downstream from subcatchment 3 and 4. The pretreatment chamber will fill up first to settle out solids. Then water will drain into the infiltration basin and begin infiltrating, after reaching capacity water will back up to the existing manhole and proceed through the existing 18" PVC as it did in existing conditions. The basin provides approximately 700 cubic ft of storage below 818.1 feet. The underground infiltration basin design storage table is provided in the attachments of this report.

The basin must draw down within 48 hours of the end of a 24 hour storm event. Currently this is modeled with an infiltration rate of 0.45 inches/hr. Assuming a 14' by 26' rock bed infiltration area, the drawdown time of a full basin is calculated as 51.3 hours below.

$$\frac{700 \text{ cubic ft}}{(14 \text{ ft} * 26 \text{ ft})} * \frac{1 \text{ hr}}{\left(0.45 \text{ in} * \frac{1 \text{ ft}}{12 \text{ in}}\right)} = 51.3 \text{ hours}$$

This is just shy of the required 48 hours, but at the 48 hour mark it is reasonable to assume the basin chambers will be empty and the only remaining water will be within the 6" rock bed and will be infiltrated by 52 hours. This drawdown time calculation is also pending the confirmation of soil and groundwater conditions.

Drawdown time needs to be 48 hours, adjust design to meet requirement

Provide soil boring from within proposed stormwater BMP to confirm proposed infiltration rate and 3 feet of separation from groundwater.

Stormwater infiltration BMP must not mobilize contaminants in soil or groundwater. Given past history of site as a gas station address any known contaminants and prevent mobilizing contaminants with stormwater infiltration. See the Minnesota Stormwater manual for guidance on infiltration BMP's on contaminated sites.



## Conclusion

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The stormwater management system for the proposed redevelopment at 10700 Bloomington Ferry Rd appears to meet the regulatory requirements of RPBCWD. If you have any questions or need additional information regarding this report, please feel free to contact me at [sjohnston@elanlab.com](mailto:sjohnston@elanlab.com). The chloride management plan required by RPBCWD is pending and will be provided with future submissions.

## Attachments

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- Existing Drainage Map
- Proposed Drainage Map
- Proposed HydroCAD Report
- Underground Infiltration Storage Table
- Chloride Management Plan – Pending
- Operations and Maintenance Manual - Pending
- Geotechnical Report - Pending

Stormwater management for site must also demonstrate compliance with water quality standards (60% TP removal and 90% TSS removal) and decrease runoff rate from existing.

## Certification

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I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

A handwritten signature in black ink, appearing to read "Stephen M. Johnston".

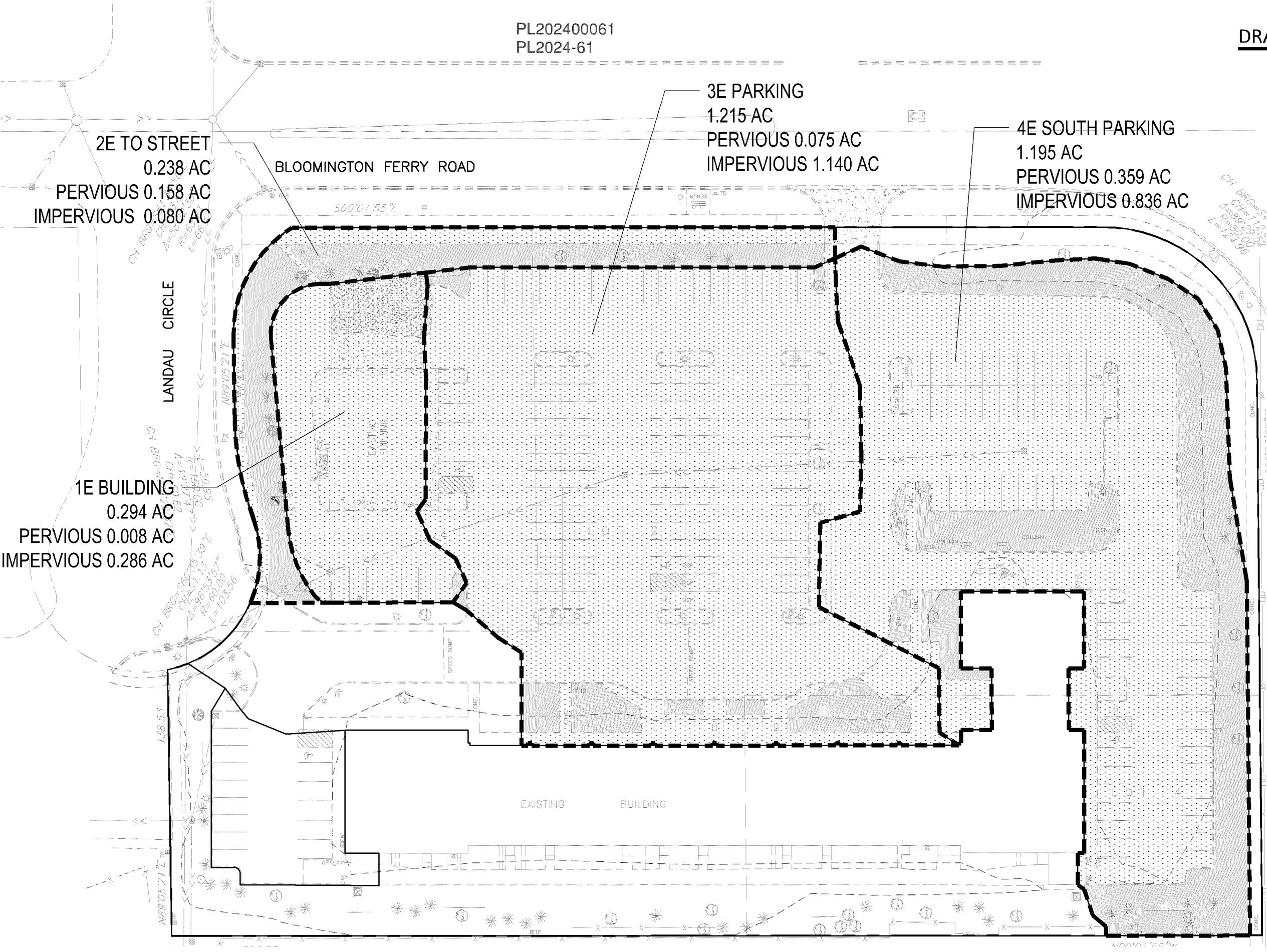
Stephen M. Johnston

Registration # 18914

May 1, 2024

DRAINAGE AREA SUMMARY

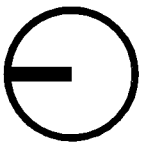
|                                                                                     |                             |
|-------------------------------------------------------------------------------------|-----------------------------|
|  | PERVIOUS AREA<br>0.600 AC   |
|  | IMPERVIOUS AREA<br>2.342 AC |
|                                                                                     | 2.942 TOTAL AREA            |



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GEN24003

EXISTING DRAINAGE MAP  
05/01/2024

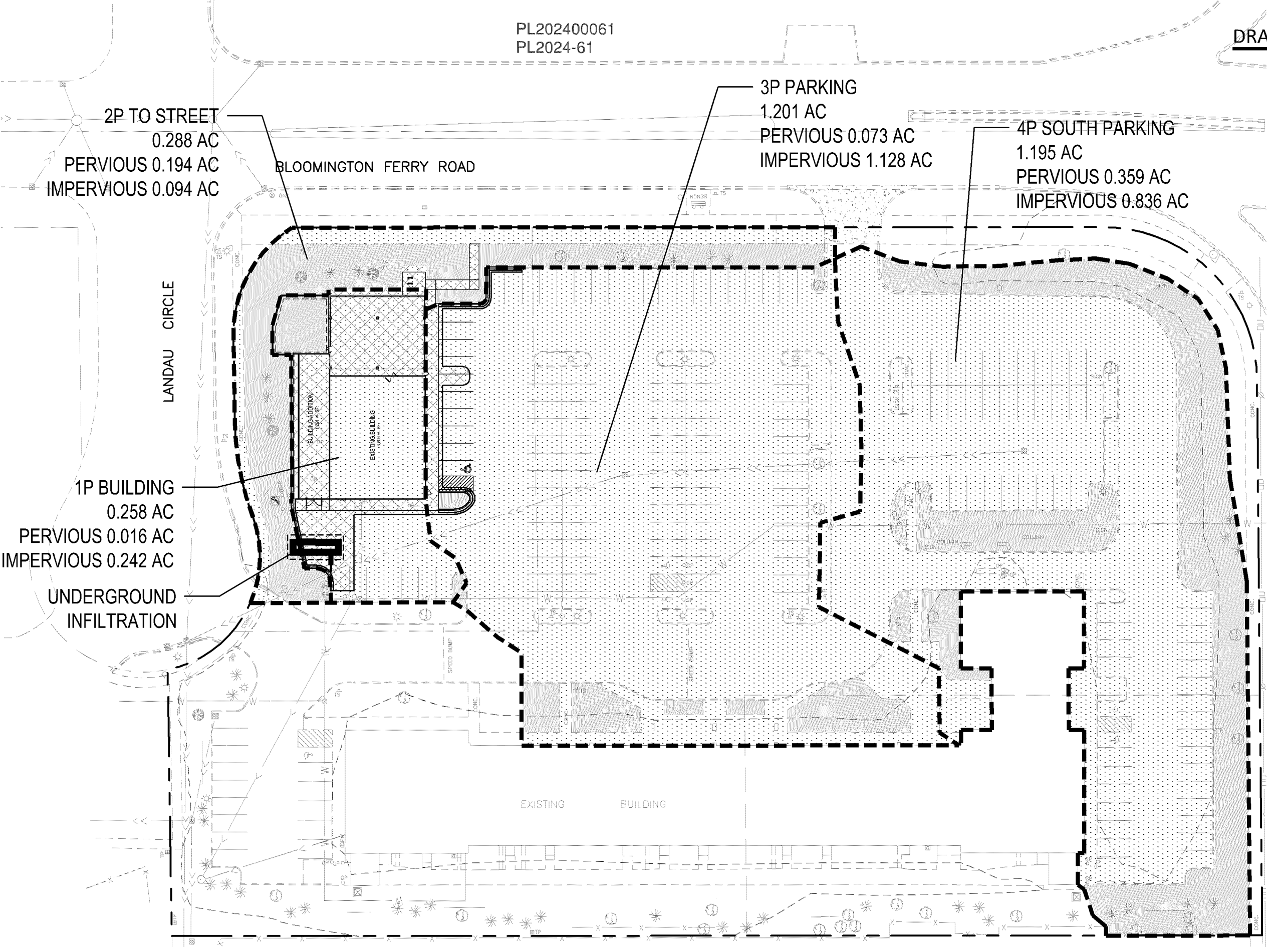
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50 150  
SCALE IN FEET

PL202400061  
PL2024-61

DRAINAGE AREA SUMMARY

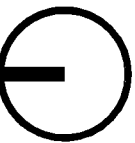


|  |                                                          |
|--|----------------------------------------------------------|
|  | PERVIOUS AREA<br>0.642 AC                                |
|  | IMPERVIOUS AREA<br>2.300 AC                              |
|  | 2.942 TOTAL AREA                                         |
|  | DISTURBED / RECONSTRUCTED<br>IMPERVIOUS AREA<br>0.162 AC |

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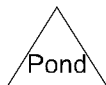
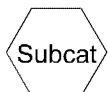
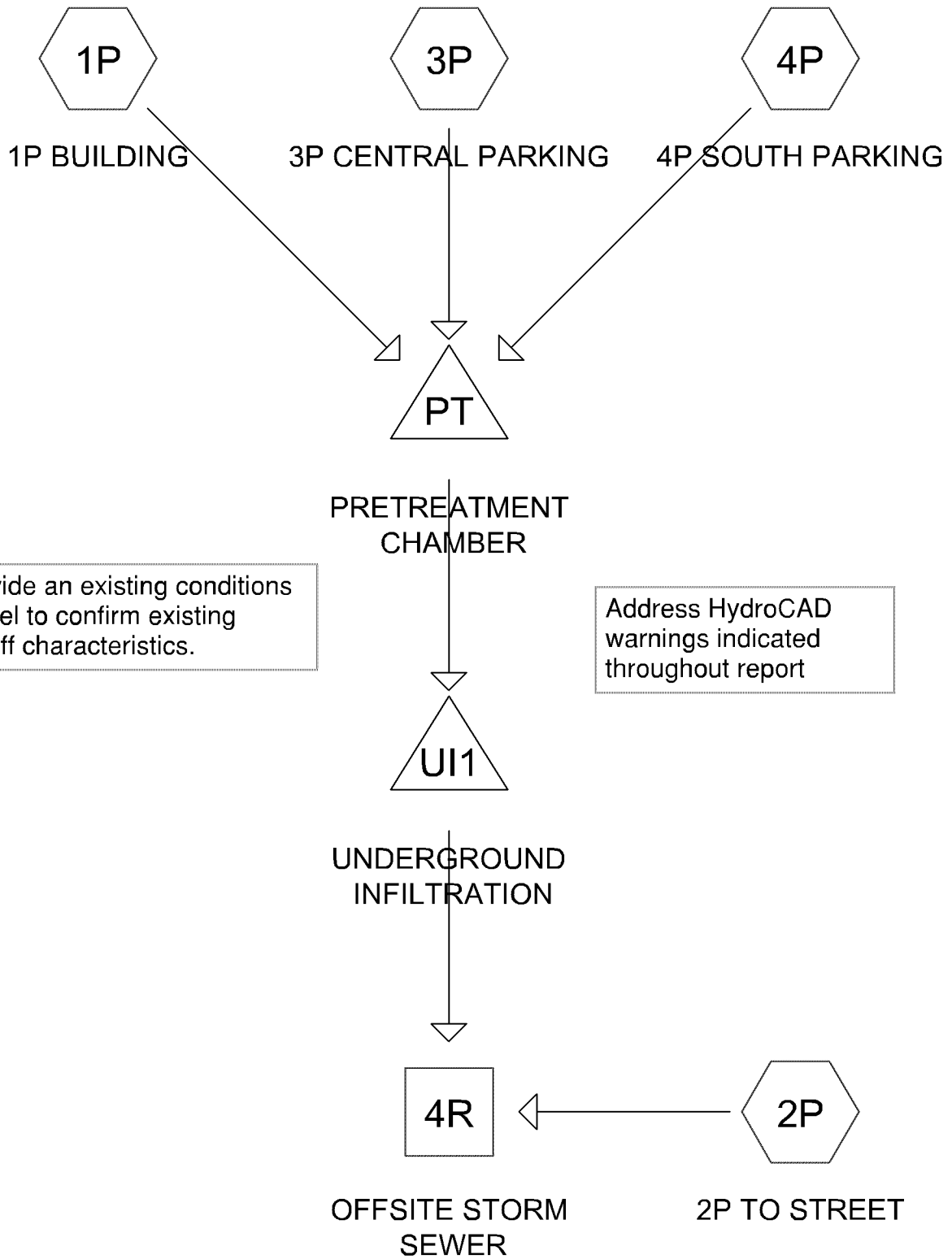
PROPOSED DRAINAGE MAP  
05/01/2024

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50 150  
SCALE IN FEET





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**Rainfall Events Listing**

| Event# | Event<br>Name | Storm Type | Curve | Mode    | Duration<br>(hours) | B/B | Depth<br>(inches) | AMC |
|--------|---------------|------------|-------|---------|---------------------|-----|-------------------|-----|
| 1      | 2 YR 24 HR    | MSE 24-hr  | 3     | Default | 24.00               | 1   | 2.85              | 2   |
| 2      | 10 YR 24 HR   | MSE 24-hr  | 3     | Default | 24.00               | 1   | 4.24              | 2   |
| 3      | 100 YR 24 HR  | MSE 24-hr  | 3     | Default | 24.00               | 1   | 7.44              | 2   |



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**Area Listing (selected nodes)**

| Area<br>(acres) | CN        | Description<br>(subcatchment-numbers)          |
|-----------------|-----------|------------------------------------------------|
| 0.642           | 61        | >75% Grass cover, Good, HSG B (1P, 2P, 3P, 4P) |
| 2.300           | 98        | Paved parking, HSG B (1P, 2P, 3P, 4P)          |
| <b>2.942</b>    | <b>90</b> | <b>TOTAL AREA</b>                              |

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**Soil Listing (selected nodes)**

| Area<br>(acres) | Soil<br>Group | Subcatchment<br>Numbers |
|-----------------|---------------|-------------------------|
| 0.000           | HSG A         |                         |
| 2.942           | HSG B         | 1P, 2P, 3P, 4P          |
| 0.000           | HSG C         |                         |
| 0.000           | HSG D         |                         |
| 0.000           | Other         |                         |
| <b>2.942</b>    |               | <b>TOTAL AREA</b>       |

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**Ground Covers (selected nodes)**

| HSG-A<br>(acres) | HSG-B<br>(acres) | HSG-C<br>(acres) | HSG-D<br>(acres) | Other<br>(acres) | Total<br>(acres) | Ground<br>Cover        | Subcatchment<br>Numbers |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------------|-------------------------|
| 0.000            | 0.642            | 0.000            | 0.000            | 0.000            | 0.642            | >75% Grass cover, Good | 1P, 2P,<br>3P, 4P       |
| 0.000            | 2.300            | 0.000            | 0.000            | 0.000            | 2.300            | Paved parking          | 1P, 2P,<br>3P, 4P       |
| <b>0.000</b>     | <b>2.942</b>     | <b>0.000</b>     | <b>0.000</b>     | <b>0.000</b>     | <b>2.942</b>     | <b>TOTAL AREA</b>      |                         |

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**Pipe Listing (selected nodes)**

| Line# | Node<br>Number | In-Invert<br>(feet) | Out-Invert<br>(feet) | Length<br>(feet) | Slope<br>(ft/ft) | n     | Width<br>(inches) | Diam/Height<br>(inches) | Inside-Fill<br>(inches) | Node<br>Name |
|-------|----------------|---------------------|----------------------|------------------|------------------|-------|-------------------|-------------------------|-------------------------|--------------|
| 1     | UI1            | 818.10              | 816.60               | 80.0             | 0.0187           | 0.010 | 0.0               | 18.0                    | 0.0                     |              |

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Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points x 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1P: 1P BUILDING**

Runoff Area=0.258 ac 93.80% Impervious Runoff Depth=2.40"

Tc=5.0 min CN=96 Runoff=1.04 cfs 0.052 af

**Subcatchment2P: 2P TO STREET**

Runoff Area=0.288 ac 32.64% Impervious Runoff Depth=0.77"

Tc=5.0 min CN=73 Runoff=0.39 cfs 0.018 af

**Subcatchment3P: 3P CENTRAL PARKING**

Runoff Area=1.201 ac 93.92% Impervious Runoff Depth=2.40"

Tc=5.0 min CN=96 Runoff=4.84 cfs 0.241 af

**Subcatchment4P: 4P SOUTH PARKING**

Runoff Area=1.195 ac 69.96% Impervious Runoff Depth=1.61"

Tc=5.0 min CN=87 Runoff=3.52 cfs 0.160 af

**Reach 4R: OFFSITE STORM SEWER**

Inflow=9.78 cfs 0.447 af

Outflow=9.78 cfs 0.447 af

**Pond PT: PRETREATMENT CHAMBER**

Peak Elev=820.58' Storage=0.001 af Inflow=9.40 cfs 0.453 af

Outflow=9.40 cfs 0.452 af

**Pond UI1: UNDERGROUND INFILTRATION**

Peak Elev=820.06' Storage=0.018 af Inflow=9.40 cfs 0.453 af

Discarded=0.01 cfs 0.024 af Primary=9.40 cfs 0.428 af Outflow=9.40 cfs 0.453 af

**Total Runoff Area = 2.942 ac Runoff Volume = 0.471 af Average Runoff Depth = 1.92"****21.82% Pervious = 0.642 ac 78.18% Impervious = 2.300 ac**

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**Summary for Subcatchment 1P: 1P BUILDING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 1.04 cfs @ 12.11 hrs, Volume= 0.052 af, Depth= 2.40"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.016     | 61 | >75% Grass cover, Good, HSG B |
| 0.242     | 98 | Paved parking, HSG B          |
| 0.258     | 96 | Weighted Average              |
| 0.016     |    | 6.20% Pervious Area           |
| 0.242     |    | 93.80% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

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**Summary for Subcatchment 2P: 2P TO STREET**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 0.39 cfs @ 12.13 hrs, Volume= 0.018 af, Depth= 0.77"  
Routed to Reach 4R : OFFSITE STORM SEWER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.194     | 61 | >75% Grass cover, Good, HSG B |
| 0.094     | 98 | Paved parking, HSG B          |
| 0.288     | 73 | Weighted Average              |
| 0.194     |    | 67.36% Pervious Area          |
| 0.094     |    | 32.64% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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**Summary for Subcatchment 3P: 3P CENTRAL PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 4.84 cfs @ 12.11 hrs, Volume= 0.241 af, Depth= 2.40"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.073     | 61 | >75% Grass cover, Good, HSG B |
| 1.128     | 98 | Paved parking, HSG B          |
| 1.201     | 96 | Weighted Average              |
| 0.073     |    | 6.08% Pervious Area           |
| 1.128     |    | 93.92% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description          |
|-------------|------------------|------------------|----------------------|-------------------|----------------------|
| 5.0         |                  |                  |                      |                   | <b>Direct Entry,</b> |



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**Summary for Subcatchment 4P: 4P SOUTH PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 3.52 cfs @ 12.12 hrs, Volume= 0.160 af, Depth= 1.61"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt=0.05$  hrs  
MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.359     | 61 | >75% Grass cover, Good, HSG B |
| 0.836     | 98 | Paved parking, HSG B          |
| 1.195     | 87 | Weighted Average              |
| 0.359     |    | 30.04% Pervious Area          |
| 0.836     |    | 69.96% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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**Summary for Reach 4R: OFFSITE STORM SEWER**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.942 ac, 78.18% Impervious, Inflow Depth = 1.82" for 2 YR 24 HR event  
Inflow = 9.78 cfs @ 12.11 hrs, Volume= 0.447 af  
Outflow = 9.78 cfs @ 12.11 hrs, Volume= 0.447 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

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MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

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**Summary for Pond PT: PRETREATMENT CHAMBER**

[93] Warning: Storage range exceeded by 2.48'

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 2.05" for 2 YR 24 HR event  
Inflow = 9.40 cfs @ 12.11 hrs, Volume= 0.453 af  
Outflow = 9.40 cfs @ 12.11 hrs, Volume= 0.452 af, Atten= 0%, Lag= 0.0 min  
Primary = 9.40 cfs @ 12.11 hrs, Volume= 0.453 af  
Routed to Pond UI1 : UNDERGROUND INFILTRATION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3  
Peak Elev= 820.58' @ 12.11 hrs Storage= 0.001 af

Plug-Flow detention time= 3.0 min calculated for 0.452 af (100% of inflow)  
Center-of-Mass det. time= 2.2 min ( 780.8 - 778.6 )

| Volume | Invert  | Avail.Storage | Storage Description                        |
|--------|---------|---------------|--------------------------------------------|
| #1     | 815.60' | 0.001 af      | <b>30.0" Round Pipe Storage</b><br>L= 5.0' |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                                                  |
|--------|---------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 816.85' | <b>Custom Weir/Orifice, Cv= 2.62 (C= 3.28)</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90<br>1.00 1.10 1.20 1.25<br>Width (feet) 2.50 2.49 2.46 2.42 2.36 2.29 2.19 2.07 1.92 1.73<br>1.50 1.19 0.70 0.00 |
| #2     | Primary | 816.85' | <b>6.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads                                                                                                                                                     |
| #3     | Primary | 815.85' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #4     | Primary | 816.10' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #5     | Primary | 816.35' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #6     | Primary | 816.60' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |

**Primary OutFlow** Max=9.05 cfs @ 12.11 hrs HW=820.46' TW=819.98' (Dynamic Tailwater)

- 1=Custom Weir/Orifice (Orifice Controls 8.32 cfs @ 3.41 fps)
- 2=Orifice/Grate (Orifice Controls 0.66 cfs @ 3.34 fps)
- 3=Orifice/Grate (Orifice Controls 0.02 cfs @ 3.34 fps)
- 4=Orifice/Grate (Orifice Controls 0.02 cfs @ 3.34 fps)
- 5=Orifice/Grate (Orifice Controls 0.02 cfs @ 3.34 fps)
- 6=Orifice/Grate (Orifice Controls 0.02 cfs @ 3.34 fps)

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MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"

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**Summary for Pond UI1: UNDERGROUND INFILTRATION**

[93] Warning: Storage range exceeded by 1.46'

[90] Warning: Qout&gt;Qin may require smaller dt or Finer Routing

[80] Warning: Exceeded Pond PT by 0.12' @ 24.10 hrs (4.56 cfs 1.551 af)

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 2.05" for 2 YR 24 HR event  
 Inflow = 9.40 cfs @ 12.11 hrs, Volume= 0.453 af  
 Outflow = 9.40 cfs @ 12.11 hrs, Volume= 0.453 af, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.024 af  
 Primary = 9.40 cfs @ 12.11 hrs, Volume= 0.428 af  
 Routed to Reach 4R : OFFSITE STORM SEWER

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3  
 Peak Elev= 820.06' @ 12.11 hrs Surf.Area= 0.008 ac Storage= 0.018 af

Plug-Flow detention time= 85.8 min calculated for 0.452 af (100% of inflow)  
 Center-of-Mass det. time= 86.5 min ( 867.4 - 780.9 )

| Volume | Invert  | Avail.Storage | Storage Description                                                                                                                                                                                                    |
|--------|---------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1A    | 814.60' | 0.010 af      | <b>14.00'W x 26.00'L x 4.00'H Field A</b><br>0.033 af Overall - 0.008 af Embedded = 0.025 af x 40.0% Voids                                                                                                             |
| #2A    | 815.10' | 0.008 af      | <b>CMP Round 36 x 2 Inside #1</b><br>Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf<br>Overall Size= 36.0"W x 36.0"H x 20.00'L<br>2 Chambers in 2 Rows<br>9.00' Header x 7.07 sf x 1 = 63.6 cf Inside |
|        |         | 0.018 af      | Total Available Storage                                                                                                                                                                                                |

Storage Group A created with Chamber Wizard

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                         |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 818.10' | <b>18.0" Round Culvert</b> L= 80.0' Ke= 0.500<br>Inlet / Outlet Invert= 818.10' / 816.60' S= 0.0187 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf |
| #2     | Discarded | 814.60' | <b>0.450 in/hr Exfiltration over Surface area</b><br>Conductivity to Groundwater Elevation = 800.00'                                                                   |

**Discarded OutFlow** Max=0.01 cfs @ 12.11 hrs HW=819.98' (Free Discharge)↑ **2=Exfiltration** ( Controls 0.01 cfs)**Primary OutFlow** Max=9.05 cfs @ 12.11 hrs HW=819.98' TW=0.00' (Dynamic Tailwater)↑ **1=Culvert** (Inlet Controls 9.05 cfs @ 5.12 fps)

**20240429\_ARC24021\_HydroCAD**

*MSE 24-hr 3 2 YR 24 HR Rainfall=2.85"*

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**Pond UI1: UNDERGROUND INFILTRATION - Chamber Wizard Field A**

**Chamber Model = CMP Round 36 (Round Corrugated Metal Pipe)**

Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf

Overall Size= 36.0"W x 36.0"H x 20.00'L

36.0" Wide + 36.0" Spacing = 72.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +3.00' Header x 1 = 23.00' Row Length +18.0" End Stone x 2 = 26.00'  
Base Length

2 Rows x 36.0" Wide + 36.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width

6.0" Stone Base + 36.0" Chamber Height + 6.0" Stone Cover = 4.00' Field Height

2 Chambers x 141.4 cf + 9.00' Header x 7.07 sf = 346.4 cf Chamber Storage

1,456.0 cf Field - 346.4 cf Chambers = 1,109.6 cf Stone x 40.0% Voids = 443.9 cf Stone Storage

Chamber Storage + Stone Storage = 790.2 cf = 0.018 af

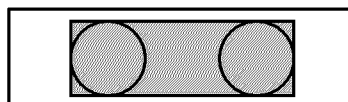
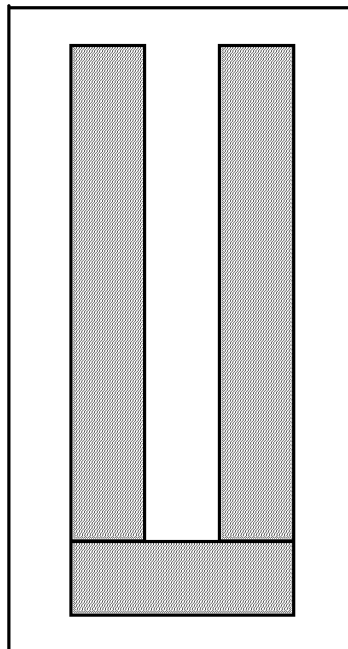
Overall Storage Efficiency = 54.3%

Overall System Size = 26.00' x 14.00' x 4.00'

2 Chambers

53.9 cy Field

41.1 cy Stone



**20240429\_ARC24021\_HydroCAD***MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"*

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Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points x 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1P: 1P BUILDING**

Runoff Area=0.258 ac 93.80% Impervious Runoff Depth=3.78"

Tc=5.0 min CN=96 Runoff=1.59 cfs 0.081 af

**Subcatchment2P: 2P TO STREET**

Runoff Area=0.288 ac 32.64% Impervious Runoff Depth=1.70"

Tc=5.0 min CN=73 Runoff=0.90 cfs 0.041 af

**Subcatchment3P: 3P CENTRAL PARKING**

Runoff Area=1.201 ac 93.92% Impervious Runoff Depth=3.78"

Tc=5.0 min CN=96 Runoff=7.40 cfs 0.378 af

**Subcatchment4P: 4P SOUTH PARKING**

Runoff Area=1.195 ac 69.96% Impervious Runoff Depth=2.86"

Tc=5.0 min CN=87 Runoff=6.12 cfs 0.285 af

**Reach 4R: OFFSITE STORM SEWER**

Inflow=16.00 cfs 0.760 af

Outflow=16.00 cfs 0.760 af

**Pond PT: PRETREATMENT CHAMBER**

Peak Elev=823.31' Storage=0.001 af Inflow=15.11 cfs 0.744 af

Outflow=15.11 cfs 0.744 af

**Pond UI1: UNDERGROUND INFILTRATION**

Peak Elev=821.98' Storage=0.018 af Inflow=15.11 cfs 0.744 af

Discarded=0.01 cfs 0.025 af Primary=15.10 cfs 0.719 af Outflow=15.11 cfs 0.744 af

**Total Runoff Area = 2.942 ac Runoff Volume = 0.785 af Average Runoff Depth = 3.20"****21.82% Pervious = 0.642 ac 78.18% Impervious = 2.300 ac**

# **20240429\_ARC24021\_HydroCAD**

MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

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## **Summary for Subcatchment 1P: 1P BUILDING**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.59 cfs @ 12.11 hrs, Volume= 0.081 af, Depth= 3.78"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.016     | 61 | >75% Grass cover, Good, HSG B |
| 0.242     | 98 | Paved parking, HSG B          |
| 0.258     | 96 | Weighted Average              |
| 0.016     |    | 6.20% Pervious Area           |
| 0.242     |    | 93.80% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description          |
|-------------|------------------|------------------|----------------------|-------------------|----------------------|
| 5.0         |                  |                  |                      |                   | <b>Direct Entry,</b> |

**20240429\_ARC24021\_HydroCAD**

*MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"*

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**Summary for Subcatchment 2P: 2P TO STREET**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 0.90 cfs @ 12.12 hrs, Volume= 0.041 af, Depth= 1.70"  
Routed to Reach 4R : OFFSITE STORM SEWER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.194     | 61 | >75% Grass cover, Good, HSG B |
| 0.094     | 98 | Paved parking, HSG B          |
| 0.288     | 73 | Weighted Average              |
| 0.194     |    | 67.36% Pervious Area          |
| 0.094     |    | 32.64% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description          |
|-------------|------------------|------------------|----------------------|-------------------|----------------------|
| 5.0         |                  |                  |                      |                   | <b>Direct Entry,</b> |



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*MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"*

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**Summary for Subcatchment 3P: 3P CENTRAL PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 7.40 cfs @ 12.11 hrs, Volume= 0.378 af, Depth= 3.78"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt=0.05$  hrs  
MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.073     | 61 | >75% Grass cover, Good, HSG B |
| 1.128     | 98 | Paved parking, HSG B          |
| 1.201     | 96 | Weighted Average              |
| 0.073     |    | 6.08% Pervious Area           |
| 1.128     |    | 93.92% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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**Summary for Subcatchment 4P: 4P SOUTH PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 6.12 cfs @ 12.12 hrs, Volume= 0.285 af, Depth= 2.86"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.359     | 61 | >75% Grass cover, Good, HSG B |
| 0.836     | 98 | Paved parking, HSG B          |
| 1.195     | 87 | Weighted Average              |
| 0.359     |    | 30.04% Pervious Area          |
| 0.836     |    | 69.96% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description          |
|-------------|------------------|------------------|----------------------|-------------------|----------------------|
| 5.0         |                  |                  |                      |                   | <b>Direct Entry,</b> |

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**Summary for Reach 4R: OFFSITE STORM SEWER**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.942 ac, 78.18% Impervious, Inflow Depth = 3.10" for 10 YR 24 HR event  
Inflow = 16.00 cfs @ 12.11 hrs, Volume= 0.760 af  
Outflow = 16.00 cfs @ 12.11 hrs, Volume= 0.760 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

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MSE 24-hr 3 10 YR 24 HR Rainfall=4.24"

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**Summary for Pond PT: PRETREATMENT CHAMBER**

[93] Warning: Storage range exceeded by 5.21'

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=7)

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 3.36" for 10 YR 24 HR event  
 Inflow = 15.11 cfs @ 12.11 hrs, Volume= 0.744 af  
 Outflow = 15.11 cfs @ 12.11 hrs, Volume= 0.744 af, Atten= 0%, Lag= 0.0 min  
 Primary = 15.11 cfs @ 12.11 hrs, Volume= 0.744 af

Routed to Pond UI1 : UNDERGROUND INFILTRATION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 823.31' @ 12.11 hrs Storage= 0.001 af

Plug-Flow detention time= 0.9 min calculated for 0.743 af (100% of inflow)

Center-of-Mass det. time= 1.4 min ( 771.5 - 770.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|---------------------|
|--------|--------|---------------|---------------------|

|    |         |          |                                            |
|----|---------|----------|--------------------------------------------|
| #1 | 815.60' | 0.001 af | <b>30.0" Round Pipe Storage</b><br>L= 5.0' |
|----|---------|----------|--------------------------------------------|

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|----------------|
|--------|---------|--------|----------------|

|    |         |         |                                                                                                                                                                                                                                 |
|----|---------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1 | Primary | 816.85' | <b>Custom Weir/Orifice, Cv= 2.62 (C= 3.28)</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90<br>1.00 1.10 1.20 1.25<br>Width (feet) 2.50 2.49 2.46 2.42 2.36 2.29 2.19 2.07 1.92 1.73<br>1.50 1.19 0.70 0.00 |
| #2 | Primary | 816.85' | <b>6.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads                                                                                                                                                     |
| #3 | Primary | 815.85' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #4 | Primary | 816.10' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #5 | Primary | 816.35' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #6 | Primary | 816.60' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |

Primary OutFlow Max=14.57 cfs @ 12.11 hrs HW=823.03' TW=821.78' (Dynamic Tailwater)

1=Custom Weir/Orifice (Orifice Controls 13.40 cfs @ 5.49 fps)  
 2=Orifice/Grate (Orifice Controls 1.06 cfs @ 5.38 fps)  
 3=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.38 fps)  
 4=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.38 fps)  
 5=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.38 fps)  
 6=Orifice/Grate (Orifice Controls 0.03 cfs @ 5.38 fps)

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**Summary for Pond UI1: UNDERGROUND INFILTRATION**

[93] Warning: Storage range exceeded by 3.38'

[80] Warning: Exceeded Pond PT by 0.27' @ 24.15 hrs (6.67 cfs 2.368 af)

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 3.36" for 10 YR 24 HR event

Inflow = 15.11 cfs @ 12.11 hrs, Volume= 0.744 af

Outflow = 15.11 cfs @ 12.11 hrs, Volume= 0.744 af, Atten= 0%, Lag= 0.0 min

Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.025 af

Primary = 15.10 cfs @ 12.11 hrs, Volume= 0.719 af

Routed to Reach 4R : OFFSITE STORM SEWER

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 821.98' @ 12.11 hrs Surf.Area= 0.008 ac Storage= 0.018 af

Plug-Flow detention time= 54.3 min calculated for 0.743 af (100% of inflow)

Center-of-Mass det. time= 55.1 min ( 826.7 - 771.6 )

| Volume | Invert  | Avail.Storage | Storage Description                                                                                                                                                                                                    |
|--------|---------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1A    | 814.60' | 0.010 af      | <b>14.00'W x 26.00'L x 4.00'H Field A</b><br>0.033 af Overall - 0.008 af Embedded = 0.025 af x 40.0% Voids                                                                                                             |
| #2A    | 815.10' | 0.008 af      | <b>CMP Round 36 x 2 Inside #1</b><br>Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf<br>Overall Size= 36.0"W x 36.0"H x 20.00'L<br>2 Chambers in 2 Rows<br>9.00' Header x 7.07 sf x 1 = 63.6 cf Inside |
|        |         | 0.018 af      | Total Available Storage                                                                                                                                                                                                |

Storage Group A created with Chamber Wizard

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                         |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 818.10' | <b>18.0" Round Culvert</b> L= 80.0' Ke= 0.500<br>Inlet / Outlet Invert= 818.10' / 816.60' S= 0.0187 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf |
| #2     | Discarded | 814.60' | <b>0.450 in/hr Exfiltration over Surface area</b><br>Conductivity to Groundwater Elevation = 800.00'                                                                   |

**Discarded OutFlow** Max=0.01 cfs @ 12.11 hrs HW=821.79' (Free Discharge)↑ **2=Exfiltration** ( Controls 0.01 cfs)**Primary OutFlow** Max=14.56 cfs @ 12.11 hrs HW=821.78' TW=0.00' (Dynamic Tailwater)↑ **1=Culvert** (Inlet Controls 14.56 cfs @ 8.24 fps)

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**Pond UI1: UNDERGROUND INFILTRATION - Chamber Wizard Field A**

**Chamber Model = CMP Round 36 (Round Corrugated Metal Pipe)**

Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf

Overall Size= 36.0"W x 36.0"H x 20.00'L

36.0" Wide + 36.0" Spacing = 72.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +3.00' Header x 1 = 23.00' Row Length +18.0" End Stone x 2 = 26.00'  
Base Length

2 Rows x 36.0" Wide + 36.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width

6.0" Stone Base + 36.0" Chamber Height + 6.0" Stone Cover = 4.00' Field Height

2 Chambers x 141.4 cf + 9.00' Header x 7.07 sf = 346.4 cf Chamber Storage

1,456.0 cf Field - 346.4 cf Chambers = 1,109.6 cf Stone x 40.0% Voids = 443.9 cf Stone Storage

Chamber Storage + Stone Storage = 790.2 cf = 0.018 af

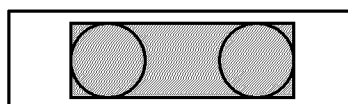
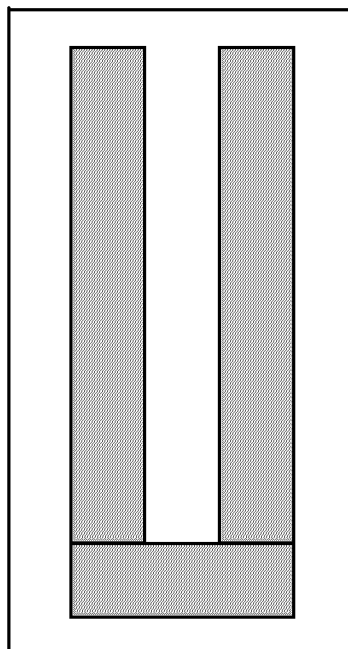
Overall Storage Efficiency = 54.3%

Overall System Size = 26.00' x 14.00' x 4.00'

2 Chambers

53.9 cy Field

41.1 cy Stone



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Time span=0.00-100.00 hrs, dt=0.05 hrs, 2001 points x 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1P: 1P BUILDING**

Runoff Area=0.258 ac 93.80% Impervious Runoff Depth=6.96"

Tc=5.0 min CN=96 Runoff=2.84 cfs 0.150 af

**Subcatchment2P: 2P TO STREET**

Runoff Area=0.288 ac 32.64% Impervious Runoff Depth=4.32"

Tc=5.0 min CN=73 Runoff=2.27 cfs 0.104 af

**Subcatchment3P: 3P CENTRAL PARKING**

Runoff Area=1.201 ac 93.92% Impervious Runoff Depth=6.96"

Tc=5.0 min CN=96 Runoff=13.22 cfs 0.697 af

**Subcatchment4P: 4P SOUTH PARKING**

Runoff Area=1.195 ac 69.96% Impervious Runoff Depth=5.91"

Tc=5.0 min CN=87 Runoff=12.13 cfs 0.588 af

**Reach 4R: OFFSITE STORM SEWER**

Inflow=30.43 cfs 1.513 af

Outflow=30.43 cfs 1.513 af

**Pond PT: PRETREATMENT CHAMBER**

Peak Elev=834.39' Storage=0.001 af Inflow=28.18 cfs 1.435 af

Outflow=28.19 cfs 1.435 af

**Pond UI1: UNDERGROUND INFILTRATION**

Peak Elev=829.74' Storage=0.018 af Inflow=28.19 cfs 1.435 af

Discarded=0.01 cfs 0.026 af Primary=28.16 cfs 1.409 af Outflow=28.17 cfs 1.435 af

**Total Runoff Area = 2.942 ac Runoff Volume = 1.538 af Average Runoff Depth = 6.27"****21.82% Pervious = 0.642 ac 78.18% Impervious = 2.300 ac**

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MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"

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**Summary for Subcatchment 1P: 1P BUILDING**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.84 cfs @ 12.11 hrs, Volume= 0.150 af, Depth= 6.96"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.016     | 61 | >75% Grass cover, Good, HSG B |
| 0.242     | 98 | Paved parking, HSG B          |
| 0.258     | 96 | Weighted Average              |
| 0.016     |    | 6.20% Pervious Area           |
| 0.242     |    | 93.80% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |



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*MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"*

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**Summary for Subcatchment 2P: 2P TO STREET**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 2.27 cfs @ 12.12 hrs, Volume= 0.104 af, Depth= 4.32"  
Routed to Reach 4R : OFFSITE STORM SEWER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt= 0.05$  hrs  
MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.194     | 61 | >75% Grass cover, Good, HSG B |
| 0.094     | 98 | Paved parking, HSG B          |
| 0.288     | 73 | Weighted Average              |
| 0.194     |    | 67.36% Pervious Area          |
| 0.094     |    | 32.64% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description          |
|-------------|------------------|------------------|----------------------|-------------------|----------------------|
| 5.0         |                  |                  |                      |                   | <b>Direct Entry,</b> |

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**Summary for Subcatchment 3P: 3P CENTRAL PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 13.22 cfs @ 12.11 hrs, Volume= 0.697 af, Depth= 6.96"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt=0.05$  hrs  
MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.073     | 61 | >75% Grass cover, Good, HSG B |
| 1.128     | 98 | Paved parking, HSG B          |
| 1.201     | 96 | Weighted Average              |
| 0.073     |    | 6.08% Pervious Area           |
| 1.128     |    | 93.92% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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**Summary for Subcatchment 4P: 4P SOUTH PARKING**

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 12.13 cfs @ 12.11 hrs, Volume= 0.588 af, Depth= 5.91"  
Routed to Pond PT : PRETREATMENT CHAMBER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs,  $dt=0.05$  hrs  
MSE 24-hr 3 100 YR 24 HR Rainfall=7.44"

| Area (ac) | CN | Description                   |
|-----------|----|-------------------------------|
| 0.359     | 61 | >75% Grass cover, Good, HSG B |
| 0.836     | 98 | Paved parking, HSG B          |
| 1.195     | 87 | Weighted Average              |
| 0.359     |    | 30.04% Pervious Area          |
| 0.836     |    | 69.96% Impervious Area        |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 5.0         |                  |                  |                      |                   | Direct Entry, |

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**Summary for Reach 4R: OFFSITE STORM SEWER**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.942 ac, 78.18% Impervious, Inflow Depth = 6.17" for 100 YR 24 HR event  
Inflow = 30.43 cfs @ 12.11 hrs, Volume= 1.513 af  
Outflow = 30.43 cfs @ 12.11 hrs, Volume= 1.513 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

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**Summary for Pond PT: PRETREATMENT CHAMBER**

[93] Warning: Storage range exceeded by 16.29'

[90] Warning: Qout&gt;Qin may require smaller dt or Finer Routing

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 6.49" for 100 YR 24 HR event  
 Inflow = 28.18 cfs @ 12.11 hrs, Volume= 1.435 af  
 Outflow = 28.19 cfs @ 12.11 hrs, Volume= 1.435 af, Atten= 0%, Lag= 0.0 min  
 Primary = 28.19 cfs @ 12.11 hrs, Volume= 1.435 af  
 Routed to Pond UI1 : UNDERGROUND INFILTRATION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3  
 Peak Elev= 834.39' @ 12.11 hrs Storage= 0.001 af

Plug-Flow detention time= 1.5 min calculated for 1.435 af (100% of inflow)  
 Center-of-Mass det. time= 0.8 min ( 760.0 - 759.2 )

| Volume | Invert  | Avail.Storage | Storage Description                        |
|--------|---------|---------------|--------------------------------------------|
| #1     | 815.60' | 0.001 af      | <b>30.0" Round Pipe Storage</b><br>L= 5.0' |

| Device | Routing | Invert  | Outlet Devices                                                                                                                                                                                                                  |
|--------|---------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 816.85' | <b>Custom Weir/Orifice, Cv= 2.62 (C= 3.28)</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90<br>1.00 1.10 1.20 1.25<br>Width (feet) 2.50 2.49 2.46 2.42 2.36 2.29 2.19 2.07 1.92 1.73<br>1.50 1.19 0.70 0.00 |
| #2     | Primary | 816.85' | <b>6.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads                                                                                                                                                     |
| #3     | Primary | 815.85' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #4     | Primary | 816.10' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #5     | Primary | 816.35' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |
| #6     | Primary | 816.60' | <b>0.5" Vert. Orifice/Grate X 4.00</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                            |

**Primary OutFlow** Max=27.24 cfs @ 12.11 hrs HW=833.45' TW=829.08' (Dynamic Tailwater)

- 1=Custom Weir/Orifice (Orifice Controls 25.04 cfs @ 10.27 fps)
- 2=Orifice/Grate (Orifice Controls 1.98 cfs @ 10.06 fps)
- 3=Orifice/Grate (Orifice Controls 0.05 cfs @ 10.06 fps)
- 4=Orifice/Grate (Orifice Controls 0.05 cfs @ 10.06 fps)
- 5=Orifice/Grate (Orifice Controls 0.05 cfs @ 10.06 fps)
- 6=Orifice/Grate (Orifice Controls 0.05 cfs @ 10.06 fps)

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**Summary for Pond UI1: UNDERGROUND INFILTRATION**

[93] Warning: Storage range exceeded by 11.14'

[80] Warning: Exceeded Pond PT by 0.10' @ 24.25 hrs (4.06 cfs 1.971 af)

Inflow Area = 2.654 ac, 83.12% Impervious, Inflow Depth = 6.49" for 100 YR 24 HR event

Inflow = 28.19 cfs @ 12.11 hrs, Volume= 1.435 af

Outflow = 28.17 cfs @ 12.11 hrs, Volume= 1.435 af, Atten= 0%, Lag= 0.0 min

Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.026 af

Primary = 28.16 cfs @ 12.11 hrs, Volume= 1.409 af

Routed to Reach 4R : OFFSITE STORM SEWER

Routing by Dyn-Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 829.74' @ 12.11 hrs Surf.Area= 0.008 ac Storage= 0.018 af

Plug-Flow detention time= 29.2 min calculated for 1.434 af (100% of inflow)

Center-of-Mass det. time= 30.3 min ( 790.3 - 760.1 )

| Volume | Invert  | Avail.Storage | Storage Description                                                                                                                                                                                                    |
|--------|---------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1A    | 814.60' | 0.010 af      | <b>14.00'W x 26.00'L x 4.00'H Field A</b><br>0.033 af Overall - 0.008 af Embedded = 0.025 af x 40.0% Voids                                                                                                             |
| #2A    | 815.10' | 0.008 af      | <b>CMP Round 36 x 2 Inside #1</b><br>Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf<br>Overall Size= 36.0"W x 36.0"H x 20.00'L<br>2 Chambers in 2 Rows<br>9.00' Header x 7.07 sf x 1 = 63.6 cf Inside |
|        |         | 0.018 af      | Total Available Storage                                                                                                                                                                                                |

Storage Group A created with Chamber Wizard

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                         |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 818.10' | <b>18.0" Round Culvert</b> L= 80.0' Ke= 0.500<br>Inlet / Outlet Invert= 818.10' / 816.60' S= 0.0187 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf |
| #2     | Discarded | 814.60' | <b>0.450 in/hr Exfiltration over Surface area</b><br>Conductivity to Groundwater Elevation = 800.00'                                                                   |

**Discarded OutFlow** Max=0.01 cfs @ 12.11 hrs HW=829.12' (Free Discharge)↑ **2=Exfiltration** ( Controls 0.01 cfs)**Primary OutFlow** Max=27.21 cfs @ 12.11 hrs HW=829.08' TW=0.00' (Dynamic Tailwater)↑ **1=Culvert** (Inlet Controls 27.21 cfs @ 15.40 fps)

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**Pond UI1: UNDERGROUND INFILTRATION - Chamber Wizard Field A**

**Chamber Model = CMP Round 36 (Round Corrugated Metal Pipe)**

Effective Size= 36.0"W x 36.0"H => 7.07 sf x 20.00'L = 141.4 cf

Overall Size= 36.0"W x 36.0"H x 20.00'L

36.0" Wide + 36.0" Spacing = 72.0" C-C Row Spacing

1 Chambers/Row x 20.00' Long +3.00' Header x 1 = 23.00' Row Length +18.0" End Stone x 2 = 26.00'  
Base Length

2 Rows x 36.0" Wide + 36.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width

6.0" Stone Base + 36.0" Chamber Height + 6.0" Stone Cover = 4.00' Field Height

2 Chambers x 141.4 cf + 9.00' Header x 7.07 sf = 346.4 cf Chamber Storage

1,456.0 cf Field - 346.4 cf Chambers = 1,109.6 cf Stone x 40.0% Voids = 443.9 cf Stone Storage

Chamber Storage + Stone Storage = 790.2 cf = 0.018 af

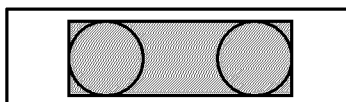
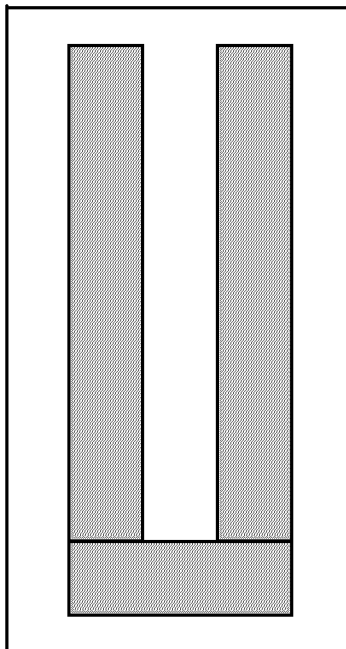
Overall Storage Efficiency = 54.3%

Overall System Size = 26.00' x 14.00' x 4.00'

2 Chambers

53.9 cy Field

41.1 cy Stone



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**Stage-Area-Storage for Pond UI1: UNDERGROUND INFILTRATION**

| Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) | Elevation<br>(feet) | Surface<br>(acres) | Storage<br>(acre-feet) |
|---------------------|--------------------|------------------------|---------------------|--------------------|------------------------|
| 814.60              | <b>0.008</b>       | 0.000                  | 825.00              | 0.008              | 0.018                  |
| 814.80              | 0.008              | 0.001                  | 825.20              | 0.008              | 0.018                  |
| 815.00              | 0.008              | 0.001                  | 825.40              | 0.008              | 0.018                  |
| 815.20              | 0.008              | 0.002                  | 825.60              | 0.008              | 0.018                  |
| 815.40              | 0.008              | 0.003                  | 825.80              | 0.008              | 0.018                  |
| 815.60              | 0.008              | 0.004                  | 826.00              | 0.008              | 0.018                  |
| 815.80              | 0.008              | 0.005                  | 826.20              | 0.008              | 0.018                  |
| 816.00              | 0.008              | 0.006                  | 826.40              | 0.008              | 0.018                  |
| 816.20              | 0.008              | 0.007                  | 826.60              | 0.008              | 0.018                  |
| 816.40              | 0.008              | 0.008                  | 826.80              | 0.008              | 0.018                  |
| 816.60              | 0.008              | 0.009                  | 827.00              | 0.008              | 0.018                  |
| 816.80              | 0.008              | 0.010                  | 827.20              | 0.008              | 0.018                  |
| 817.00              | 0.008              | 0.011                  | 827.40              | 0.008              | 0.018                  |
| 817.20              | 0.008              | 0.012                  | 827.60              | 0.008              | 0.018                  |
| 817.40              | 0.008              | 0.013                  | 827.80              | 0.008              | 0.018                  |
| 817.60              | 0.008              | 0.014                  | 828.00              | 0.008              | 0.018                  |
| 817.80              | 0.008              | 0.015                  | 828.20              | 0.008              | 0.018                  |
| 818.00              | 0.008              | 0.016                  | 828.40              | 0.008              | 0.018                  |
| 818.20              | 0.008              | 0.017                  | 828.60              | 0.008              | 0.018                  |
| 818.40              | 0.008              | 0.017                  | 828.80              | 0.008              | 0.018                  |
| 818.60              | 0.008              | <b>0.018</b>           | 829.00              | 0.008              | 0.018                  |
| 818.80              | 0.008              | <b>0.018</b>           | 829.20              | 0.008              | 0.018                  |
| 819.00              | 0.008              | 0.018                  | 829.40              | 0.008              | 0.018                  |
| 819.20              | 0.008              | 0.018                  | 829.60              | 0.008              | 0.018                  |
| 819.40              | 0.008              | 0.018                  |                     |                    |                        |
| 819.60              | 0.008              | 0.018                  |                     |                    |                        |
| 819.80              | 0.008              | 0.018                  |                     |                    |                        |
| 820.00              | 0.008              | 0.018                  |                     |                    |                        |
| 820.20              | 0.008              | 0.018                  |                     |                    |                        |
| 820.40              | 0.008              | 0.018                  |                     |                    |                        |
| 820.60              | 0.008              | 0.018                  |                     |                    |                        |
| 820.80              | 0.008              | 0.018                  |                     |                    |                        |
| 821.00              | 0.008              | 0.018                  |                     |                    |                        |
| 821.20              | 0.008              | 0.018                  |                     |                    |                        |
| 821.40              | 0.008              | 0.018                  |                     |                    |                        |
| 821.60              | 0.008              | 0.018                  |                     |                    |                        |
| 821.80              | 0.008              | 0.018                  |                     |                    |                        |
| 822.00              | 0.008              | 0.018                  |                     |                    |                        |
| 822.20              | 0.008              | 0.018                  |                     |                    |                        |
| 822.40              | 0.008              | 0.018                  |                     |                    |                        |
| 822.60              | 0.008              | 0.018                  |                     |                    |                        |
| 822.80              | 0.008              | 0.018                  |                     |                    |                        |
| 823.00              | 0.008              | 0.018                  |                     |                    |                        |
| 823.20              | 0.008              | 0.018                  |                     |                    |                        |
| 823.40              | 0.008              | 0.018                  |                     |                    |                        |
| 823.60              | 0.008              | 0.018                  |                     |                    |                        |
| 823.80              | 0.008              | 0.018                  |                     |                    |                        |
| 824.00              | 0.008              | 0.018                  |                     |                    |                        |
| 824.20              | 0.008              | 0.018                  |                     |                    |                        |
| 824.40              | 0.008              | 0.018                  |                     |                    |                        |
| 824.60              | 0.008              | 0.018                  |                     |                    |                        |
| 824.80              | 0.008              | 0.018                  |                     |                    |                        |