

PL202000231



Stormwater Management Plan

Roers Bloomington Senior Apartments
Bloomington, MN

Prepared by Loucks
December 21, 2020

Loucks Project No. 20458.0A

Roers Bloomington Senior Apartments
Bloomington, Minnesota

Stormwater Management Plan
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Roers Bloomington Senior Apartments
Bloomington, Minnesota

Stormwater Management Plan

Introduction

This stormwater management plan was created for Roers Bloomington Senior Apartments located at 8131 34th Avenue South in Bloomington, Minnesota.

The project site is approximately 2.48± acres. The project consists of constructing a senior apartment building with surface and below grade parking. All necessary utilities, pavements and landscape features will be included in the design.

Methodology

City of Bloomington and Lower Minnesota River Watershed District

1. Rate Control
 - a. Peak rates shall not increase from existing conditions for the 2-yr, 10-yr, and 100-yr storm events.
2. Water Quality
 - a. No net increase from existing discharge of total suspended solids (TSS)
 - b. No net increase from existing discharge of total phosphorus (TP).
3. Volume Reduction
 - a. Provide for the abstraction onsite of 1.1 inches of runoff from impervious surfaces.

The stormwater calculations were made utilizing the stormwater-modeling program HydroCAD 10.00. Calculations were performed for the Type II 24-hour 100-year rainfall events per ATLAS 14, 2-year, 10-year, and 100-year rainfall events of 2.86 inches, 4.26 inches, and 7.32 inches respectively to meet the city and watershed requirements.

Existing Conditions

The existing site is currently a parking lot. There are no stormwater BMP's or treatment devices on the existing site. The existing site will be broken up into 3 drainage areas. Drainage area DA-1E drains to the north existing storm sewer. Drainage area DA-2E drains to the storm sewer that drains to the south. The third and final drainage area DA-3E is the drainage area that drains directly to the bluff.

Proposed Conditions

The proposed site consists of constructing an apartment building with underground parking, surface pavements and associated utilities. The proposed plan is to break the site up into four drainage areas. Drainage area DA-1P is the area that will continue to drain to the north storm sewer. Drainage area DA-2P is the drainage area that will drain to the proposed underground storm vault. Drainage area DA-3P is the portion of the site that will drain to the storm sewer on the south side of the site. Drainage Area DA-4P is the area that will drain directly to the bluff.

Below are the peak discharge rates of the existing area and the newly proposed area.

Table 1.1 – Existing Peak Runoff Rates

Previously Designed Conditions					
			2-YR Event	10-YR Event	100-YR Event
Subcatch	Area (SF)	Impervious (SF)	Rate (cfs)	Rate (cfs)	Rate (cfs)
DA-1E	17,763	16,342	1.38	2.12	3.70
DA-2E	48,806	39,638	3.48	5.54	9.97
DA-3E	41,950	0	1.32	3.04	7.42
Total EXISTING	108,519	55,980	6.05	10.38	20.28

Table 1.2 – Proposed Peak Runoff Rates

Proposed Conditions					
			2-YR Event	10-YR Event	100-YR Event
Subcatch	Area (SF)	Impervious (SF)	Rate (cfs)	Rate (cfs)	Rate (cfs)
DA-1P	19,078	16,434	1.45	2.24	3.95
Storm Vault	45,506	44,866	0.13	0.13	3.04
DA-3P	4,070	1,291	0.22	0.41	0.86
DA-4P	39,225	0	1.24	2.84	6.93
Total PROPOSED	108,519	62,591	2.96	5.46	12.42

Volume Control

The proposed infiltration basins are designed to meet the requirement of retaining 1.1 inch of rainfall over the impervious surfaces of the development with a maximum drawdown time of 48 hours. The calculations for the required volumes are:

Required Volume (ft³) = Impervious Surfaces (SF) * 1.1 (in) * TP Removal Factor * 1/12 (ft/in)
 Required Volume (ft³) = 62,591(SF) * 1.1 (in) * 1 * 1/12 (ft/in) = 5,738 CF

Volume Provided: Proposed Storm Vault = 8,740 CF

The volume below the outlet meets the required volume of 8,738 cubic-feet.

These volumes will drawdown in less than 48 hours. The calculations for the drawdown time are shown below:

$$\begin{aligned} \text{Allowable Depth for 48 Hour Drawdown} &= \text{Infiltration Rate (in/hr)} * 1/12 \text{ (ft/in)} * 48 \text{ hr} \\ \text{Allowable Depth for 48 Hour Drawdown} &= 0.8 \text{ (in/hr)} * 1/12 \text{ (ft/in)} * 48 \text{ hr} = 3.2 \text{ ft} \end{aligned}$$

Water Quality

The City and Watershed require no net increase from existing discharges of total suspended solids (TSS) and total phosphorus (TP). Table 1.3 below summarizes the existing and proposed conditions, showing no increase in TSS or TP discharging from the site.

Table 1.3 – Annual Load Summary

Load Type	Existing Discharge (lbs)	Proposed Discharge (lbs)
TSS	523.80	268.8
TP (Particulate)	1.586	0.814

NO-NET INCREASE APPLIES TO NEW DEVELOPMENT. REDEVELOPMENT REQUIRES 60% REMOVAL FOR TP AND 90% FOR TSS.

Best Management Practices

Best management practices (BMP's) will be implemented during construction per the project Stormwater Pollution Prevention Plan (SWPPP). The final SWPPP will be prepared as part of the construction documents as required and updated as the development occurs. Proposed BMP's will minimize erosion and manage sedimentation as required by the National Pollution Discharge Elimination System (NPDES). During construction, erosion control measures will include dust control, silt fencing, inlet protection, a temporary rock construction entrance, and a concrete wash-out area. Permanent BMP's will include filtration systems and surface paving of disturbed areas.

Conclusion

The proposed Stormwater Management Plan for the Roers Project is designed to meet the City and Watershed District stormwater requirements. The plan provides an improved solution for the conveyance of stormwater from this site by reducing peak runoff rates to below existing conditions. On-site filtration will meet the requirement for quality control.

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Appendix A

Existing HydroCAD Report

EXISTING SITE



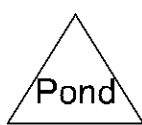
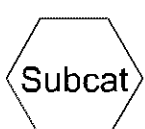
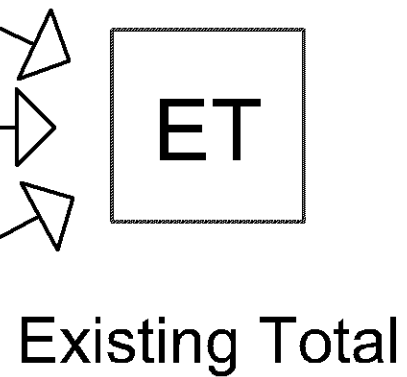
Drainage Area to the North



Drainage Area to the South Storm Sewer



Drainage Area to Bluff



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1E: Drainage Area to the North

Runoff Area=17,763 sf 92.00% Impervious Runoff Depth=2.41"
Tc=10.0 min CN=96 Runoff=1.38 cfs 0.082 af

Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff Area=48,806 sf 81.22% Impervious Runoff Depth=2.12"
Tc=10.0 min CN=93 Runoff=3.48 cfs 0.198 af

Subcatchment DA-3E: Drainage Area to Bluff

Runoff Area=41,950 sf 0.00% Impervious Runoff Depth=0.77"
Tc=5.0 min CN=73 Runoff=1.32 cfs 0.062 af

Reach ET: Existing Total

Inflow=6.05 cfs 0.342 af
Outflow=6.05 cfs 0.342 af

Total Runoff Area = 2.491 ac Runoff Volume = 0.342 af Average Runoff Depth = 1.65"
48.41% Pervious = 1.206 ac 51.59% Impervious = 1.285 ac

Summary for Subcatchment DA-1E: Drainage Area to the North

Runoff = 1.38 cfs @ 12.17 hrs, Volume= 0.082 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
16,342	98	Paved roads w/curbs & sewers, HSG A
1,421	74	>75% Grass cover, Good, HSG C
17,763	96	Weighted Average
1,421		8.00% Pervious Area
16,342		92.00% Impervious Area

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

Summary for Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff = 3.48 cfs @ 12.17 hrs, Volume= 0.198 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
39,638	98	Paved roads w/curbs & sewers, HSG A
9,168	74	>75% Grass cover, Good, HSG C
48,806	93	Weighted Average
9,168		18.78% Pervious Area
39,638		81.22% Impervious Area

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

Summary for Subcatchment DA-3E: Drainage Area to Bluff

Runoff = 1.32 cfs @ 12.13 hrs, Volume= 0.062 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
41,950	73	Woods, Fair, HSG C
41,950		100.00% Pervious Area

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

Summary for Reach ET: Existing Total

Inflow Area = 2.491 ac, 51.59% Impervious, Inflow Depth = 1.65" for 2-Year event
Inflow = 6.05 cfs @ 12.16 hrs, Volume= 0.342 af
Outflow = 6.05 cfs @ 12.16 hrs, Volume= 0.342 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1E: Drainage Area to the North

Runoff Area=17,763 sf 92.00% Impervious Runoff Depth=3.80"
Tc=10.0 min CN=96 Runoff=2.12 cfs 0.129 af

Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff Area=48,806 sf 81.22% Impervious Runoff Depth=3.47"
Tc=10.0 min CN=93 Runoff=5.54 cfs 0.324 af

Subcatchment DA-3E: Drainage Area to Bluff

Runoff Area=41,950 sf 0.00% Impervious Runoff Depth=1.72"
Tc=5.0 min CN=73 Runoff=3.04 cfs 0.138 af

Reach ET: Existing Total

Inflow=10.38 cfs 0.591 af
Outflow=10.38 cfs 0.591 af

Total Runoff Area = 2.491 ac Runoff Volume = 0.591 af Average Runoff Depth = 2.85"
48.41% Pervious = 1.206 ac 51.59% Impervious = 1.285 ac

Summary for Subcatchment DA-1E: Drainage Area to the North

Runoff = 2.12 cfs @ 12.17 hrs, Volume= 0.129 af, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
16,342	98	Paved roads w/curbs & sewers, HSG A
1,421	74	>75% Grass cover, Good, HSG C
17,763	96	Weighted Average
1,421		8.00% Pervious Area
16,342		92.00% Impervious Area

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

Summary for Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff = 5.54 cfs @ 12.17 hrs, Volume= 0.324 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
39,638	98	Paved roads w/curbs & sewers, HSG A
9,168	74	>75% Grass cover, Good, HSG C
48,806	93	Weighted Average
9,168		18.78% Pervious Area
39,638		81.22% Impervious Area

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

Summary for Subcatchment DA-3E: Drainage Area to Bluff

Runoff = 3.04 cfs @ 12.12 hrs, Volume= 0.138 af, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
41,950	73	Woods, Fair, HSG C
41,950		100.00% Pervious Area

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

Summary for Reach ET: Existing Total

Inflow Area = 2.491 ac, 51.59% Impervious, Inflow Depth = 2.85" for 10-Year event
 Inflow = 10.38 cfs @ 12.15 hrs, Volume= 0.591 af
 Outflow = 10.38 cfs @ 12.15 hrs, Volume= 0.591 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1E: Drainage Area to the North

Runoff Area=17,763 sf 92.00% Impervious Runoff Depth=6.84"
Tc=10.0 min CN=96 Runoff=3.70 cfs 0.233 af

Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff Area=48,806 sf 81.22% Impervious Runoff Depth=6.49"
Tc=10.0 min CN=93 Runoff=9.97 cfs 0.606 af

Subcatchment DA-3E: Drainage Area to Bluff

Runoff Area=41,950 sf 0.00% Impervious Runoff Depth=4.21"
Tc=5.0 min CN=73 Runoff=7.42 cfs 0.338 af

Reach ET: Existing Total

Inflow=20.28 cfs 1.176 af
Outflow=20.28 cfs 1.176 af

Total Runoff Area = 2.491 ac Runoff Volume = 1.176 af Average Runoff Depth = 5.67"
48.41% Pervious = 1.206 ac 51.59% Impervious = 1.285 ac

Summary for Subcatchment DA-1E: Drainage Area to the North

Runoff = 3.70 cfs @ 12.17 hrs, Volume= 0.233 af, Depth= 6.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
16,342	98	Paved roads w/curbs & sewers, HSG A
1,421	74	>75% Grass cover, Good, HSG C
17,763	96	Weighted Average
1,421		8.00% Pervious Area
16,342		92.00% Impervious Area

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

Summary for Subcatchment DA-2E: Drainage Area to the South Storm Sewer

Runoff = 9.97 cfs @ 12.17 hrs, Volume= 0.606 af, Depth= 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
39,638	98	Paved roads w/curbs & sewers, HSG A
9,168	74	>75% Grass cover, Good, HSG C
48,806	93	Weighted Average
9,168		18.78% Pervious Area
39,638		81.22% Impervious Area

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

Summary for Subcatchment DA-3E: Drainage Area to Bluff

Runoff = 7.42 cfs @ 12.12 hrs, Volume= 0.338 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
41,950	73	Woods, Fair, HSG C
41,950		100.00% Pervious Area

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

Summary for Reach ET: Existing Total

Inflow Area = 2.491 ac, 51.59% Impervious, Inflow Depth = 5.67" for 100-Year event
Inflow = 20.28 cfs @ 12.15 hrs, Volume= 1.176 af
Outflow = 20.28 cfs @ 12.15 hrs, Volume= 1.176 af, Atten= 0%, Lag= 0.0 min

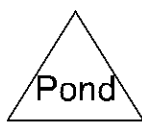
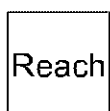
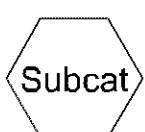
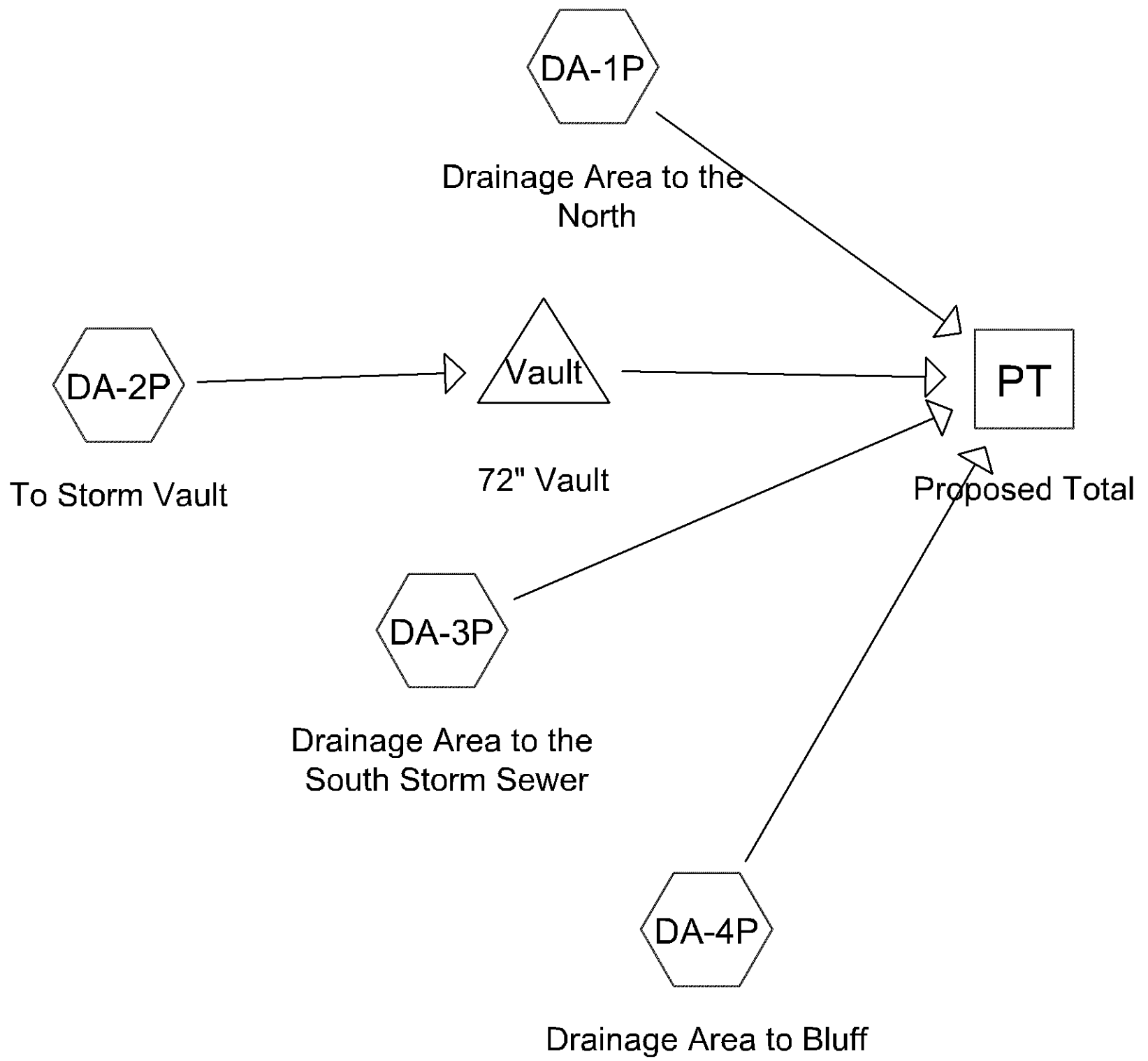
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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Appendix B

Proposed HydroCAD Report

PROPOSED SITE



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1P: Drainage Area to the North	Runoff Area=19,078 sf 86.14% Impervious Runoff Depth=2.31" Tc=10.0 min CN=95 Runoff=1.45 cfs 0.084 af
Subcatchment DA-2P: To Storm Vault	Runoff Area=45,506 sf 98.59% Impervious Runoff Depth=2.63" Tc=5.0 min CN=98 Runoff=4.39 cfs 0.229 af
Subcatchment DA-3P: Drainage Area to the South Storm Sewer	Runoff Area=4,070 sf 31.72% Impervious Runoff Depth=1.27" Tc=5.0 min CN=82 Runoff=0.22 cfs 0.010 af
Subcatchment DA-4P: Drainage Area to Bluff	Runoff Area=39,225 sf 0.00% Impervious Runoff Depth=0.77" Tc=5.0 min CN=73 Runoff=1.24 cfs 0.058 af
Reach PT: Proposed Total	Inflow=2.96 cfs 0.381 af Outflow=2.96 cfs 0.381 af
Pond Vault: 72" Vault	Peak Elev=805.66' Storage=6,422 cf Inflow=4.39 cfs 0.229 af Outflow=0.13 cfs 0.229 af

Total Runoff Area = 2.477 ac Runoff Volume = 0.381 af Average Runoff Depth = 1.85"
41.98% Pervious = 1.040 ac 58.02% Impervious = 1.437 ac

Summary for Subcatchment DA-1P: Drainage Area to the North

Runoff = 1.45 cfs @ 12.17 hrs, Volume= 0.084 af, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
16,434	98	Paved roads w/curbs & sewers, HSG A
2,644	74	>75% Grass cover, Good, HSG C
19,078	95	Weighted Average
2,644		13.86% Pervious Area
16,434		86.14% Impervious Area

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

Summary for Subcatchment DA-2P: To Storm Vault

Runoff = 4.39 cfs @ 12.11 hrs, Volume= 0.229 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
44,866	98	Unconnected roofs, HSG A
640	74	>75% Grass cover, Good, HSG C
45,506	98	Weighted Average
640		1.41% Pervious Area
44,866		98.59% Impervious Area
44,866		100.00% Unconnected

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

Summary for Subcatchment DA-3P: Drainage Area to the South Storm Sewer

Runoff = 0.22 cfs @ 12.12 hrs, Volume= 0.010 af, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
1,291	98	Unconnected roofs, HSG A
2,779	74	>75% Grass cover, Good, HSG C
4,070	82	Weighted Average
2,779		68.28% Pervious Area
1,291		31.72% Impervious Area
1,291		100.00% Unconnected

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

Summary for Subcatchment DA-4P: Drainage Area to Bluff

Runoff = 1.24 cfs @ 12.13 hrs, Volume= 0.058 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-Year Rainfall=2.86"

Area (sf)	CN	Description
39,225	73	Woods, Fair, HSG C
39,225		100.00% Pervious Area

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

Summary for Reach PT: Proposed Total

Inflow Area = 2.477 ac, 58.02% Impervious, Inflow Depth = 1.85" for 2-Year event
Inflow = 2.96 cfs @ 12.14 hrs, Volume= 0.381 af
Outflow = 2.96 cfs @ 12.14 hrs, Volume= 0.381 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Roers Bloomington

Prepared by {enter your company name here}

Printed 12/21/2020

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Summary for Pond Vault: 72" Vault

Inflow Area = 1.045 ac, 98.59% Impervious, Inflow Depth = 2.63" for 2-Year event
 Inflow = 4.39 cfs @ 12.11 hrs, Volume= 0.229 af
 Outflow = 0.13 cfs @ 12.00 hrs, Volume= 0.229 af, Atten= 97%, Lag= 0.0 min
 Primary = 0.13 cfs @ 12.00 hrs, Volume= 0.229 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 805.66' @ 13.60 hrs Surf.Area= 7,276 sf Storage= 6,422 cf

Plug-Flow detention time= 468.8 min calculated for 0.229 af (100% of inflow)
 Center-of-Mass det. time= 468.4 min (1,221.2 - 752.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	803.70'	5,323 cf	17.00'W x 214.00'L x 7.00'H Field A 25,466 cf Overall - 12,158 cf Embedded = 13,308 cf x 40.0% Voids
#2A	804.20'	12,158 cf	CMP Round 72 x 20 Inside #1 Effective Size= 72.0"W x 72.0"H => 28.27 sf x 20.00'L = 565.5 cf Overall Size= 72.0"W x 72.0"H x 20.00'L 20 Chambers in 2 Rows 15.00' Header x 28.27 sf x 2 = 848.2 cf Inside
#3	801.70'	2,183 cf	17.00'W x 214.00'L x 2.00'H Prismatic 7,276 cf Overall x 30.0% Voids
		19,664 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	801.70'	12.0" Round Culvert L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 801.70' / 801.20' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	801.70'	0.800 in/hr Exfiltration over Surface area
#3	Device 1	807.20'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 12.00 hrs HW=803.85' (Free Discharge)

- 1=Culvert (Passes 0.13 cfs of 4.63 cfs potential flow)
- 2=Exfiltration (Exfiltration Controls 0.13 cfs)
- 3=Orifice/Grate (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1P: Drainage Area to the North	Runoff Area=19,078 sf 86.14% Impervious Runoff Depth=3.69" Tc=10.0 min CN=95 Runoff=2.24 cfs 0.135 af
Subcatchment DA-2P: To Storm Vault	Runoff Area=45,506 sf 98.59% Impervious Runoff Depth=4.02" Tc=5.0 min CN=98 Runoff=6.60 cfs 0.350 af
Subcatchment DA-3P: Drainage Area to the South Storm Sewer	Runoff Area=4,070 sf 31.72% Impervious Runoff Depth=2.43" Tc=5.0 min CN=82 Runoff=0.41 cfs 0.019 af
Subcatchment DA-4P: Drainage Area to Bluff	Runoff Area=39,225 sf 0.00% Impervious Runoff Depth=1.72" Tc=5.0 min CN=73 Runoff=2.84 cfs 0.129 af
Reach PT: Proposed Total	Inflow=5.46 cfs 0.633 af Outflow=5.46 cfs 0.633 af
Pond Vault: 72" Vault	Peak Elev=807.07' Storage=10,542 cf Inflow=6.60 cfs 0.350 af Outflow=0.13 cfs 0.350 af

Total Runoff Area = 2.477 ac Runoff Volume = 0.633 af Average Runoff Depth = 3.07"
41.98% Pervious = 1.040 ac 58.02% Impervious = 1.437 ac

Summary for Subcatchment DA-1P: Drainage Area to the North

Runoff = 2.24 cfs @ 12.17 hrs, Volume= 0.135 af, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
16,434	98	Paved roads w/curbs & sewers, HSG A
2,644	74	>75% Grass cover, Good, HSG C
19,078	95	Weighted Average
2,644		13.86% Pervious Area
16,434		86.14% Impervious Area

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

Summary for Subcatchment DA-2P: To Storm Vault

Runoff = 6.60 cfs @ 12.11 hrs, Volume= 0.350 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
44,866	98	Unconnected roofs, HSG A
640	74	>75% Grass cover, Good, HSG C
45,506	98	Weighted Average
640		1.41% Pervious Area
44,866		98.59% Impervious Area
44,866		100.00% Unconnected

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

Summary for Subcatchment DA-3P: Drainage Area to the South Storm Sewer

Runoff = 0.41 cfs @ 12.12 hrs, Volume= 0.019 af, Depth= 2.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
1,291	98	Unconnected roofs, HSG A
2,779	74	>75% Grass cover, Good, HSG C
4,070	82	Weighted Average
2,779		68.28% Pervious Area
1,291		31.72% Impervious Area
1,291		100.00% Unconnected

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

Summary for Subcatchment DA-4P: Drainage Area to Bluff

Runoff = 2.84 cfs @ 12.12 hrs, Volume= 0.129 af, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-Year Rainfall=4.26"

Area (sf)	CN	Description
39,225	73	Woods, Fair, HSG C
39,225		100.00% Pervious Area

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

Summary for Reach PT: Proposed Total

Inflow Area = 2.477 ac, 58.02% Impervious, Inflow Depth = 3.07" for 10-Year event
Inflow = 5.46 cfs @ 12.14 hrs, Volume= 0.633 af
Outflow = 5.46 cfs @ 12.14 hrs, Volume= 0.633 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Roers Bloomington

Prepared by {enter your company name here}

Printed 12/21/2020

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Summary for Pond Vault: 72" Vault

Inflow Area = 1.045 ac, 98.59% Impervious, Inflow Depth = 4.02" for 10-Year event
 Inflow = 6.60 cfs @ 12.11 hrs, Volume= 0.350 af
 Outflow = 0.13 cfs @ 11.75 hrs, Volume= 0.350 af, Atten= 98%, Lag= 0.0 min
 Primary = 0.13 cfs @ 11.75 hrs, Volume= 0.350 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 807.07' @ 15.03 hrs Surf.Area= 7,276 sf Storage= 10,542 cf

Plug-Flow detention time= 734.2 min calculated for 0.350 af (100% of inflow)
 Center-of-Mass det. time= 733.8 min (1,480.3 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	803.70'	5,323 cf	17.00'W x 214.00'L x 7.00'H Field A 25,466 cf Overall - 12,158 cf Embedded = 13,308 cf x 40.0% Voids
#2A	804.20'	12,158 cf	CMP Round 72 x 20 Inside #1 Effective Size= 72.0"W x 72.0"H => 28.27 sf x 20.00'L = 565.5 cf Overall Size= 72.0"W x 72.0"H x 20.00'L 20 Chambers in 2 Rows 15.00' Header x 28.27 sf x 2 = 848.2 cf Inside
#3	801.70'	2,183 cf	17.00'W x 214.00'L x 2.00'H Prismatic 7,276 cf Overall x 30.0% Voids
		19,664 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	801.70'	12.0" Round Culvert L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 801.70' / 801.20' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	801.70'	0.800 in/hr Exfiltration over Surface area
#3	Device 1	807.20'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 11.75 hrs HW=803.81' (Free Discharge)

- 1=Culvert (Passes 0.13 cfs of 4.56 cfs potential flow)
- 2=Exfiltration (Exfiltration Controls 0.13 cfs)
- 3=Orifice/Grate (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA-1P: Drainage Area to the North	Runoff Area=19,078 sf 86.14% Impervious Runoff Depth=6.72" Tc=10.0 min CN=95 Runoff=3.95 cfs 0.245 af
Subcatchment DA-2P: To Storm Vault	Runoff Area=45,506 sf 98.59% Impervious Runoff Depth=7.08" Tc=5.0 min CN=98 Runoff=11.39 cfs 0.616 af
Subcatchment DA-3P: Drainage Area to the South Storm Sewer	Runoff Area=4,070 sf 31.72% Impervious Runoff Depth=5.22" Tc=5.0 min CN=82 Runoff=0.86 cfs 0.041 af
Subcatchment DA-4P: Drainage Area to Bluff	Runoff Area=39,225 sf 0.00% Impervious Runoff Depth=4.21" Tc=5.0 min CN=73 Runoff=6.93 cfs 0.316 af
Reach PT: Proposed Total	Inflow=12.42 cfs 1.219 af Outflow=12.42 cfs 1.219 af
Pond Vault: 72" Vault	Peak Elev=808.29' Storage=14,156 cf Inflow=11.39 cfs 0.616 af Outflow=3.04 cfs 0.616 af

Total Runoff Area = 2.477 ac Runoff Volume = 1.219 af Average Runoff Depth = 5.90"
41.98% Pervious = 1.040 ac 58.02% Impervious = 1.437 ac

Summary for Subcatchment DA-1P: Drainage Area to the North

Runoff = 3.95 cfs @ 12.17 hrs, Volume= 0.245 af, Depth= 6.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
16,434	98	Paved roads w/curbs & sewers, HSG A
2,644	74	>75% Grass cover, Good, HSG C
19,078	95	Weighted Average
2,644		13.86% Pervious Area
16,434		86.14% Impervious Area

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

Summary for Subcatchment DA-2P: To Storm Vault

Runoff = 11.39 cfs @ 12.11 hrs, Volume= 0.616 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
44,866	98	Unconnected roofs, HSG A
640	74	>75% Grass cover, Good, HSG C
45,506	98	Weighted Average
640		1.41% Pervious Area
44,866		98.59% Impervious Area
44,866		100.00% Unconnected

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

Summary for Subcatchment DA-3P: Drainage Area to the South Storm Sewer

Runoff = 0.86 cfs @ 12.11 hrs, Volume= 0.041 af, Depth= 5.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
1,291	98	Unconnected roofs, HSG A
2,779	74	>75% Grass cover, Good, HSG C
4,070	82	Weighted Average
2,779		68.28% Pervious Area
1,291		31.72% Impervious Area
1,291		100.00% Unconnected

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

Summary for Subcatchment DA-4P: Drainage Area to Bluff

Runoff = 6.93 cfs @ 12.12 hrs, Volume= 0.316 af, Depth= 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 100-Year Rainfall=7.32"

Area (sf)	CN	Description
39,225	73	Woods, Fair, HSG C
39,225		100.00% Pervious Area

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

Summary for Reach PT: Proposed Total

Inflow Area = 2.477 ac, 58.02% Impervious, Inflow Depth = 5.90" for 100-Year event
 Inflow = 12.42 cfs @ 12.15 hrs, Volume= 1.219 af
 Outflow = 12.42 cfs @ 12.15 hrs, Volume= 1.219 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond Vault: 72" Vault

Inflow Area = 1.045 ac, 98.59% Impervious, Inflow Depth = 7.08" for 100-Year event
 Inflow = 11.39 cfs @ 12.11 hrs, Volume= 0.616 af
 Outflow = 3.04 cfs @ 12.30 hrs, Volume= 0.616 af, Atten= 73%, Lag= 11.6 min
 Primary = 3.04 cfs @ 12.30 hrs, Volume= 0.616 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
 Peak Elev= 808.29' @ 12.30 hrs Surf.Area= 7,276 sf Storage= 14,156 cf

Plug-Flow detention time= 536.3 min calculated for 0.616 af (100% of inflow)
 Center-of-Mass det. time= 537.1 min (1,276.7 - 739.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	803.70'	5,323 cf	17.00'W x 214.00'L x 7.00'H Field A 25,466 cf Overall - 12,158 cf Embedded = 13,308 cf x 40.0% Voids
#2A	804.20'	12,158 cf	CMP Round 72 x 20 Inside #1 Effective Size= 72.0"W x 72.0"H => 28.27 sf x 20.00'L = 565.5 cf Overall Size= 72.0"W x 72.0"H x 20.00'L 20 Chambers in 2 Rows 15.00' Header x 28.27 sf x 2 = 848.2 cf Inside
#3	801.70'	2,183 cf	17.00'W x 214.00'L x 2.00'H Prismatic 7,276 cf Overall x 30.0% Voids
		19,664 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	801.70'	12.0" Round Culvert L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 801.70' / 801.20' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	801.70'	0.800 in/hr Exfiltration over Surface area
#3	Device 1	807.20'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

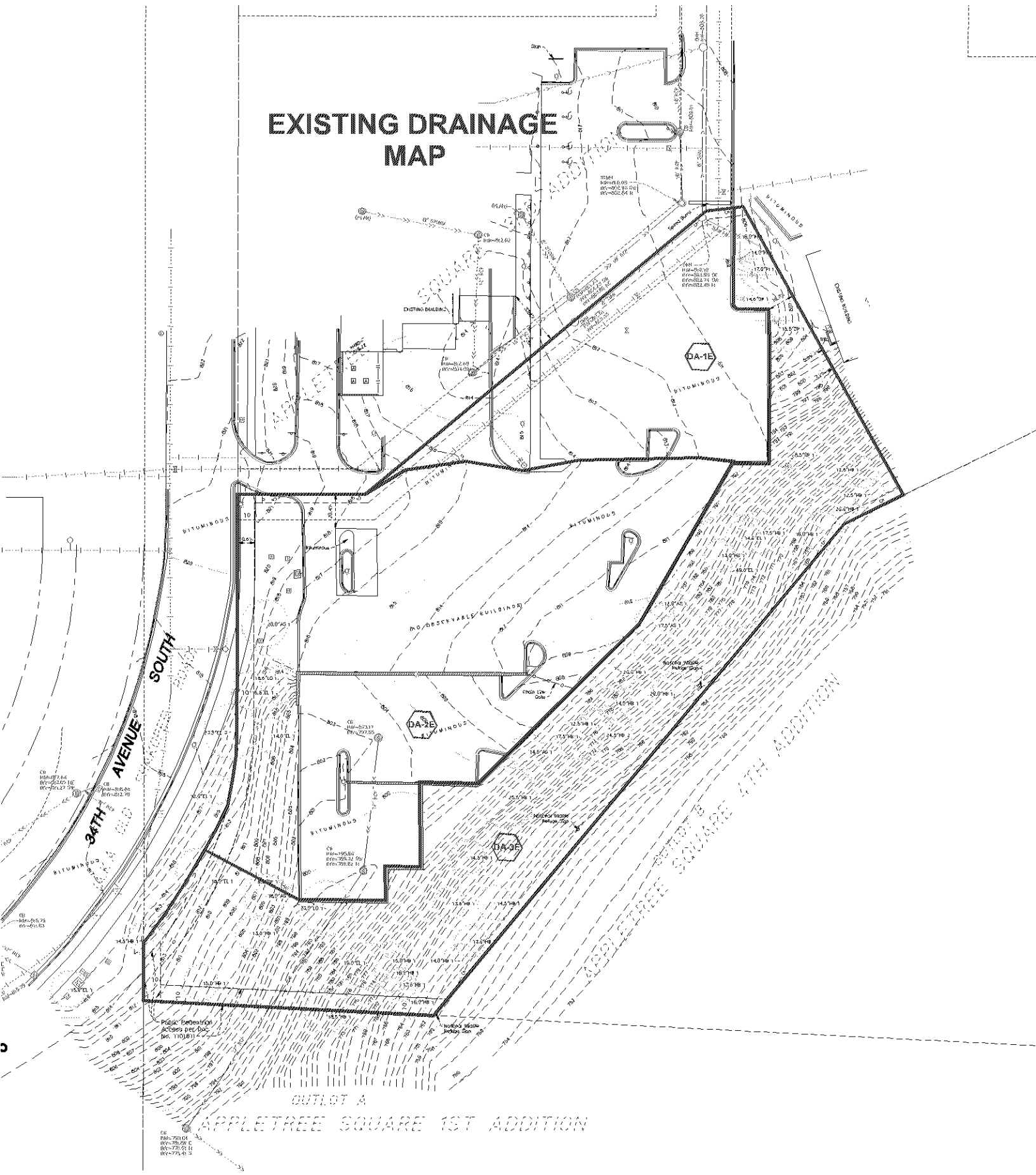
Primary OutFlow Max=3.03 cfs @ 12.30 hrs HW=808.29' (Free Discharge)

- 1=Culvert (Passes 3.03 cfs of 8.88 cfs potential flow)
- 2=Exfiltration (Exfiltration Controls 0.13 cfs)
- 3=Orifice/Grate (Orifice Controls 2.90 cfs @ 3.69 fps)

Figures

Existing Drainage Exhibit
Proposed Drainage Exhibit
Existing MIDS Results
Proposed MIDS Results

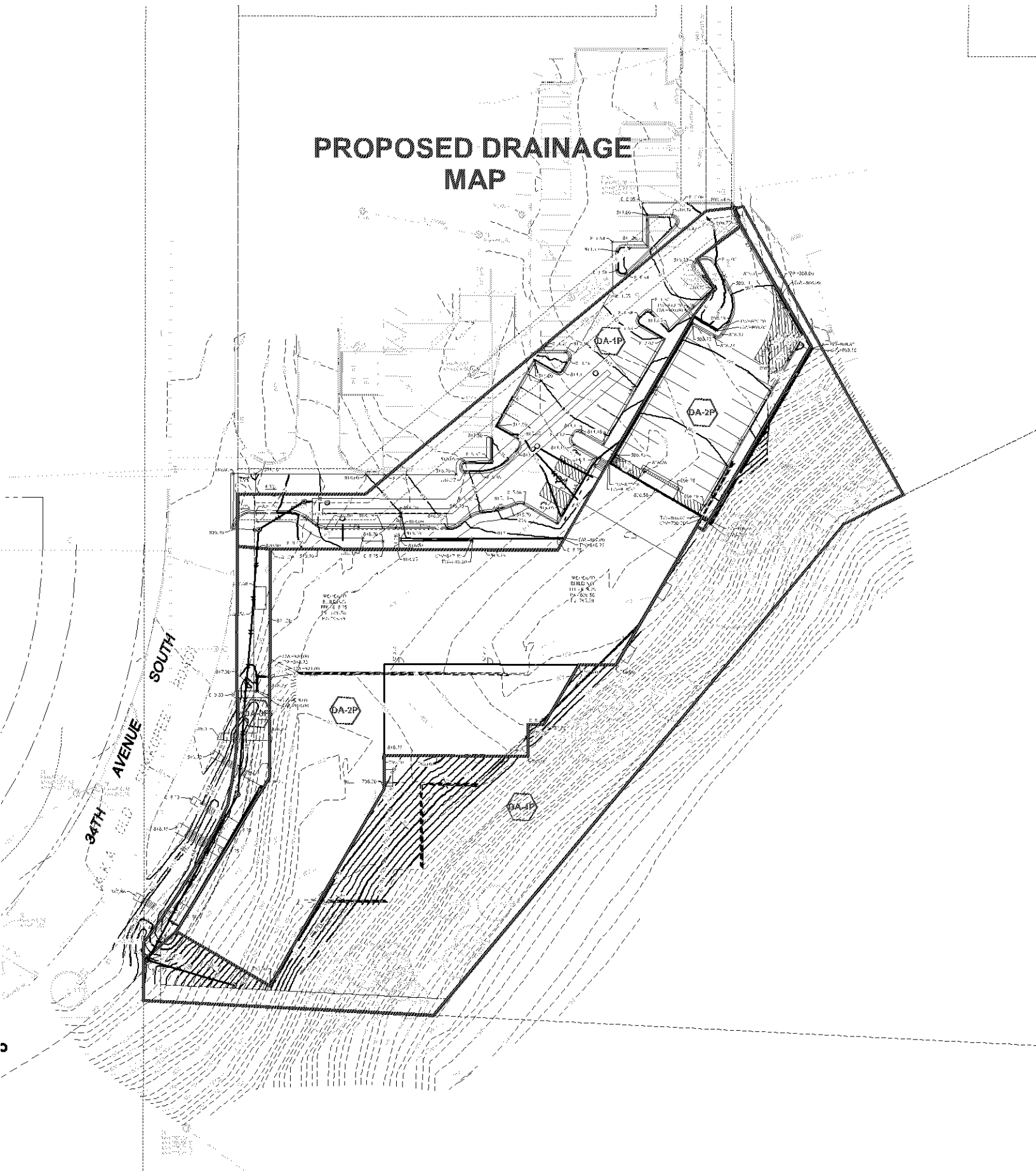
EXISTING DRAINAGE MAP



Public Trail Access per Doc No. 1103811

OUTLOT A
APPLETREE SQUARE 1ST ADDITION

PROPOSED DRAINAGE MAP



PL202000231 Project Information

Calculator Version:	Version 3: January 2017
Project Name:	Roers Bloomington Existing Site
User Name / Company Name:	Loucks
Date:	12/21/2020
Project Description:	Bloomington Senior Apartmets
Construction Permit?:	Yes

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55425
Annual Rainfall (inches):	31.7
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			1.206		1.206
			Impervious Area (acres)		1.285
			Total Area (acres)		2.491

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed					0
			Impervious Area (acres)		
			Total Area (acres)		0

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	5131	ft ³
Volume removed by BMPs towards performance goal:		ft ³
Percent volume removed towards performance goal		%

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	3.5331	acre-ft
Annual runoff volume removed by BMPs:		acre-ft
Percent annual runoff volume removed:		%
Post development annual particulate P load:	1.586	lbs
Annual particulate P removed by BMPs:		lbs
Post development annual dissolved P load:	1.297	lbs
Annual dissolved P removed by BMPs:		lbs
Percent annual total phosphorus removed:		%
Post development annual TSS load:	523.8	lbs
Annual TSS removed by BMPs:		lbs
Percent annual TSS removed:		%

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft ³)	Volume Recieved (ft ³)	Volume Retained (ft ³)	Volume Outflow (ft ³)	Percent Retained (%)

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)

PL202000231

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
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Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
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TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
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BMP Schematic

PL202000231 Project Information

Calculator Version:	Version 3: January 2017
Project Name:	Roers Bloomington Proposed
User Name / Company Name:	Loucks
Date:	12/21/20
Project Description:	Bloomington Senior Apartments
Construction Permit?:	Yes

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55425
Annual Rainfall (inches):	31.7
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			1.054		1.054
			Impervious Area (acres)		1.437
			Total Area (acres)		2.491

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			0.015		0.015
			Impervious Area (acres)		1.03
			Total Area (acres)		1.045

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	5738	ft ³
Volume removed by BMPs towards performance goal:		ft ³
Percent volume removed towards performance goal		%

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	3.7969	acre-ft
Annual runoff volume removed by BMPs:	0	acre-ft
Percent annual runoff volume removed:	0	%
Post development annual particulate P load:	1.704	lbs
Annual particulate P removed by BMPs:	0.89	lbs
Post development annual dissolved P load:	1.394	lbs
Annual dissolved P removed by BMPs:	0	lbs
Percent annual total phosphorus removed:	29	%
Post development annual TSS load:	562.9	lbs
Annual TSS removed by BMPs:	294.1	lbs
Percent annual TSS removed:	52	%

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft ³)	Volume Recieved (ft ³)	Volume Retained (ft ³)	Volume Outflow (ft ³)	Percent Retained (%)
1 - Sand filter	0	4113	0	4113	0

Annual Volume Summary

USE THE INFILTRATION BMP FOR CALCULATING REMOVAL EFFICIEINCES.

PL202000231

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Sand filter	2.3342	0	0	2.3342	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Sand filter	1.0476	0	0.8905	0.1571	85

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Sand filter	0.8571	0	0	0.8571	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Sand filter	346.03	0	294.13	51.9	85

BMP Schematic

