

Stormwater Management
Report

Southview Heights
St. Joseph, MN

Prepared for:

Lumber One Avon, Inc.
St. Joseph, MN

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Project # 0012336.00

SUMMARY

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



John S. Blenker, PE
Lic. No. 54832

01/22/18
Date

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SUMMARY

Introduction:

Southview Heights is a proposed residential redevelopment within the city of St. Joseph, Minnesota. The proposed improvements will encompass the entire 6.05-acre property which will include patio homes, duplexes, and 8-plexes.

Prior to 2012 the property had a commercial building with adjacent bituminous and gravel parking lots. After demolition of the existing facilities in 2012, the property has been used as a farm field for meadow hay.

Storm water management for the site must comply with the City of St. Joseph and the Sauk River Watershed District storm water requirements as well as the requirements of the National Pollutant Discharge Elimination System (NPDES) program. Based on these requirements, the proposed runoff rates and volumes from the site is limited to that of existing conditions for the 2-, 10-, and 100-year event storms as well as the 100-year, 10-day snowmelt. Water Quality is based on the NPDES/MPCA requirements for the Application for General Storm water Permit for Construction Activity. TSS and PH removals are based on MIDs software.

To accomplish this storm water management, a storm water system using grass swales, rain gardens and an infiltration basin to treat and store the storm water before discharge is proposed.

This report documents the criteria and assumptions associated with the water quality and rate control calculations for the site. All applicable drainage maps and calculations have been included in the appendices for your convenience. The existing pond to the west of the property and also the existing basin to the south of the property have been remodeled to show volumes and discharge rates since it appears they were not constructed as designed as part of the Liberty Pointe Plat and Construction Plans.

It was assumed that the ground water elevation was below the 1067.09 elevation, which is the lowest shot elevation in the existing basin to the south of the property. There wasn't any standing water in that basin at the time of the topographic survey. There was, however, water in the pond to the west of the property, but that was assumed to be perched water. The ground water elevation will be verified at the time of construction.

Methods:

The SCS synthetic unit hydrograph method incorporated into the software program HydroCAD version 10.0, was used for calculating the runoff rates and volumes generated from the existing and proposed site for the 2-year, 10-year, 100-year 24-hour storm event, and 100-year, 10-day snowmelt event. Based on the ALTAS 14 data the 2-year, 10-year, and 100-year rain events are equivalent to 2.66-inches, 3.92-inches, and 6.38-inches, respectively. The 100-year, 10-day snowmelt runoff event is equivalent to 7.20-inches per the Sauk River Watershed District Administrative Rules. Water Quality volumes (WQV) are based on the requirements of the NPDES permit.

Site Conditions:

The parts of the existing property that were once the commercial building and parking lot were modeled to try and accurately represent the compacted soils due to vehicle and construction traffic.

SUMMARY

We didn't think using the Type A soils and meadow grasses (CN=30) would accurately show how much runoff is actually coming off the site. Likewise, we didn't think using all those areas as impervious (CN=98) would accurately depict the actual runoff from the site. Thus, we modeled those building and parking areas as <50% Grass Cover, Poor (CN=68) to represent the actual site conditions.

Curve Number's used in the analysis of the site were as follows:

Table 1: Curve Numbers

Ground Cover	Soil HSG A	Soil HSG B	Soil HSG C
Impervious	98	98	98
Water Surface/Wetlands	98	98	98
>75% Grass Cover, Good	39	61	74
<50% Grass Cover, Poor	68	79	86
Woods, Good	30	55	70

Existing off-site storm water retention facility model results are as follows:

Table 2: Existing Pond & Basin

Name	100-Year HWL	EOF	Outlet
West Pond	1076.24	1076.16	1076.05
South Basin	1074.97	1076.10	1073.57

Rate Control:

The following table is a summary of the existing and proposed condition's total peak flow rates and volumes for the 2, 10, 100-year 24-hour storm events and the 10-day snowmelt.

Table 3: Total Rate Control

West Pond												
	2-Year			10-Year			100-Year			Snowmelt		
	Rate (cfs)	Volume (AF)	HWL	Rate (cfs)	Volume (AF)	HWL	Rate (cfs)	Volume (AF)	HWL	Rate (cfs)	Volume (AF)	HWL
Existing	0.00	0.00	1071.91	0.00	0.00	1073.53	0.00	0.00	1076.24	0.00	0.00	1076.86
Proposed	0.00	0.02	1071.94	0.00	0.05	1073.62	3.00	0.17	1076.26	1.13	0.55	1076.89
Difference	0.00	(0.02)	(0.03)	0.00	(0.05)	(0.09)	(3.00)	(0.17)	(0.02)	(1.13)	(0.55)	(0.03)
East Ditch												
	2-Year			10-Year			100-Year			Snowmelt		
	Rate (cfs)	Volume (AF)		Rate (cfs)	Volume (AF)		Rate (cfs)	Volume (AF)		Rate (cfs)	Volume (AF)	
Existing	1.42	0.14		6.82	0.46		21.92	3.03		22.18	10.08	
Proposed	0.74	0.01		3.13	0.32		14.14	1.12		5.99	2.08	
Difference	0.68	0.13		3.69	0.14		7.78	1.91		16.19	8.00	
Total Difference	0.68	0.11		3.69	0.09		4.78	1.74		15.06	7.45	

Water Quality:

Water quality was achieved through the use of two types of permanent BMPs, two rain gardens (4P & 5P) and an infiltration basin (6P). The three BMPs are designed to infiltrate one-inch of the WQV per the NPDES permit requirements. Prior to storm water entering the rain gardens,

SUMMARY

grass swales or rain guardians will be provided to reduce sediment loading. Prior to storm water entering the basin, a grass swale will be utilized to reduce sediment loading.

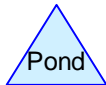
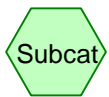
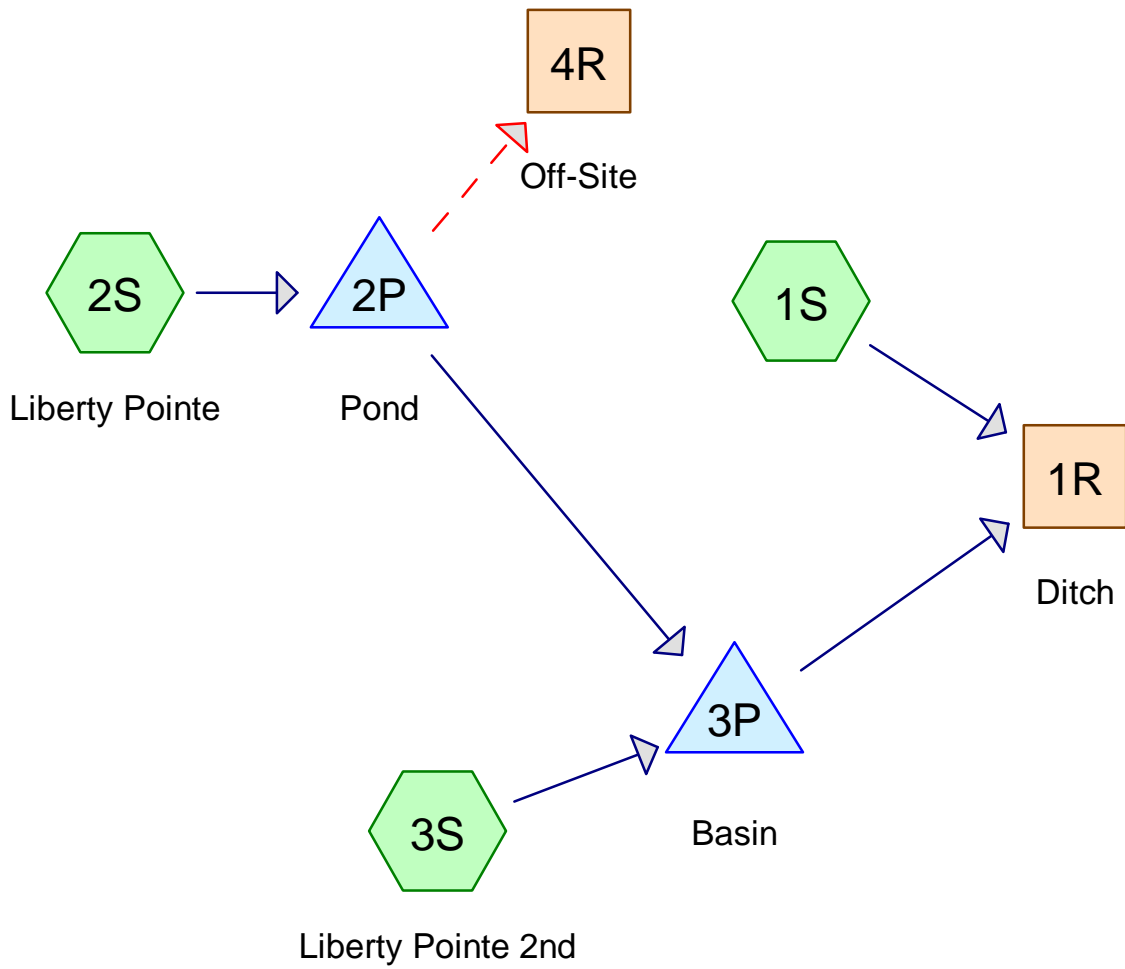
MIDs was used to calculate TSS and PH removal for the platted lots. Rain gardens 4P and 5P are modeled as bioretention basins (w/o underdrain) and basin 6P is modeled as a infiltration basin. The TSS and PH removals for the platted lots are 82% and 82%, respectively.

MIDs calculations can be found in Appendix I. NPDES WQV calculations can be found in Appendix J.

Summary:

Rate control and water quality can be provided with the rain gardens and basin. The rear yards for the duplex lots on the west property line sheet flow into the existing pond off-site and do not meet the rate control requirements, however, do to the small runoff amounts and since the storm water flows over green space before entering the existing pond, we feel it will not make a significant impact on the pond or any existing infrastructure.

Appendix A



Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=263,852 sf 0.00% Impervious Runoff Depth=0.27"
Tc=10.0 min CN=62 Runoff=1.42 cfs 5,980 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.79% Impervious Runoff Depth=0.43"
Tc=10.0 min CN=67 Runoff=8.09 cfs 24,241 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=0.43"
Tc=10.0 min CN=67 Runoff=6.14 cfs 18,410 cf

Reach 1R: Ditch Inflow=1.42 cfs 5,980 cf
Outflow=1.42 cfs 5,980 cf

Reach 4R: Off-Site Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond 2P: Pond Peak Elev=1,071.91' Storage=23,783 cf Inflow=8.09 cfs 24,241 cf
Discarded=0.01 cfs 8,609 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.01 cfs 8,609 cf

Pond 3P: Basin Peak Elev=1,071.05' Storage=17,620 cf Inflow=6.14 cfs 18,410 cf
Discarded=0.02 cfs 13,391 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 13,391 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 48,632 cf Average Runoff Depth = 0.40"
72.35% Pervious = 1,062,161 sf 27.65% Impervious = 405,875 sf

Summary for Subcatchment 1S:

Runoff = 1.42 cfs @ 12.23 hrs, Volume= 5,980 cf, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
205,202	68	<50% Grass cover, Poor, HSG A
58,651	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
263,852	62	Weighted Average
263,852		100.00% Pervious Area
0		0.00% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 8.09 cfs @ 12.20 hrs, Volume= 24,241 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
202,870	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,517	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,622		63.21% Pervious Area
251,783		36.79% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 6.14 cfs @ 12.20 hrs, Volume= 18,410 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
107,859	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,432	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,687		70.35% Pervious Area
154,092		29.65% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area =	1,468,036 sf, 27.65% Impervious,	Inflow Depth = 0.05"	for 2-yr event
Inflow =	1.42 cfs @ 12.23 hrs,	Volume=	5,980 cf
Outflow =	1.42 cfs @ 12.23 hrs,	Volume=	5,980 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 684,405 sf, 36.79% Impervious, Inflow Depth = 0.43" for 2-yr event
 Inflow = 8.09 cfs @ 12.20 hrs, Volume= 24,241 cf
 Outflow = 0.01 cfs @ 24.19 hrs, Volume= 8,609 cf, Atten= 100%, Lag= 719.4 min
 Discarded = 0.01 cfs @ 24.19 hrs, Volume= 8,609 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,071.91' @ 24.19 hrs Surf.Area= 19,732 sf Storage= 23,783 cf

Plug-Flow detention time= 6,434.8 min calculated for 8,609 cf (36% of inflow)
 Center-of-Mass det. time= 6,306.2 min (7,171.5 - 865.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.01 cfs @ 24.19 hrs HW=1,071.91' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Basin

Inflow Area = 1,204,184 sf, 33.71% Impervious, Inflow Depth = 0.18" for 2-yr event
 Inflow = 6.14 cfs @ 12.20 hrs, Volume= 18,410 cf
 Outflow = 0.02 cfs @ 24.14 hrs, Volume= 13,391 cf, Atten= 100%, Lag= 716.4 min
 Discarded = 0.02 cfs @ 24.14 hrs, Volume= 13,391 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,071.05' @ 24.14 hrs Surf.Area= 8,428 sf Storage= 17,620 cf

Plug-Flow detention time= 6,285.2 min calculated for 13,391 cf (73% of inflow)
 Center-of-Mass det. time= 6,192.5 min (7,057.8 - 865.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

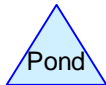
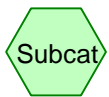
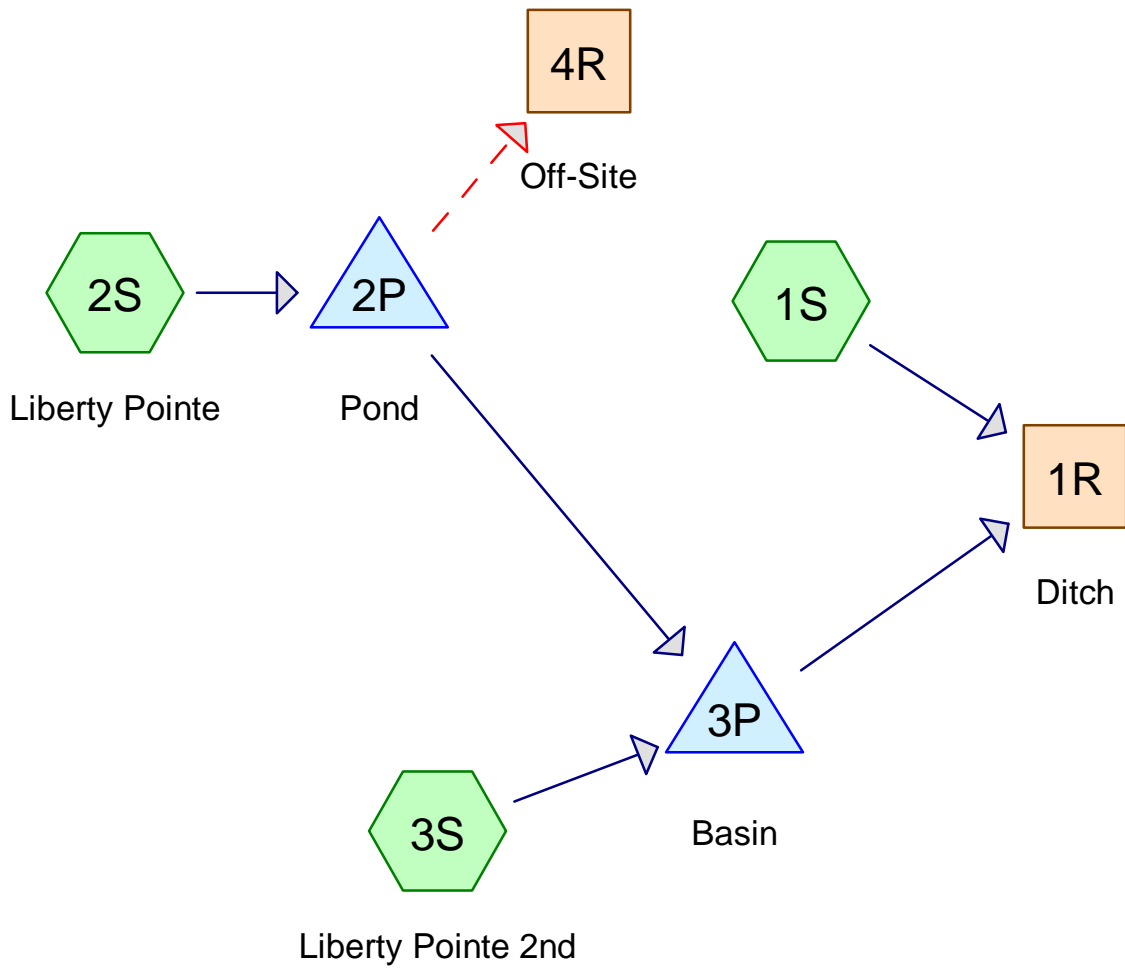
Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.02 cfs @ 24.14 hrs HW=1,071.05' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Appendix B



Routing Diagram for 20180115_0012336_Existing_Post2012
 Prepared by Westwood Professional Services, Inc., Printed 1/17/2018
 HydroCAD® 10.00-19 s/n 02396 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=263,852 sf 0.00% Impervious Runoff Depth=0.82"
Tc=10.0 min CN=62 Runoff=6.82 cfs 18,089 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.79% Impervious Runoff Depth=1.10"
Tc=10.0 min CN=67 Runoff=25.45 cfs 62,501 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=1.10"
Tc=10.0 min CN=67 Runoff=19.33 cfs 47,467 cf

Reach 1R: Ditch Inflow=6.82 cfs 20,120 cf
Outflow=6.82 cfs 20,120 cf

Reach 4R: Off-Site Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond 2P: Pond Peak Elev=1,073.53' Storage=61,414 cf Inflow=25.45 cfs 62,501 cf
Discarded=0.03 cfs 20,177 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.03 cfs 20,177 cf

Pond 3P: Basin Peak Elev=1,073.70' Storage=45,111 cf Inflow=19.33 cfs 47,467 cf
Discarded=0.03 cfs 20,757 cf Primary=0.12 cfs 2,031 cf Secondary=0.00 cfs 0 cf Outflow=0.15 cfs 22,789 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 128,057 cf Average Runoff Depth = 1.05"
72.35% Pervious = 1,062,161 sf 27.65% Impervious = 405,875 sf

Summary for Subcatchment 1S:

Runoff = 6.82 cfs @ 12.19 hrs, Volume= 18,089 cf, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
205,202	68	<50% Grass cover, Poor, HSG A
58,651	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
263,852	62	Weighted Average
263,852		100.00% Pervious Area
0		0.00% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 25.45 cfs @ 12.19 hrs, Volume= 62,501 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
202,870	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,517	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,622		63.21% Pervious Area
251,783		36.79% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 19.33 cfs @ 12.19 hrs, Volume= 47,467 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
107,859	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,432	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,687		70.35% Pervious Area
154,092		29.65% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area = 1,468,036 sf, 27.65% Impervious, Inflow Depth = 0.16" for 10-yr event
Inflow = 6.82 cfs @ 12.19 hrs, Volume= 20,120 cf
Outflow = 6.82 cfs @ 12.19 hrs, Volume= 20,120 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 684,405 sf, 36.79% Impervious, Inflow Depth = 1.10" for 10-yr event
 Inflow = 25.45 cfs @ 12.19 hrs, Volume= 62,501 cf
 Outflow = 0.03 cfs @ 24.18 hrs, Volume= 20,177 cf, Atten= 100%, Lag= 719.8 min
 Discarded = 0.03 cfs @ 24.18 hrs, Volume= 20,177 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.53' @ 24.18 hrs Surf.Area= 26,498 sf Storage= 61,414 cf

Plug-Flow detention time= 6,530.7 min calculated for 20,177 cf (32% of inflow)
 Center-of-Mass det. time= 6,420.8 min (7,259.6 - 838.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.03 cfs @ 24.18 hrs HW=1,073.53' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 0.49'

Inflow Area = 1,204,184 sf, 33.71% Impervious, Inflow Depth = 0.47" for 10-yr event
 Inflow = 19.33 cfs @ 12.19 hrs, Volume= 47,467 cf
 Outflow = 0.15 cfs @ 22.84 hrs, Volume= 22,789 cf, Atten= 99%, Lag= 639.3 min
 Discarded = 0.03 cfs @ 22.84 hrs, Volume= 20,757 cf
 Primary = 0.12 cfs @ 22.84 hrs, Volume= 2,031 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.70' @ 22.84 hrs Surf.Area= 12,370 sf Storage= 45,111 cf

Plug-Flow detention time= 6,025.2 min calculated for 22,789 cf (48% of inflow)
 Center-of-Mass det. time= 5,920.5 min (6,759.3 - 838.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

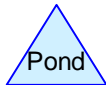
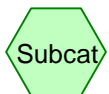
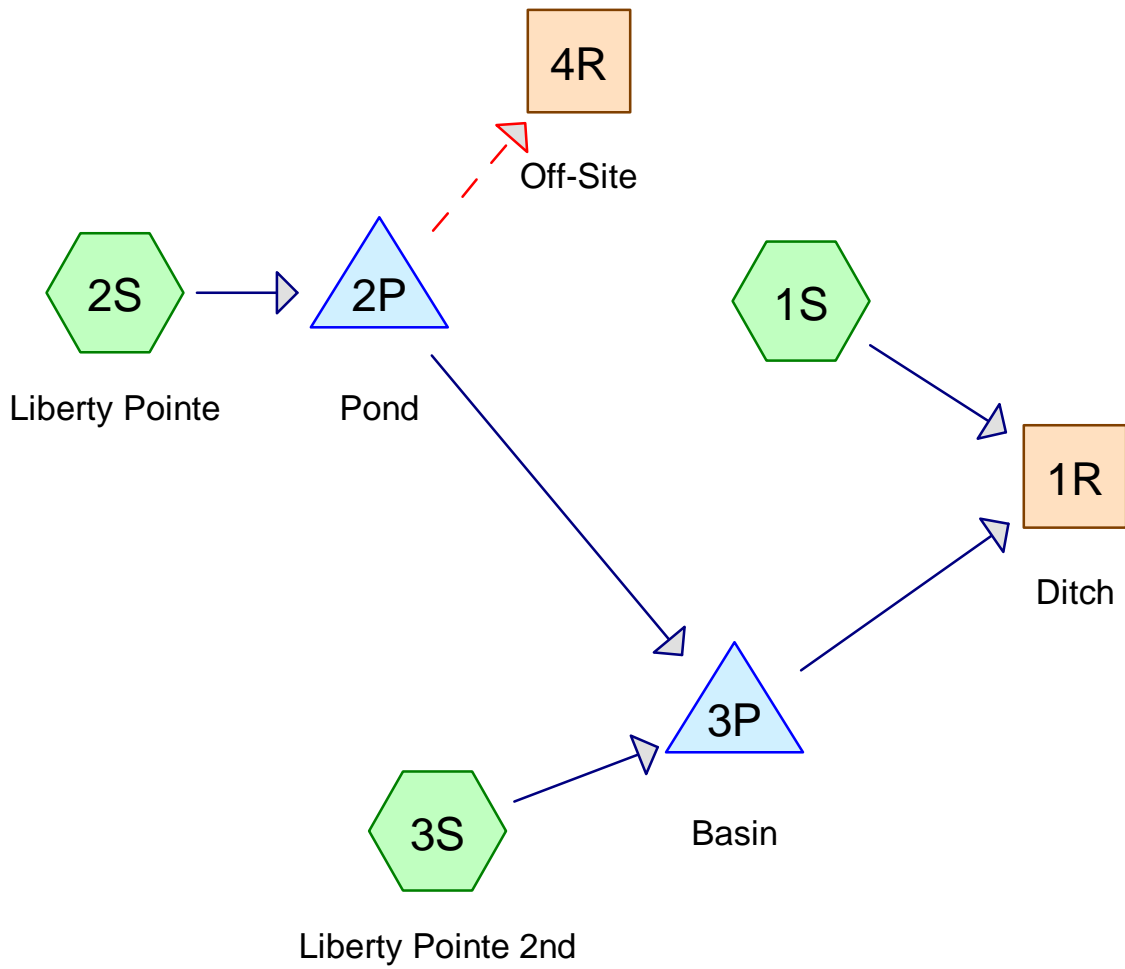
Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 22.84 hrs HW=1,073.70' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.11 cfs @ 22.84 hrs HW=1,073.70' (Free Discharge)
 ↑1=Culvert (Inlet Controls 0.11 cfs @ 1.23 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Appendix C



Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=263,852 sf 0.00% Impervious Runoff Depth=2.35"
Tc=10.0 min CN=62 Runoff=21.92 cfs 51,769 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.79% Impervious Runoff Depth=2.82"
Tc=10.0 min CN=67 Runoff=68.90 cfs 160,846 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=2.82"
Tc=10.0 min CN=67 Runoff=52.33 cfs 122,157 cf

Reach 1R: Ditch Inflow=21.92 cfs 131,841 cf
Outflow=21.92 cfs 131,841 cf

Reach 4R: Off-Site Inflow=0.58 cfs 9,489 cf
Outflow=0.58 cfs 9,489 cf

Pond 2P: Pond Peak Elev=1,076.24' Storage=148,348 cf Inflow=68.90 cfs 160,846 cf
Discarded=0.06 cfs 39,827 cf Primary=0.15 cfs 4,202 cf Secondary=0.58 cfs 9,489 cf Outflow=0.79 cfs 53,518 cf

Pond 3P: Basin Peak Elev=1,074.97' Storage=62,327 cf Inflow=52.33 cfs 126,358 cf
Discarded=0.03 cfs 21,086 cf Primary=8.94 cfs 80,072 cf Secondary=0.00 cfs 0 cf Outflow=8.98 cfs 101,158 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 334,771 cf Average Runoff Depth = 2.74"
72.35% Pervious = 1,062,161 sf 27.65% Impervious = 405,875 sf

Summary for Subcatchment 1S:

Runoff = 21.92 cfs @ 12.18 hrs, Volume= 51,769 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
205,202	68	<50% Grass cover, Poor, HSG A
58,651	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
263,852	62	Weighted Average
263,852		100.00% Pervious Area
0		0.00% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 68.90 cfs @ 12.18 hrs, Volume= 160,846 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
202,870	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,517	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,622		63.21% Pervious Area
251,783		36.79% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 52.33 cfs @ 12.18 hrs, Volume= 122,157 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
107,859	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,432	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,687		70.35% Pervious Area
154,092		29.65% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area = 1,468,036 sf, 27.65% Impervious, Inflow Depth = 1.08" for 100-yr event
Inflow = 21.92 cfs @ 12.18 hrs, Volume= 131,841 cf
Outflow = 21.92 cfs @ 12.18 hrs, Volume= 131,841 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.58 cfs @ 20.28 hrs, Volume= 9,489 cf
Outflow = 0.58 cfs @ 20.28 hrs, Volume= 9,489 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 684,405 sf, 36.79% Impervious, Inflow Depth = 2.82" for 100-yr event
 Inflow = 68.90 cfs @ 12.18 hrs, Volume= 160,846 cf
 Outflow = 0.79 cfs @ 20.28 hrs, Volume= 53,518 cf, Atten= 99%, Lag= 486.2 min
 Discarded = 0.06 cfs @ 20.28 hrs, Volume= 39,827 cf
 Primary = 0.15 cfs @ 20.28 hrs, Volume= 4,202 cf
 Secondary = 0.58 cfs @ 20.28 hrs, Volume= 9,489 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,076.24' @ 20.28 hrs Surf.Area= 39,858 sf Storage= 148,348 cf

Plug-Flow detention time= 5,034.2 min calculated for 53,518 cf (33% of inflow)
 Center-of-Mass det. time= 4,938.1 min (5,755.7 - 817.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.06 cfs @ 20.28 hrs HW=1,076.24' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.15 cfs @ 20.28 hrs HW=1,076.24' (Free Discharge)
 ↑**1=Culvert** (Barrel Controls 0.15 cfs @ 2.19 fps)

Secondary OutFlow Max=0.54 cfs @ 20.28 hrs HW=1,076.24' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.54 cfs @ 0.69 fps)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 1.76'

Inflow Area = 1,204,184 sf, 33.71% Impervious, Inflow Depth = 1.26" for 100-yr event
 Inflow = 52.33 cfs @ 12.18 hrs, Volume= 126,358 cf
 Outflow = 8.98 cfs @ 12.63 hrs, Volume= 101,158 cf, Atten= 83%, Lag= 26.8 min
 Discarded = 0.03 cfs @ 12.63 hrs, Volume= 21,086 cf
 Primary = 8.94 cfs @ 12.63 hrs, Volume= 80,072 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,074.97' @ 12.63 hrs Surf.Area= 15,027 sf Storage= 62,327 cf

Plug-Flow detention time= 1,498.7 min calculated for 101,158 cf (80% of inflow)
 Center-of-Mass det. time= 1,416.9 min (2,254.3 - 837.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

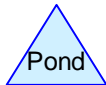
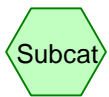
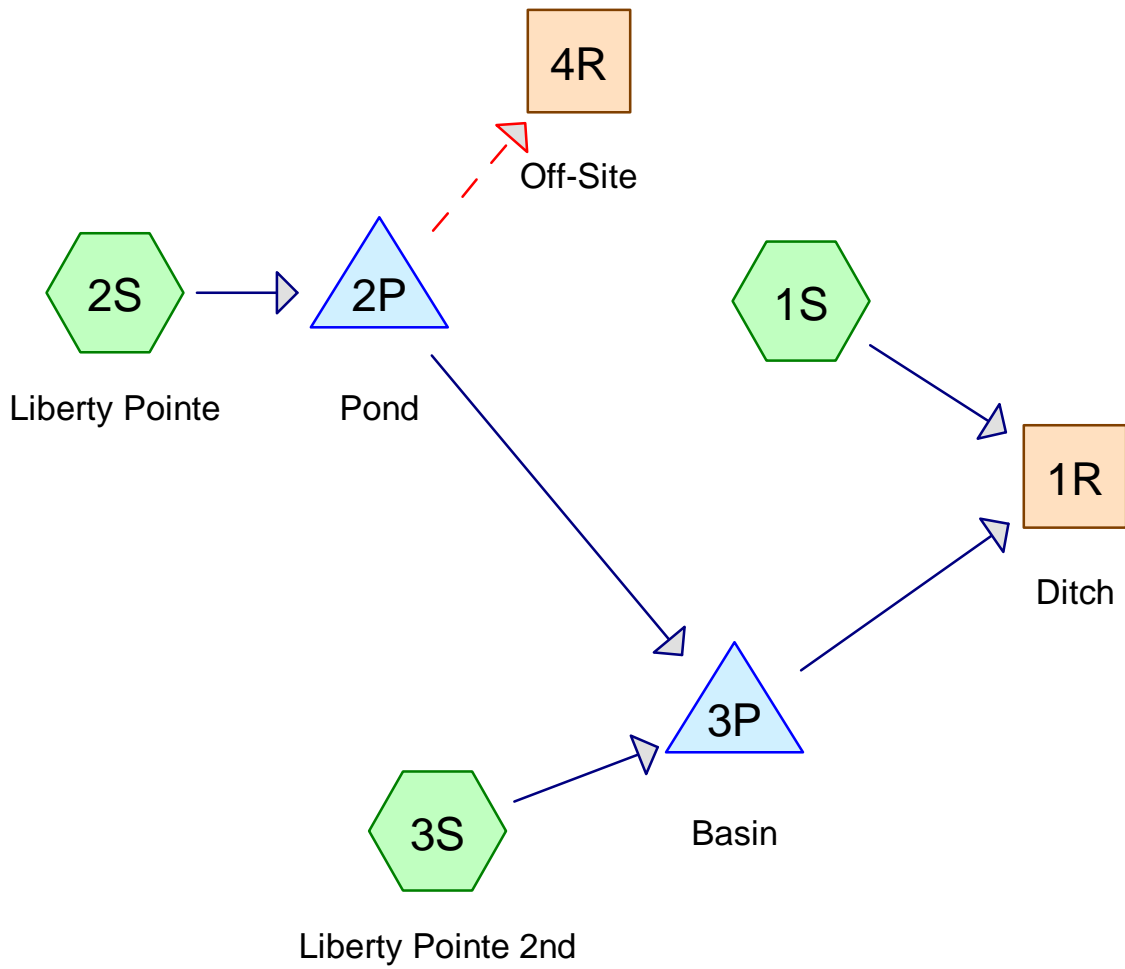
Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.63 hrs HW=1,074.97' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=8.94 cfs @ 12.63 hrs HW=1,074.97' (Free Discharge)
 ↑1=Culvert (Barrel Controls 8.94 cfs @ 5.37 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Appendix D



Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=263,852 sf 0.00% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=7.23 cfs 153,045 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.79% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=18.75 cfs 396,982 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=14.24 cfs 301,493 cf

Reach 1R: Ditch Inflow=22.18 cfs 438,898 cf
 Outflow=22.18 cfs 438,898 cf

Reach 4R: Off-Site Inflow=15.63 cfs 177,973 cf
 Outflow=15.63 cfs 177,973 cf

Pond 2P: Pond Peak Elev=1,076.86' Storage=175,495 cf Inflow=18.75 cfs 396,982 cf
 Discarded=0.08 cfs 29,314 cf Primary=2.07 cfs 46,915 cf Secondary=15.63 cfs 177,973 cf Outflow=17.77 cfs 254,203 cf

Pond 3P: Basin Peak Elev=1,075.57' Storage=71,782 cf Inflow=16.30 cfs 348,408 cf
 Discarded=0.04 cfs 18,588 cf Primary=15.05 cfs 285,853 cf Secondary=0.00 cfs 0 cf Outflow=15.08 cfs 304,441 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 851,519 cf Average Runoff Depth = 6.96"
72.35% Pervious = 1,062,161 sf 27.65% Impervious = 405,875 sf

Summary for Subcatchment 1S:

Runoff = 7.23 cfs @ 121.01 hrs, Volume= 153,045 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
205,202	68		<50% Grass cover, Poor, HSG A
58,651	39		>75% Grass cover, Good, HSG A
0	98		Paved parking, HSG A
263,852	62	98	Weighted Average, AMC Adjusted
263,852			100.00% Pervious Area
0			0.00% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 18.75 cfs @ 121.01 hrs, Volume= 396,982 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
202,870	39		>75% Grass cover, Good, HSG A
193,532	61		>75% Grass cover, Good, HSG B
84	74		>75% Grass cover, Good, HSG C
112,517	98		Paved parking, HSG A
125,027	98		Paved parking, HSG B
14,239	98		Water Surface, HSG A
17,088	32		Woods/grass comb., Good, HSG A
16,539	58		Woods/grass comb., Good, HSG B
2,509	72		Woods/grass comb., Good, HSG C
684,405	67	98	Weighted Average, AMC Adjusted
432,622			63.21% Pervious Area
251,783			36.79% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 14.24 cfs @ 121.01 hrs, Volume= 301,493 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
107,859	39		>75% Grass cover, Good, HSG A
257,829	61		>75% Grass cover, Good, HSG B
48,432	98		Paved parking, HSG A
105,661	98		Paved parking, HSG B
519,780	67	98	Weighted Average, AMC Adjusted
365,687			70.35% Pervious Area
154,092			29.65% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area = 1,468,036 sf, 27.65% Impervious, Inflow Depth > 3.59" for 10-day Snowmelt event
Inflow = 22.18 cfs @ 121.03 hrs, Volume= 438,898 cf
Outflow = 22.18 cfs @ 121.03 hrs, Volume= 438,898 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow	=	15.63 cfs @ 121.07 hrs,	Volume=	177,973 cf
Outflow	=	15.63 cfs @ 121.07 hrs,	Volume=	177,973 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 684,405 sf, 36.79% Impervious, Inflow Depth > 6.96" for 10-day Snowmelt event
 Inflow = 18.75 cfs @ 121.01 hrs, Volume= 396,982 cf
 Outflow = 17.77 cfs @ 121.07 hrs, Volume= 254,203 cf, Atten= 5%, Lag= 3.5 min
 Discarded = 0.08 cfs @ 121.07 hrs, Volume= 29,314 cf
 Primary = 2.07 cfs @ 121.07 hrs, Volume= 46,915 cf
 Secondary = 15.63 cfs @ 121.07 hrs, Volume= 177,973 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,076.86' @ 121.07 hrs Surf.Area= 48,074 sf Storage= 175,495 cf

Plug-Flow detention time= 1,568.3 min calculated for 254,192 cf (64% of inflow)
 Center-of-Mass det. time= 795.6 min (8,156.3 - 7,360.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.08 cfs @ 121.07 hrs HW=1,076.86' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=2.07 cfs @ 121.07 hrs HW=1,076.86' (Free Discharge)
 ↑**1=Culvert** (Inlet Controls 2.07 cfs @ 3.06 fps)

Secondary OutFlow Max=15.62 cfs @ 121.07 hrs HW=1,076.86' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 15.62 cfs @ 2.25 fps)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 2.36'

Inflow Area = 1,204,184 sf, 33.71% Impervious, Inflow Depth > 3.47" for 10-day Snowmelt event
 Inflow = 16.30 cfs @ 121.01 hrs, Volume= 348,408 cf
 Outflow = 15.08 cfs @ 121.08 hrs, Volume= 304,441 cf, Atten= 7%, Lag= 4.2 min
 Discarded = 0.04 cfs @ 121.08 hrs, Volume= 18,588 cf
 Primary = 15.05 cfs @ 121.08 hrs, Volume= 285,853 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,075.57' @ 121.08 hrs Surf.Area= 16,109 sf Storage= 71,782 cf

Plug-Flow detention time= 956.8 min calculated for 304,441 cf (87% of inflow)
 Center-of-Mass det. time= 422.0 min (7,987.2 - 7,565.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

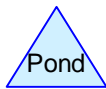
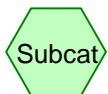
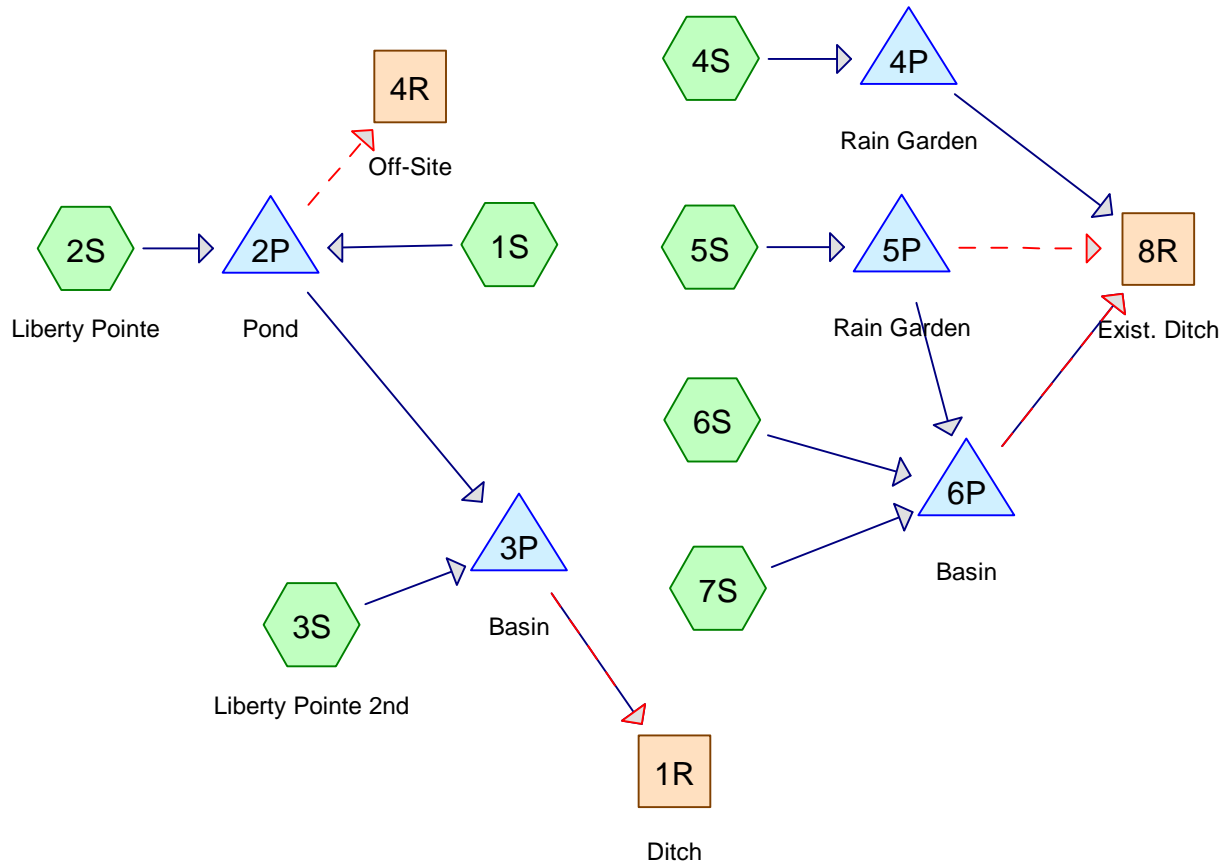
Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.04 cfs @ 121.08 hrs HW=1,075.57' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=15.06 cfs @ 121.08 hrs HW=1,075.57' (Free Discharge)
 ↑1=Culvert (Barrel Controls 15.06 cfs @ 5.95 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Appendix E



Routing Diagram for 20180115_0012336_Proposed
 Prepared by Westwood Professional Services, Inc., Printed 1/17/2018
 HydroCAD® 10.00-19 s/n 02396 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=41,389 sf 33.30% Impervious Runoff Depth=0.20"
Tc=10.0 min CN=59 Runoff=0.11 cfs 677 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.81% Impervious Runoff Depth=0.43"
Tc=10.0 min CN=67 Runoff=8.09 cfs 24,241 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=0.43"
Tc=10.0 min CN=67 Runoff=6.14 cfs 18,410 cf

Subcatchment 4S: Runoff Area=34,548 sf 58.65% Impervious Runoff Depth=0.70"
Tc=10.0 min CN=74 Runoff=0.81 cfs 2,016 cf

Subcatchment 5S: Runoff Area=87,272 sf 68.60% Impervious Runoff Depth=0.95"
Tc=10.0 min CN=79 Runoff=2.90 cfs 6,883 cf

Subcatchment 6S: Runoff Area=64,791 sf 70.10% Impervious Runoff Depth=1.00"
Tc=10.0 min CN=80 Runoff=2.29 cfs 5,406 cf

Subcatchment 7S: Runoff Area=35,853 sf 16.51% Impervious Runoff Depth=0.03"
Tc=10.0 min CN=49 Runoff=0.00 cfs 91 cf

Reach 1R: Ditch Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach 4R: Off-Site Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach 8R: Exist. Ditch Inflow=0.74 cfs 557 cf
Outflow=0.74 cfs 557 cf

Pond 2P: Pond Peak Elev=1,071.94' Storage=24,451 cf Inflow=8.18 cfs 24,918 cf
Discarded=0.01 cfs 8,834 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.01 cfs 8,834 cf

Pond 3P: Basin Peak Elev=1,071.05' Storage=17,620 cf Inflow=6.14 cfs 18,410 cf
Discarded=0.02 cfs 13,391 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 13,391 cf

Pond 4P: Rain Garden Peak Elev=1,072.07' Storage=1,284 cf Inflow=0.81 cfs 2,016 cf
Discarded=0.03 cfs 2,016 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 2,016 cf

Pond 5P: Rain Garden Peak Elev=1,073.39' Storage=1,574 cf Inflow=2.90 cfs 6,883 cf
Discarded=0.05 cfs 1,632 cf Primary=1.21 cfs 4,693 cf Secondary=0.74 cfs 557 cf Outflow=1.99 cfs 6,883 cf

Pond 6P: Basin Peak Elev=1,072.89' Storage=10,189 cf Inflow=3.24 cfs 10,190 cf
Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.00 cfs 0 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 57,724 cf Average Runoff Depth = 0.47"
62.45% Pervious = 916,727 sf 37.55% Impervious = 551,310 sf

Summary for Subcatchment 1S:

Runoff = 0.11 cfs @ 12.27 hrs, Volume= 677 cf, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
27,606	39	>75% Grass cover, Good, HSG A
13,783	98	Paved parking, HSG A
41,389	59	Weighted Average
27,606		66.70% Pervious Area
13,783		33.30% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 8.09 cfs @ 12.20 hrs, Volume= 24,241 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
202,706	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,680	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,458		63.19% Pervious Area
251,946		36.81% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 6.14 cfs @ 12.20 hrs, Volume= 18,410 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
107,843	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,448	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,671		70.35% Pervious Area
154,108		29.65% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 0.81 cfs @ 12.19 hrs, Volume= 2,016 cf, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
14,286	39	>75% Grass cover, Good, HSG A
20,262	98	Paved parking, HSG A
34,548	74	Weighted Average
14,286		41.35% Pervious Area
20,262		58.65% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 2.90 cfs @ 12.18 hrs, Volume= 6,883 cf, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
27,400	39	>75% Grass cover, Good, HSG A
59,872	98	Paved parking, HSG A
87,272	79	Weighted Average
27,400		31.40% Pervious Area
59,872		68.60% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 2.29 cfs @ 12.18 hrs, Volume= 5,406 cf, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
19,370	39	>75% Grass cover, Good, HSG A
45,421	98	Paved parking, HSG A
64,791	80	Weighted Average
19,370		29.90% Pervious Area
45,421		70.10% Impervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.00 cfs @ 15.03 hrs, Volume= 91 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 2-yr Rainfall=2.66"

Area (sf)	CN	Description
29,935	39	>75% Grass cover, Good, HSG A
5,918	98	Paved parking, HSG A
35,853	49	Weighted Average
29,935		83.49% Pervious Area
5,918		16.51% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 8R: Exist. Ditch

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

Inflow Area = 222,463 sf, 59.10% Impervious, Inflow Depth = 0.03" for 2-yr event
Inflow = 0.74 cfs @ 12.27 hrs, Volume= 557 cf
Outflow = 0.74 cfs @ 12.27 hrs, Volume= 557 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 725,793 sf, 36.61% Impervious, Inflow Depth = 0.41" for 2-yr event
 Inflow = 8.18 cfs @ 12.20 hrs, Volume= 24,918 cf
 Outflow = 0.01 cfs @ 24.19 hrs, Volume= 8,834 cf, Atten= 100%, Lag= 719.4 min
 Discarded = 0.01 cfs @ 24.19 hrs, Volume= 8,834 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,071.94' @ 24.19 hrs Surf.Area= 19,869 sf Storage= 24,451 cf

Plug-Flow detention time= 6,437.9 min calculated for 8,834 cf (35% of inflow)
 Center-of-Mass det. time= 6,308.3 min (7,174.8 - 866.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.01 cfs @ 24.19 hrs HW=1,071.94' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Basin

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth = 0.18" for 2-yr event
 Inflow = 6.14 cfs @ 12.20 hrs, Volume= 18,410 cf
 Outflow = 0.02 cfs @ 24.14 hrs, Volume= 13,391 cf, Atten= 100%, Lag= 716.4 min
 Discarded = 0.02 cfs @ 24.14 hrs, Volume= 13,391 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,071.05' @ 24.14 hrs Surf.Area= 8,428 sf Storage= 17,620 cf

Plug-Flow detention time= 6,284.9 min calculated for 13,390 cf (73% of inflow)
 Center-of-Mass det. time= 6,192.5 min (7,057.8 - 865.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.02 cfs @ 24.14 hrs HW=1,071.05' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: Rain Garden

Inflow Area = 34,548 sf, 58.65% Impervious, Inflow Depth = 0.70" for 2-yr event
 Inflow = 0.81 cfs @ 12.19 hrs, Volume= 2,016 cf
 Outflow = 0.03 cfs @ 15.16 hrs, Volume= 2,016 cf, Atten= 96%, Lag= 178.4 min
 Discarded = 0.03 cfs @ 15.16 hrs, Volume= 2,016 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,072.07' @ 15.16 hrs Surf.Area= 1,550 sf Storage= 1,284 cf

Plug-Flow detention time= 604.9 min calculated for 2,016 cf (100% of inflow)
 Center-of-Mass det. time= 604.9 min (1,446.4 - 841.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.58'	10,865 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.58	374	0	0
1,071.00	593	203	203
1,072.00	1,365	979	1,182
1,073.00	4,000	2,683	3,865
1,074.00	10,000	7,000	10,865

Device	Routing	Invert	Outlet Devices
#1	Primary	1,072.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,070.58'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.03 cfs @ 15.16 hrs HW=1,072.07' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.58' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: Rain Garden

Inflow Area = 87,272 sf, 68.60% Impervious, Inflow Depth = 0.95" for 2-yr event
 Inflow = 2.90 cfs @ 12.18 hrs, Volume= 6,883 cf
 Outflow = 1.99 cfs @ 12.27 hrs, Volume= 6,883 cf, Atten= 31%, Lag= 5.5 min
 Discarded = 0.05 cfs @ 12.27 hrs, Volume= 1,632 cf
 Primary = 1.21 cfs @ 12.27 hrs, Volume= 4,693 cf
 Secondary = 0.74 cfs @ 12.27 hrs, Volume= 557 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.39' @ 12.27 hrs Surf.Area= 2,716 sf Storage= 1,574 cf

Plug-Flow detention time= 49.6 min calculated for 6,883 cf (100% of inflow)
 Center-of-Mass det. time= 49.6 min (877.4 - 827.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,072.58'	10,519 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,072.58	1,163	0	0
1,073.00	1,950	654	654
1,074.00	3,892	2,921	3,575
1,074.25	5,416	1,164	4,738
1,075.00	10,000	5,781	10,519

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,073.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,072.58'	0.800 in/hr Exfiltration over Surface area
#3	Primary	1,072.75'	12.0" Round Culvert L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,072.75' / 1,072.45' S= 0.0050 '/ Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Discarded OutFlow Max=0.05 cfs @ 12.27 hrs HW=1,073.39' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.21 cfs @ 12.27 hrs HW=1,073.39' (Free Discharge)
 ↑**3=Culvert** (Barrel Controls 1.21 cfs @ 3.21 fps)

Secondary OutFlow Max=0.74 cfs @ 12.27 hrs HW=1,073.39' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.74 cfs @ 1.02 fps)

Summary for Pond 6P: Basin

[81] Warning: Exceeded Pond 5P by 0.31' @ 35.29 hrs

Inflow Area = 187,916 sf, 59.18% Impervious, Inflow Depth = 0.65" for 2-yr event
 Inflow = 3.24 cfs @ 12.20 hrs, Volume= 10,190 cf
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,072.89' @ 24.57 hrs Surf.Area= 6,167 sf Storage= 10,189 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.80'	28,528 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.80	1,275	0	0
1,071.00	2,409	2,210	2,210
1,072.00	4,253	3,331	5,541
1,073.00	6,398	5,326	10,867
1,074.00	8,462	7,430	18,297
1,075.00	12,000	10,231	28,528

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.00'	12.0" Round Culvert L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.00' / 1,072.75' S= 0.0083 '/' Cc= 0.900 n= 0.010, Flow Area= 0.79 sf
#2	Secondary	1,073.50'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

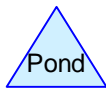
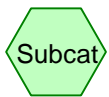
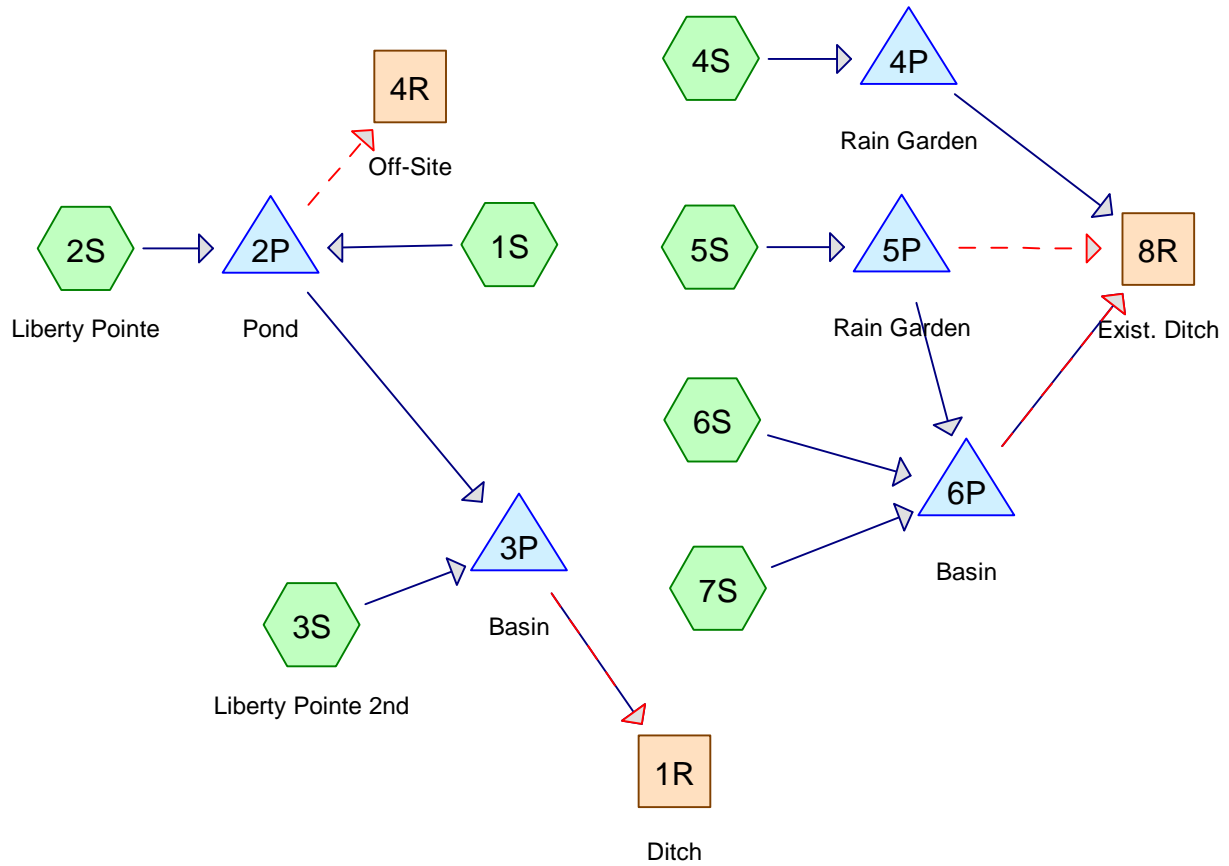
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,069.80' (Free Discharge)

↑1=Culvert (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,069.80' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Appendix F



Routing Diagram for 20180115_0012336_Proposed
 Prepared by Westwood Professional Services, Inc., Printed 1/17/2018
 HydroCAD® 10.00-19 s/n 02396 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=41,389 sf 33.30% Impervious Runoff Depth=0.68"
Tc=10.0 min CN=59 Runoff=0.81 cfs 2,329 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.81% Impervious Runoff Depth=1.10"
Tc=10.0 min CN=67 Runoff=25.45 cfs 62,501 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=1.10"
Tc=10.0 min CN=67 Runoff=19.33 cfs 47,467 cf

Subcatchment 4S: Runoff Area=34,548 sf 58.65% Impervious Runoff Depth=1.54"
Tc=10.0 min CN=74 Runoff=1.88 cfs 4,427 cf

Subcatchment 5S: Runoff Area=87,272 sf 68.60% Impervious Runoff Depth=1.90"
Tc=10.0 min CN=79 Runoff=5.93 cfs 13,809 cf

Subcatchment 6S: Runoff Area=64,791 sf 70.10% Impervious Runoff Depth=1.98"
Tc=10.0 min CN=80 Runoff=4.58 cfs 10,668 cf

Subcatchment 7S: Runoff Area=35,853 sf 16.51% Impervious Runoff Depth=0.28"
Tc=10.0 min CN=49 Runoff=0.13 cfs 825 cf

Reach 1R: Ditch Inflow=0.12 cfs 2,031 cf
Outflow=0.12 cfs 2,031 cf

Reach 4R: Off-Site Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach 8R: Exist. Ditch Inflow=3.13 cfs 14,098 cf
Outflow=3.13 cfs 14,098 cf

Pond 2P: Pond Peak Elev=1,073.62' Storage=63,712 cf Inflow=26.25 cfs 64,830 cf
Discarded=0.03 cfs 20,794 cf Primary=0.00 cfs 0 cf Secondary=0.00 cfs 0 cf Outflow=0.03 cfs 20,794 cf

Pond 3P: Basin Peak Elev=1,073.70' Storage=45,111 cf Inflow=19.33 cfs 47,467 cf
Discarded=0.03 cfs 20,757 cf Primary=0.12 cfs 2,031 cf Secondary=0.00 cfs 0 cf Outflow=0.15 cfs 22,789 cf

Pond 4P: Rain Garden Peak Elev=1,072.37' Storage=1,870 cf Inflow=1.88 cfs 4,427 cf
Discarded=0.04 cfs 2,870 cf Primary=0.57 cfs 1,557 cf Outflow=0.61 cfs 4,427 cf

Pond 5P: Rain Garden Peak Elev=1,073.63' Storage=2,260 cf Inflow=5.93 cfs 13,809 cf
Discarded=0.06 cfs 1,893 cf Primary=1.96 cfs 8,704 cf Secondary=3.13 cfs 3,212 cf Outflow=5.15 cfs 13,809 cf

Pond 6P: Basin Peak Elev=1,073.37' Storage=13,364 cf Inflow=6.52 cfs 20,196 cf
Primary=0.52 cfs 9,329 cf Secondary=0.00 cfs 0 cf Outflow=0.52 cfs 9,329 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 142,026 cf Average Runoff Depth = 1.16"
62.45% Pervious = 916,727 sf 37.55% Impervious = 551,310 sf

Summary for Subcatchment 1S:

Runoff = 0.81 cfs @ 12.20 hrs, Volume= 2,329 cf, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
27,606	39	>75% Grass cover, Good, HSG A
13,783	98	Paved parking, HSG A
41,389	59	Weighted Average
27,606		66.70% Pervious Area
13,783		33.30% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 25.45 cfs @ 12.19 hrs, Volume= 62,501 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
202,706	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,680	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,458		63.19% Pervious Area
251,946		36.81% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 19.33 cfs @ 12.19 hrs, Volume= 47,467 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
107,843	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,448	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,671		70.35% Pervious Area
154,108		29.65% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 1.88 cfs @ 12.18 hrs, Volume= 4,427 cf, Depth= 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
14,286	39	>75% Grass cover, Good, HSG A
20,262	98	Paved parking, HSG A
34,548	74	Weighted Average
14,286		41.35% Pervious Area
20,262		58.65% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 5.93 cfs @ 12.18 hrs, Volume= 13,809 cf, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
27,400	39	>75% Grass cover, Good, HSG A
59,872	98	Paved parking, HSG A
87,272	79	Weighted Average
27,400		31.40% Pervious Area
59,872		68.60% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 4.58 cfs @ 12.18 hrs, Volume= 10,668 cf, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
19,370	39	>75% Grass cover, Good, HSG A
45,421	98	Paved parking, HSG A
64,791	80	Weighted Average
19,370		29.90% Pervious Area
45,421		70.10% Impervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.13 cfs @ 12.28 hrs, Volume= 825 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 10-yr Rainfall=3.92"

Area (sf)	CN	Description
29,935	39	>75% Grass cover, Good, HSG A
5,918	98	Paved parking, HSG A
35,853	49	Weighted Average
29,935		83.49% Pervious Area
5,918		16.51% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area =	1,245,573 sf, 33.71% Impervious,	Inflow Depth =	0.02" for 10-yr event
Inflow =	0.12 cfs @ 22.84 hrs,	Volume=	2,031 cf
Outflow =	0.12 cfs @ 22.84 hrs,	Volume=	2,031 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 8R: Exist. Ditch

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

Inflow Area = 222,463 sf, 59.10% Impervious, Inflow Depth = 0.76" for 10-yr event
Inflow = 3.13 cfs @ 12.23 hrs, Volume= 14,098 cf
Outflow = 3.13 cfs @ 12.23 hrs, Volume= 14,098 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 725,793 sf, 36.61% Impervious, Inflow Depth = 1.07" for 10-yr event
 Inflow = 26.25 cfs @ 12.19 hrs, Volume= 64,830 cf
 Outflow = 0.03 cfs @ 24.18 hrs, Volume= 20,794 cf, Atten= 100%, Lag= 719.8 min
 Discarded = 0.03 cfs @ 24.18 hrs, Volume= 20,794 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.62' @ 24.18 hrs Surf.Area= 26,848 sf Storage= 63,712 cf

Plug-Flow detention time= 6,536.7 min calculated for 20,794 cf (32% of inflow)
 Center-of-Mass det. time= 6,426.1 min (7,265.8 - 839.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.03 cfs @ 24.18 hrs HW=1,073.62' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,070.50' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 0.49'

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth = 0.46" for 10-yr event
 Inflow = 19.33 cfs @ 12.19 hrs, Volume= 47,467 cf
 Outflow = 0.15 cfs @ 22.84 hrs, Volume= 22,789 cf, Atten= 99%, Lag= 639.3 min
 Discarded = 0.03 cfs @ 22.84 hrs, Volume= 20,757 cf
 Primary = 0.12 cfs @ 22.84 hrs, Volume= 2,031 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.70' @ 22.84 hrs Surf.Area= 12,370 sf Storage= 45,111 cf

Plug-Flow detention time= 6,024.9 min calculated for 22,788 cf (48% of inflow)
 Center-of-Mass det. time= 5,920.5 min (6,759.3 - 838.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 22.84 hrs HW=1,073.70' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.11 cfs @ 22.84 hrs HW=1,073.70' (Free Discharge)
 ↑1=Culvert (Inlet Controls 0.11 cfs @ 1.23 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: Rain Garden

Inflow Area = 34,548 sf, 58.65% Impervious, Inflow Depth = 1.54" for 10-yr event
 Inflow = 1.88 cfs @ 12.18 hrs, Volume= 4,427 cf
 Outflow = 0.61 cfs @ 12.44 hrs, Volume= 4,427 cf, Atten= 68%, Lag= 15.7 min
 Discarded = 0.04 cfs @ 12.44 hrs, Volume= 2,870 cf
 Primary = 0.57 cfs @ 12.44 hrs, Volume= 1,557 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,072.37' @ 12.44 hrs Surf.Area= 2,343 sf Storage= 1,870 cf

Plug-Flow detention time= 407.0 min calculated for 4,427 cf (100% of inflow)
 Center-of-Mass det. time= 407.0 min (1,230.3 - 823.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.58'	10,865 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.58	374	0	0
1,071.00	593	203	203
1,072.00	1,365	979	1,182
1,073.00	4,000	2,683	3,865
1,074.00	10,000	7,000	10,865

Device	Routing	Invert	Outlet Devices
#1	Primary	1,072.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,070.58'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.04 cfs @ 12.44 hrs HW=1,072.37' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.56 cfs @ 12.44 hrs HW=1,072.37' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.56 cfs @ 0.93 fps)

Summary for Pond 5P: Rain Garden

Inflow Area = 87,272 sf, 68.60% Impervious, Inflow Depth = 1.90" for 10-yr event
 Inflow = 5.93 cfs @ 12.18 hrs, Volume= 13,809 cf
 Outflow = 5.15 cfs @ 12.23 hrs, Volume= 13,809 cf, Atten= 13%, Lag= 2.9 min
 Discarded = 0.06 cfs @ 12.23 hrs, Volume= 1,893 cf
 Primary = 1.96 cfs @ 12.23 hrs, Volume= 8,704 cf
 Secondary = 3.13 cfs @ 12.23 hrs, Volume= 3,212 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.63' @ 12.23 hrs Surf.Area= 3,169 sf Storage= 2,260 cf

Plug-Flow detention time= 33.1 min calculated for 13,809 cf (100% of inflow)
 Center-of-Mass det. time= 33.1 min (846.1 - 813.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,072.58'	10,519 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,072.58	1,163	0	0
1,073.00	1,950	654	654
1,074.00	3,892	2,921	3,575
1,074.25	5,416	1,164	4,738
1,075.00	10,000	5,781	10,519

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,073.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,072.58'	0.800 in/hr Exfiltration over Surface area
#3	Primary	1,072.75'	12.0" Round Culvert L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,072.75' / 1,072.45' S= 0.0050 '/ Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Discarded OutFlow Max=0.06 cfs @ 12.23 hrs HW=1,073.63' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.96 cfs @ 12.23 hrs HW=1,073.63' (Free Discharge)
 ↑**3=Culvert** (Barrel Controls 1.96 cfs @ 3.58 fps)

Secondary OutFlow Max=3.13 cfs @ 12.23 hrs HW=1,073.63' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 3.13 cfs @ 1.66 fps)

Summary for Pond 6P: Basin

[81] Warning: Exceeded Pond 5P by 0.47' @ 27.47 hrs

Inflow Area = 187,916 sf, 59.18% Impervious, Inflow Depth = 1.29" for 10-yr event
 Inflow = 6.52 cfs @ 12.19 hrs, Volume= 20,196 cf
 Outflow = 0.52 cfs @ 13.80 hrs, Volume= 9,329 cf, Atten= 92%, Lag= 97.1 min
 Primary = 0.52 cfs @ 13.80 hrs, Volume= 9,329 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.37' @ 13.80 hrs Surf.Area= 7,159 sf Storage= 13,364 cf

Plug-Flow detention time= 343.9 min calculated for 9,328 cf (46% of inflow)
 Center-of-Mass det. time= 249.8 min (1,073.7 - 823.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.80'	28,528 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.80	1,275	0	0
1,071.00	2,409	2,210	2,210
1,072.00	4,253	3,331	5,541
1,073.00	6,398	5,326	10,867
1,074.00	8,462	7,430	18,297
1,075.00	12,000	10,231	28,528

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.00'	12.0" Round Culvert L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.00' / 1,072.75' S= 0.0083 '/ Cc= 0.900 n= 0.010, Flow Area= 0.79 sf
#2	Secondary	1,073.50'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

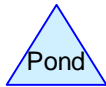
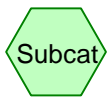
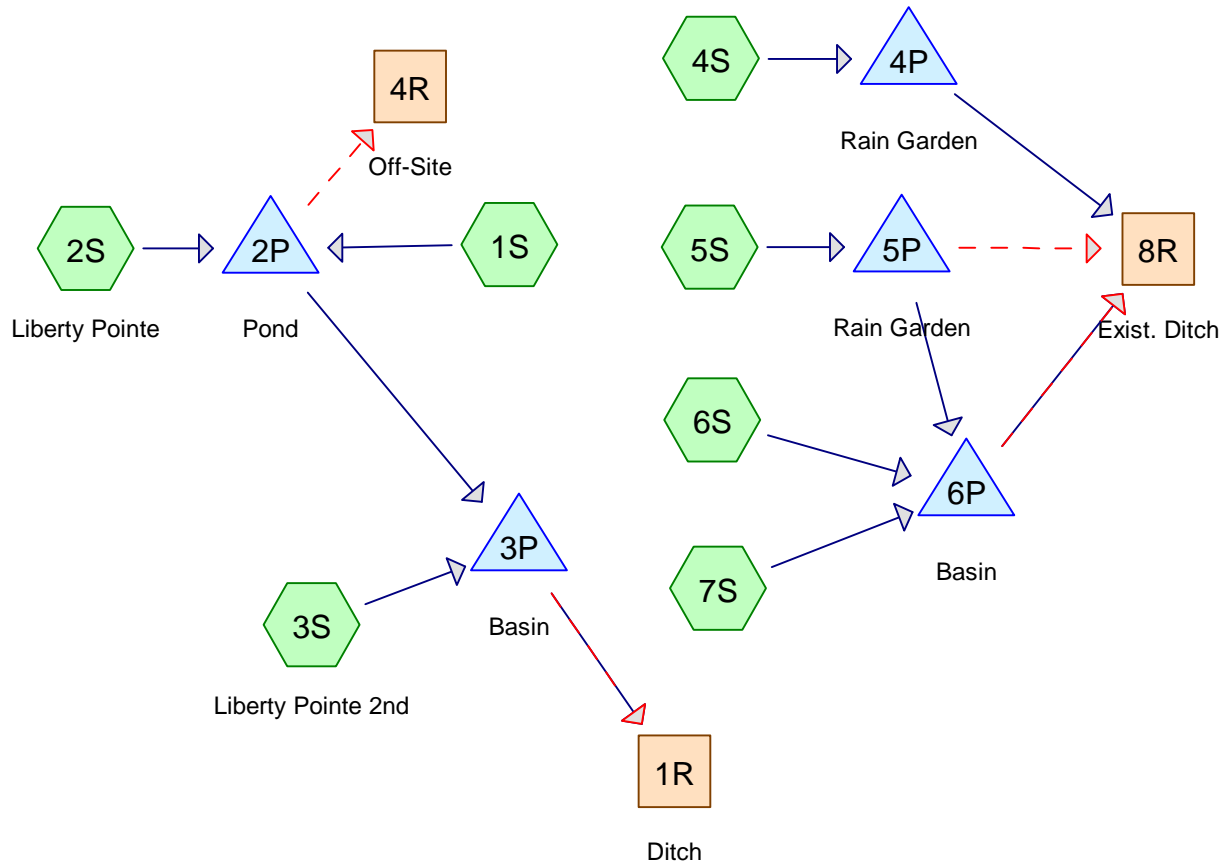
Primary OutFlow Max=0.52 cfs @ 13.80 hrs HW=1,073.37' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.52 cfs @ 2.96 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,069.80' (Free Discharge)

↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Appendix G



Routing Diagram for 20180115_0012336_Proposed
 Prepared by Westwood Professional Services, Inc., Printed 1/17/2018
 HydroCAD® 10.00-19 s/n 02396 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=41,389 sf 33.30% Impervious Runoff Depth=2.09"
 Tc=10.0 min CN=59 Runoff=3.00 cfs 7,194 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.81% Impervious Runoff Depth=2.82"
 Tc=10.0 min CN=67 Runoff=68.90 cfs 160,846 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth=2.82"
 Tc=10.0 min CN=67 Runoff=52.33 cfs 122,157 cf

Subcatchment 4S: Runoff Area=34,548 sf 58.65% Impervious Runoff Depth=3.51"
 Tc=10.0 min CN=74 Runoff=4.32 cfs 10,096 cf

Subcatchment 5S: Runoff Area=87,272 sf 68.60% Impervious Runoff Depth=4.02"
 Tc=10.0 min CN=79 Runoff=12.40 cfs 29,242 cf

Subcatchment 6S: Runoff Area=64,791 sf 70.10% Impervious Runoff Depth=4.13"
 Tc=10.0 min CN=80 Runoff=9.42 cfs 22,276 cf

Subcatchment 7S: Runoff Area=35,853 sf 16.51% Impervious Runoff Depth=1.26"
 Tc=10.0 min CN=49 Runoff=1.38 cfs 3,754 cf

Reach 1R: Ditch Inflow=8.94 cfs 81,316 cf
 Outflow=8.94 cfs 81,316 cf

Reach 4R: Off-Site Inflow=0.79 cfs 15,357 cf
 Outflow=0.79 cfs 15,357 cf

Reach 8R: Exist. Ditch Inflow=14.14 cfs 48,965 cf
 Outflow=14.14 cfs 48,965 cf

Pond 2P: Pond Peak Elev=1,076.26' Storage=149,206 cf Inflow=71.90 cfs 168,040 cf
 Discarded=0.06 cfs 39,895 cf Primary=0.19 cfs 5,451 cf Secondary=0.79 cfs 15,357 cf Outflow=1.03 cfs 60,703 cf

Pond 3P: Basin Peak Elev=1,074.97' Storage=62,327 cf Inflow=52.33 cfs 127,607 cf
 Discarded=0.03 cfs 21,088 cf Primary=8.94 cfs 81,316 cf Secondary=0.00 cfs 0 cf Outflow=8.98 cfs 102,403 cf

Pond 4P: Rain Garden Peak Elev=1,072.65' Storage=2,640 cf Inflow=4.32 cfs 10,096 cf
 Discarded=0.06 cfs 3,259 cf Primary=3.47 cfs 6,837 cf Outflow=3.53 cfs 10,096 cf

Pond 5P: Rain Garden Peak Elev=1,073.96' Storage=3,434 cf Inflow=12.40 cfs 29,242 cf
 Discarded=0.07 cfs 2,277 cf Primary=2.91 cfs 16,373 cf Secondary=8.04 cfs 10,591 cf Outflow=11.02 cfs 29,242 cf

Pond 6P: Basin Peak Elev=1,073.80' Storage=16,624 cf Inflow=13.59 cfs 42,403 cf
 Primary=1.87 cfs 22,805 cf Secondary=4.37 cfs 8,731 cf Outflow=6.24 cfs 31,536 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 355,564 cf Average Runoff Depth = 2.91"
62.45% Pervious = 916,727 sf 37.55% Impervious = 551,310 sf

Summary for Subcatchment 1S:

Runoff = 3.00 cfs @ 12.18 hrs, Volume= 7,194 cf, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
27,606	39	>75% Grass cover, Good, HSG A
13,783	98	Paved parking, HSG A
41,389	59	Weighted Average
27,606		66.70% Pervious Area
13,783		33.30% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 68.90 cfs @ 12.18 hrs, Volume= 160,846 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
202,706	39	>75% Grass cover, Good, HSG A
193,532	61	>75% Grass cover, Good, HSG B
84	74	>75% Grass cover, Good, HSG C
112,680	98	Paved parking, HSG A
125,027	98	Paved parking, HSG B
14,239	98	Water Surface, HSG A
17,088	32	Woods/grass comb., Good, HSG A
16,539	58	Woods/grass comb., Good, HSG B
2,509	72	Woods/grass comb., Good, HSG C
684,405	67	Weighted Average
432,458		63.19% Pervious Area
251,946		36.81% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 52.33 cfs @ 12.18 hrs, Volume= 122,157 cf, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
107,843	39	>75% Grass cover, Good, HSG A
257,829	61	>75% Grass cover, Good, HSG B
48,448	98	Paved parking, HSG A
105,661	98	Paved parking, HSG B
519,780	67	Weighted Average
365,671		70.35% Pervious Area
154,108		29.65% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 4.32 cfs @ 12.18 hrs, Volume= 10,096 cf, Depth= 3.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
14,286	39	>75% Grass cover, Good, HSG A
20,262	98	Paved parking, HSG A
34,548	74	Weighted Average
14,286		41.35% Pervious Area
20,262		58.65% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 12.40 cfs @ 12.17 hrs, Volume= 29,242 cf, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
27,400	39	>75% Grass cover, Good, HSG A
59,872	98	Paved parking, HSG A
87,272	79	Weighted Average
27,400		31.40% Pervious Area
59,872		68.60% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 9.42 cfs @ 12.17 hrs, Volume= 22,276 cf, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
19,370	39	>75% Grass cover, Good, HSG A
45,421	98	Paved parking, HSG A
64,791	80	Weighted Average
19,370		29.90% Pervious Area
45,421		70.10% Impervious Area

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

Summary for Subcatchment 7S:

Runoff = 1.38 cfs @ 12.19 hrs, Volume= 3,754 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 100-yr Rainfall=6.38"

Area (sf)	CN	Description
29,935	39	>75% Grass cover, Good, HSG A
5,918	98	Paved parking, HSG A
35,853	49	Weighted Average
29,935		83.49% Pervious Area
5,918		16.51% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area =	1,245,573 sf, 33.71% Impervious,	Inflow Depth = 0.78"	for 100-yr event
Inflow =	8.94 cfs @ 12.63 hrs,	Volume=	81,316 cf
Outflow =	8.94 cfs @ 12.63 hrs,	Volume=	81,316 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow = 0.79 cfs @ 18.99 hrs, Volume= 15,357 cf
Outflow = 0.79 cfs @ 18.99 hrs, Volume= 15,357 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 8R: Exist. Ditch

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

Inflow Area = 222,463 sf, 59.10% Impervious, Inflow Depth = 2.64" for 100-yr event
Inflow = 14.14 cfs @ 12.30 hrs, Volume= 48,965 cf
Outflow = 14.14 cfs @ 12.30 hrs, Volume= 48,965 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 725,793 sf, 36.61% Impervious, Inflow Depth = 2.78" for 100-yr event
 Inflow = 71.90 cfs @ 12.18 hrs, Volume= 168,040 cf
 Outflow = 1.03 cfs @ 18.99 hrs, Volume= 60,703 cf, Atten= 99%, Lag= 408.6 min
 Discarded = 0.06 cfs @ 18.99 hrs, Volume= 39,895 cf
 Primary = 0.19 cfs @ 18.99 hrs, Volume= 5,451 cf
 Secondary = 0.79 cfs @ 18.99 hrs, Volume= 15,357 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,076.26' @ 18.99 hrs Surf.Area= 40,143 sf Storage= 149,206 cf

Plug-Flow detention time= 4,484.7 min calculated for 60,703 cf (36% of inflow)
 Center-of-Mass det. time= 4,389.3 min (5,207.5 - 818.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.06 cfs @ 18.99 hrs HW=1,076.26' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.18 cfs @ 18.99 hrs HW=1,076.26' (Free Discharge)
 ↑**1=Culvert** (Barrel Controls 0.18 cfs @ 2.34 fps)

Secondary OutFlow Max=0.78 cfs @ 18.99 hrs HW=1,076.26' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.78 cfs @ 0.78 fps)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 1.76'

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth = 1.23" for 100-yr event
 Inflow = 52.33 cfs @ 12.18 hrs, Volume= 127,607 cf
 Outflow = 8.98 cfs @ 12.63 hrs, Volume= 102,403 cf, Atten= 83%, Lag= 26.8 min
 Discarded = 0.03 cfs @ 12.63 hrs, Volume= 21,088 cf
 Primary = 8.94 cfs @ 12.63 hrs, Volume= 81,316 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,074.97' @ 12.63 hrs Surf.Area= 15,027 sf Storage= 62,327 cf

Plug-Flow detention time= 1,483.3 min calculated for 102,403 cf (80% of inflow)
 Center-of-Mass det. time= 1,401.0 min (2,241.0 - 840.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.03 cfs @ 12.63 hrs HW=1,074.97' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=8.94 cfs @ 12.63 hrs HW=1,074.97' (Free Discharge)
 ↑1=Culvert (Barrel Controls 8.94 cfs @ 5.37 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: Rain Garden

Inflow Area = 34,548 sf, 58.65% Impervious, Inflow Depth = 3.51" for 100-yr event
 Inflow = 4.32 cfs @ 12.18 hrs, Volume= 10,096 cf
 Outflow = 3.53 cfs @ 12.24 hrs, Volume= 10,096 cf, Atten= 18%, Lag= 3.6 min
 Discarded = 0.06 cfs @ 12.24 hrs, Volume= 3,259 cf
 Primary = 3.47 cfs @ 12.24 hrs, Volume= 6,837 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,072.65' @ 12.24 hrs Surf.Area= 3,090 sf Storage= 2,640 cf

Plug-Flow detention time= 204.2 min calculated for 10,096 cf (100% of inflow)
 Center-of-Mass det. time= 204.3 min (1,010.5 - 806.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.58'	10,865 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.58	374	0	0
1,071.00	593	203	203
1,072.00	1,365	979	1,182
1,073.00	4,000	2,683	3,865
1,074.00	10,000	7,000	10,865

Device	Routing	Invert	Outlet Devices
#1	Primary	1,072.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,070.58'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.06 cfs @ 12.24 hrs HW=1,072.65' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=3.47 cfs @ 12.24 hrs HW=1,072.65' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 3.47 cfs @ 1.72 fps)

Summary for Pond 5P: Rain Garden

Inflow Area = 87,272 sf, 68.60% Impervious, Inflow Depth = 4.02" for 100-yr event
 Inflow = 12.40 cfs @ 12.17 hrs, Volume= 29,242 cf
 Outflow = 11.02 cfs @ 12.22 hrs, Volume= 29,242 cf, Atten= 11%, Lag= 2.6 min
 Discarded = 0.07 cfs @ 12.22 hrs, Volume= 2,277 cf
 Primary = 2.91 cfs @ 12.22 hrs, Volume= 16,373 cf
 Secondary = 8.04 cfs @ 12.22 hrs, Volume= 10,591 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.96' @ 12.22 hrs Surf.Area= 3,821 sf Storage= 3,434 cf

Plug-Flow detention time= 22.1 min calculated for 29,242 cf (100% of inflow)
 Center-of-Mass det. time= 22.1 min (819.9 - 797.9)

Volume	Invert	Avail.Storage	Storage Description
#1	1,072.58'	10,519 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,072.58	1,163	0	0
1,073.00	1,950	654	654
1,074.00	3,892	2,921	3,575
1,074.25	5,416	1,164	4,738
1,075.00	10,000	5,781	10,519

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,073.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,072.58'	0.800 in/hr Exfiltration over Surface area
#3	Primary	1,072.75'	12.0" Round Culvert L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,072.75' / 1,072.45' S= 0.0050 '/ Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Discarded OutFlow Max=0.07 cfs @ 12.22 hrs HW=1,073.96' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=2.91 cfs @ 12.22 hrs HW=1,073.96' (Free Discharge)
 ↑**3=Culvert** (Barrel Controls 2.91 cfs @ 3.88 fps)

Secondary OutFlow Max=8.03 cfs @ 12.22 hrs HW=1,073.96' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 8.03 cfs @ 2.25 fps)

Summary for Pond 6P: Basin

[81] Warning: Exceeded Pond 5P by 0.48' @ 27.91 hrs

Inflow Area = 187,916 sf, 59.18% Impervious, Inflow Depth = 2.71" for 100-yr event
 Inflow = 13.59 cfs @ 12.18 hrs, Volume= 42,403 cf
 Outflow = 6.24 cfs @ 12.38 hrs, Volume= 31,536 cf, Atten= 54%, Lag= 12.1 min
 Primary = 1.87 cfs @ 12.38 hrs, Volume= 22,805 cf
 Secondary = 4.37 cfs @ 12.38 hrs, Volume= 8,731 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.80' @ 12.38 hrs Surf.Area= 8,044 sf Storage= 16,624 cf

Plug-Flow detention time= 181.5 min calculated for 31,535 cf (74% of inflow)
 Center-of-Mass det. time= 105.8 min (924.1 - 818.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.80'	28,528 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.80	1,275	0	0
1,071.00	2,409	2,210	2,210
1,072.00	4,253	3,331	5,541
1,073.00	6,398	5,326	10,867
1,074.00	8,462	7,430	18,297
1,075.00	12,000	10,231	28,528

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.00'	12.0" Round Culvert L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.00' / 1,072.75' S= 0.0083 '/ Cc= 0.900 n= 0.010, Flow Area= 0.79 sf
#2	Secondary	1,073.50'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

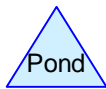
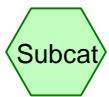
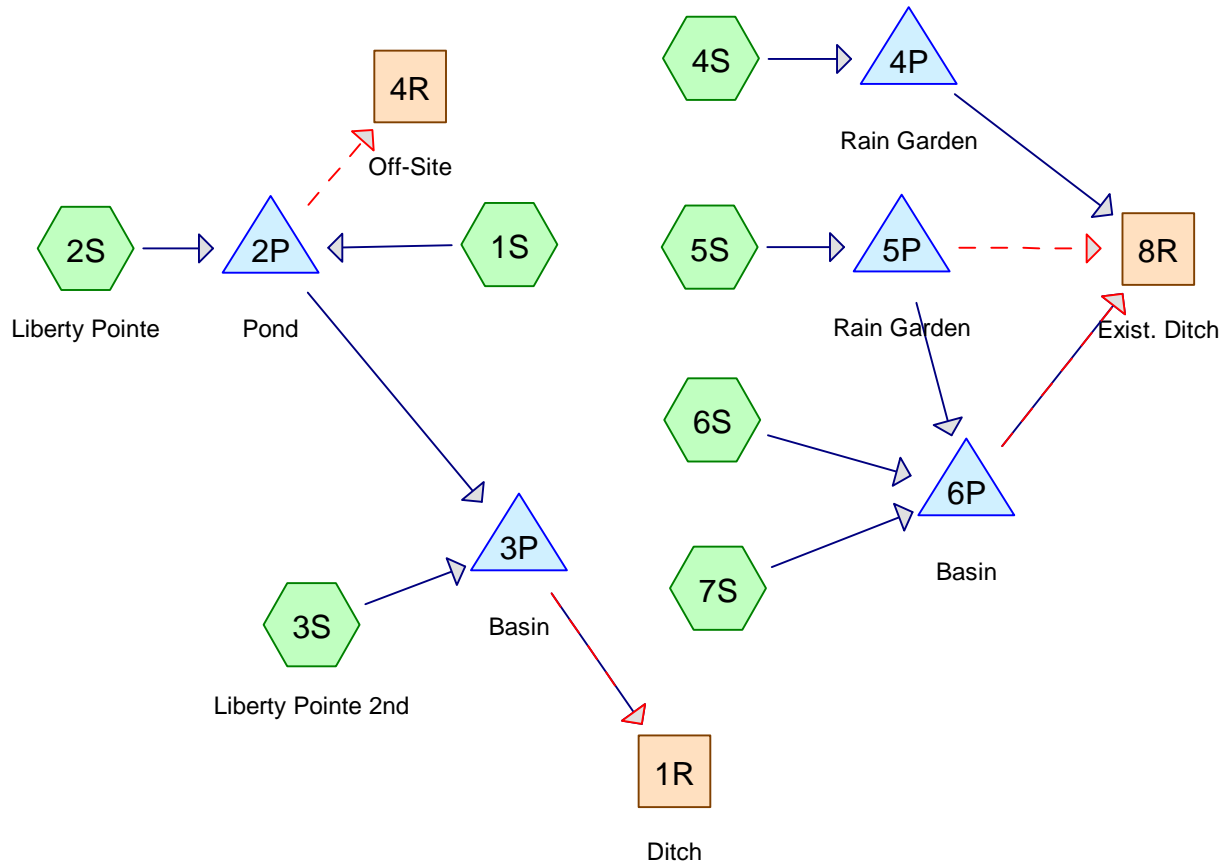
Primary OutFlow Max=1.87 cfs @ 12.38 hrs HW=1,073.80' (Free Discharge)

↑**1=Culvert** (Barrel Controls 1.87 cfs @ 3.82 fps)

Secondary OutFlow Max=4.36 cfs @ 12.38 hrs HW=1,073.80' (Free Discharge)

↑**2=Broad-Crested Rectangular Weir** (Weir Controls 4.36 cfs @ 1.47 fps)

Appendix H



Routing Diagram for 20180115_0012336_Proposed
 Prepared by Westwood Professional Services, Inc., Printed 1/17/2018
 HydroCAD® 10.00-19 s/n 02396 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-240.00 hrs, dt=0.01 hrs, 24001 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 1S: Runoff Area=41,389 sf 33.30% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=1.13 cfs 24,007 cf

Subcatchment 2S: Liberty Pointe Runoff Area=684,405 sf 36.81% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=18.75 cfs 396,982 cf

Subcatchment 3S: Liberty Pointe 2nd Runoff Area=519,780 sf 29.65% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=14.24 cfs 301,493 cf

Subcatchment 4S: Runoff Area=34,548 sf 58.65% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=0.95 cfs 20,039 cf

Subcatchment 5S: Runoff Area=87,272 sf 68.60% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=2.39 cfs 50,621 cf

Subcatchment 6S: Runoff Area=64,791 sf 70.10% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=1.78 cfs 37,581 cf

Subcatchment 7S: Runoff Area=35,853 sf 16.51% Impervious Runoff Depth>6.96"
 Tc=10.0 min AMC Adjusted CN=98 Runoff=0.98 cfs 20,796 cf

Reach 1R: Ditch Inflow=15.17 cfs 289,011 cf
 Outflow=15.17 cfs 289,011 cf

Reach 4R: Off-Site Inflow=16.72 cfs 198,321 cf
 Outflow=16.72 cfs 198,321 cf

Reach 8R: Exist. Ditch Inflow=5.99 cfs 90,768 cf
 Outflow=5.99 cfs 90,768 cf

Pond 2P: Pond Peak Elev=1,076.89' Storage=177,040 cf Inflow=19.89 cfs 420,989 cf
 Discarded=0.08 cfs 29,587 cf Primary=2.19 cfs 50,112 cf Secondary=16.72 cfs 198,321 cf Outflow=18.98 cfs 278,020 cf

Pond 3P: Basin Peak Elev=1,075.59' Storage=72,020 cf Inflow=16.42 cfs 351,604 cf
 Discarded=0.04 cfs 18,591 cf Primary=15.17 cfs 289,011 cf Secondary=0.00 cfs 0 cf Outflow=15.21 cfs 307,602 cf

Pond 4P: Rain Garden Peak Elev=1,072.41' Storage=1,975 cf Inflow=0.95 cfs 20,039 cf
 Discarded=0.05 cfs 10,627 cf Primary=0.90 cfs 9,409 cf Outflow=0.95 cfs 20,036 cf

Pond 5P: Rain Garden Peak Elev=1,073.43' Storage=1,671 cf Inflow=2.39 cfs 50,621 cf
 Discarded=0.05 cfs 16,562 cf Primary=1.32 cfs 29,610 cf Secondary=1.02 cfs 4,444 cf Outflow=2.39 cfs 50,616 cf

Pond 6P: Basin Peak Elev=1,073.71' Storage=15,901 cf Inflow=4.07 cfs 87,987 cf
 Primary=1.55 cfs 60,298 cf Secondary=2.52 cfs 16,617 cf Outflow=4.07 cfs 76,915 cf

Total Runoff Area = 1,468,036 sf Runoff Volume = 851,519 cf Average Runoff Depth = 6.96"
62.45% Pervious = 916,727 sf 37.55% Impervious = 551,310 sf

Summary for Subcatchment 1S:

Runoff = 1.13 cfs @ 121.01 hrs, Volume= 24,007 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
27,606	39		>75% Grass cover, Good, HSG A
13,783	98		Paved parking, HSG A
41,389	59	98	Weighted Average, AMC Adjusted
27,606			66.70% Pervious Area
13,783			33.30% Impervious Area

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

Summary for Subcatchment 2S: Liberty Pointe

Runoff = 18.75 cfs @ 121.01 hrs, Volume= 396,982 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
202,706	39		>75% Grass cover, Good, HSG A
193,532	61		>75% Grass cover, Good, HSG B
84	74		>75% Grass cover, Good, HSG C
112,680	98		Paved parking, HSG A
125,027	98		Paved parking, HSG B
14,239	98		Water Surface, HSG A
17,088	32		Woods/grass comb., Good, HSG A
16,539	58		Woods/grass comb., Good, HSG B
2,509	72		Woods/grass comb., Good, HSG C
684,405	67	98	Weighted Average, AMC Adjusted
432,458			63.19% Pervious Area
251,946			36.81% Impervious Area

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

Summary for Subcatchment 3S: Liberty Pointe 2nd

Runoff = 14.24 cfs @ 121.01 hrs, Volume= 301,493 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
107,843	39		>75% Grass cover, Good, HSG A
257,829	61		>75% Grass cover, Good, HSG B
48,448	98		Paved parking, HSG A
105,661	98		Paved parking, HSG B
519,780	67	98	Weighted Average, AMC Adjusted
365,671			70.35% Pervious Area
154,108			29.65% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 0.95 cfs @ 121.01 hrs, Volume= 20,039 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
14,286	39		>75% Grass cover, Good, HSG A
20,262	98		Paved parking, HSG A
34,548	74	98	Weighted Average, AMC Adjusted
14,286			41.35% Pervious Area
20,262			58.65% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 2.39 cfs @ 121.01 hrs, Volume= 50,621 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
27,400	39		>75% Grass cover, Good, HSG A
59,872	98		Paved parking, HSG A
87,272	79	98	Weighted Average, AMC Adjusted
27,400			31.40% Pervious Area
59,872			68.60% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 1.78 cfs @ 121.01 hrs, Volume= 37,581 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
19,370	39		>75% Grass cover, Good, HSG A
45,421	98		Paved parking, HSG A
64,791	80	98	Weighted Average, AMC Adjusted
19,370			29.90% Pervious Area
45,421			70.10% Impervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.98 cfs @ 121.01 hrs, Volume= 20,796 cf, Depth> 6.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 MSE 24-hr 3 240.00 hrs 10-day Snowmelt Rainfall=7.20", AMC=4

Area (sf)	CN	Adj	Description
29,935	39		>75% Grass cover, Good, HSG A
5,918	98		Paved parking, HSG A
35,853	49	98	Weighted Average, AMC Adjusted
29,935			83.49% Pervious Area
5,918			16.51% Impervious Area

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

Summary for Reach 1R: Ditch

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

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth > 2.78" for 10-day Snowmelt event
Inflow = 15.17 cfs @ 121.08 hrs, Volume= 289,011 cf
Outflow = 15.17 cfs @ 121.08 hrs, Volume= 289,011 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Off-Site

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

Inflow	=	16.72 cfs @ 121.07 hrs,	Volume=	198,321 cf
Outflow	=	16.72 cfs @ 121.07 hrs,	Volume=	198,321 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Reach 8R: Exist. Ditch

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

Inflow Area = 222,463 sf, 59.10% Impervious, Inflow Depth > 4.90" for 10-day Snowmelt event
Inflow = 5.99 cfs @ 121.02 hrs, Volume= 90,768 cf
Outflow = 5.99 cfs @ 121.02 hrs, Volume= 90,768 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs

Summary for Pond 2P: Pond

Inflow Area = 725,793 sf, 36.61% Impervious, Inflow Depth > 6.96" for 10-day Snowmelt event
 Inflow = 19.89 cfs @ 121.01 hrs, Volume= 420,989 cf
 Outflow = 18.98 cfs @ 121.07 hrs, Volume= 278,020 cf, Atten= 5%, Lag= 3.4 min
 Discarded = 0.08 cfs @ 121.07 hrs, Volume= 29,587 cf
 Primary = 2.19 cfs @ 121.07 hrs, Volume= 50,112 cf
 Secondary = 16.72 cfs @ 121.07 hrs, Volume= 198,321 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,076.89' @ 121.07 hrs Surf.Area= 48,499 sf Storage= 177,040 cf

Plug-Flow detention time= 1,509.8 min calculated for 278,020 cf (66% of inflow)
 Center-of-Mass det. time= 758.9 min (8,119.6 - 7,360.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.50'	182,594 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.50	14,239	0	0
1,071.00	16,048	7,572	7,572
1,072.00	20,113	18,081	25,652
1,073.00	24,335	22,224	47,876
1,074.00	28,396	26,366	74,242
1,075.00	32,460	30,428	104,670
1,076.00	36,694	34,577	139,247
1,077.00	50,000	43,347	182,594

Device	Routing	Invert	Outlet Devices
#1	Primary	1,076.05'	12.0" Round Culvert L= 409.0' Ke= 0.500 Inlet / Outlet Invert= 1,076.05' / 1,073.21' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Secondary	1,076.16'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#3	Discarded	1,070.51'	0.100 in/hr Exfiltration over Surface area above 1,070.51' Excluded Surface area = 14,275 sf

Discarded OutFlow Max=0.08 cfs @ 121.07 hrs HW=1,076.89' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=2.19 cfs @ 121.07 hrs HW=1,076.89' (Free Discharge)
 ↑**1=Culvert** (Inlet Controls 2.19 cfs @ 3.12 fps)

Secondary OutFlow Max=16.70 cfs @ 121.07 hrs HW=1,076.89' (Free Discharge)
 ↑**2=Broad-Crested Rectangular Weir** (Weir Controls 16.70 cfs @ 2.30 fps)

Summary for Pond 3P: Basin

[79] Warning: Submerged Pond 2P Primary device # 1 OUTLET by 2.38'

Inflow Area = 1,245,573 sf, 33.71% Impervious, Inflow Depth > 3.39" for 10-day Snowmelt event
 Inflow = 16.42 cfs @ 121.01 hrs, Volume= 351,604 cf
 Outflow = 15.21 cfs @ 121.08 hrs, Volume= 307,602 cf, Atten= 7%, Lag= 4.2 min
 Discarded = 0.04 cfs @ 121.08 hrs, Volume= 18,591 cf
 Primary = 15.17 cfs @ 121.08 hrs, Volume= 289,011 cf
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,075.59' @ 121.08 hrs Surf.Area= 16,135 sf Storage= 72,020 cf

Plug-Flow detention time= 951.9 min calculated for 307,589 cf (87% of inflow)
 Center-of-Mass det. time= 418.4 min (7,990.2 - 7,571.8)

Volume	Invert	Avail.Storage	Storage Description
#1	1,068.00'	99,756 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,068.00	3,095	0	0
1,069.00	4,535	3,815	3,815
1,070.00	6,960	5,748	9,563
1,072.00	9,764	16,724	26,287
1,074.00	12,828	22,592	48,879
1,075.00	15,105	13,967	62,845
1,076.00	16,858	15,982	78,827
1,077.00	25,000	20,929	99,756

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.57'	24.0" Round Culvert L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.57' / 1,073.17' S= 0.0167 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Discarded	1,068.00'	0.100 in/hr Exfiltration over Surface area
#3	Secondary	1,076.10'	10.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.04 cfs @ 121.08 hrs HW=1,075.59' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=15.21 cfs @ 121.08 hrs HW=1,075.59' (Free Discharge)
 ↑1=Culvert (Barrel Controls 15.21 cfs @ 5.96 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,068.00' (Free Discharge)
 ↑3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: Rain Garden

Inflow Area = 34,548 sf, 58.65% Impervious, Inflow Depth > 6.96" for 10-day Snowmelt event
 Inflow = 0.95 cfs @ 121.01 hrs, Volume= 20,039 cf
 Outflow = 0.95 cfs @ 121.02 hrs, Volume= 20,036 cf, Atten= 0%, Lag= 0.6 min
 Discarded = 0.05 cfs @ 121.02 hrs, Volume= 10,627 cf
 Primary = 0.90 cfs @ 121.02 hrs, Volume= 9,409 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,072.41' @ 121.02 hrs Surf.Area= 2,458 sf Storage= 1,975 cf

Plug-Flow detention time= 270.4 min calculated for 20,035 cf (100% of inflow)
 Center-of-Mass det. time= 269.4 min (7,630.2 - 7,360.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,070.58'	10,865 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,070.58	374	0	0
1,071.00	593	203	203
1,072.00	1,365	979	1,182
1,073.00	4,000	2,683	3,865
1,074.00	10,000	7,000	10,865

Device	Routing	Invert	Outlet Devices
#1	Primary	1,072.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,070.58'	0.800 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.05 cfs @ 121.02 hrs HW=1,072.41' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.90 cfs @ 121.02 hrs HW=1,072.41' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.90 cfs @ 1.09 fps)

Summary for Pond 5P: Rain Garden

Inflow Area = 87,272 sf, 68.60% Impervious, Inflow Depth > 6.96" for 10-day Snowmelt event
 Inflow = 2.39 cfs @ 121.01 hrs, Volume= 50,621 cf
 Outflow = 2.39 cfs @ 121.02 hrs, Volume= 50,616 cf, Atten= 0%, Lag= 0.6 min
 Discarded = 0.05 cfs @ 121.02 hrs, Volume= 16,562 cf
 Primary = 1.32 cfs @ 121.02 hrs, Volume= 29,610 cf
 Secondary = 1.02 cfs @ 121.02 hrs, Volume= 4,444 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.43' @ 121.02 hrs Surf.Area= 2,784 sf Storage= 1,671 cf

Plug-Flow detention time= 46.3 min calculated for 50,616 cf (100% of inflow)
 Center-of-Mass det. time= 45.6 min (7,406.4 - 7,360.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,072.58'	10,519 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,072.58	1,163	0	0
1,073.00	1,950	654	654
1,074.00	3,892	2,921	3,575
1,074.25	5,416	1,164	4,738
1,075.00	10,000	5,781	10,519

Device	Routing	Invert	Outlet Devices
#1	Secondary	1,073.25'	5.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	1,072.58'	0.800 in/hr Exfiltration over Surface area
#3	Primary	1,072.75'	12.0" Round Culvert L= 60.0' Ke= 0.500 Inlet / Outlet Invert= 1,072.75' / 1,072.45' S= 0.0050 '/ Cc= 0.900 n= 0.011 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Discarded OutFlow Max=0.05 cfs @ 121.02 hrs HW=1,073.43' (Free Discharge)
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.32 cfs @ 121.02 hrs HW=1,073.43' (Free Discharge)
 ↑**3=Culvert** (Barrel Controls 1.32 cfs @ 3.27 fps)

Secondary OutFlow Max=1.02 cfs @ 121.02 hrs HW=1,073.43' (Free Discharge)
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 1.02 cfs @ 1.14 fps)

Summary for Pond 6P: Basin

[81] Warning: Exceeded Pond 5P by 0.47' @ 185.90 hrs

Inflow Area = 187,916 sf, 59.18% Impervious, Inflow Depth > 5.62" for 10-day Snowmelt event
 Inflow = 4.07 cfs @ 121.01 hrs, Volume= 87,987 cf
 Outflow = 4.07 cfs @ 121.02 hrs, Volume= 76,915 cf, Atten= 0%, Lag= 0.5 min
 Primary = 1.55 cfs @ 121.02 hrs, Volume= 60,298 cf
 Secondary = 2.52 cfs @ 121.02 hrs, Volume= 16,617 cf

Routing by Stor-Ind method, Time Span= 0.00-240.00 hrs, dt= 0.01 hrs
 Peak Elev= 1,073.71' @ 121.02 hrs Surf.Area= 7,856 sf Storage= 15,901 cf

Plug-Flow detention time= 746.8 min calculated for 76,915 cf (87% of inflow)
 Center-of-Mass det. time= 373.5 min (7,697.8 - 7,324.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,069.80'	28,528 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,069.80	1,275	0	0
1,071.00	2,409	2,210	2,210
1,072.00	4,253	3,331	5,541
1,073.00	6,398	5,326	10,867
1,074.00	8,462	7,430	18,297
1,075.00	12,000	10,231	28,528

Device	Routing	Invert	Outlet Devices
#1	Primary	1,073.00'	12.0" Round Culvert L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 1,073.00' / 1,072.75' S= 0.0083 '/ Cc= 0.900 n= 0.010, Flow Area= 0.79 sf
#2	Secondary	1,073.50'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.55 cfs @ 121.02 hrs HW=1,073.71' (Free Discharge)
 ↑1=Culvert (Barrel Controls 1.55 cfs @ 3.68 fps)

Secondary OutFlow Max=2.51 cfs @ 121.02 hrs HW=1,073.71' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 2.51 cfs @ 1.22 fps)

Appendix I

Project Information

Calculator Version: Version 3: January 2017
 Project Name: Southview Heights
 User Name / Company Name:
 Date: 1/22/18
 Project Description:
 Construction Permit?: Yes

Site Information

Retention Requirement (inches): 1
 Site's Zip Code: 56374
 Annual Rainfall (inches): 27.9
 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	2.72				2.72
			Impervious Area (acres)		3.33
			Total Area (acres)		6.05

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	2.09				2.09
			Impervious Area (acres)		3.02
			Total Area (acres)		5.11

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	12088	ft3
Volume removed by BMPs towards performance goal:	10551	ft3
Percent volume removed towards performance goal	87	%

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	7.4734	acre-ft
Annual runoff volume removed by BMPs:	6.1641	acre-ft
Percent annual runoff volume removed:	82	%
Post development annual particulate P load:	3.354	lbs
Annual particulate P removed by BMPs:	2.766	lbs
Post development annual dissolved P load:	2.744	lbs
Annual dissolved P removed by BMPs:	2.263	lbs
Percent annual total phosphorus removed:	82	%
Post development annual TSS load:	1107.8	lbs
Annual TSS removed by BMPs:	913.8	lbs
Percent annual TSS removed:	82	%

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	1294	1706	1294	412	76
2 - Bioretention basin (w/o underdrain)	312	4973	312	4661	6
1 - Infiltration basin/Infiltration trench (abc)	9278	8945	8945	0	100

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 (%)
1 - Bioretention basin (w/o underdrain)	1.0379	0	0.9024	0.1355	87
2 - Bioretention basin (w/o underdrain)	2.9211	0	0.5625	2.3586	19
1 - Infiltration basin/Infiltration trench (abc)	2.7004	2.3586	4.6993	0.3597	93

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	0.4658	0	0.405	0.0608	87
2 - Bioretention basin (w/o underdrain)	1.311	0	0.2525	1.0585	19
1 - Infiltration basin/Infiltration trench (abc)	1.2119	1.0585	2.109	0.1614	93

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	0.3811	0	0.3313	0.0498	87
2 - Bioretention basin (w/o underdrain)	1.0726	0	0.2065	0.8661	19
1 - Infiltration basin/Infiltration trench (abc)	0.9916	0.8661	1.7256	0.1321	93

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Bioretention basin (w/o underdrain)	153.86	0	133.77	20.09	87
2 - Bioretention basin (w/o underdrain)	433.03	0	83.39	349.64	19
1 - Infiltration basin/Infiltration trench (abc)	400.3	349.64	696.61	53.33	93

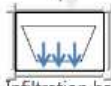
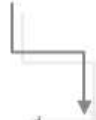
BMP Schematic



1 - Bioretention basin (w/o underdrain)



2 - Bioretention basin (w/o underdrain)



1 - Infiltration basin/
Infiltration trench

Appendix J

Southview Heights
0012336.00

Date of Comps = 1/17/2018

Rain Garden: 4P

From CAD:	Elev. (ft)	Area (sf)
Bottom	1070.58	374
NWL	1072.25	1,352
Permanent Pool =		1,441 CF
Average Depth =		1.1 Feet

	Area (Ac)	% Imp.	Impervious (Ac)
Proposed	0.79	59%	0.47
Existing	0	#DIV/0!	0.00
	<hr/>		<hr/>
	0.79 Ac		0.47 Ac

NPDES required dead storage = 1422 CF
Is the Permanent Pool Volume
greater than the NPDES requirement? YES

NPDES WQV (1" new, 0.5" existing) = 0.04 AF
= 1,706 CF
Pond Elevation at 1,706 CF
Elevation = 1,072.30 Feet
Surface Area = 1.910 Ac
Pond Discharge at 1,072.30 Feet
Q = 0.45 CFS
Runoff per Surface Acre = 0.24 CFS/Ac

Is this less than the maximum 5.66cfs/ac? YES

Southview Heights
0012336.00

Date of Comps = 1/17/2018

Rain Garden: 5P

From CAD:	Elev. (ft)	Area (sf)
Bottom	1072.58	1,162
NWL	1073.25	2,425
Permanent Pool =		1,202 CF
Average Depth =		0.5 Feet

	Area (Ac)	% Imp.	Impervious (Ac)
Proposed	2	69%	1.37
Existing	0	#DIV/0!	0.00
	<hr/>		<hr/>
	2 Ac		1.37 Ac

NPDES required dead storage = 3600 CF
Is the Permanent Pool Volume
greater than the NPDES requirement? NO

NPDES WQV (1" new, 0.5" existing) = 0.11 AF
= 4,973 CF
Pond Elevation at 4,973 CF
Elevation = 1,074.29 Feet
Surface Area = 1.910 Ac
Pond Discharge at 1,074.29 Feet
Q = 17.28 CFS
Runoff per Surface Acre = 9.05 CFS/Ac

Is this less than the maximum 5.66cfs/ac? NO

Southview Heights
0012336.00

Date of Comps = 1/17/2018

Basin: 6P

From CAD:	Elev. (ft)	Area (sf)
Bottom	1069.8	1,275
NWL	1073	4,524
Permanent Pool =		9,278 CF
Average Depth =		2.1 Feet

	Area (Ac)	% Imp.	Impervious (Ac)
Proposed	2.3	51%	1.18
Existing	0	#DIV/0!	0.00
	<hr/>		<hr/>
	2.3 Ac		1.18 Ac

NPDES required dead storage = 4140 CF
Is the Permanent Pool Volume
greater than the NPDES requirement? YES

NPDES WQV (1" new, 0.5" existing) = 0.10 AF
= 4,283 CF
Pond Elevation at 4,283 CF
Elevation = 1,071.72 Feet
Surface Area = 1.910 Ac
Pond Discharge at 1,071.72 Feet
Q = 0.00 CFS
Runoff per Surface Acre = 0.00 CFS/Ac

Is this less than the maximum 5.66cfs/ac? YES

Appendix K



SOUTHVIEW HEIGHTS

N:\012336.00\DWG\CIVIL\0012336.00\DA01.DWG

DESIGNED: _____ WRH
 CHECKED: _____ WRH
 DRAWN: _____ JJN
 FIELD CREW: _____
 FIELD WORK DATE: _____

INITIAL ISSUE: 01/22/18
 REVISIONS: _____

PREPARED FOR:

LUMBER ONE AVON, INC.

PO BOX 7
 AVON, MN 56310

SOUTHVIEW HEIGHTS

ST. JOSEPH, MN

Westwood

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 Fax (320) 358-2001 St. Cloud, MN 56303
 Toll Free (800) 270-9495 westwoodps.com
 Westwood Professional Services, Inc.

EXISTING DRAINAGE

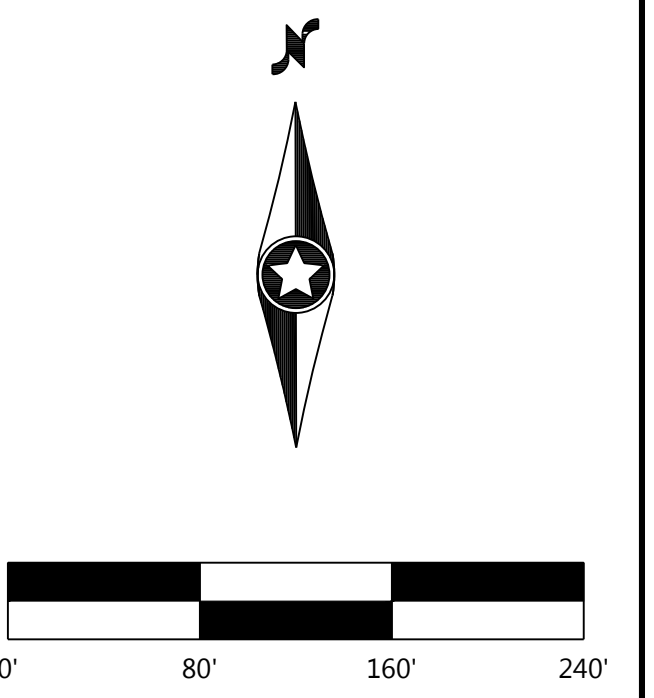
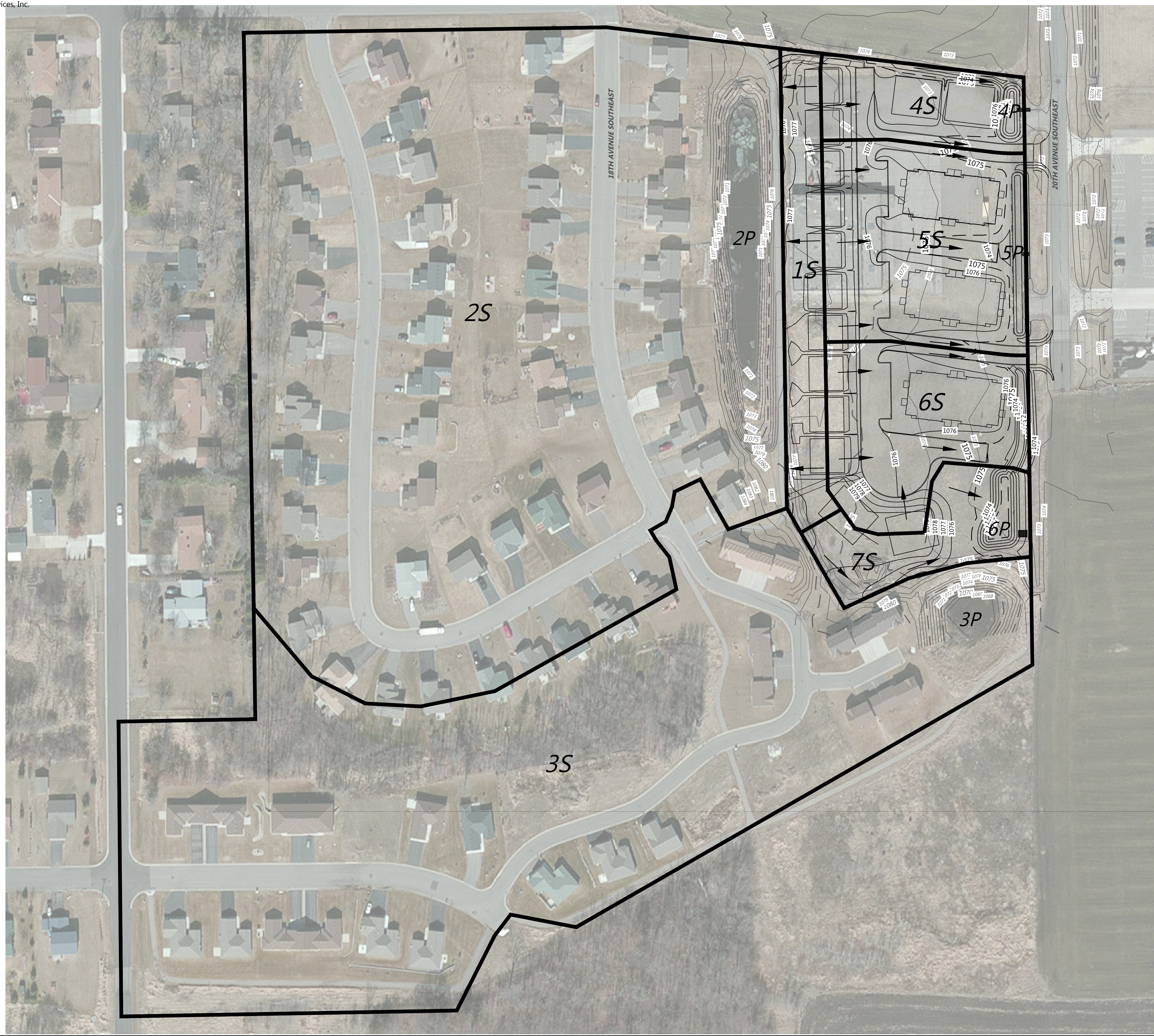
SHEET NUMBER:

1 OF **1**

DATE: 01/22/18

0012336.00

Appendix L



SOUTHVIEW HEIGHTS

N:\012336.00\DWG\CIVIL\0012336.00\DA01.DWG

DESIGNED: _____ WRH
 CHECKED: _____ WRH
 DRAWN: _____ JIN
 FIELD CREW: _____
 FIELD WORK DATE: _____

INITIAL ISSUE: 01/22/18
 REVISIONS: _____

PREPARED FOR:
LUMBER ONE AVON, INC.
 PO BOX 7
 AVON, MN 56310

SOUTHVIEW HEIGHTS
 ST. JOSEPH, MN

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 Westwood Professional Services, Inc.

PROPOSED DRAINAGE

SHEET NUMBER:
1 OF **1**
 DATE: 01/22/18