

KAW VALLEY ENGINEERING, INC.

PRELIMINARY STORMWATER REPORT for STREETS OF WEST PRYOR

NWQ PRYOR ROAD AND LOWENSTEIN DRIVE LEE'S SUMMIT, MISSOURI

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Prepared By:

KAW VALLEY ENGINEERING, INC. 2319 N Jackson Junction City, Kansas 66441

KVE Project No. A14D7067-1



Leon D. Osbourne, P.E. Project Manager

William Heatherman, P.E. Project Engineer Consulting Engineers

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INTRODUCTION

This drainage report was prepared to accompany the submittal of the Preliminary Development Plan for the proposed improvements located at NWQ Pryor Road and Lowenstein Drive in Lee's Summit, Missouri. The proposed improvements include approximately 72.7 acres of mixed use commercial development and multi-family and single-family housing. This revision covers updates made to the plans during review, including details of the West Detention Pond and modifications to the watershed area and drainage patterns for the East and South basins, as discussed in more detail in each section.

DESIGN CRITERIA

- Adopted design Criteria
 - o APWA Division V Section 5600 Storm Drainage Systems and Facilities
- Lee's Summit Missouri
 - o Preliminary Development Plan Checklist

PROJECT LOCATION



Figure 1: Project Location Map

As seen in Figure 1, the project is located in the NWC of NW Lowenstein Drive and NW Pryor Road. The project site is bound by NW Pryor Road and Summit Woods Crossing shopping center to the East, Lowenstein Park and residential properties to the south and southwest, and by Interstate 470 to the north.

EXISTING CONDITIONS

The project site is mostly undeveloped with the exception of some single family residential homes that are being removed. The project site is well covered with a low scrubby vegetation interspersed with dense stands of trees. See **APPENDIX A** for existing and proposed drainage area maps.

FEMA FIRM

The site is currently located on FIRM Map Number 29095C0291F Panel 291 of 6480. The project site is located in Areas determined to be outside 500-year floodplain determined to be outside the 1% and 0.2% annual chance floodplains. See **APPENDIX B** for a FEMA Firmette encompassing the project site.

Existing Watershed

The project site is located within Cedar Creek and Boggs Hollow Watersheds and discharges in several directions.

The South watershed discharges to the roadside ditch along Lowenstein Drive and into the drainage way through the City Park. The West watershed drains to the west into a roadside ditch and concrete channel that proceeds along Lowenstein Drive and through open ditches to the west towards Cedar Creek. Both of these systems are part of the Cedar Creek watershed.

The East watershed ultimately discharges to several crossroad culverts under I-470. A portion of the roadside flow on Pryor, up to the inlet capacities, is directed via storm sewers into the detention pond on the Summit Woods development, which then drains via pipe system under I-470 on the east side of US-50. The remainder of the area, including all overflow beyond inlet capacities on Pryor, drains to the existing MoDOT ditch on I-470 until it reaches the box culvert crossing I-470 and ramps approximately 1,100 feet west of Pryor Road. The East watershed is tributary to the Boggs Hollow watershed, which then ultimately joins Cedar Cree.

The total pre-project acreages tributary of each of these three primary sub-basins is as follows:

Table 1: Pre-Project Tributary Areas

	Subwatershed
	Area
	(acres)
East (Boggs Hollow)	23.0
South (Cedar Creek)	24.0
West (Cedar Creek)	24.9
Total	71.9

The difference between this total and the formal site size of 72.7 acres is attributable to excluding Lowenstein Road right-of-way from the drainage area and the addition of a sliver of the cell tower tract that drains into the West watershed.

Existing Soils

Soils data for the site was obtained from the NRCS soil survey. A summary of the site soils and their properties is shown on the chart below. According to the NRCS, the on-site soils are predominately Type D soils (17%), Type C soils (66%) or Type C/D (17%). The composite CN values used for rainfall mass calculations reflect a conservative estimate of the predominant Type D soils contained onsite.

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10113	Oska silty clay loam, 5 to 9 percent slopes, eroded	D	5.6	8.2%
10117	Sampsel silty clay loam, 5 to 9 percent slopes	C/D	11.3	16.7%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	С	27.3	40.2%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	D	5.2	7.6%
10141	Snead-Rock outcrop complex, 14 to 30 percent slopes	D	0.6	0.9%
10179	Udarents-Urban land- Oska complex, 5 to 9 percent slopes	С	0.4	0.5%
10181	Udarents-Urban land- Sampsel complex, 5 to 9 percent slopes	С	17.6	25.9%
Totals for Area of Inter	est	67.9	100.0%	

Existing Stormwater Appurtenances

There are three existing small ponds on the project that capture and detain an undetermined amount storm water. The existing watersheds discharging to the ponds and their respective outlet structures have not been investigated as the ponds will be removed and larger detention basins will be provided to accommodate the proposed development. There are miscellaneous culverts located on the project site allowing storm water to pass under residential driveways and through other existing features. No other storm water appurtenances are present on the project site.

Offsite Drainage Areas

The project site sits at the upper portion of the Cedar Creek and Boggs Hollow Watersheds and therefore has minimal offsite drainage areas passing through the project site. The only offsite area is a sliver of land from the cell tower property which drains into the western basin, as shown on the Existing Drainage Area exhibit in **APPENDIX A**.

PRE- AND POST-DEVELOPMENT SITE CONDITIONS

Due to space constraints on the eastern portion of the site, the project proposes to transfer a substantial portion of the East and South watersheds via storm sewer into the West watershed, where it can be detained in a larger regional detention basin (the "West Basin"). The basin will capture 41.1 acres, an increase from the 24.9 acres that are tributary to west side now.

To transfer these area, two main trunk lines of storm sewer will pass under the ridge lines to discharge into the West basin. These trunk line and the inlets and lateral pipes leading to them are designed to capture up to the 100-year flow, so that they can be directed into the West basin.

A remaining portion of the South watershed located near the relocated intersection of Lowenstein Road and Pryor Avenue will be directed to a basin at the corner of Chipman Road and Pryor Ave (the "South Basin"). This basin captures 12.3 acres.

Cumulatively, the two detention basins capture 53.4 acres. The remaining 18.5 acres is primarily from the perimeter of the East, South and West basins, located along drives or sloped areas that could not be captured due to grading.

Portions of Lots 6, 7 and 8 are also designed to remain in the East watershed and be discharged primarily through an outlet into the MoDOT ditch at a point 560 ft west of Pryor Road.

A small portion of this remaining area will drain the 10-year storm via storm inlet into the drain on Pryor Road near the northernmost entrance to the site, which will then connect to the detention pond in the Summit Woods development.

The area has been limited so that the predevelopment peak runoff from the East watershed is not exceeded in post-development conditions, except for a variance requested for a minor exceedance in the 2-year event.

Per APWA 5600, pre- and post-development site flows will be analyzed for the 2-, 10-, and 100-year design storms.

Pre / Post Site Land use

The pre-project CN is estimated for preliminary study purposes as 77. The post-project curve number is estimated as 94 for commercial areas, and 83 in the single-family residential portion of the West watershed. The composite CN for the areas to the West Basin was estimated at 91. The composite CN to the South Basin is estimated at 94.

Allowable Release Rates by Watershed

The allowable release rates for three watersheds were calculated by considering both the predevelopment versus post-development peaks and by the detention basin release rate guidance given in APWA 5608.4. In light of the changes made to watershed boundaries, the allowable release rates were based on pre-project drainage areas to each outlet.

Table 2: Allowable Release Rates

Drainage Area	Area (Acres) (Pre-Project)	Design Storm	Allowable Release Rate (cfs/acre)	Total Allowable Release Rate (cfs) from Watershed - APWA	Total Allowable Release Rate (cfs) from Watershed - APWA
West Watershed		50% (2 yr)	0.5	12.5	43
	24.9	10% (10 yr)	2	49.8	83
Watershea		1% (100 yr)	3	74.7	167
C . II		50% (2 yr)	0.5	12	41
South Watershed	24	10% (10 yr)	2	48	80
Watershed		1% (100 yr)	3	72	161
- ·		50% (2 yr)	0.5	11.5	41
East Watershed	23	10% (10 yr)	2	46	80
watersneu		1% (100 yr)	3	69	160

Actual Detention Pond Release Rates

The calculation of the actual release rates from each watershed was based on the size of the adjusted watersheds and the proposed detention basins. Runoff from the undetained areas was added to the detention basin outflows to calculate an equivalent total watershed release rate. For the post-project area of the East basin, there is no detention structure, but the total contributory area is less than before the project.

The detention areas were analyzed using Hydraflow Hydrographs. The detailed calculations are found in **APPENDIX D**. The SCS method was used to generate hydrographs, and then routed through standard methods in each pond. Composite orifice and weir structures were estimated to control the release rate. Storage volumes were approximated from the grading plan. Detailed refinements of each basin will be undertaken during final design. Each basin also contains a wet pond for water feature/amenity, as well as an excess volume above the permanent pool that can be used for the Water Quality Capture requirement (described later).

The West watershed contains a second upper pond that will act as an additional amenity and forebay. It is not intended to be a significant retention structure and will gather water from a smaller subarea. Any effect of the upper pond was neglected in these preliminary calculations.

As shown in the charts below, the proposed extended wet detention basins adequately accommodate and reduce post-development storm water flows to APWA required levels for the West and South watersheds. The only exception is in the net release rate from the 2-year storm, which is exceeded slightly. This is unavoidable due to impact from the undetained residual areas.

However, in all cases, the net release rate is less than the pre-development flows from the original drainage areas, as can be seen in the data in **APPENDIX D**.

The APWA release rates set as the target were impractical as a control for the East watershed, since there was no detention basin proposed in that area. In the case of the East watershed, the area is draining into MoDOT's right of way and then ultimately into the much larger Bogg's Hollow watershed. There are no habitable structures or neighborhoods through which this flow would pass first before joining the larger watershed. For these reasons, it is proposed to use the pre-development limit from the full watershed area as the controlling target in the East watershed. In addition, the 2-year release rate is slightly above the pre-development release rate. A variance is requested. No adverse impact is anticipated to the downstream system as a result.

Table 3: Summary of Discharge Rates

Water- shed	Post- Project Area to Detention (acres)	Post-Project Area Un- Detained (acres)	Design Storm	Actual Release Rate from Detention Area (cfs)	Total Release Rate from Watershed (including un- detained area) (cfs)	Allowable Release Rate from Water- shed - APWA (cfs)	Pre- Develop- ment Release Rate (cfs)
West	41.0	2.7	50% (2 yr)	14.5	20.6 *	12.5	43
Water- shed			10% (10 yr)	20.9	31.2	49.8	83
Silea			1% (100 yr)	46.9	54.7	74.7	167
South	12.4	3.5	50% (2 yr)	1.0	15.3 *	12	41
Water- shed			10% (10 yr)	4.3	24.0	48	80
Siled			1% (100 yr)	21.2	49.1	72	161
East	0	12.3	50% (2 yr)	n/a	49.9 **	11.5	41
Waters- hed			10% (10 yr)	n/a	78.6 *	46	80
nea			1% (100 yr)	n/a	133.4 *	69	160

^{*} Release rate from the combination of detained and undetained areas exceeds APWA but is less than predevelopment condition. Variance requested.

^{**} Release rate from the undetained area in the 2-year storm only exceeds the pre-development condition. Variance requested.

PROPOSED STORM SEWER SYSTEM

The proposed storm sewer system is comprised of several general systems that direct site storm sewer flows to the proposed extended wet detention basins located in the west and south watersheds. See **APPENDIX C** for a preliminary layout of the storm sewer system. The proposed storm sewer layout is schematic in nature and inlet size and placement are estimated to accommodate storm sewer flows based on the preliminary grading. The storm sewer arrangement is subject to change and will be adjusted as needed when the final site plan layout is prepared.

A particular feature of the storm sewer system are the two trunk lines needed to carry flows from the East and South watersheds to the West basin for detention. These pipes are sized to carry up to the 100-year flow. Due to the crossing of the ridge line, they become deep in places, with corresponding deep junction structures. See **APPENDIX E** for preliminary sizing and layout of the primary trunk line for this system.

The remaining storm sewers on the west side of the new site ridge line will drain independently in shallower systems. These pipes will only need to be sized for the 10-year storm (per APWA), since overland swale flow can direct the 100-year overflow to each basin.

The pipe system feeding the South basin from north of Lowenstein will also be sized for the 100-year flow, since otherwise any overland swale flow would be intercepted at Lowenstein and bypass the detention area.

PROPOSED EXTENDED WET DETENTION

Wet detention ponds are proposed for the West and South watersheds to reduce the increase in post-development storm water flows and to provide aesthetic water features for the proposed development. The proposed wet detention basin sizes are preliminary in nature and are both currently sized to show that adequate detention is available. The proposed wet detention pond sizes will be adjusted as needed when the final site plan layout is prepared. See **APPENDIX D** for wet detention pond routing. See the information below for preliminary design information. It is assumed that the wet detention ponds will hold water at their design wet pond elevation and storm water detention and water quality treatment will occur above this elevation.

West Wet Detention Pond

Top Elevation = 962.0
Bottom elevation = 940.0
Wet Pond Elevation = 950.0
Storage Volume at Wet Pond Elevation = 746,323 Cubic Feet
Overflow Structure Elevation = 956.0
Max 100 yr WSE = 955.2
Max 100 yr Storage Volume = 1,328,063 Cubic Feet

South Wet Detention Pond

Top Elevation = 980.0
Bottom elevation = 960.0
Wet Pond Elevation = 970.0
Storage Volume at Wet Pond Elevation = 190,016 Cubic Feet
Overflow Structure Elevation = 977.0
Max 100 yr WSE = 976.3
Max 100 yr Storage Volume = 402,542 Cubic Feet

MARC/APWA BMP CALCULATIONS

Per APWA 5608.4, the project site is required to provide 40-hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). As mentioned above, both of the detention basins will be designed as extended wet detention basins (EWDBs) that will be maintained to have a permanent pool elevation. The EWDB's final design will be prepared per the MARC Manual section 8.8.

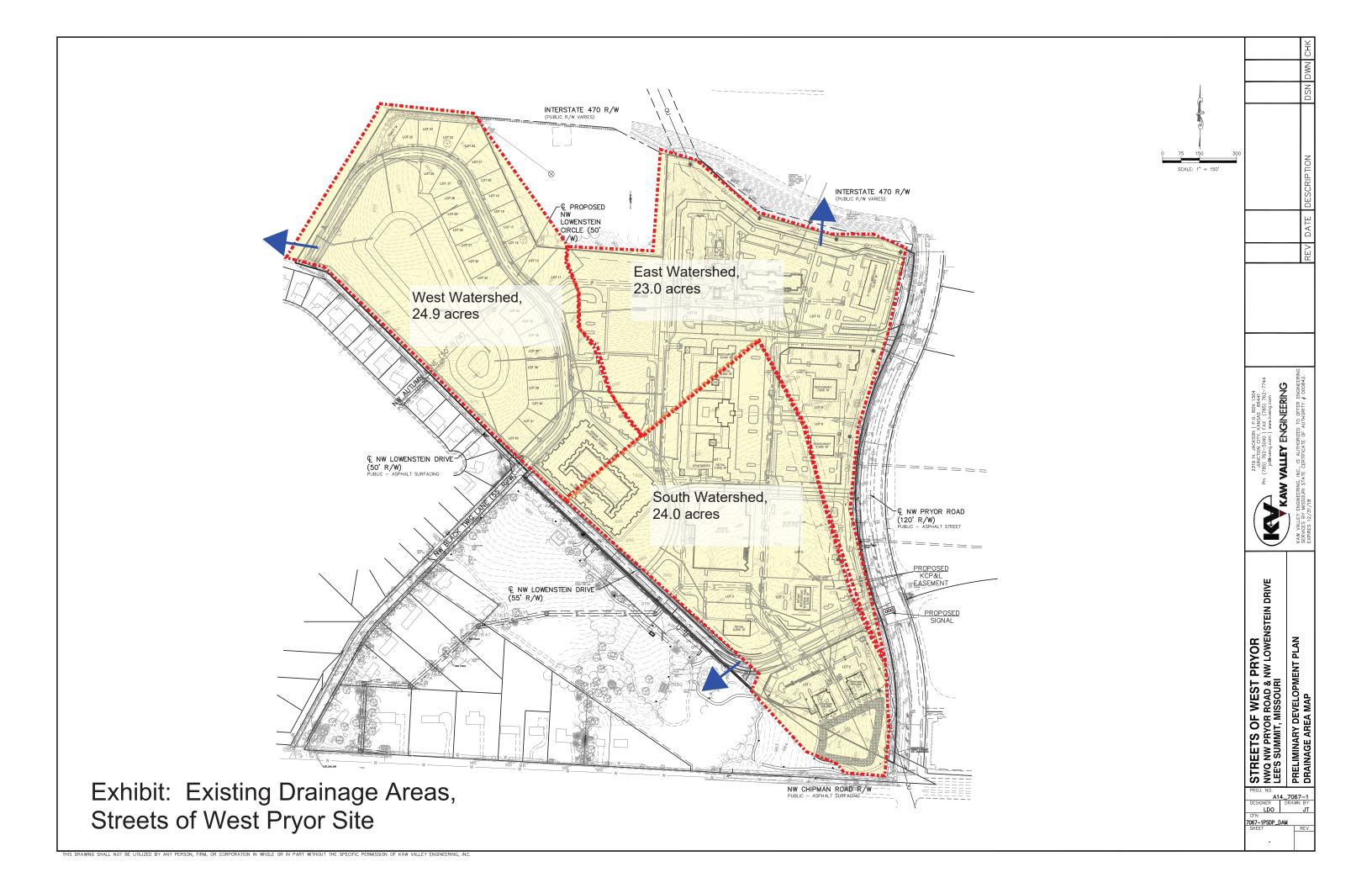
DOWNSTREAM CONDITIONS

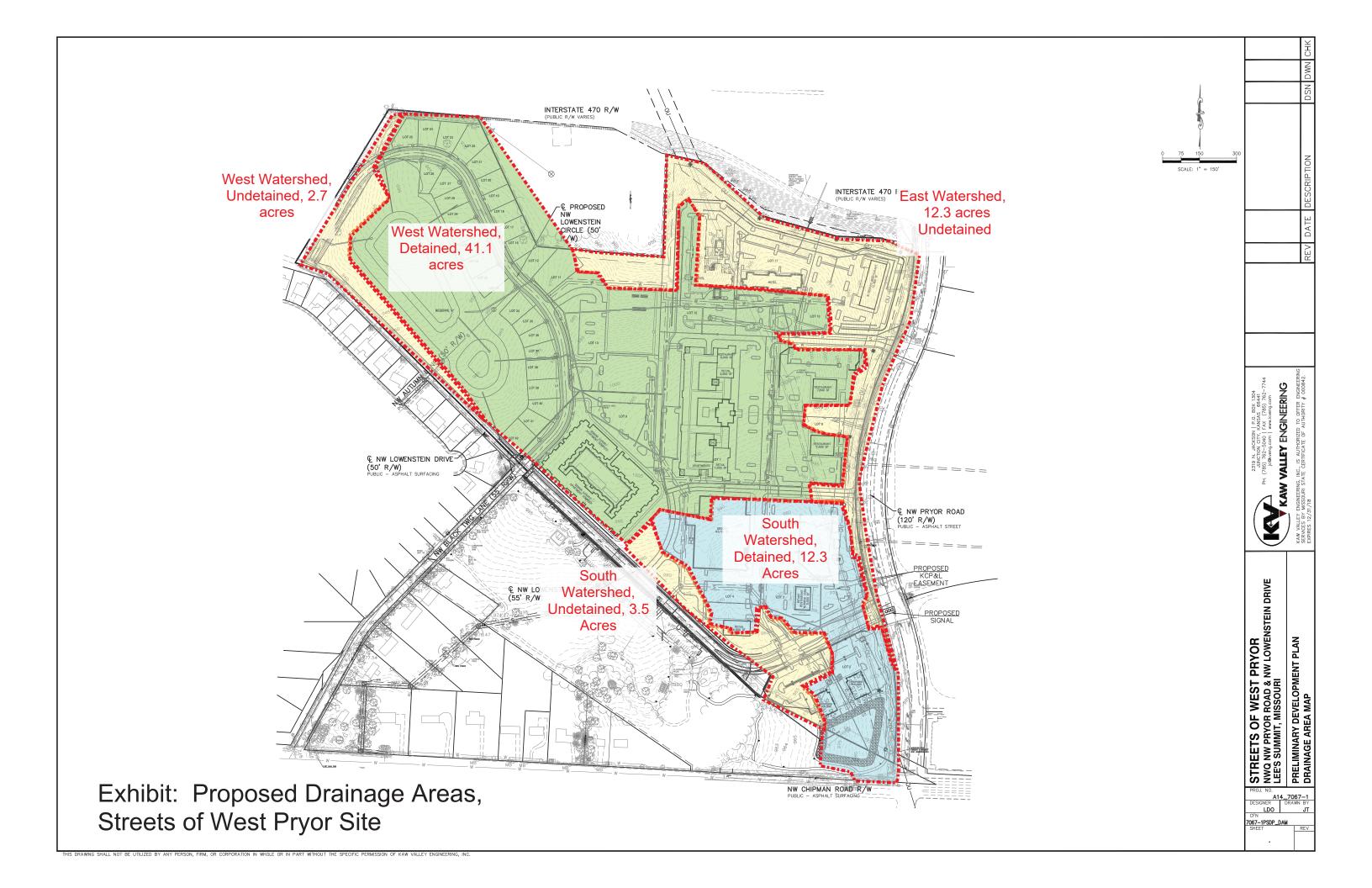
The proposed development will mitigate for changes to the watershed by providing significant detention and addressing the water quality storm. Release rates from detention areas are in line with City standards, except for deviations as reported for the 2-year storms and for the East Watershed. Release rates from the East Watershed are below to the pre-development peak in all but the 2-year storm, and are well below the pre-development peak for the West and South watersheds.

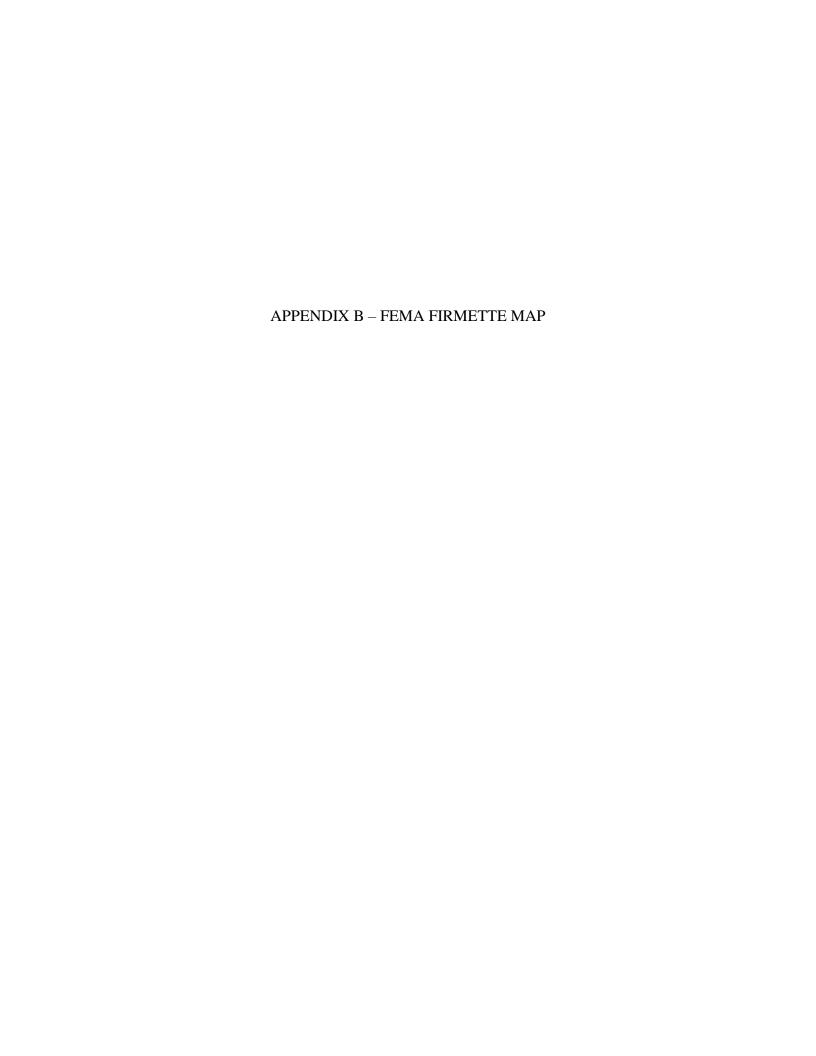
CONCLUSION

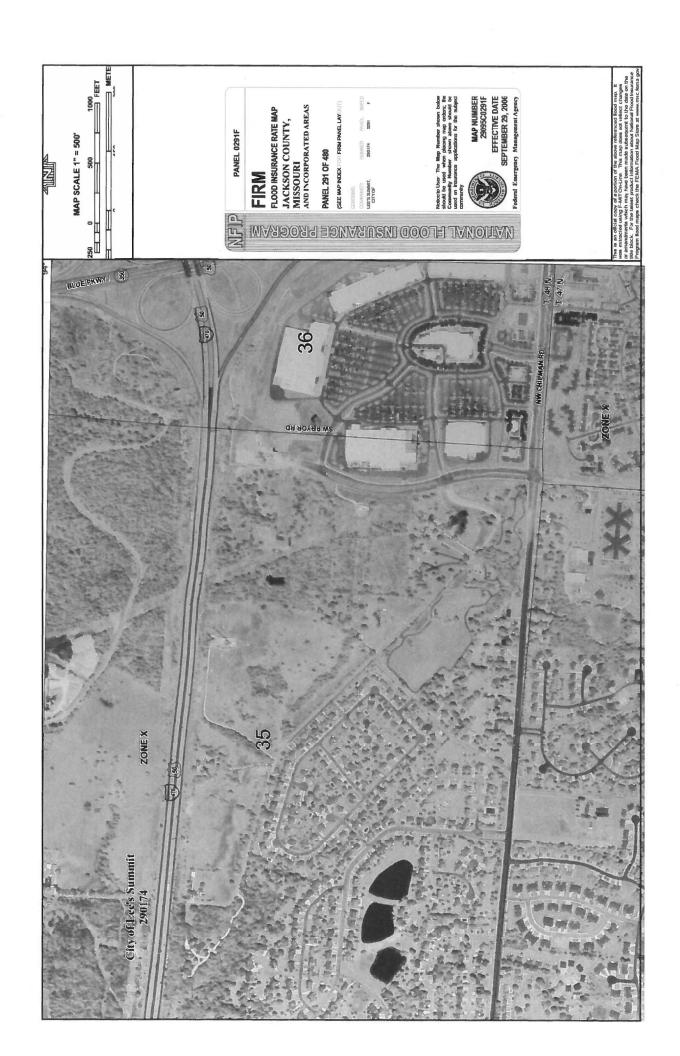
The proposed development will effectively capture, detain and treat stormwater from the proposed development in substantially in accordance with the requirements set forth by the City of Lee's Summit. A waiver from the strict application of the APWA 5608.4 release rate standard is requested for the combined releases in the 2-year storm and for the release rate from the East Watershed, based on both conditions remaining below the pre-development peak of the existing watershed. Additionally, a waiver from the pre-development peak limit is requested for the 2-year discharge from the East Watershed.

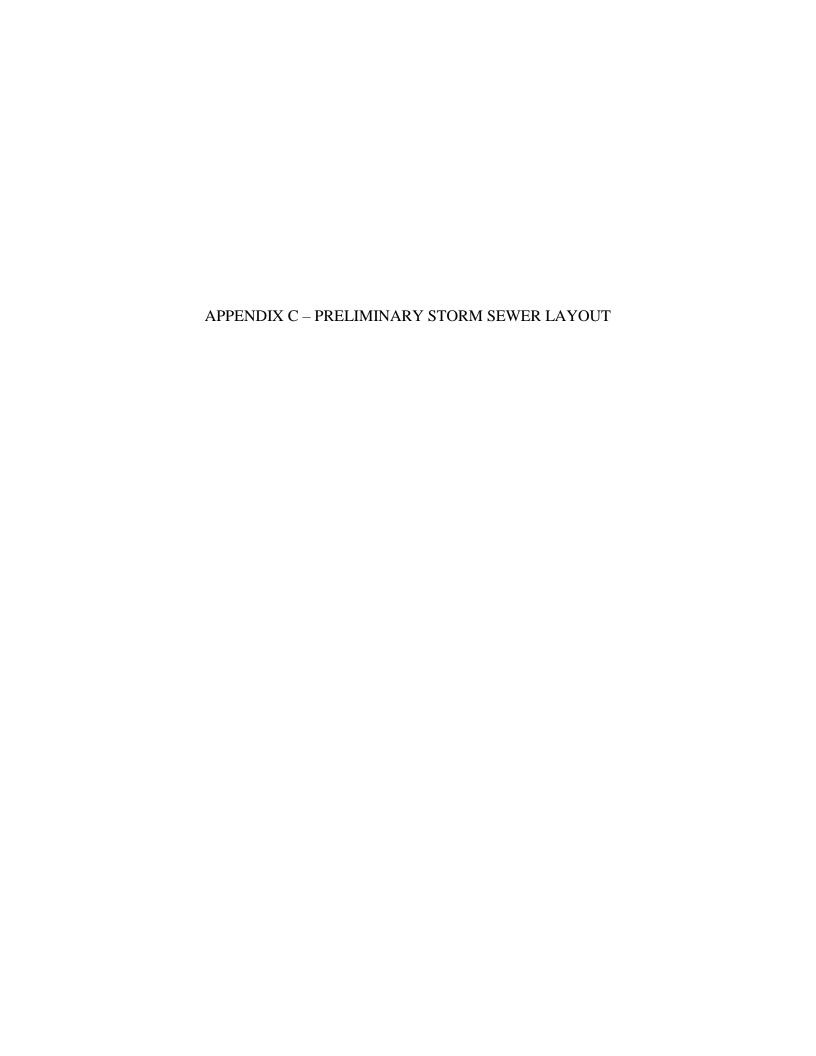


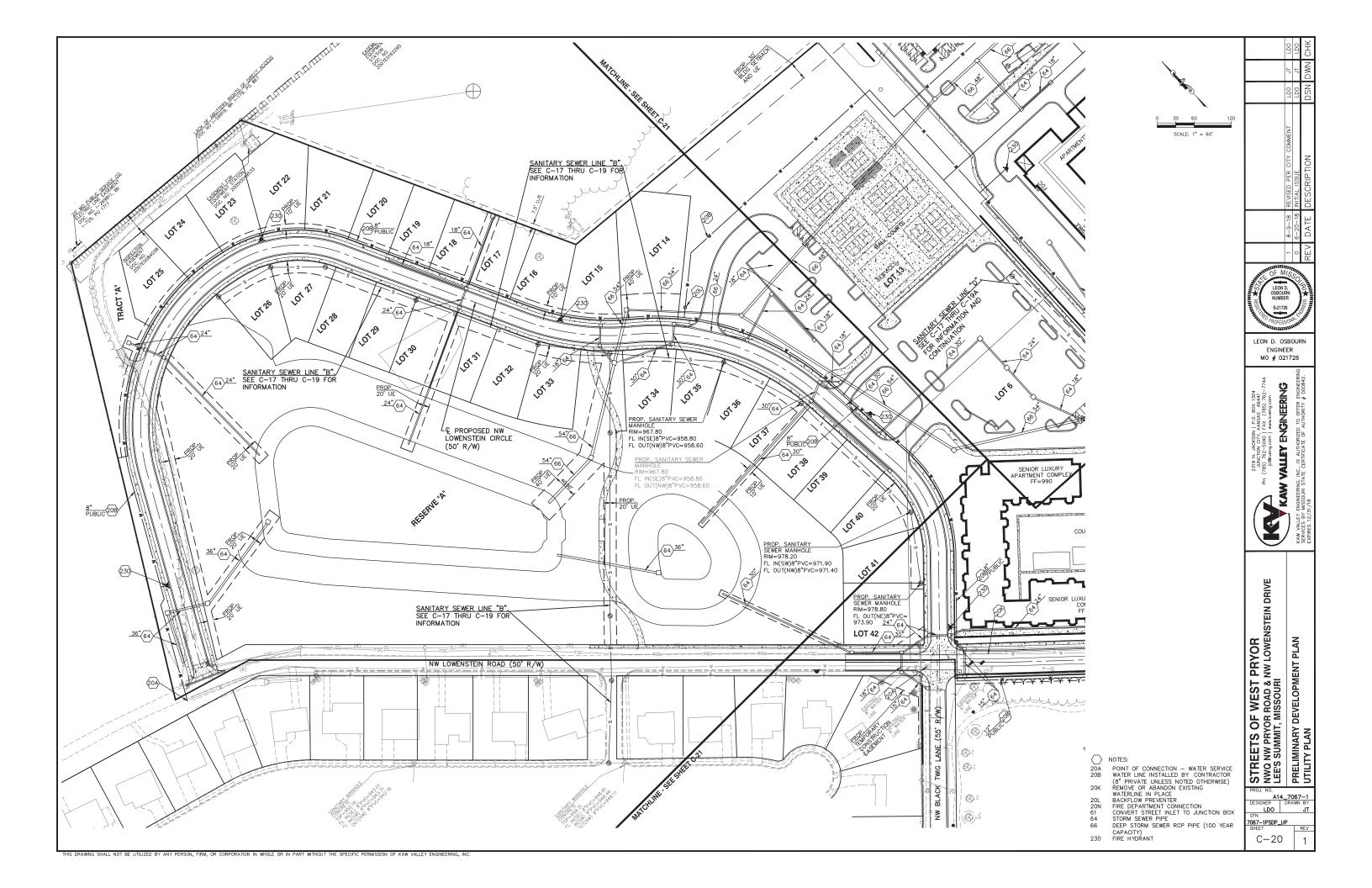


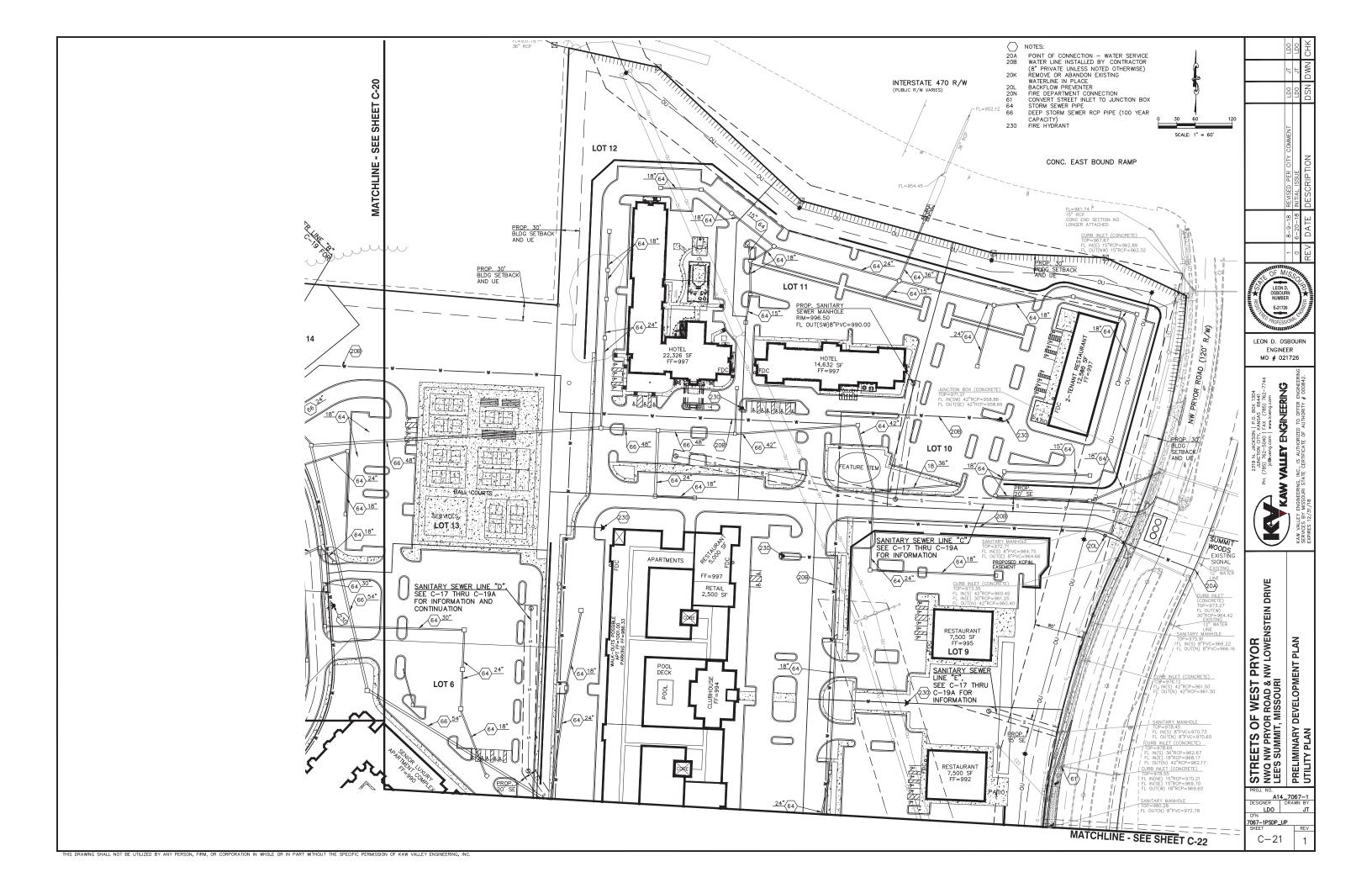


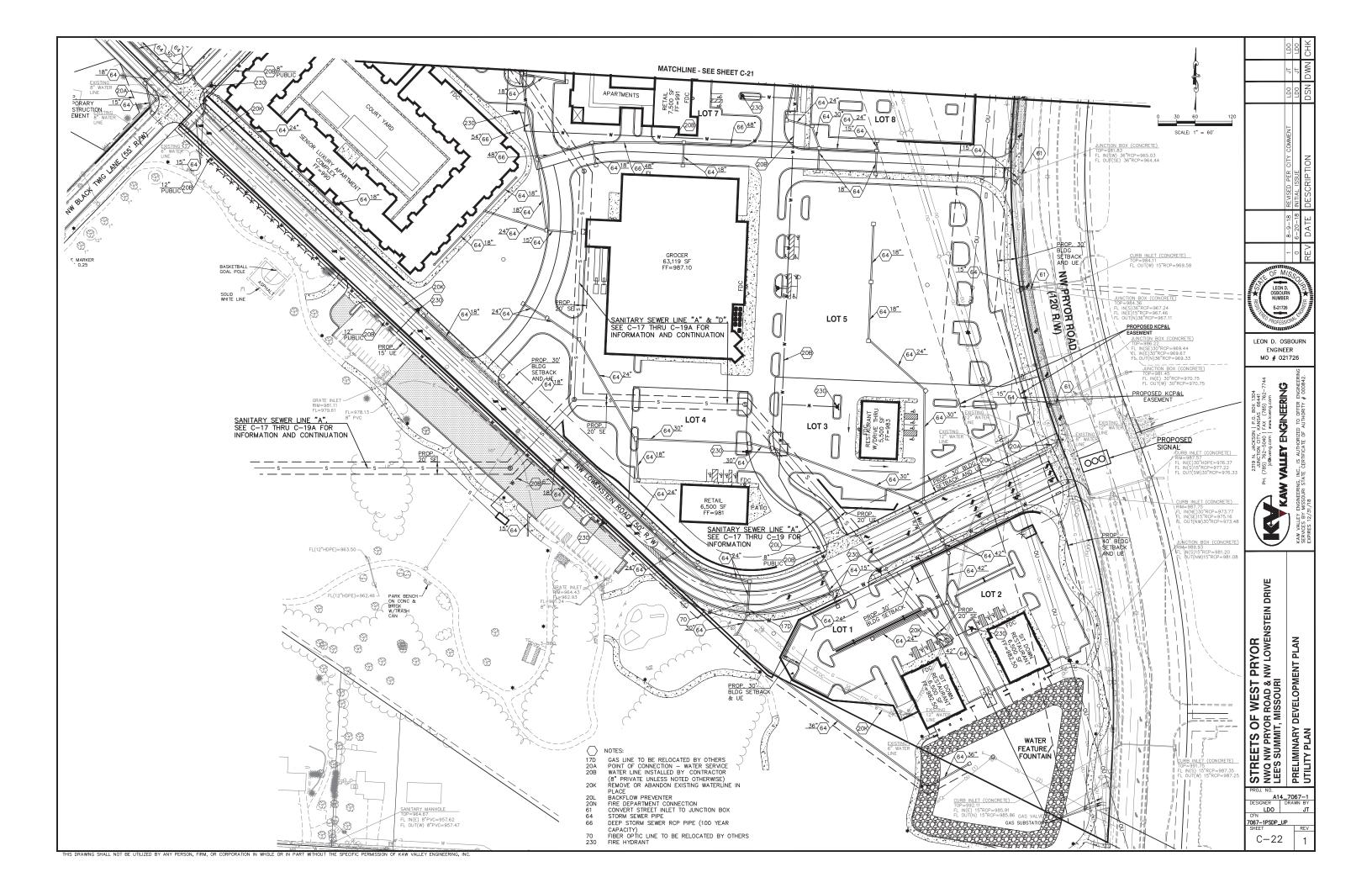






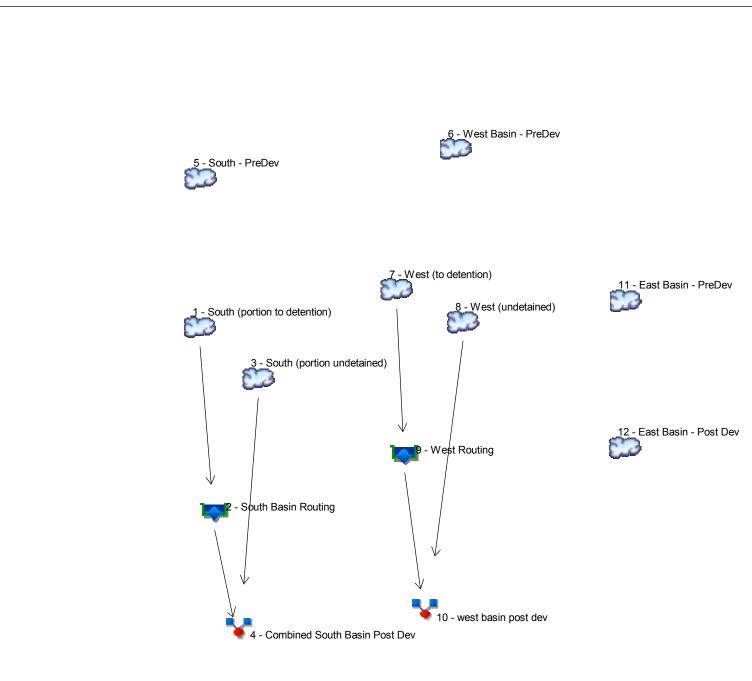






APPENDIX D – HYDRAFLOW HYDROGRAPH DETENTION CALCULATION	ONS
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Watershed Model Schematic



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	SCS Runoff	South (portion to detention)
2	Reservoir	South Basin Routing
3	SCS Runoff	South (portion undetained)
4	Combine	Combined South Basin Post Dev
5	SCS Runoff	South - PreDev
6	SCS Runoff	West Basin - PreDev
7	SCS Runoff	West (to detention)
8	SCS Runoff	West (undetained)
9	Reservoir	West Routing
10	Combine	west basin post dev
11	SCS Runoff	East Basin - PreDev
12	SCS Runoff	East Basin - Post Dev

Hydrograph Return Period Recap Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

1 SCS I 2 Reser 3 SCS I 4 Comb 5 SCS I 6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	S Runoff	1 2, 3	1-yr 16.05 0.000 4.567 4.567 2.533	2-yr 53.74 0.958 15.29 15.29	3-yr	5-yr	10-yr 81.98	25-yr	50-yr	100-yr	Description
2 Reser 3 SCS I 4 Comb 5 SCS I 6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	ervoir 6 Runoff hbine 6 Runoff 6 Runoff 6 Runoff	2, 3	0.000 4.567 4.567	0.958 15.29			81.98				
3 SCS I 4 Comb 5 SCS I 6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	S Runoff S Runoff S Runoff S Runoff S Runoff	2, 3	4.567 4.567	15.29			1			136.06	South (portion to detention)
4 Comb 5 SCS I 6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	nbine S Runoff S Runoff S Runoff	2, 3	4.567				4.331			21.22	South Basin Routing
5 SCS I 6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	Runoff Runoff Runoff			15.29			23.33			38.72	South (portion undetained)
6 SCS I 7 SCS I 8 SCS I 9 Reser 10 Comb	S Runoff S Runoff		2.533				23.96			49.05	Combined South Basin Post Dev
7 SCS I 8 SCS I 9 Reser 10 Comb	S Runoff			41.36			80.24			160.78	South - PreDev
8 SCS I 9 Reser 10 Comb			2.628	42.91			83.24			166.81	West Basin - PreDev
9 Reser	Runoff		35.20	141.86			224.02			381.10	West (to detention)
10 Comb			2.754	10.96			17.26			29.29	West (undetained)
	ervoir	7	2.900	14.54			20.88			46.86	West Routing
	nbine	8, 9	3.471	20.64			31.20			54.76	west basin post dev
11 SCS I	Runoff		2.573	41.43			80.18			160.31	East Basin - PreDev
12 SCS I	Runoff		12.55	49.92			78.61			133.43	East Basin - Post Dev

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Hydrograph Summary Report Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

łyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	53.74	1	719	130,963				South (portion to detention)
2	Reservoir	0.958	1	988	54,860	1	973.23	291,870	South Basin Routing
3	SCS Runoff	15.29	1	719	37,266				South (portion undetained)
4	Combine	15.29	1	719	92,126	2, 3			Combined South Basin Post Dev
5	SCS Runoff	41.36	1	725	131,134				South - PreDev
6	SCS Runoff	42.91	1	725	136,051				West Basin - PreDev
7	SCS Runoff	141.86	1	722	393,263				West (to detention)
8	SCS Runoff	10.96	1	719	25,835				West (undetained)
9	Reservoir	14.54	1	756	390,131	7	952.14	956,904	West Routing
10	Combine	20.64	1	720	415,965	8, 9			west basin post dev
11	SCS Runoff	41.43	1	724	124,242				East Basin - PreDev
12	SCS Runoff	49.92	1	719	117,692				East Basin - Post Dev

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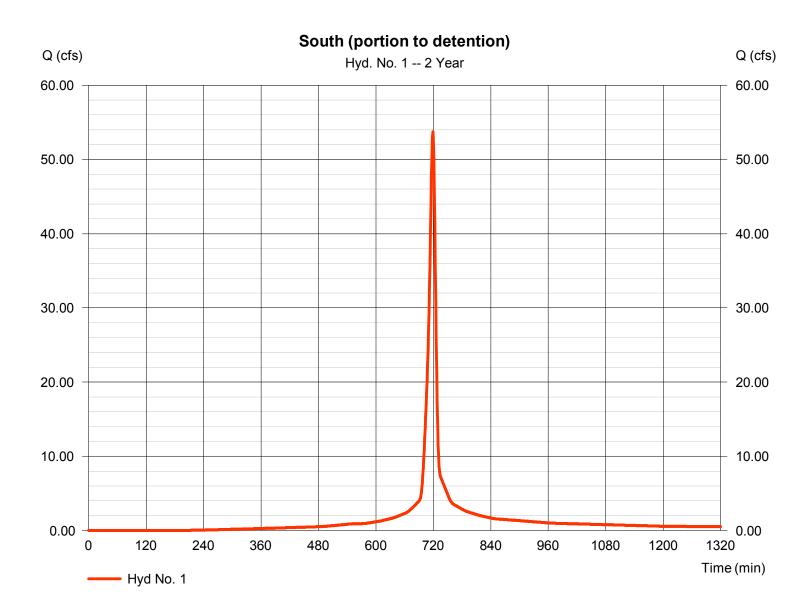
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 1

South (portion to detention)

Hydrograph type = SCS Runoff Peak discharge = 53.74 cfsStorm frequency Time to peak = 719 min = 2 yrsTime interval = 1 min Hyd. volume = 130,963 cuft Drainage area = 12.300 acCurve number = 94 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. = 3.60 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

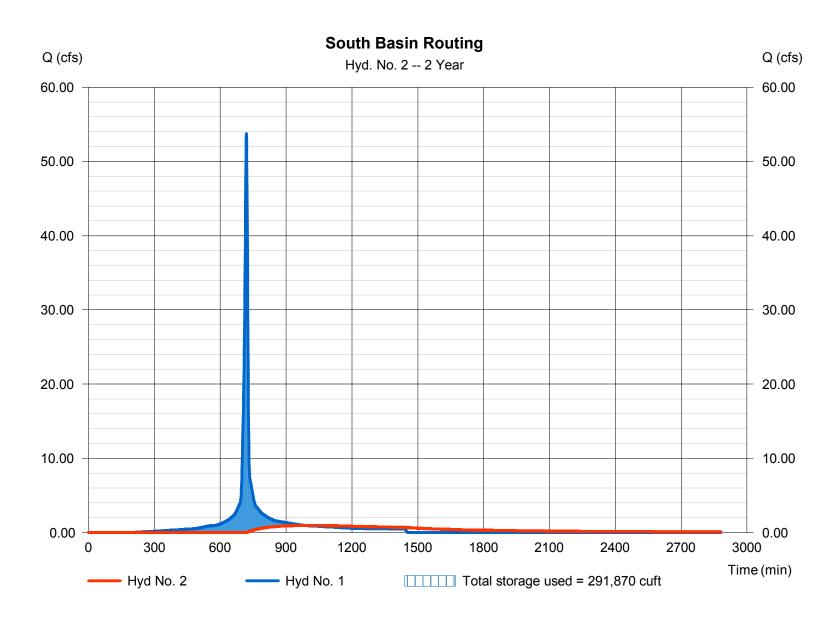
Monday, 08 / 6 / 2018

Hyd. No. 2

South Basin Routing

Hydrograph type = Reservoir Peak discharge = 0.958 cfsStorm frequency Time to peak = 988 min = 2 yrsTime interval = 1 min Hyd. volume = 54,860 cuftInflow hyd. No. = 1 - South (portion to detention)Max. Elevation = 973.23 ft= South Basin Reservoir name Max. Storage = 291,870 cuft

Storage Indication method used. Wet pond routing start elevation = 970.00 ft.



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Pond No. 2 - South Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 960.00 ft

Stage / Storage Table

Culvert / Orifice Structures

Stage (ft)	Elevation (ft)	Elevation (ft) Contour area (sqft)		Total storage (cuft)
0.00	960.00	10,984	0	0
2.00	962.00	13,783	24,712	24,712
4.00	964.00	16,924	30,650	55,362
6.00	966.00	20,407	37,273	92,635
8.00	968.00	24,234	44,582	137,217
10.00	970.00	28,632	52,800	190,016
12.00	972.00	31,874	60,471	250,487
14.00	974.00	35,258	67,097	317,584
16.00	976.00	38,788	74,011	391,595
18.00	978.00	42,463	81,215	472,810
20.00	980.00	46,796	89,215	562,025

[A] [B] [C] [PrfRsr] [A] [B] [C] [D] = 36.000.00 0.00 = 0.00 30.00 0.00 0.00 Rise (in) 0.00 Crest Len (ft) Span (in) = 36.000.00 0.00 0.00 Crest El. (ft) = 972.00 977.00 0.00 0.00 No. Barrels = 1 0 0 Weir Coeff. = 0.562.60 3.33 3.33 0 Invert El. (ft) = 965.00 0.00 0.00 0.00 Weir Type = 25 degV Broad 0.00 0.00 0.00 Multi-Stage No Length (ft) = 0.00= Yes No No 0.00 = 0.00 0.00

Slope (%) n/a N-Value = .013 .013 .013 n/a = 0.000 (by Contour) 0.60 0.60 0.60 Orifice Coeff. = 0.60Exfil.(in/hr) Multi-Stage TW Elev. (ft) = 0.00= n/aNo No No

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Weir Structures

Stage / Storage / Discharge Table

Stage	Storage	Elevation	Clv A	Clv B	CIv C	PrfRsr	Wr A	Wr B	Wr C	Wr D	Exfil	User	Total
ft	cuft	ft	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs	cfs
0.00	0	960.00	0.00					0.00					0.000
2.00	24,712	962.00	0.00					0.00					0.000
4.00	55,362	964.00	0.00					0.00					0.000
6.00	92,635	966.00	0.00					0.00					0.000
8.00	137,217	968.00	0.00					0.00					0.000
10.00	190,016	970.00	0.00					0.00					0.000
12.00	250,487	972.00	0.00					0.00					0.000
14.00	317,584	974.00	3.30 ic				3.18	0.00					3.185
16.00	391,595	976.00	18.02 ic				18.02	0.00					18.02
18.00	472,810	978.00	49.65 ic				49.65	78.00					127.65
20.00	562,025	980.00	95.34 ic				95.34 s	405.30					500.64

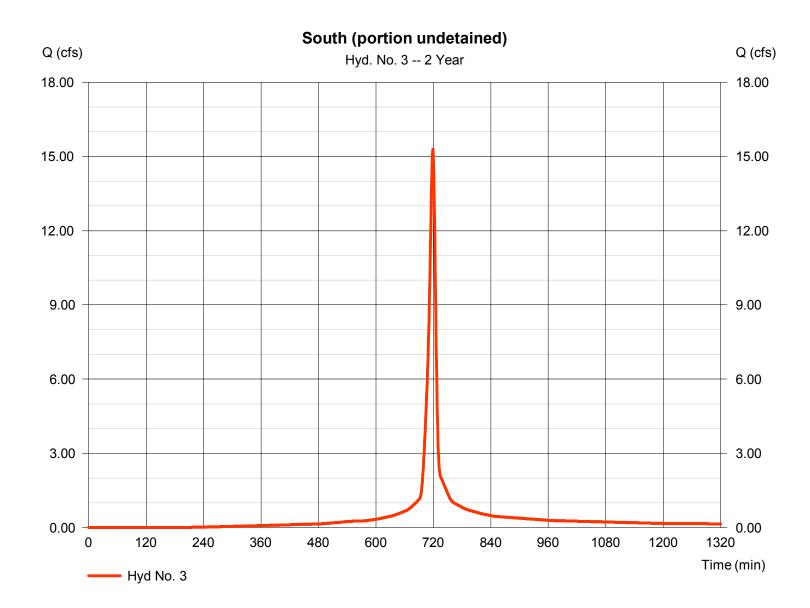
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Monday, 08 / 6 / 2018

Hyd. No. 3

South (portion undetained)

= 15.29 cfsHydrograph type = SCS Runoff Peak discharge Storm frequency Time to peak = 719 min = 2 yrsTime interval = 1 min Hyd. volume = 37.266 cuft Drainage area Curve number = 3.500 ac= 94 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. Distribution = 3.60 in= Type II Storm duration = 484 = 24 hrs Shape factor



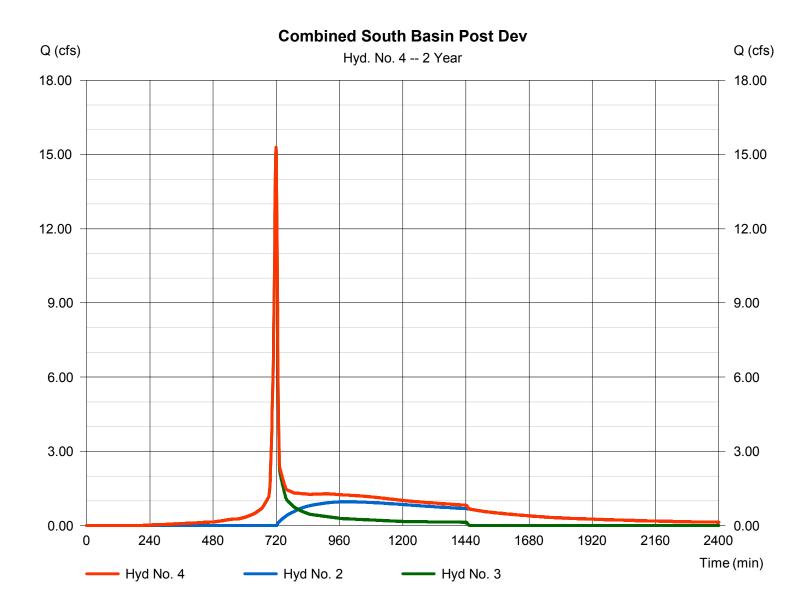
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Monday, 08 / 6 / 2018

Hyd. No. 4

Combined South Basin Post Dev

Hydrograph type = Combine Peak discharge = 15.29 cfsStorm frequency = 2 yrs Time to peak = 719 min Time interval = 1 min Hyd. volume = 92,126 cuft Inflow hyds. = 2, 3 = 3.500 acContrib. drain. area



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= 24 hrs

Monday, 08 / 6 / 2018

= 484

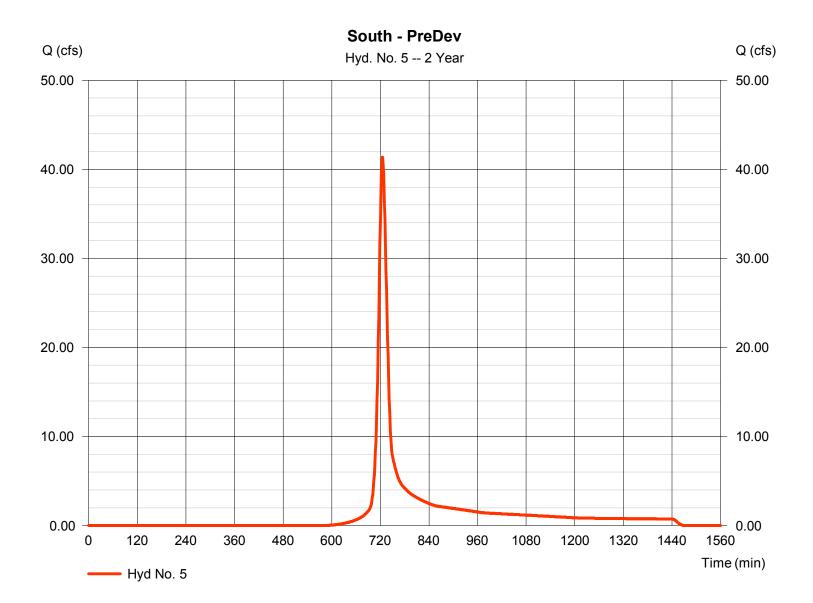
Hyd. No. 5

South - PreDev

Storm duration

Hydrograph type = SCS Runoff Peak discharge = 41.36 cfsStorm frequency = 2 yrsTime to peak = 725 min Time interval = 1 min Hyd. volume = 131,134 cuft Drainage area Curve number = 24.000 ac= 77 = 0 ftBasin Slope = 0.0 % Hydraulic length Time of conc. (Tc) = 20.00 min Tc method = User Total precip. Distribution = Type II = 3.60 in

Shape factor



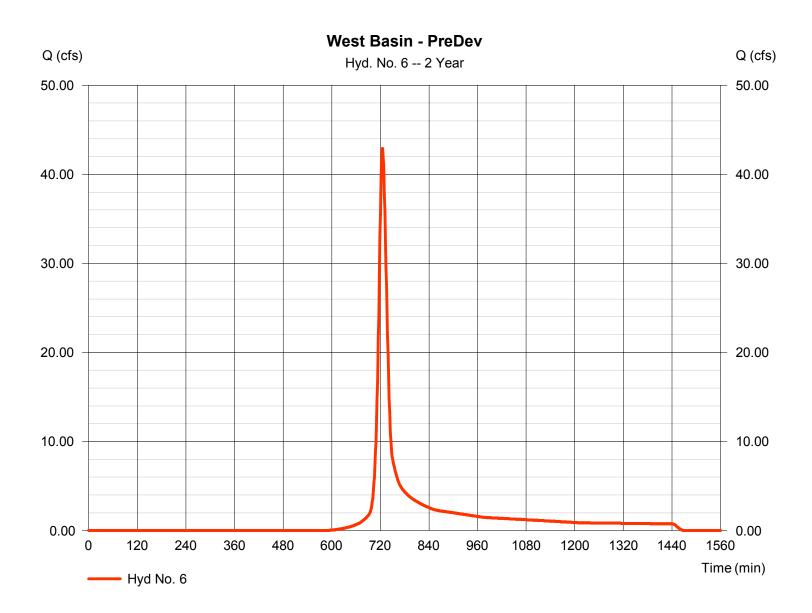
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Monday, 08 / 6 / 2018

Hyd. No. 6

West Basin - PreDev

Hydrograph type = SCS Runoff Peak discharge = 42.91 cfsStorm frequency Time to peak = 725 min = 2 yrsTime interval = 1 min Hyd. volume = 136,051 cuftDrainage area = 24.900 acCurve number = 77 = 0 ftBasin Slope = 0.0 % Hydraulic length = 20.00 min Tc method = User Time of conc. (Tc) Total precip. = Type II = 3.60 inDistribution Storm duration = 484 = 24 hrs Shape factor



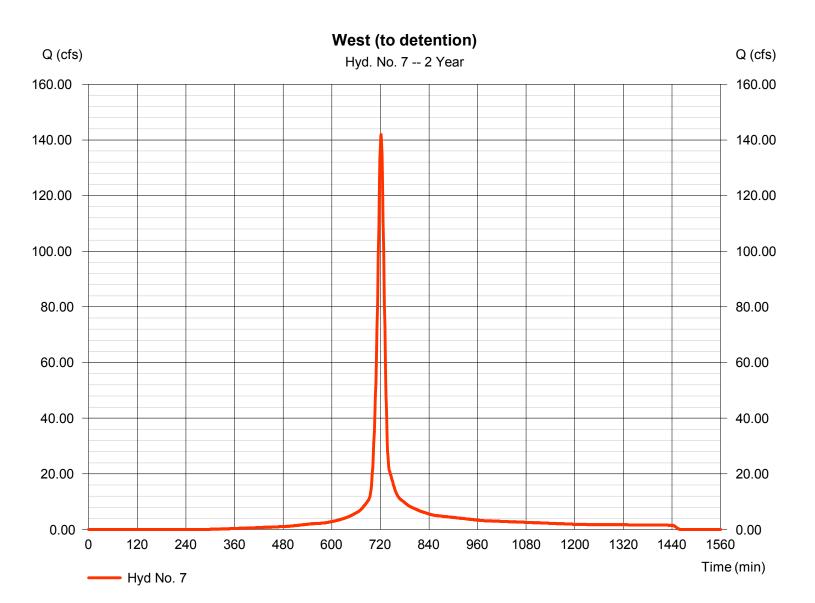
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Monday, 08 / 6 / 2018

Hyd. No. 7

West (to detention)

Hydrograph type = SCS Runoff Peak discharge = 141.86 cfsStorm frequency Time to peak = 722 min = 2 yrsTime interval = 1 min Hyd. volume = 393,263 cuft Drainage area = 41.100 ac Curve number = 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 15.00 min Total precip. = 3.60 inDistribution = Type II Storm duration = 24 hrs Shape factor = 484



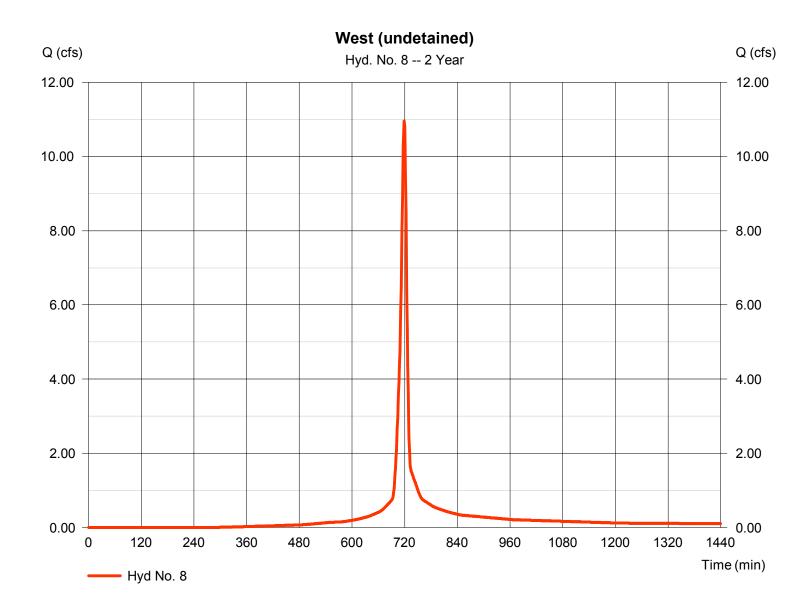
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Monday, 08 / 6 / 2018

Hyd. No. 8

West (undetained)

Hydrograph type = SCS Runoff Peak discharge = 10.96 cfsStorm frequency Time to peak = 719 min = 2 yrsTime interval = 1 min Hyd. volume = 25.835 cuft Drainage area Curve number = 2.700 ac= 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. Distribution = 3.60 in= Type II Storm duration = 484 = 24 hrs Shape factor



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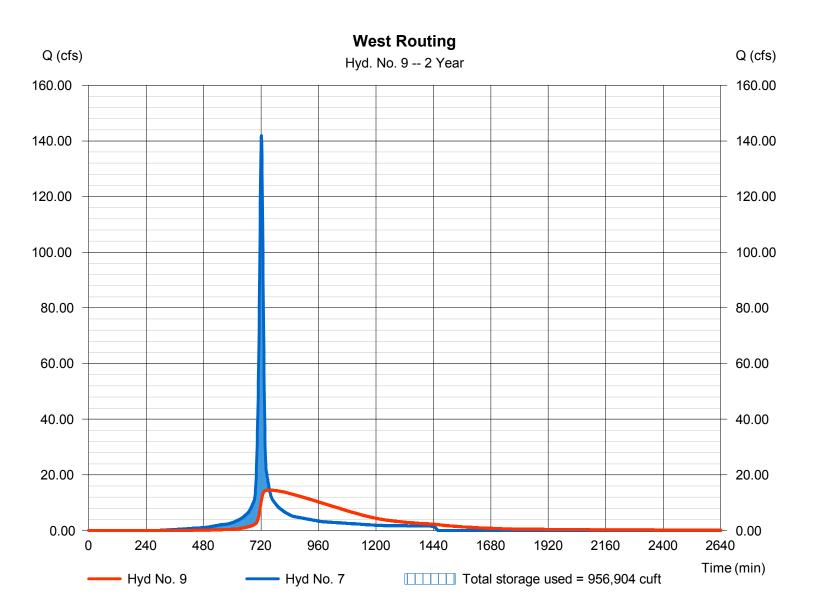
Monday, 08 / 6 / 2018

Hyd. No. 9

West Routing

Hydrograph type = Reservoir Peak discharge = 14.54 cfsStorm frequency Time to peak = 756 min = 2 yrsTime interval = 1 min Hyd. volume = 390,131 cuftInflow hyd. No. = 7 - West (to detention) Max. Elevation = 952.14 ft= West Basin Reservoir name Max. Storage = 956,904 cuft

Storage Indication method used. Wet pond routing start elevation = 950.00 ft.



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Pond No. 1 - West Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 940.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)		
0.00	940.00	57,158	0	0		
2.00	942.00	63,864	120,948	120,948		
4.00	944.00	70,818	134,609	255,557		
6.00	946.00	78,022	148,767	404,324		
8.00	948.00	85,474	163,423	567,747		
10.00	950.00	93,176	178,577	746,323		
12.00	952.00	101,126	194,228	940,552		
14.00	954.00	126,218	226,858	1,167,410		
16.00	956.00	141,067	267,121	1,434,531		
18.00	958.00	187,658	327,586	1,762,117		
20.00	960.00	218,192	405,426	2,167,543		
22.00	962.00	237,915	455,919	2,623,462		

Culvert / Orifice Structures

Weir Structures

	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]	
Rise (in)	= 36.00	12.00	15.00	0.00	Crest Len (ft)	Inactive	90.00	0.00	0.00	
Span (in)	= 36.00	12.00	15.00	0.00	Crest El. (ft)	= 0.00	956.00	0.00	0.00	
No. Barrels	= 1	3	3	0	Weir Coeff.	= 3.33	2.60	3.33	3.33	
Invert El. (ft)	= 940.00	950.00	953.00	0.00	Weir Type	=	Broad			
Length (ft)	= 300.00	0.00	0.00	0.00	Multi-Stage	= No	No	No	No	
Slope (%)	= 1.00	0.00	0.00	n/a						
N-Value	= .013	.013	.013	n/a						
Orifice Coeff.	= 0.60	0.60	0.60	0.60	Exfil.(in/hr)	= 0.000 (by Contour)				
Multi-Stage	= n/a	Yes	Yes	No	TW Elev. (ft)	= 0.00				

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	CIv A cfs	Clv B cfs	CIv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	940.00	0.00	0.00	0.00			0.00					0.000
2.00	120,948	942.00	0.00	0.00	0.00			0.00					0.000
4.00	255,557	944.00	0.00	0.00	0.00			0.00					0.000
6.00	404,324	946.00	0.00	0.00	0.00			0.00					0.000
8.00	567,747	948.00	0.00	0.00	0.00			0.00					0.000
10.00	746,323	950.00	0.00	0.00	0.00			0.00					0.000
12.00	940,552	952.00	13.89 ic	13.89 ic	0.00			0.00					13.89
14.00	1,167,410	954.00	31.97 ic	21.22 ic	10.75 ic			0.00					31.97
16.00	1,434,531	956.00	53.92 ic	26.60 ic	27.32 ic			0.00					53.92
18.00	1,762,117	958.00	68.14 ic	31.07 ic	37.07 ic			661.85					729.99
20.00	2,167,543	960.00	79.72 oc	34.96 ic	44.75 ic			1872.00					1951.71
22.00	2,623,462	962.00	89.76 oc	38.47 ic	51.29 ic			3439.08					3528.84

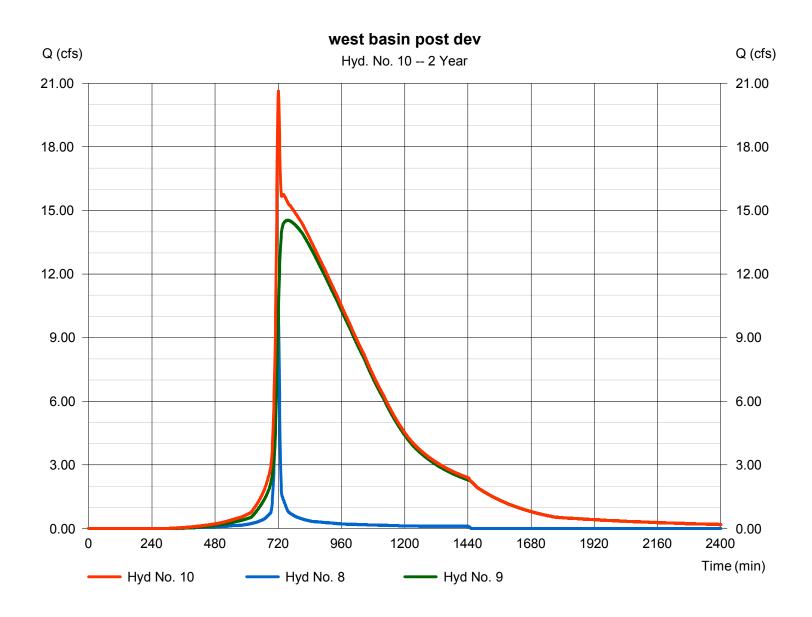
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Hyd. No. 10

west basin post dev

Hydrograph type = Combine Peak discharge = 20.64 cfsStorm frequency = 2 yrs Time to peak = 720 min Time interval = 1 min Hyd. volume = 415,965 cuft Inflow hyds. Contrib. drain. area = 2.700 ac= 8, 9



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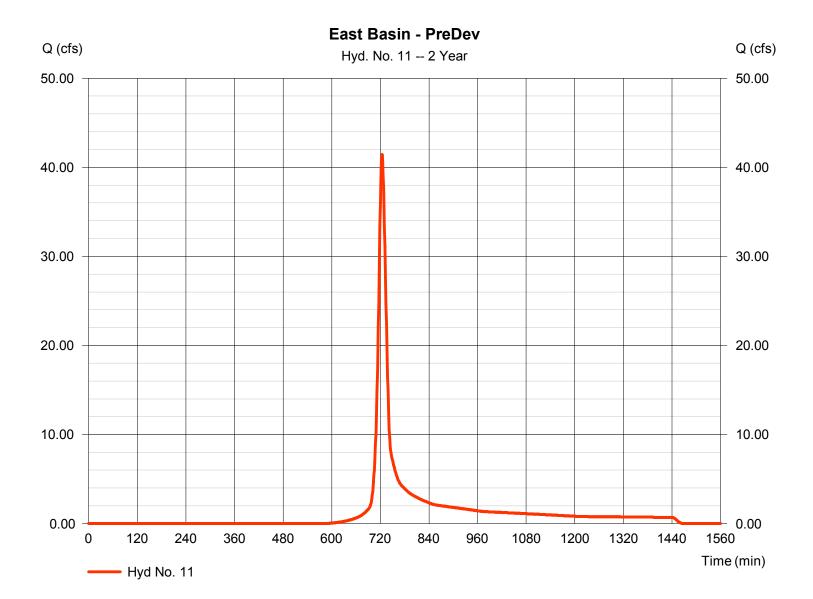
Monday, 08 / 6 / 2018

Hyd. No. 11

East Basin - PreDev

Hydrograph type = SCS Runoff Peak discharge = 41.43 cfsStorm frequency Time to peak = 724 min = 2 yrsTime interval = 1 min Hyd. volume = 124,242 cuft Drainage area Curve number = 23.000 ac= 77 = 0 ftBasin Slope = 0.0 % Hydraulic length

Tc method = User Time of conc. (Tc) = 18.00 min
Total precip. = 3.60 in Distribution = Type II
Storm duration = 24 hrs Shape factor = 484



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Monday, 08 / 6 / 2018

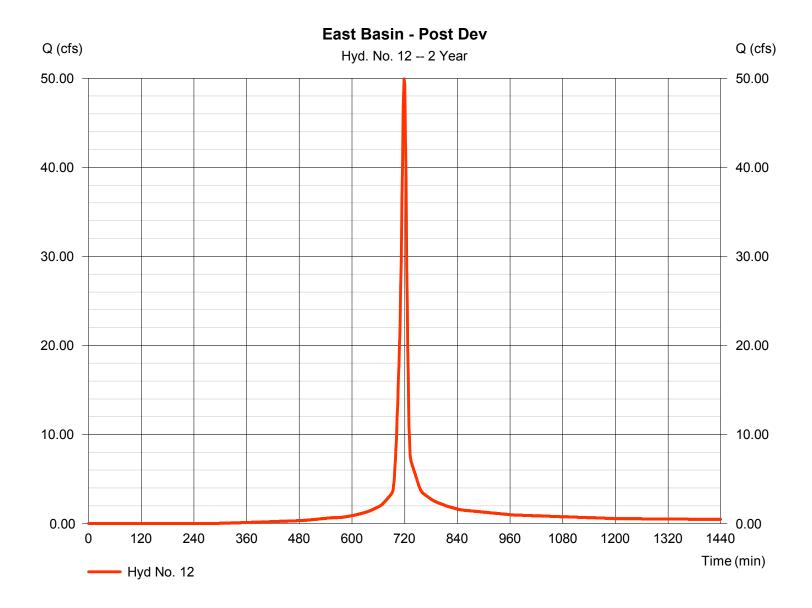
Hyd. No. 12

East Basin - Post Dev

Hydrograph type= SCS RunoffPeak discharge= 49.92 cfsStorm frequency= 2 yrsTime to peak= 719 minTime interval= 1 minHyd. volume= 117,692 cuft

Drainage area = 12.300 ac Curve number = 91 Basin Slope = 0.0 % Hydraulic length = 0 ft

Tc method = User Time of conc. (Tc) = 10.00 min
Total precip. = 3.60 in Distribution = Type II
Storm duration = 24 hrs Shape factor = 484



Hydrograph Summary Report Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

lyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	81.98	1	719	205,571				South (portion to detention)
2	Reservoir	4.331	1	780	128,656	1	974.26	327,165	South Basin Routing
3	SCS Runoff	23.33	1	719	58,496				South (portion undetained)
4	Combine	23.96	1	719	187,152	2, 3			Combined South Basin Post Dev
5	SCS Runoff	80.24	1	725	250,547				South - PreDev
6	SCS Runoff	83.24	1	725	259,942				West Basin - PreDev
7	SCS Runoff	224.02	1	722	637,617				West (to detention)
8	SCS Runoff	17.26	1	719	41,887				West (undetained)
9	Reservoir	20.88	1	758	633,965	7	953.34	1,092,904	West Routing
10	Combine	31.20	1	720	675,852	8, 9			west basin post dev
11	SCS Runoff	80.18	1	724	237,379				East Basin - PreDev
12	SCS Runoff	78.61	1	719	190,820				East Basin - Post Dev

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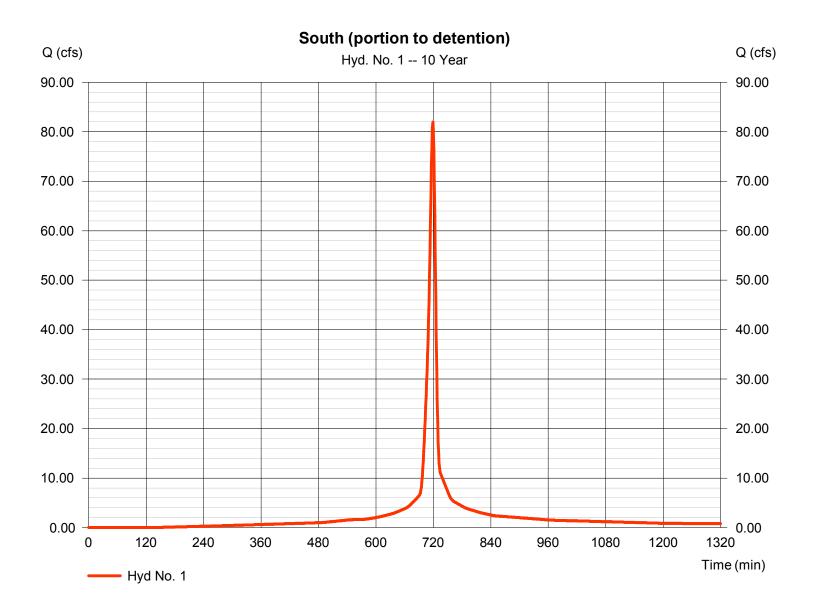
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Monday, 08 / 6 / 2018

Hyd. No. 1

South (portion to detention)

Hydrograph type = SCS Runoff Peak discharge = 81.98 cfsStorm frequency = 10 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 205,571 cuft Drainage area = 12.300 acCurve number = 94 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. = 5.30 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



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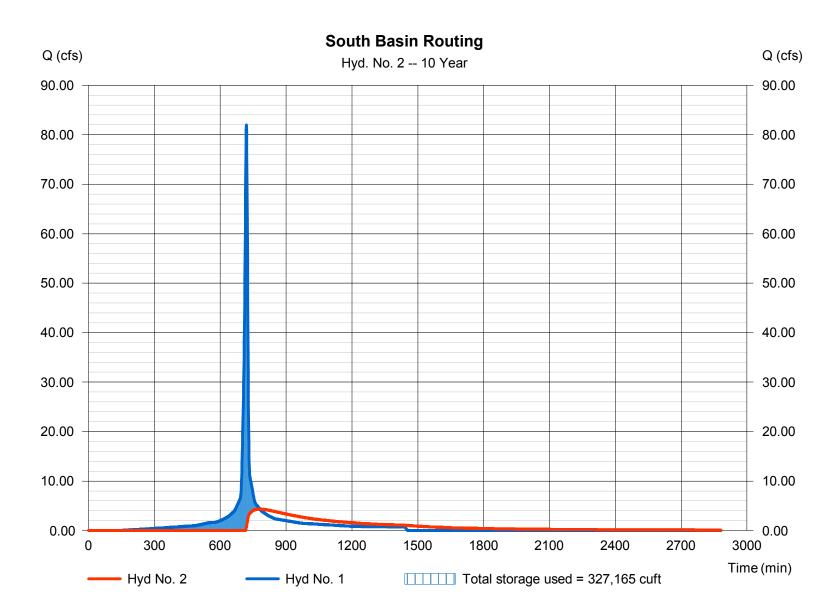
Monday, 08 / 6 / 2018

Hyd. No. 2

South Basin Routing

Hydrograph type = Reservoir Peak discharge = 4.331 cfsStorm frequency = 10 yrsTime to peak = 780 min Time interval = 1 min Hyd. volume = 128,656 cuft Inflow hyd. No. = 1 - South (portion to detention)Max. Elevation = 974.26 ft= South Basin Reservoir name Max. Storage = 327,165 cuft

Storage Indication method used. Wet pond routing start elevation = 970.00 ft.



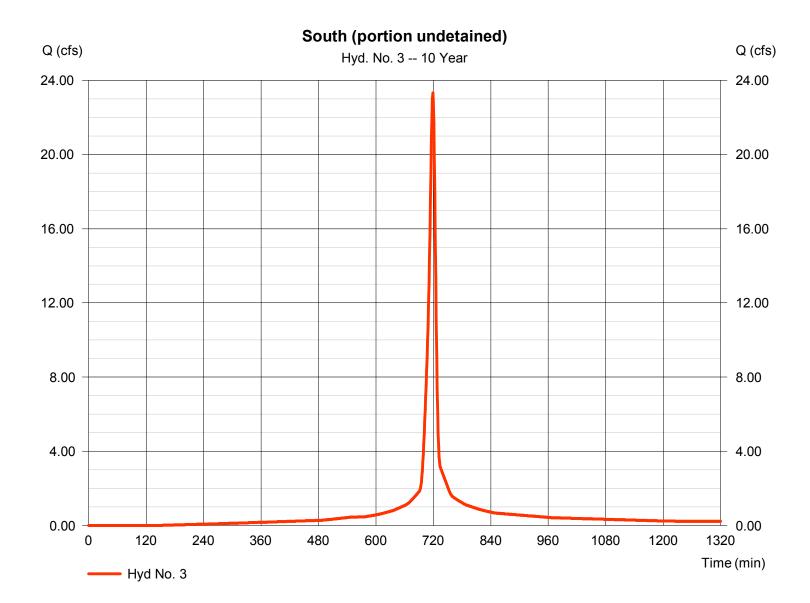
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Monday, 08 / 6 / 2018

Hyd. No. 3

South (portion undetained)

Hydrograph type = SCS Runoff Peak discharge = 23.33 cfsStorm frequency Time to peak = 719 min = 10 yrsTime interval = 1 min Hyd. volume = 58.496 cuft Drainage area Curve number = 3.500 ac= 94 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. = 5.30 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



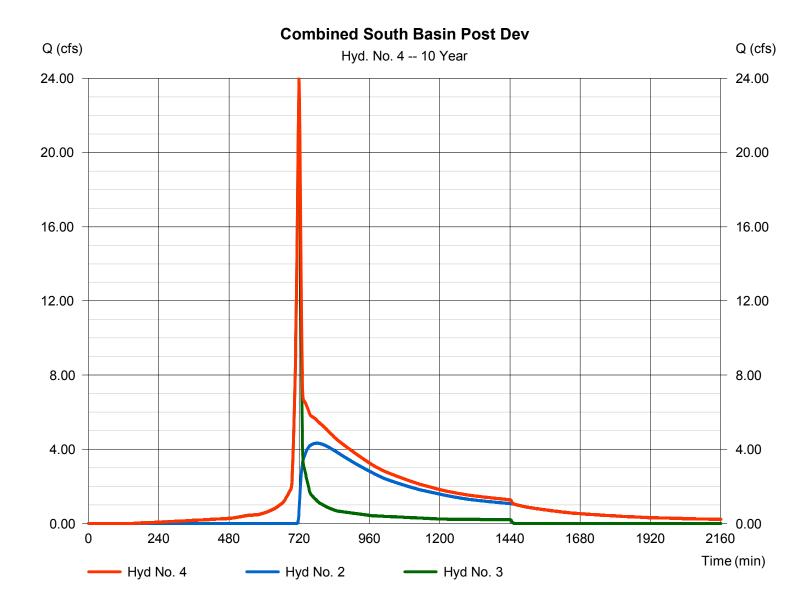
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Monday, 08 / 6 / 2018

Hyd. No. 4

Combined South Basin Post Dev

= Combine Hydrograph type Peak discharge = 23.96 cfsStorm frequency = 10 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 187,152 cuft Inflow hyds. = 2, 3 = 3.500 acContrib. drain. area



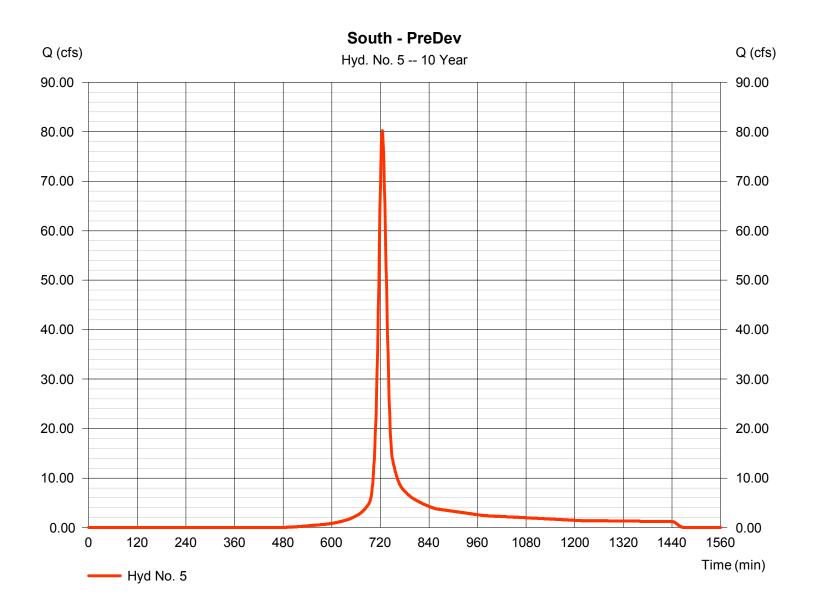
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Monday, 08 / 6 / 2018

Hyd. No. 5

South - PreDev

Hydrograph type = SCS Runoff Peak discharge = 80.24 cfsStorm frequency = 10 yrsTime to peak = 725 min Time interval = 1 min Hyd. volume = 250,547 cuft Drainage area Curve number = 24.000 ac= 77 = 0 ftBasin Slope = 0.0 %Hydraulic length Time of conc. (Tc) = 20.00 min Tc method = User Total precip. Distribution = 5.30 in= Type II Storm duration = 484 = 24 hrs Shape factor



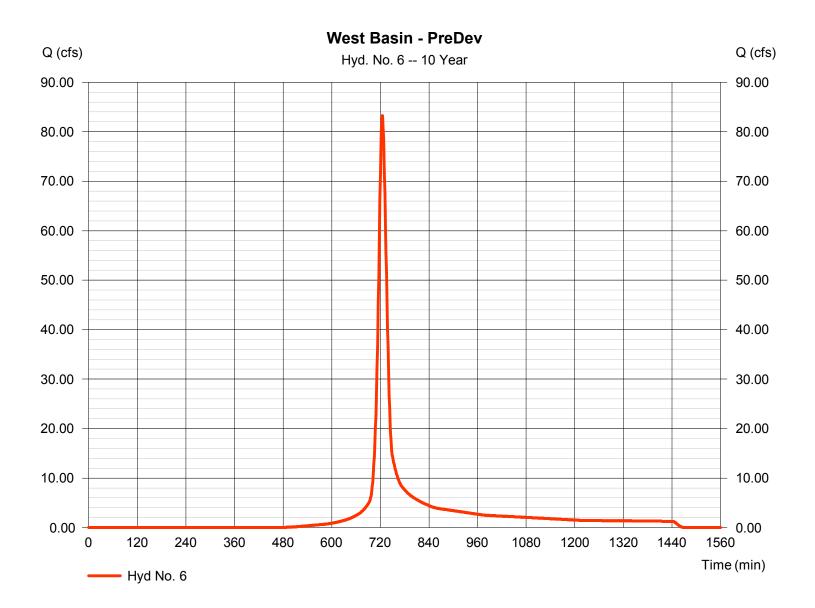
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Monday, 08 / 6 / 2018

Hyd. No. 6

West Basin - PreDev

Hydrograph type = SCS Runoff Peak discharge = 83.24 cfsStorm frequency = 10 yrsTime to peak = 725 min Time interval = 1 min Hyd. volume = 259.942 cuft Drainage area = 24.900 ac Curve number = 77 = 0 ftBasin Slope = 0.0 %Hydraulic length Time of conc. (Tc) = 20.00 min Tc method = User Total precip. Distribution = 5.30 in= Type II Storm duration = 484 = 24 hrs Shape factor



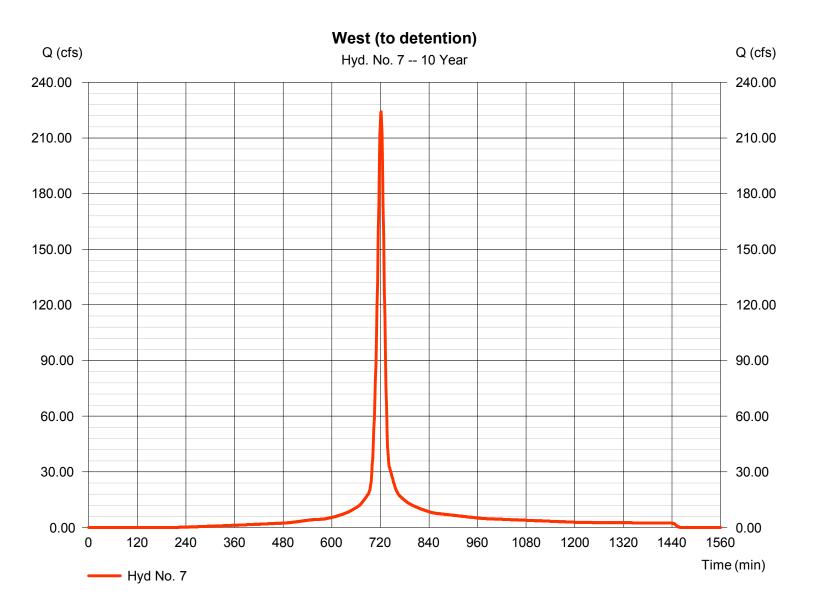
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Monday, 08 / 6 / 2018

Hyd. No. 7

West (to detention)

Hydrograph type = SCS Runoff Peak discharge = 224.02 cfsStorm frequency = 10 yrsTime to peak = 722 min Time interval = 1 min Hyd. volume = 637.617 cuft Drainage area = 41.100 ac Curve number = 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method = User Time of conc. (Tc) = 15.00 min Total precip. = 5.30 inDistribution = Type II Storm duration = 24 hrs Shape factor = 484



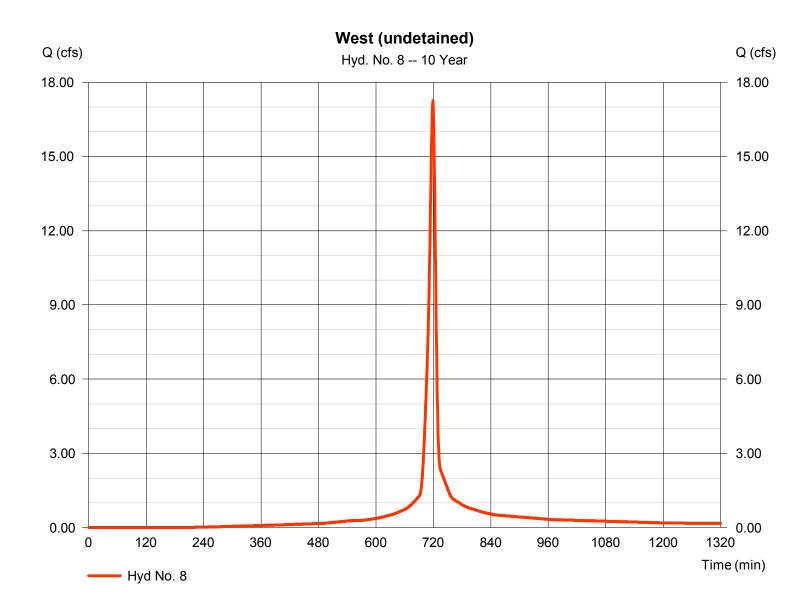
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Monday, 08 / 6 / 2018

Hyd. No. 8

West (undetained)

= SCS Runoff Hydrograph type Peak discharge = 17.26 cfsStorm frequency = 10 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 41,887 cuft Drainage area Curve number = 2.700 ac= 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method = User Time of conc. (Tc) = 10.00 min Total precip. = 5.30 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



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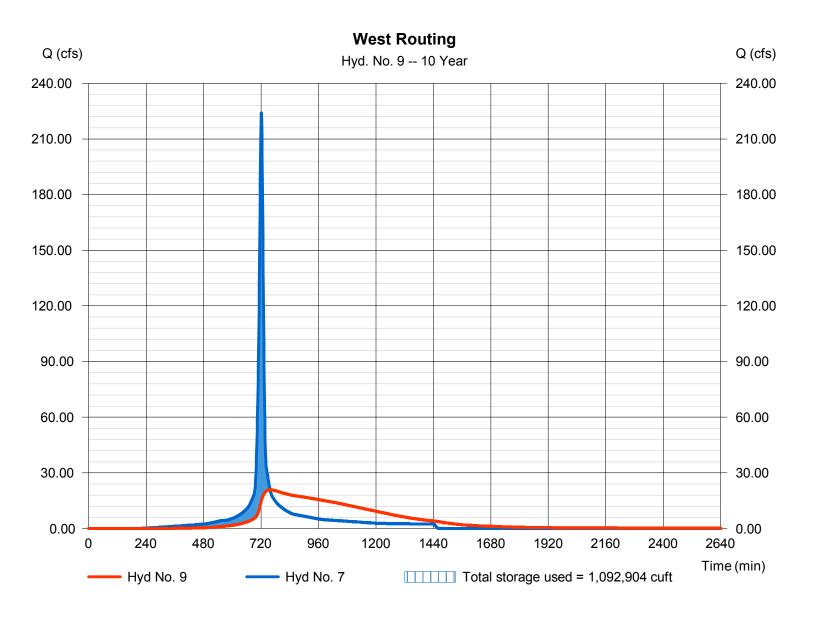
Monday, 08 / 6 / 2018

Hyd. No. 9

West Routing

Hydrograph type = Reservoir Peak discharge = 20.88 cfsStorm frequency = 10 yrsTime to peak = 758 min Time interval = 1 min Hyd. volume = 633,965 cuft = 7 - West (to detention) Inflow hyd. No. Max. Elevation = 953.34 ftReservoir name = West Basin Max. Storage = 1,092,904 cuft

Storage Indication method used. Wet pond routing start elevation = 950.00 ft.



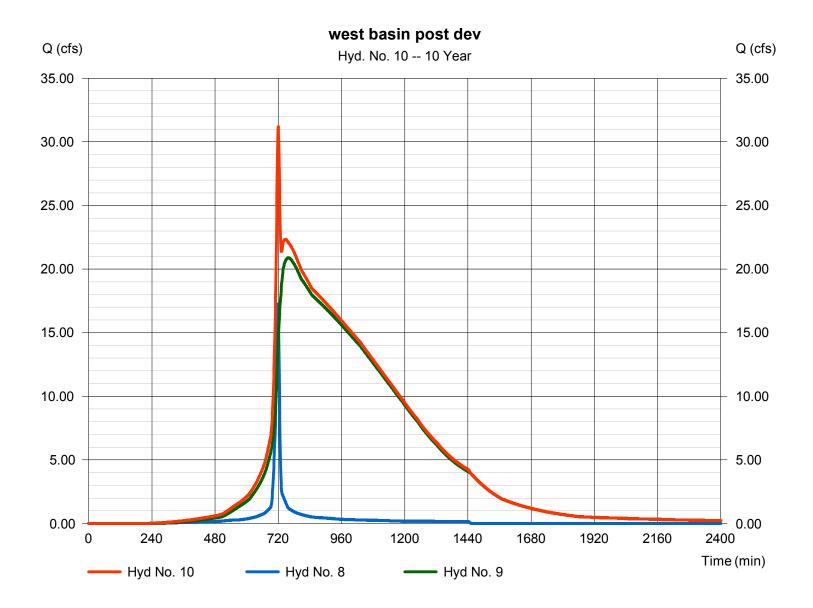
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Monday, 08 / 6 / 2018

Hyd. No. 10

west basin post dev

= Combine Hydrograph type Peak discharge = 31.20 cfsStorm frequency = 10 yrsTime to peak = 720 min Time interval = 1 min Hyd. volume = 675,852 cuft Inflow hyds. Contrib. drain. area = 2.700 ac= 8, 9



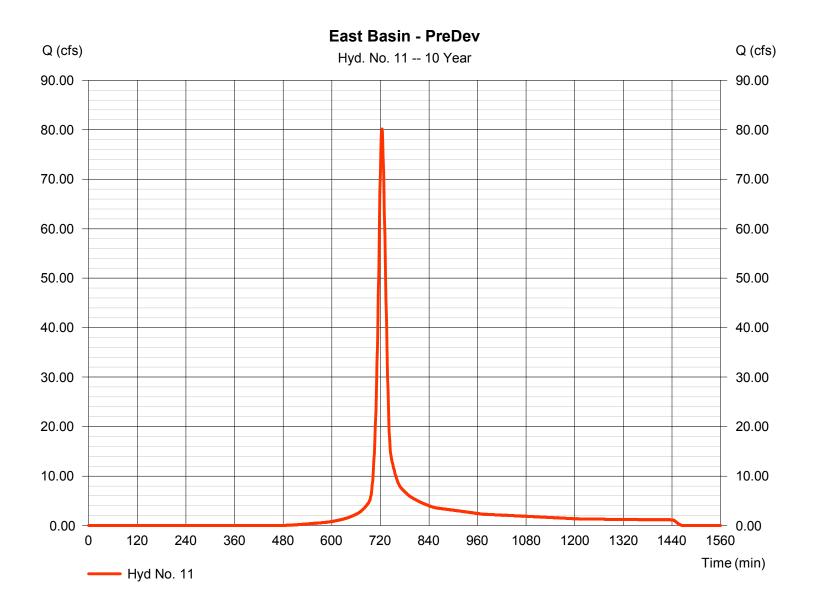
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Hyd. No. 11

East Basin - PreDev

= SCS Runoff Hydrograph type Peak discharge = 80.18 cfsStorm frequency = 10 yrsTime to peak = 724 min Time interval = 1 min Hyd. volume = 237,379 cuftDrainage area = 23.000 acCurve number = 77 = 0 ftBasin Slope = 0.0 %Hydraulic length Time of conc. (Tc) Tc method = User = 18.00 min Total precip. Distribution = 5.30 in= Type II Storm duration = 484 = 24 hrs Shape factor



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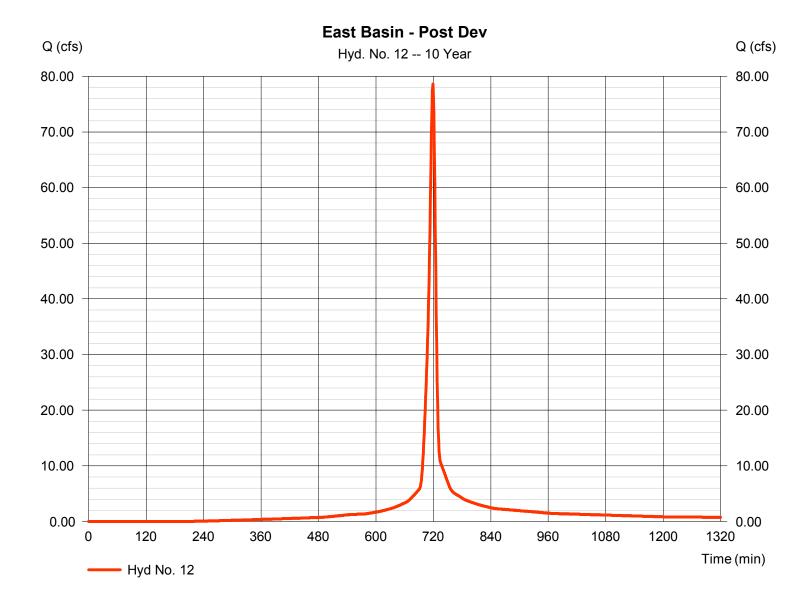
Monday, 08 / 6 / 2018

Hyd. No. 12

East Basin - Post Dev

Hydrograph type = SCS Runoff Peak discharge = 78.61 cfsStorm frequency = 10 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 190,820 cuft Drainage area = 12.300 acCurve number = 91

= 0 ftBasin Slope = 0.0 % Hydraulic length Time of conc. (Tc) Tc method = User = 10.00 min Total precip. Distribution = Type II = 5.30 inStorm duration = 484 = 24 hrs Shape factor



Hydrograph Summary Report Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	136.06	1	719	351,779				South (portion to detention)
2	Reservoir	21.22	1	732	274,257	1	976.27	402,524	South Basin Routing
3	SCS Runoff	38.72	1	719	100,100				South (portion undetained)
4	Combine	49.05	1	720	374,357	2, 3			Combined South Basin Post Dev
5	SCS Runoff	160.78	1	725	507,689				South - PreDev
6	SCS Runoff	166.81	1	725	526,727				West Basin - PreDev
7	SCS Runoff	381.10	1	722	1,121,535				West (to detention)
8	SCS Runoff	29.29	1	719	73,677				West (undetained)
9	Reservoir	46.86	1	748	1,117,157	7	955.20	1,328,063	West Routing
10	Combine	54.76	1	723	1,190,834	8, 9			west basin post dev
11	SCS Runoff	160.31	1	724	481,006				East Basin - PreDev
12	SCS Runoff	133.43	1	719	335,642				East Basin - Post Dev

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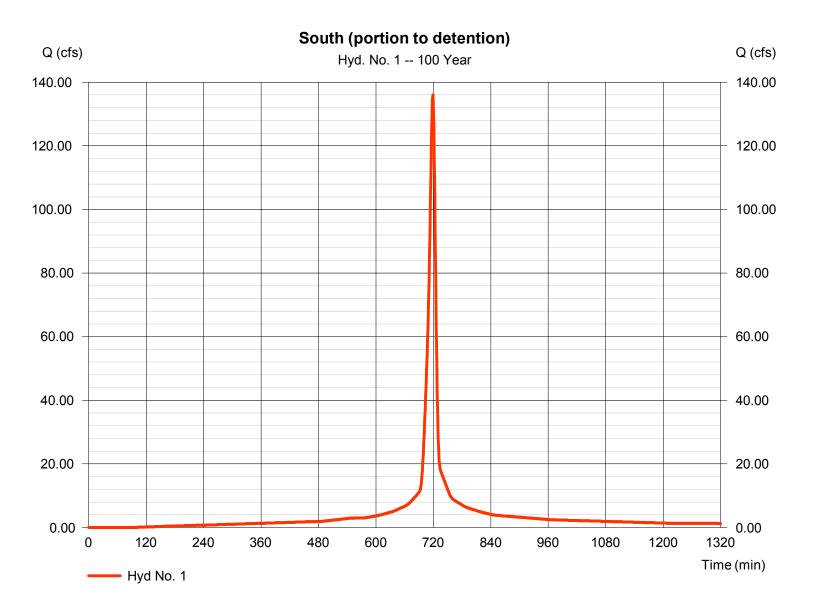
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Monday, 08 / 6 / 2018

Hyd. No. 1

South (portion to detention)

Hydrograph type = SCS Runoff Peak discharge = 136.06 cfsStorm frequency = 100 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 351,779 cuft Drainage area = 12.300 acCurve number = 94 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method = User Time of conc. (Tc) = 10.00 min Total precip. = 8.60 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



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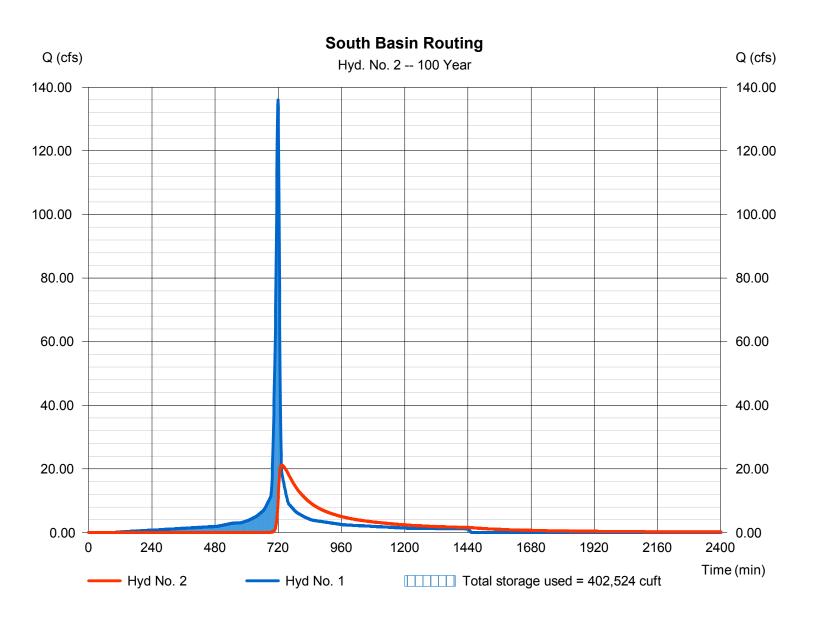
Monday, 08 / 6 / 2018

Hyd. No. 2

South Basin Routing

Hydrograph type = Reservoir Peak discharge = 21.22 cfsStorm frequency Time to peak = 732 min = 100 yrsTime interval = 1 min Hyd. volume = 274,257 cuft Inflow hyd. No. = 1 - South (portion to detention)Max. Elevation = 976.27 ft= South Basin Reservoir name Max. Storage = 402,524 cuft

Storage Indication method used. Wet pond routing start elevation = 970.00 ft.



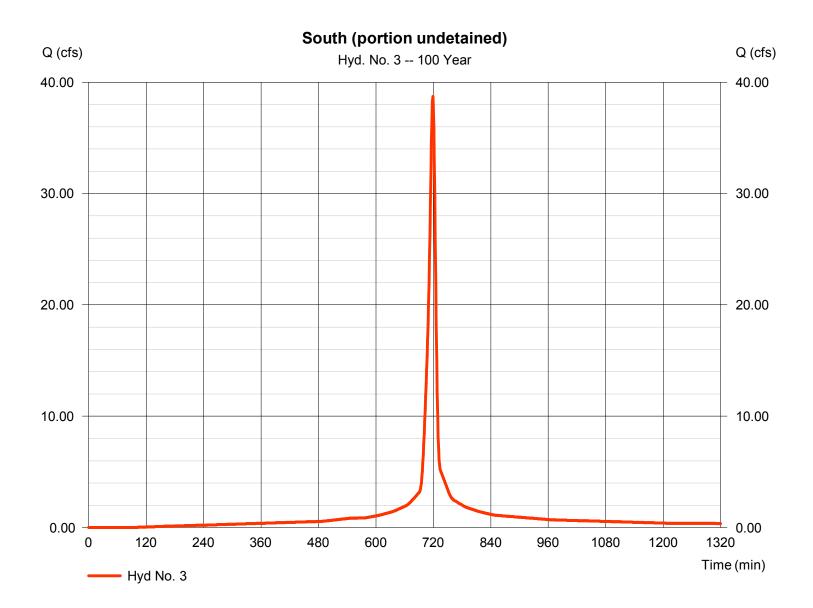
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 3

South (portion undetained)

Hydrograph type = SCS Runoff Peak discharge = 38.72 cfsStorm frequency = 100 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 100,100 cuftDrainage area Curve number = 3.500 ac= 94 = 0 ftBasin Slope = 0.0 %Hydraulic length Time of conc. (Tc) Tc method = User = 10.00 min Total precip. = 8.60 inDistribution = Type II Storm duration = 484 = 24 hrs Shape factor



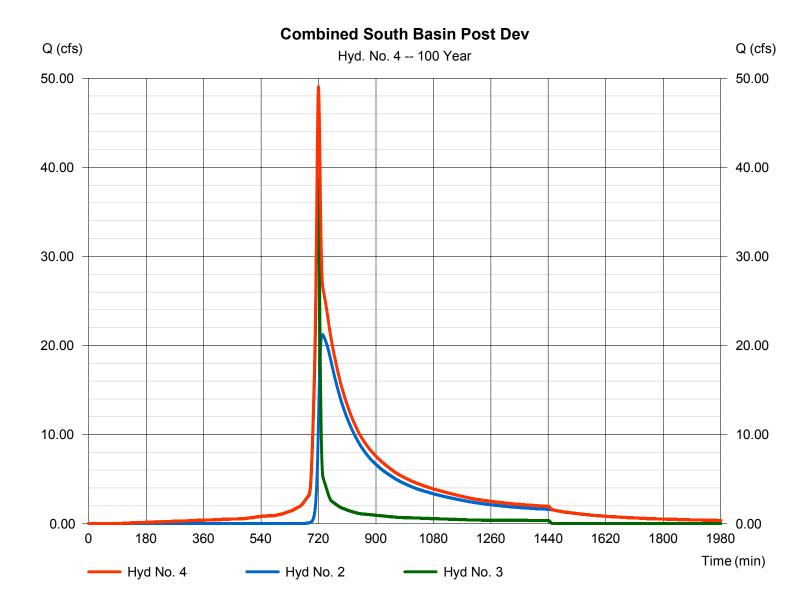
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 4

Combined South Basin Post Dev

= Combine Hydrograph type Peak discharge = 49.05 cfsStorm frequency = 100 yrsTime to peak = 720 min Time interval = 1 min Hyd. volume = 374,357 cuft Inflow hyds. = 2, 3 = 3.500 acContrib. drain. area



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

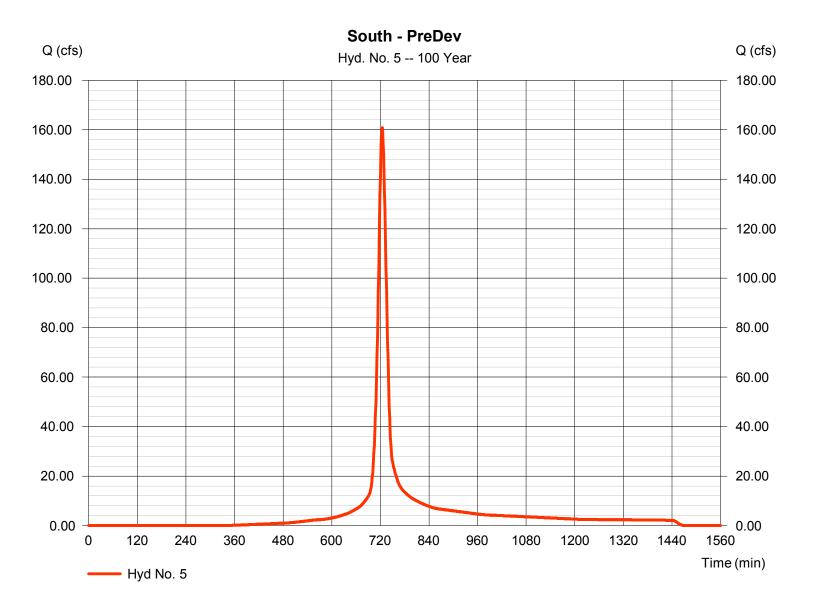
Monday, 08 / 6 / 2018

Hyd. No. 5

South - PreDev

Hydrograph type = SCS Runoff Peak discharge = 160.78 cfsStorm frequency = 100 yrsTime to peak = 725 min Time interval = 1 min Hyd. volume = 507,689 cuftDrainage area Curve number = 24.000 ac= 77 = 0 ftBasin Slope = 0.0 %Hydraulic length

Tc method = User Time of conc. (Tc) = 20.00 min
Total precip. = 8.60 in Distribution = Type II
Storm duration = 24 hrs Shape factor = 484



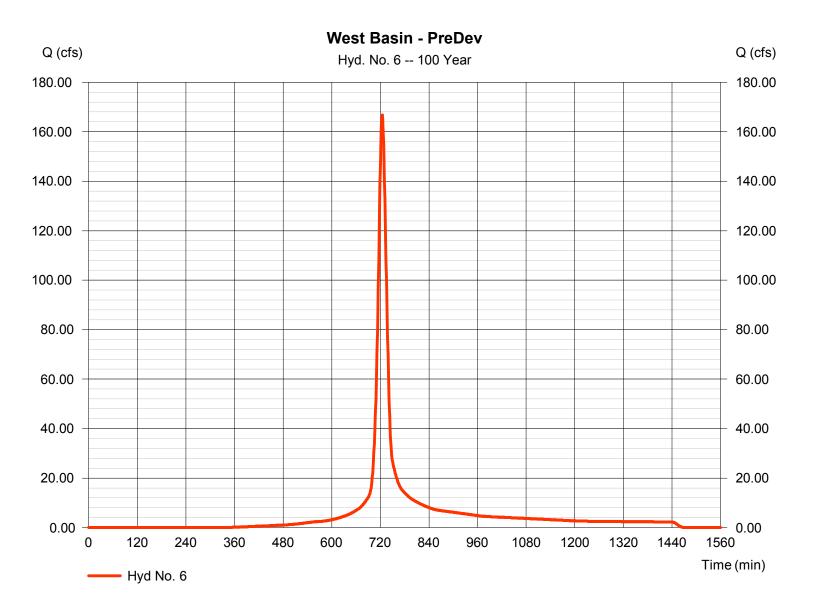
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 6

West Basin - PreDev

Hydrograph type = SCS Runoff Peak discharge = 166.81 cfsStorm frequency = 100 yrsTime to peak = 725 min Time interval = 1 min Hyd. volume = 526,727 cuft Drainage area = 24.900 acCurve number = 77 = 0 ftBasin Slope = 0.0 %Hydraulic length Time of conc. (Tc) = 20.00 min Tc method = User Total precip. Distribution = 8.60 in= Type II Storm duration = 484 = 24 hrs Shape factor



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

= 24 hrs

Monday, 08 / 6 / 2018

= 484

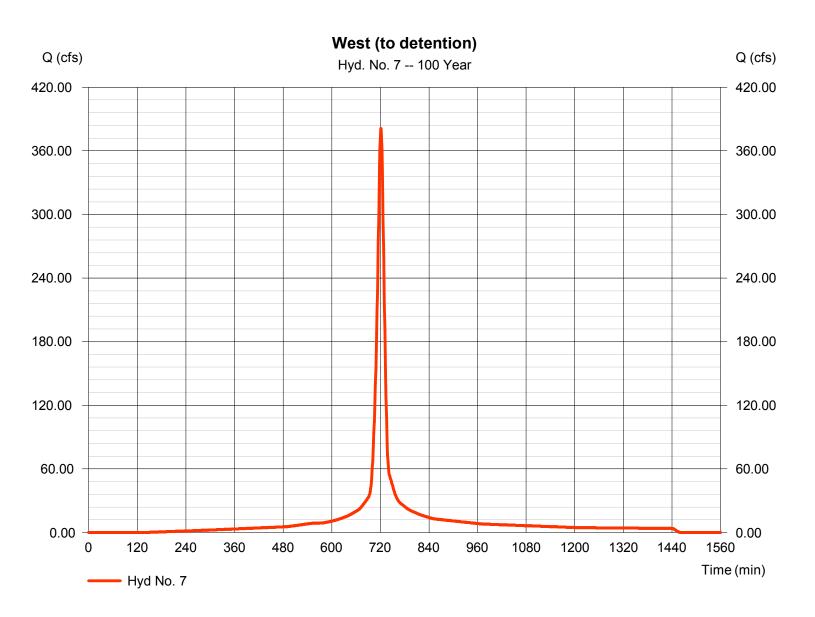
Hyd. No. 7

West (to detention)

Storm duration

Hydrograph type = SCS Runoff Peak discharge = 381.10 cfsStorm frequency Time to peak = 722 min = 100 yrsTime interval = 1 min Hyd. volume = 1,121,535 cuft Drainage area = 41.100 acCurve number = 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method = User Time of conc. (Tc) = 15.00 min Total precip. = 8.60 inDistribution = Type II

Shape factor



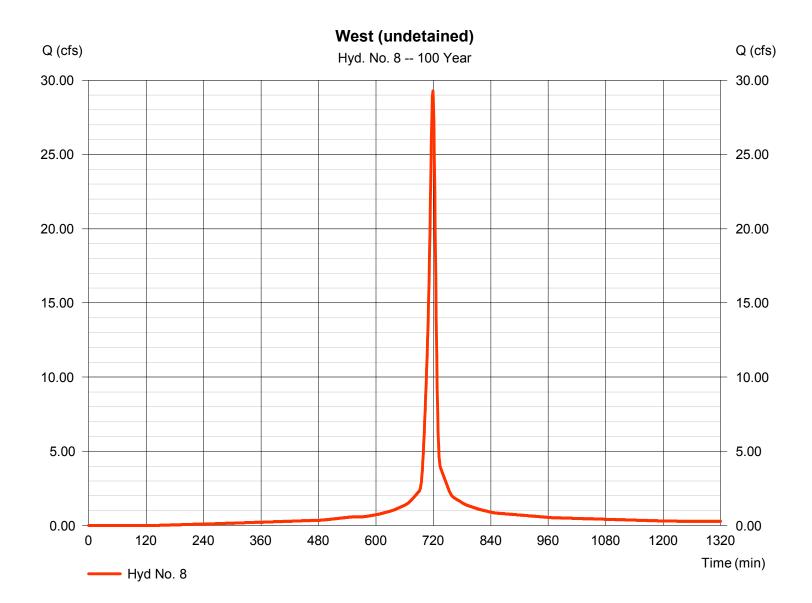
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 8

West (undetained)

= SCS Runoff Hydrograph type Peak discharge = 29.29 cfsStorm frequency = 100 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 73,677 cuftDrainage area = 2.700 acCurve number = 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTc method = User Time of conc. (Tc) = 10.00 min Total precip. = 8.60 inDistribution = Type II Storm duration = 24 hrs Shape factor = 484



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 9

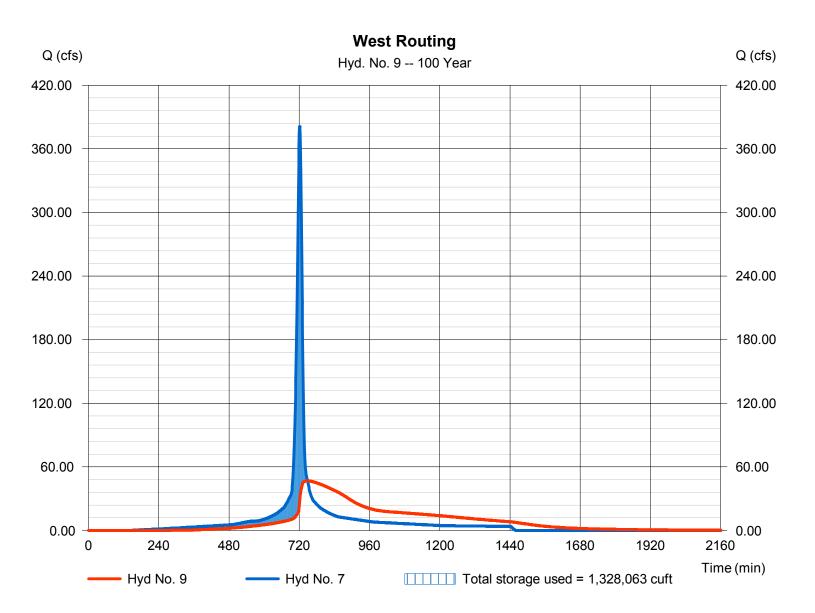
West Routing

Hydrograph type = Reservoir Peak discharge = 46.86 cfs Storm frequency = 100 yrs Time to peak = 748 min

Time interval = 1 min Hyd. volume = 1,117,157 cuft Inflow hyd. No. = 7 - West (to detention) Max. Elevation = 955.20 ft

Reservoir name = West Basin Max. Storage = 1,328,063 cuft

Storage Indication method used. Wet pond routing start elevation = 950.00 ft.



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

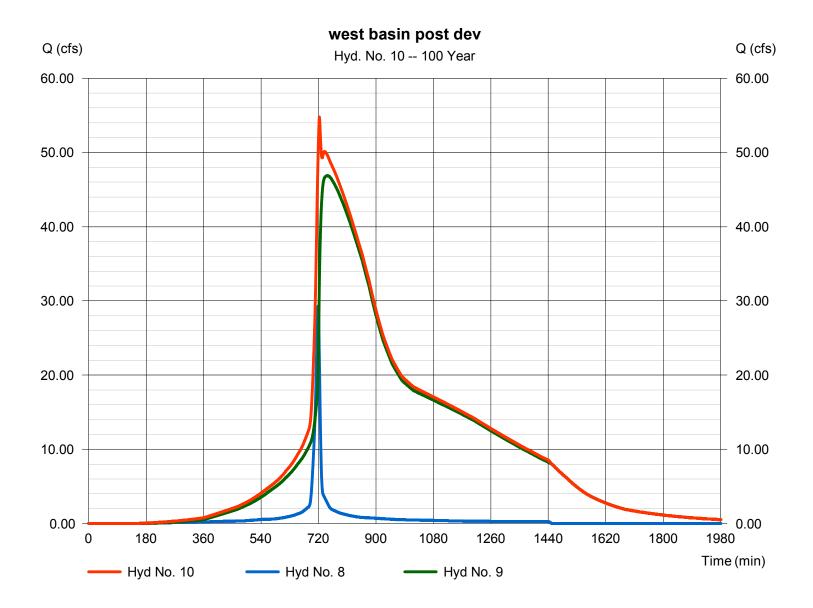
Monday, 08 / 6 / 2018

Hyd. No. 10

west basin post dev

Hydrograph type= CombinePeak discharge= 54.76 cfsStorm frequency= 100 yrsTime to peak= 723 minTime interval= 1 minHyd. volume= 1,190,834 cuft

Inflow hyds. = 8, 9 Contrib. drain. area = 2.700 ac



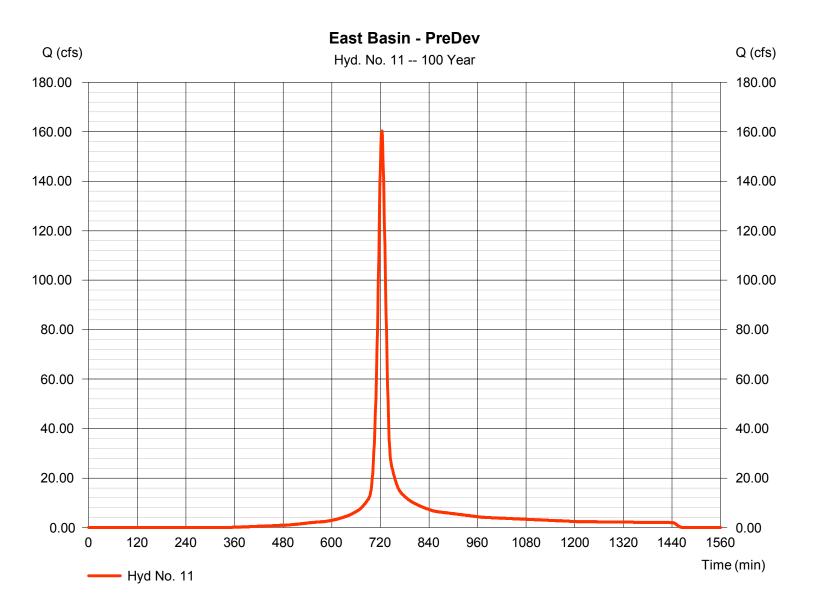
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Hyd. No. 11

East Basin - PreDev

Hydrograph type = SCS Runoff Peak discharge = 160.31 cfsStorm frequency = 100 yrsTime to peak = 724 min Time interval = 1 min Hyd. volume = 481,006 cuft Drainage area = 23.000 acCurve number = 77 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 18.00 min Total precip. Distribution = 8.60 in= Type II Storm duration = 484 = 24 hrs Shape factor



Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

= 24 hrs

Monday, 08 / 6 / 2018

= 484

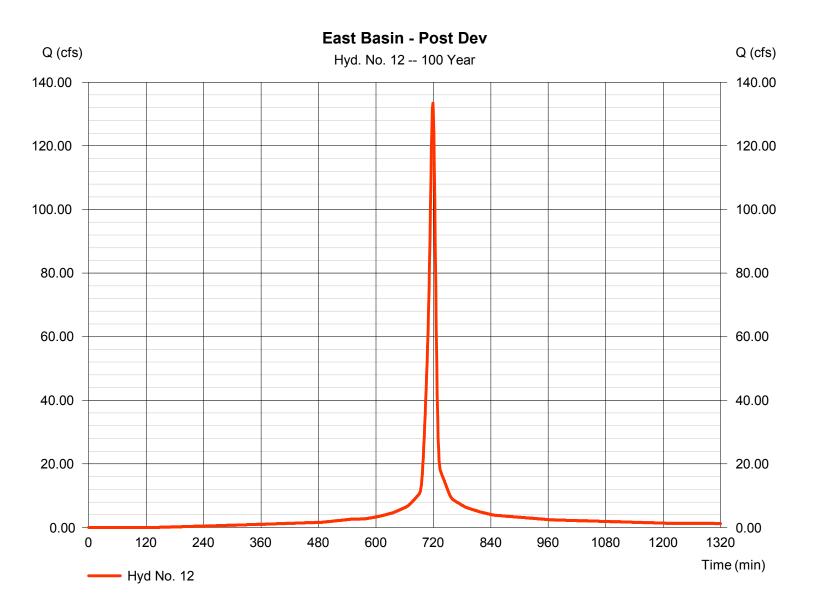
Hyd. No. 12

Storm duration

East Basin - Post Dev

Hydrograph type = SCS Runoff Peak discharge = 133.43 cfsStorm frequency = 100 yrsTime to peak = 719 min Time interval = 1 min Hyd. volume = 335.642 cuft Drainage area = 12.300 acCurve number = 91 Basin Slope = 0.0 %Hydraulic length = 0 ftTime of conc. (Tc) Tc method = User = 10.00 min Total precip. = 8.60 inDistribution = Type II

Shape factor



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 08 / 6 / 2018

Return Period	Intensity-Du	ıration-Frequency Ed	quation Coefficients ((FHA)
(Yrs)	В	D	E	(N/A)
1	0.0000	0.0000	0.0000	
2	79.5706	15.0000	0.8977	
3	0.0000	0.0000	0.0000	
5	168.3971	19.5000	1.0189	
10	90.6951	15.4000	0.8336	
25	106.7203	15.3000	0.8080	
50	136.5555	16.2000	0.8170	
100	160.7297	16.8000	0.8186	

File name: KC APWA 5600 Adjusted for K.idf

Intensity = $B / (Tc + D)^E$

Return		Intensity Values (in/hr)														
Period (Yrs)	5 min	10	15	20	25	30	35	40	45	50	55	60				
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
2	5.41	4.42	3.76	3.27	2.90	2.61	2.37	2.18	2.02	1.88	1.76	1.65				
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95				
10	7.34	6.12	5.27	4.64	4.16	3.77	3.46	3.19	2.97	2.78	2.62	2.47				
25	9.37	7.84	6.78	5.99	5.39	4.90	4.50	4.17	3.89	3.65	3.44	3.25				
50	11.26	9.47	8.21	7.27	6.54	5.96	5.48	5.08	4.74	4.44	4.19	3.96				
100	12.90	10.89	9.47	8.40	7.57	6.90	6.35	5.89	5.50	5.16	4.86	4.60				

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\Hydroflow IDF Curves\SCS Numbers PCP files\Lee's Summit MO.pcp

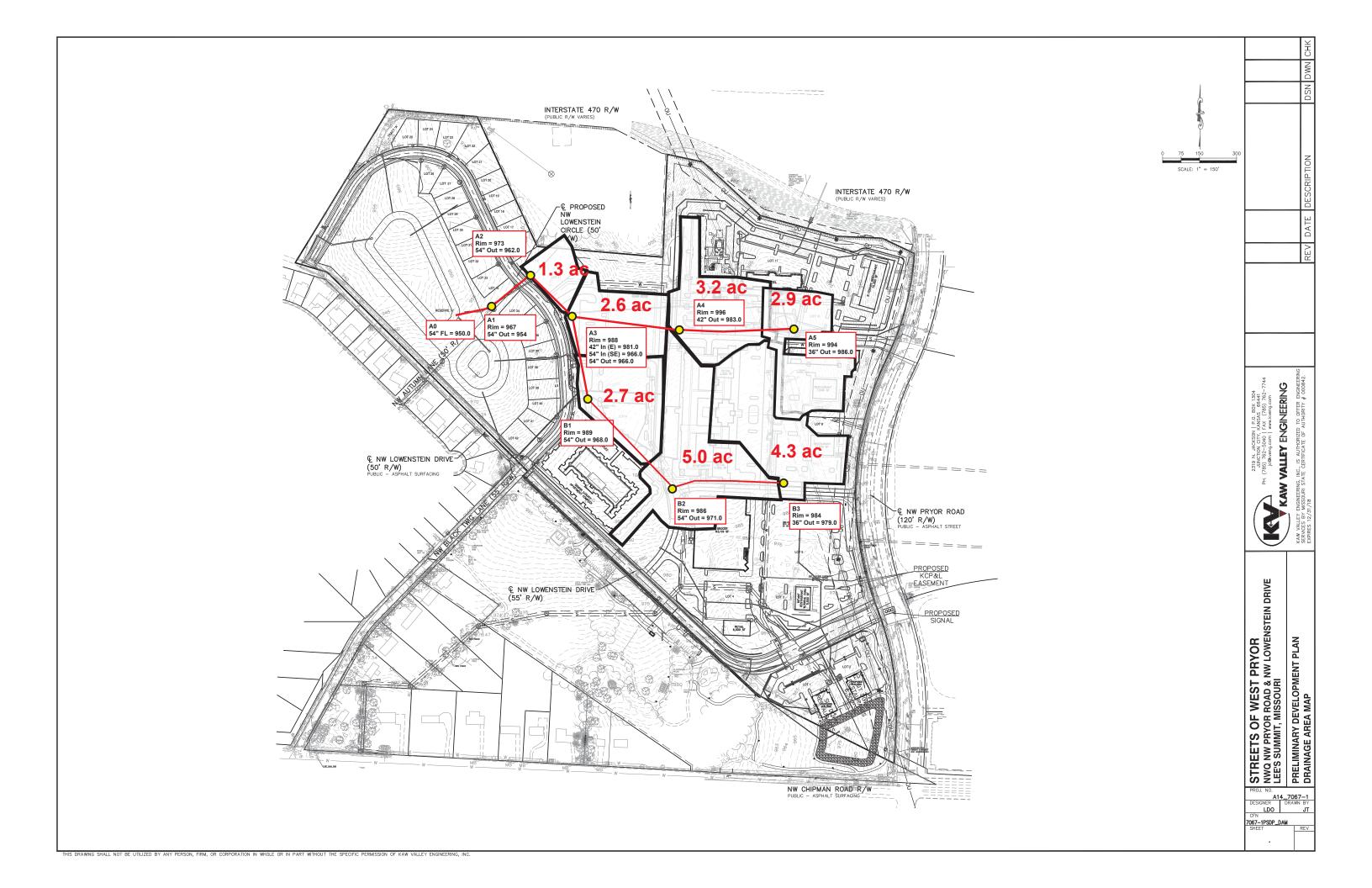
	Rainfall Precipitation Table (in)												
Storm Distribution	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr					
SCS 24-hour	1.37	3.60	0.00	0.00	5.30	0.00	0.00	8.60					
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					

Monday, 08 / 6 / 2018

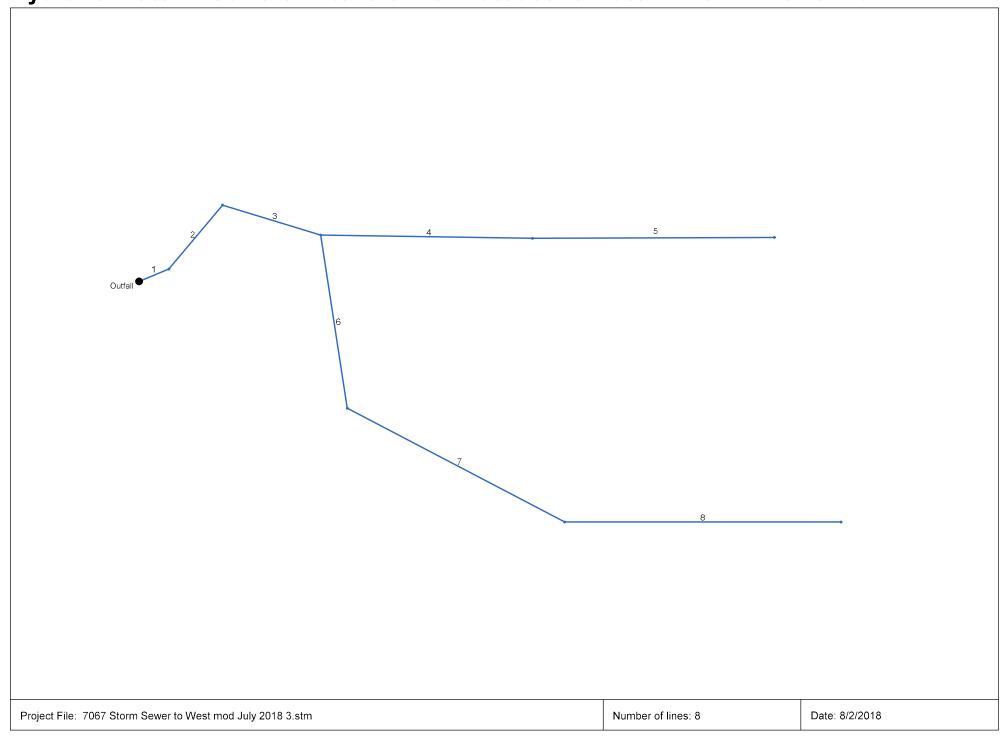
Watershed Model Schematic Hydrograph Return Period Recap 2 - Year Summary Report Hydrograph Reports Hydrograph No. 1, SCS Runoff, South (portion to detention) Hydrograph No. 2, Reservoir, South Basin Routing Pond Report - South Basin Hydrograph No. 3, SCS Runoff, South (portion undetained)							
Hydrograph Return Period Recap	2						
2 - Year							
Summary Report	3						
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Pond Report - South Basin	6						
Hydrograph No. 3, SCS Runoff, South (portion undetained)	7						
Hydrograph No. 4, Combine, Combined South Basin Post Dev	8						
Hydrograph No. 5, SCS Runoff, South - PreDev	9						
Hydrograph No. 6, SCS Runoff, West Basin - PreDev	10						
Hydrograph No. 7, SCS Runoff, West (to detention)	11						
Hydrograph No. 8, SCS Runoff, West (undetained)	12						
Hydrograph No. 9, Reservoir, West Routing							
Pond Report - West Basin							
Hydrograph No. 10, Combine, west basin post dev							
Hydrograph No. 11, SCS Runoff, East Basin - PreDev							
Hydrograph No. 12, SCS Runoff, East Basin - Post Dev	17						
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Summary Report							
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Hydrograph No. 1, SCS Runoff, South (portion to detention)							
Hydrograph No. 2, Reservoir, South Basin Routing							
Hydrograph No. 3, SCS Runoff, South (portion undetained)							
Hydrograph No. 4, Combine, Combined South Basin Post Dev							
Hydrograph No. 5, SCS Runoff, South - PreDev							
Hydrograph No. 6, SCS Runoff, West Basin - PreDev							
Hydrograph No. 7, SCS Runoff, West (to detention)							
Hydrograph No. 8, SCS Runoff, West (undetained)							
Hydrograph No. 9, Reservoir, West Routing							
Hydrograph No. 10, Combine, west basin post dev							
Hydrograph No. 11, SCS Runoff, East Basin - PreDev							
Hydrograph No. 12, SCS Runoff, East Basin - Post Dev	30						
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Hydrograph No. 2, Reservoir, South Basin Routing							
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Hydrograph No. 4, Combine, Combined South Basin Post Dev							
Hydrograph No. 5, SCS Runoff, South - PreDev							
Hydrograph No. 6, SCS Runoff, West Basin - PreDev							
Hydrograph No. 7, SCS Runoff, West (to detention)	38						

Hydrograph No. 8, SCS Runoff, West (undetained)	
Hydrograph No. 9, Reservoir, West Routing	
Hydrograph No. 10, Combine, west basin post dev	
Hydrograph No. 12, SCS Runoff, East Basin - Post Dev	
IDF Report	44

APPENDIX E – HYDRAFLOW STORM SEWER CALCULATIONS – SELECT PROFILES	



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Storm Sewer Inventory Report

ine		Alignment				Flov	v Data					Line ID					
No.	Dnstr Line No.			Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert EI Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	90.000	-22.542	мн	0.00	0.00	0.80	5.0	950.00	4.44	954.00	54	Cir	0.013	0.52	965.00	A1 to A0
2	1	233.000	-27.580	МН	0.00	1.30	0.80	5.0	954.00	3.43	962.00	54	Cir	0.013	0.94	970.00	A2 to A1
3	2	286.000	67.141	мн	0.00	2.60	0.80	5.0	962.00	1.40	966.00	54	Cir	0.013	0.92	989.00	A3 to A2
4	3	590.000	-16.130	мн	0.00	3.20	0.80	5.0	981.00	0.34	983.00	42	Cir	0.013	0.15	996.00	A4 to A3
5	4	674.000	-1.113	мн	0.00	2.90	0.80	5.0	983.00	0.45	986.00	36	Cir	0.013	1.00	994.00	A5 to A4
6	3	490.000	64.287	мн	0.00	2.70	0.80	5.0	966.00	0.41	968.00	54	Cir	0.013	0.84	989.00	B1 to A3
7	6	684.000	-53.583	мн	0.00	5.00	0.80	5.0	968.00	0.44	971.00	54	Cir	0.013	0.52	986.00	B2 to B1
8	7	770.000	-27.723	мн	0.00	4.30	0.80	5.0	971.00	1.04	979.00	36	Cir	0.013	1.00	984.00	B3 to B2
Projec	t File: 706	7 Storm Sev	ver to Wes	ىل. t mod	ılv 2018 3 et	m						Number	of lines: 8			Date: 8	/2/2018

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	A1 to A0	183.4	54	Cir	90.000	950.00	954.00	4.444	952.61	957.91	1.26	957.91	End	Manhole
2	A2 to A1	185.5	54	Cir	233.000	954.00	962.00	3.433	958.22	965.93	n/a	965.93	1	Manhole
3	A3 to A2	177.2	54	Cir	286.000	962.00	966.00	1.399	966.47	969.86	2.13	969.86	2	Manhole
4	A4 to A3	57.28	42	Cir	590.000	981.00	983.00	0.339	983.80	985.80	0.11	985.92	3	Manhole
5	A5 to A4	29.92	36	Cir	674.000	983.00	986.00	0.445	986.38	987.94	0.59	988.54	4	Manhole
6	B1 to A3	107.1	54	Cir	490.000	966.00	968.00	0.408	971.47*	972.92*	0.59	973.51	3	Manhole
7	B2 to B1	89.16	54	Cir	684.000	968.00	971.00	0.439	973.73	974.99	0.29	975.28	6	Manhole
8	B3 to B2	44.36	36	Cir	770.000	971.00	979.00	1.039	975.28	981.17	n/a	981.17 j	7	Manhole

Project File: 7067 Storm Sewer to West mod July 2018 3.stm

Number of lines: 8

Run Date: 8/2/2018

NOTES: Return period = 100 Yrs.; *Surcharged (HGL above crown).; j - Line contains hyd. jump.

