

)

#### Introduction

GINEERING

**D**LHTIONS

This storm water memorandum will study the re-development of a 0.44-acre site located at the Northwest corner of Maple Street and NE Douglas Street, Lee's Summit, Jackson County, Missouri. The site is located in the Cedar Creek watershed and drains southeasterly toward an existing public storm sewer system and northwesterly via overland flow. The development will NOT meet the City of Lee's Summit and APWA Section 5600 storm water detention requirements for Comprehensive Controls. The site will develop a parking lot and deck area and onsite storm water detention with extended 40-hour controls for the Water Quality storm event.

#### Purpose

This memorandum has been prepared to evaluate potential hydrologic and hydraulic issues related to the development of the proposed projects and recommend improvements if necessary to mitigate any anticipated negative downstream impacts. Exhibit A is the Proposed Drainage Area Map

#### Storm Study Methodology

Rational Method Site Impervious Area Rational Coefficient Hydrologic Soil Group

24.1% of Site (PRE) 45.2% of Site (POST) 0.48 Pre / 0.65 Post C

#### **Additional Resources**

Exhibit

С	FEMA Firmette, 29095C0417G, dated January 20, 2017	None
D	US Fish and Wildlife Wetland Inventory	None Identified
E	Soil Map	

#### APWA Section 5600.4.C.1 Comprehensive Control

- Ground Cover: Commercial
- Drainage Area: 0.44 acres
- Runoff Coefficient: Pre A (0.48) Pre B (0.37) Post A (0.65)
- Time of Concentration: Pre A (9.6) Pre B (9.1) Post A (7.2) minutes Allowable Discharge Rates
  - 2-YR: 0.22 cfs
  - 10-YR: 0.88 cfs

P: (816) 623-9888

• 100-YR: 1.32 cfs

#### Peak Discharge Summary and Allowable Detention Basin Discharge

Condition	Q (2-YR) cfs	Q (10-YR) cfs	Q (100-YR) cfs
Area A	0.89	1.32	1.99
Area B	0.22	0.33	0.49
Allowable Site Discharge	0.22	0.44	1.32
Design Detention Discharge	0.22	0.33	1.25

The proposed release rates will meet the APWA Section 5600 Allowable Release Rates

Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

Hydraflow Report which includes both proposed hydrographs along with detention basin sizing and routing hydrographs may be found in Exhibit B.

#### **Detention Design**

HINLERING

DLUTIONS

Designation: Detention Basin Type: Earthen Basin Side Slopes: 3:1 Max. Bottom Slope: 2% Min., Turf Lined Basin Bottom Elevation: 1038.00 Basin Top Berm Elevation: 1043.50 Basin Volume: 2,118 cf @ 1043.50 Control Structure: Infiltration Control Structure Effluent Pipe: 6" HDPE, FL (Out) = 1042.00' Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1042.50, Crest Length=50' Top of Dam: 1043.50, Q=1.99, Depth=0.22', Velocity=2.13 fps See Table below for a summary of detention basin data.

#### Detention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)						
	Detention Basin											
2-Year	1.11	10	0.22	0	1042.04	374						
10-Year	1.64	10	0.33	0	1042.25	552						
100-Year	1.48	10	0.76	12	1042.51	779						

As shown in the above table, post detention peak discharge rates have been attenuated well below existing.

#### Conclusion

The development along with the proposed infiltration basin will meet all requirements of the City of Lee's Summit and APWA Section 5600 for storm water attenuation. There are no known Stream Buffer setback areas required due to the size of the upstream watershed. There are no known floodplain or wetlands onsite per the exhibits provided within this report from FEMA and National Wetland Mapper. Additionally, there are no required stream buffers due to the upstream watershed area being less than 40 acres.

Due to the reduction in existing peak flow rates from this site the development will not create a negative impact on the downstream system and will provide the required storm attenuation for the proposed development of the site.

Matt Schlicht, PE 2006019708



50 SE 30th Street Lee's Summit, MO 64082

www.engineeringsolutionskc.com



Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

# Exhibit A Proposed Drainage Area Map

t



			North		<u>RE</u> NLE: 1" =	10' <u>) E VE</u> = 10'	lopm	ENT	DRAIN	IAGE	PLAN	Bilineering 2005002186-D Surveying LS-218 Oklahoma Engineering 6254 Nebraska Engineering 6254 Nebraska Engineering 6254
												100 NE DOUGLAS STREET Lee's Summit, Jackson County, Missouri
	F	igh Pole										Project: 100 NE DOUGLAS LSMO Issue Date: January 24, 2025
												Pre Development Preliminary Development Plans for: 100 NE DOUGLAS STREET Lee's Summit, Jackson County, Missouri
Lake	MultFam M	SnglFam S	Undev U	Other Z								Motthew J. Schlicht MO PE 2006019708
0.90 URFACE CODE P or U U	0.66 P=Pavec U=Unpav CHANNE CHANNEL LENGTH 79.0	0.51 ved EL FLOW UP ELEV 1042.0	0.3 Overwrite DN ELEV 1041.0	e Slope or E if necessary REACH SLOPE % 1.27	Elevations / /ELOCITY F/S 1.8	Cal Overland Flow T(l) 8.9 9.1	TC Used Min 5 Max 15 T(I) 8.9 9.1	COMPUTA Cal Channel One T(T) 0.7 0.0	Cal Channel Two T(T) 0.0 0.0	Total T© 10 9.6 9.1	AREA ID PRE A B	REVISIONS
U Hydrology . 3-1.	79.0 for Small V	Vatershe	1041.0 ds - Techr	1.27 nical Releas	1.8 se 55", Ap	6.4 9.1 pendix F,	6.4 9.1 Figure 3-1.	0.7	0.0	9.1	1.0 2.0	C.201



AC Month Bar North Bar Nor	BORNERING & SURVEYING BORNEBRING & SURVEYING ENGINEBRING & SURVEYING ENGINEBRING & SURVEYING ENGINEBRING & SURVEYING ENGINEERING 2005002186-D Surveying 2005002186-D Surveying 2005002186-D Surveying 2005002186-D Surveying 2005002186-D Surveying E-1695 Surveying E-1695 Surveying E-218 Oklahoma Engineering 6254 Nabraska
Renter y Made Novel Hande NUZ 2017 Pre Areg 2 Fotal Area 5965.57 sf Impervious Area 689.27 sf	Induced Engineering CA2821
12,989.85 sf 7,481.08 sf	Post Development   Project:     Preliminary Development Plans for:   100 NE DOUGLAS STREET     100 NE DOUGLAS STREET   100 NE DOUGLAS STREET     Lee's Summit, Jackson County, Missouri   January 24, 20
NM     NM       1     Mage Print       1     Mage Print  <	Matthew J. Schlicht Northew J. Schlicht Motthew J. Schlicht Nor PE 25226 NE PE E-14335 REVISIONS

	Ι							ADDA		PRE	A		-	m	<b>m</b>	B 1.0	B 1.0 2.0	B 1.0 2.0	B 1.0 2.0
							Tatal		T© 10		9.6		9.1	9.1	0.1	9.1	9.1 7.2 9.1	9.1 7.2 9.1	9.1 7.2 9.1
			1	NO		la I	Channel	Two	T(T)T		0.0	00	0.0	0.0		0.0	0.0	0.0	0.0
	ſ		OMOUT AT	UMPULAL		3	Channel	One	T(T)		0.7	00	2.5	2.0	20	0.7	0.0	0.0	0.0
			C CL			Used	Min 5	Max 15	T(I)		8.9	9.1				6.4	6.4 9.1	6.4 9.1 P.1.	6.4 9.1 1.
						Cal	Dverland	Flow	T(I)		8.9	9.1			R d	6.4	6.4 9.1	6.4 9.1 ¢ F, Figure 3	6.4 6.4 9.1 6.F, Figure 3
	Γ			Ī	Elevations	7		VELOCITY	F/S		1.8				18	1.8	1.8	1.8 Appendio	1.8 ", Appendio
	Other	Z			e Slope or I	if necessar	REACH	SLOPE	%		1.27				1.27	1.27	1.27	1.27 Release 55	1.27 Release 55
	m Undev	>	0.3		Overwrit		W - FIRST	N	ELEV		1041.0				1041.0	1041.0	1041.0	- 1041.0 - Technical	1041.0
	am SnglFa	S	0.51		Deve	paved	NNEL FLO		THELEV		1042.0				1042.0	1042.0	1042.0	1042.0 Vatersheds	1042.0
	MultFa	Σ	0.66	L L	7 1 2 1 2 2		CHA	CHANN	LENG:		79.0				79.0	79.0	79.0	79.0 for Small V	79.0 for Small M
	ark Lake		0.90	CLIDTA.	AURIA	CODE	۵.	ō	2	1					>	<b>D</b>		U Hydrology	Hydrotogy 8. 3-1.
Ś	Grass/P	o	0:30	Ar Clono	adoio io			SLOPE	%	0	n'z	3.0			2.0	30	2.0 3.0 0m "I Irhan	2.0 2.0 3.0 0m "Urban lion 5602.5.	2.0 3.0 0m "Urban lion 5602.5. ase 55", El
Z L L L L	Ξ	۵	09.0	th - DoFlay,		cessary	MAX	N	ELEV	1010.0	1042.0	1042.0			1042.0	1042.0	1042.0 1042.0 nuta taken fr	1042.0 1042.0 nula taken fr rks Associal	1042.0 1042.0 nula taken fr rks Associal chnical Rele
22	: Bus/Com	m	0.87	write   and	Rip- on	it ner	LOW - 100'	₽	ELEV	10440	0.440	0.0401			1044.0	1044.0 1045.0	1044.0 1045.0	1044.0 1045.0 /ed] Form	1044.0 1045.0 ed] Form Public Wor rsheds - Te
	Asph/Conc	×	0.90	Oven			ERLAND F	OVRLND	LENGTH	1000	1000	0.001			100.0	100.0	100.0 100.0 slope) (Pav	100.0 100.0 slope) [Pav m Americar	100.0 100.0 slope) [Pav m American Small Wate
	e types:	E CODES	/alues				0	្នុ	VALUE	0.48	0.97	10.0			0.65	0.65	0.65 0.37 82 x SORT	0.65 0.37 82 x SORT la taken fro	0.65 0.37 82 x SORT Ja taken fro drology for
	Surfac	SURFAC	<b>.</b>					SURFACE		~	1	4			Z	2 2	Z Z city = 20.32	Z Z city = 20.32 ^1/3 Formi	Z city = 20.32 M1/3 Formt n "Urban H
		Buindin	ary		5	đ				10410	10420	0.740		0.107	1041.0	) 1041.0 0 1042.0	) 1041.0 ) 1042.0 /ed] Velc	1041.0 1042.0 /ed) Velo	1041.0 1042.0 ed Velo ih) / (stope
		o are sell co	Ite If necess		WATEDOU		!			1044.0	1045.0			40.44	) 1044.C	1044.0	1044.0 1045.0 0pe) [Unpav	) 1044.0 1045.0 ppe) [Unpav verland leng	1044.0 1045.0 ppe) [Unpav verland leng
		Voliuw areas	UNIONO		TOTAL			AL WIKS		0 179.0	4 97.0			1700	0 179.0	0 179.0 4 97.0	0 179.0 4 97.0 x SQRT(slc	0 179.0 4 97.0 × SQRT(slo :) × SQRT(o	0 179.0 4 97.0 × SQRT(slo ) × SQRT(o ength / Velc
		T	1				TOT		E.	0.31	0.14			100	0.3(	0.30	0.30 0.1/ /= 16.1345	0.30 0.1/ = 16.1345 1.8 × (1.1-C	0.30 0.14 = 16.1345 : 1.8 × (1.1-C = Channel L
							A LUA		PRE	×	6	POST		Ţ	- 0	- 0	2 Velocity	1 2 Velocity * T(I) =	2 2 * T(I) = 1

,



Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

# Exhibit B Hydraflow Report

Hydraflow Table of Contents:\acad\100 NE DOUGLAS LSMO\STORM STUDY\100 NE Douglas Storm.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Thursday, 01 / 23 / 2025

Watershed Model Schematic	1
Hydrograph Return Period Recap	2

### 2 - Year

Summary Report	*	3
Hydrograph Reports		4
Hydrograph No. 1, Rational, Pre A		4
Hydrograph No. 2, Rational, Pre B		5
Hydrograph No. 3, Rational, Post A		6
Hydrograph No. 4, Reservoir, Infiltration		7
Pond Report - Infiltration		8

## 10 - Year

Summary Report	10
Hydrograph Reports	11
Hydrograph No. 1, Rational, Pre A	11
Hydrograph No. 2, Rational, Pre B	12
Hydrograph No. 3, Rational, Post A	13
Hydrograph No. 4, Reservoir, Infiltration	14

### 100 - Year

	Summary Report	15
	Hydrograph Reports	16
	Hydrograph No. 1, Rational, Pre A.	16
	Hydrograph No. 2, Rational, Pre B	17
	Hydrograph No. 3, Rational, Post A	18
	Hydrograph No. 4, Reservoir, Infiltration	19
IDF	- Report	20

# Watershed Model Schematic Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

3





#### Legend

Hvd. Origin **Description** Dettershi **D**.

1	Rational	Pre A
2	Rational	Pre B
3	Rational	Post A

4 Reservoir Infiltration

Project: Z:\acad\100 NE DOUGLAS LSMO\STORM STUDY\100 NE Douglas Storm.gpwThursday, 01 / 23 / 2025

# Hydrograph Return Period Recap Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No	Hydrograph	Inflow				Hydrograph					
NO.	(origin)	nyu(s)	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	Description
1 2 3	Rational Rational Rational			0.595 0.221 0.891			0.877 0.326 1.315			1.327 0.493 1.989	Pre A Pre B Post A
4	Reservoir	3		0.000			0.000			0.761	Infiltration
			1								
	ł										
					1						
					÷						
Proj.	file: Z:\acad	100 NE E	DOUGL	AS LSM	O\STOR	M STU	DY\100	NE Dou	glas <b>TSto</b>	rsolæjpv0:	1 / 23 / 2025

# Hydrograph Summary Report Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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 2	Rational Rational	0.595 0.221	1	10 9	357 119				Pre A Pre B
3	Rational	0.891	1	7	374				Post A
4	Reservoir	0.000	1	n/a	o	3	1042.04	374	Infiltration
4	Reservoir	0.000	1	n/a	0	3	1042.04	374	Infiltration
								-	
Z:\ad	cad\100 NE D	OUGLAS	S LSMO	STORM	STELLDY VP(	fichtie 20 de	<b>gl</b> as Storm.g	pīvihursday, 01	1 / 23 / 2025

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 1

### Pre A

Hydrograph type	= Rational		Peak discharge	= 0.595 cfs
Storm frequency	= 2 yrs		Time to peak	= 0.17 hrs
Time interval	= 1 min		Hyd. volume	= 357 cuft
Drainage area	= 0.300 ac	<u>.</u>	Runoff coeff.	= 0.48
Intensity	= 4.130 in/hr		Tc by User	= 10.00 min
IDF Curve	= KCMO.IDF		Asc/Rec limb fact	= 1/1



4

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 2

### Pre B

Hydrograph type	= Rational	Peak discharge	= 0.221 cfs	
Storm frequency	= 2 yrs	Time to peak	= 0.15 hrs	
Time interval	= 1 min	Hyd. volume	= 119 cuft	
Drainage area	= 0.140 ac	Runoff coeff.	= 0.37	
Intensity	= 4.266 in/hr	Tc by User	= 9.00 min	
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1	



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

### Hyd. No. 3

### Post A

Hydrograph type	= Rational	Peak discharge	= 0.891 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.12 hrs
Time interval	= 1 min	Hyd. volume	= 374 cuft
Drainage area	= 0.300 ac	Runoff coeff.	= 0.65
Intensity	= 4.569 in/hr	Tc by User	= 7.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 4

Infiltration

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 3 - Post A	Max. Elevation	= 1042.04 ft
Reservoir name	= Infiltration	Max. Storage	= 374 cuft

Storage Indication method used.



# **Pond Report**

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

#### Pond No. 1 - Infiltration

#### **Pond Data**

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1038.00 ft

#### Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1038.00	73	0	0
1.00	1039.00	73	73	73
2.00	1040.00	73	73	146
3.00	1041.00	73	73	218
4.00	1042.00	182	123	342
5.00	1043.00	1,795	849	1,191
5.50	1043.50	1,914	927	2,118

#### **Culvert / Orifice Structures**

	[A]	[B]	[C]	[PrfRsr]		[A]	[B]	[C]	[D]	
Rise (in)	= 8.00	0.00	0.00	0.00	Crest Len (ft)	= 50.00	0.00	0.00	0.00	
Span (in)	= 8.00	0.00	0.00	0.00	Crest El. (ft)	= 1042.50	0.00	0.00	0.00	
No. Barrels	= 1	0	0	0	Weir Coeff.	= 3.33	3.33	3.33	3.33	
Invert El. (ft)	= 1042.50	0.00	0.00	0.00	Weir Type	= Ciplti				
Length (ft)	= 25.00	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	No	No	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

**Weir Structures** 

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv 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	1038.00	0.00				0.00						0.000
0.10	7	1038.10	0.00				0.00						0.000
0.20	15	1038.20	0.00				0.00	499					0.000
0.30	22	1038.30	0.00				0.00						0.000
0.40	29	1038.40	0.00				0.00						0.000
0.50	36	1038.50	0.00				0.00						0.000
0.60	44	1038.60	0.00				0.00						0.000
0.70	51	1038.70	0.00				0.00						0.000
0.80	58	1038.80	0.00				0.00						0.000
0.90	66	1038.90	0.00				0.00						0.000
1.00	73	1039.00	0.00				0.00						0.000
1.10	80	1039.10	0.00				0.00						0.000
1.20	87	1039.20	0.00				0.00						0.000
1.30	95	1039.30	0.00				0.00				40 mm 10		0.000
1.40	102	1039.40	0.00				0.00						0.000
1.50	109	1039.50	0.00				0.00					-	0.000
1.60	116	1039.60	0.00				0.00					***	0.000
1.70	124	1039,70	0.00	19 10 to			0.00						0.000
1.80	131	1039.80	0.00				0.00		-	-			0.000
1.90	138	1039.90	0.00				0.00				-		0.000
2.00	146	1040.00	0.00				0.00						0.000
2.10	153	1040.10	0.00				0.00						0.000
2.20	160	1040.20	0.00	to us an			0.00	-					0.000
2.30	167	1040.30	0.00				0.00					-	0.000
2.40	175	1040.40	0.00				0.00						0.000
2.50	182	1040.50	0.00				0.00						0.000
2.60	189	1040.60	0.00				0.00						0.000
2.70	197	1040.70	0.00				0.00						0.000
2.80	204	1040.80	0.00				0.00						0.000
2.90	211	1040.90	0.00				0.00		Ac-24 MA				0.000
3.00	218	1041.00	0.00				0.00			01177 M			0.000
3.10	231	1041.10	0.00			10-10-01	0.00					-	0.000
3.20	243	1041.20	0.00				0.00					****	0.000
3.30	255	1041.30	0.00	<b></b>			0.00					to an er	0.000
										0	ontinuor	on novt	0000

Infiltration

#### Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.40	268	1041.40	0.00				0.00						0.000
3.50	280	1041.50	0.00				0.00						0.000
3.60	292	1041.60	0.00				0.00						0.000
3.70	305	1041.70	0.00				0.00	****					0.000
3.80	317	1041.80	0.00				0.00						0.000
3.90	329	1041.90	0.00				0.00						0.000
4.00	342	1042.00	0.00				0.00						0.000
4.10	427	1042.10	0.00				0.00						0.000
4.20	512	1042.20	0.00		-		0.00		+				0.000
4.30	596	1042.30	0.00				0.00						0.000
4.40	681	1042.40	0.00		antaga ga		0.00			-			0.000
4.50	766	1042.50	0.00				0.00						0.000
4.60	851	1042.60	0.04 ic				5.25		-				5.289
4.70	936	1042.70	0.13 ic				14.87						15.01
4.80	1,021	1042.80	0.28 ic				27.33						27.62
4.90	1,106	1042.90	0.47 ic				42.09						42.56
5.00	1,191	1043.00	0.68 ic				58.87						59.54
5.05	1,284	1043.05	0.78 ic				67.92			aliana (			68.70
5.10	1,377	1043.10	0.83 oc				77.40						78.23
5.15	1,469	1043.15	0.85 oc				87.28						88.14
5.20	1,562	1043.20	0.89 oc		the serves		97.55						98.44
5.25	1,655	1043.25	0.96 oc				108.20						109.16
5.30	1,747	1043.30	1.03 oc				119.20						120.23
5.35	1,840	1043.35	1.10 oc				130.56						131.66
5.40	1,933	1043.40	1.16 oc				142.25	ar ar in					143.41
5.45	2,025	1043.45	1.22 oc				154.28			words are			155.49
5.50	2,118	1043.50	1.27 oc				166.50						167.77

τ.

...End

÷

# Hydrograph Summary Report Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	Rational Rational	0.877 0.326	1	10 9	526 176				Pre A Pre B
3	Rational	1.315	1	7	552				Post A
4	Reservoir	0.000	1	n/a	0	3	1042.25	552	Infiltration
Z:\ac	ad\100 NE D	OUGLAS	S LSMO	STORM	SREUUDIVIPEDIONIE 1000 Vugtars Storm.			pīvhursday, 0	1 / 23 / 2025

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 1

### Pre A

Hydrograph type	= Rational	Peak discharge	= 0.877 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 526 cuft
Drainage area	= 0.300 ac	Runoff coeff.	= 0.48
Intensity	= 6.092 in/hr	Tc by User	= 10.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

### Hyd. No. 2

### Pre B

Hydrograph type	= Rational	Peak discharge	= 0.326 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.15 hrs
Time interval	= 1 min	Hyd. volume	= 176 cuft
Drainage area	= 0.140 ac	<sup>•</sup> Runoff coeff.	= 0.37
Intensity	= 6.294 in/hr	Tc by User	= 9.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 3

Post A

Hydrograph type	= Rational	Peak discharge	= 1.315 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.12 hrs
Time interval	= 1 min	Hyd. volume	= 552 cuft
Drainage area	= 0.300 ac	Runoff coeff.	= 0.65
Intensity	= 6.745 in/hr	Tc by User	= 7.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 4

Infiltration

Hydrograph type	= Reservoir		Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs		Time to peak	= n/a
Time interval	= 1 min		Hyd. volume	= 0 cuft
Inflow hyd. No.	= 3 - Post A	2	Max. Elevation	= 1042.25 ft
Reservoir name	= Infiltration		Max. Storage	= 552 cuft

Storage Indication method used.



# Hydrograph Summary Report Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	Rational	1.327	1	10	796				Pre A
2	Rational	0.493	1	9	266				Pre B
3	Rational	1.989	1	10	830		1042 51	770	Post A
4	Reservoir	0.701	1	12	70	3	1042.51	119	Innitiation
	1								
		с. 2. 							
							2.52 ·····		
Z:\a	cad\100 NE D	OUGLA	S LSMO	STORM	STELLDY	80 <b>de 106</b> .	igeer Storm.	pī <b>m</b> hursday, 0	1 / 23 / 2025
_									

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 1

Pre A

Hydrograph type	= Rational	Peak discharge	= 1.327 cfs	
Storm frequency	= 100 yrs	Time to peak	= 0.17 hrs	
Time interval	= 1 min	Hyd. volume	= 796 cuft	
Drainage area	= 0.300 ac	Runoff coeff.	= 0.48	
Intensity	= 9.213 in/hr	Tc by User	= 10.00 min	
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1	



ł.

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

### Hyd. No. 2

### Pre B

Hydrograph type	= Rational	Peak discharge	= 0.493 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.15 hrs
Time interval	= 1 min	Hyd. volume	= 266 cuft
Drainage area	= 0.140 ac	Runoff coeff.	= 0.37
Intensity	= 9.519 in/hr	Tc by User	= 9.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1

)



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

### Hyd. No. 3

Post A

Hydrograph type	= Rational	Peak discharge	= 1.989 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.12 hrs
Time interval	= 1 min	Hyd. volume	= 836 cuft
Drainage area	= 0.300 ac	Runoff coeff.	= 0.65
Intensity	= 10.202 in/hr	Tc by User	= 7.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

## Hyd. No. 4

Infiltration

Hydrograph type	= Reservoir	Peak discharge	= 0.761  cfs
Time interval	= 100  yrs	Hvd volumo	= 0.20  m/s
Inflow hvd No	= 3 - Post A	Max Elevation	= 70  cull = 1042 51 ft
Reservoir name	= Infiltration	Max. Storage	= 779  cuft

Storage Indication method used.



# **Hydraflow Rainfall Report**

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Return Intensity-Duration-Frequency Equation Coefficients (FHA) Period (Yrs) в D Е (N/A) 1 64.1474 17.7000 0.8922 2 95.7859 19.2000 0.9317 3 0.0000 0.0000 0.0000 5 118.7799 19.1000 0.9266 -----10 125.1300 18.2000 0.9051 ----158.9867 25 18.7000 0.9180 50 171.2459 18.3000 0.9078 100 187.3624 18.1000 0.9031

File name: KCMO.IDF

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

Return	Intensity Values (in/hr)											
(Yrs)	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.96	3.31	2.86	2.52	2.25	2.04	1.87	1.72	1.60	1.49	1.40	1.32
2	4.92	4.13	3.56	3.14	2.81	2.54	2.32	2.14	1.98	1.85	1.73	1.63
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	6.23	5.23	4.51	3.98	3.56	3.22	2.94	2.71	2.52	2.35	2.20	2.07
10	7.27	6.09	5.26	4.63	4.14	3.75	3.43	3.16	2.93	2.74	2.57	2.42
25	8.70	7.30	6.30	5.54	4.96	4.49	4.10	3.78	3.51	3.27	3.07	2.89
50	9.83	8.24	7.11	6.26	5.60	5.07	4.64	4.27	3.97	3.70	3.47	3.27
100	11.00	9.21	7.95	7.00	6.26	5.67	5.19	4.78	4.44	4.14	3.89	3.66

Tc = time in minutes. Values may exceed 60.

	Rainfall Precipitation Table (in)								
Storm Distribution	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-уг	
SCS 24-hour	1.37	3.71	0.00	3.30	5.68	6.00	6.80	9.26	
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00	
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00	
Huff-2nd	2.49	3.10	0.00	4.01	4.64	5.52	6.21	6.90	
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	1.55	0.00	2.75	4.00	5.38	6.50	8.00	
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10	

#### Precip, file name: Z:\acad\KCMO.ncn



Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

# Exhibit C FEMA FIRMette

to my 2

ų.

# National Flood Hazard Layer FIRMette



#### Legend



2,000

1,500

250

n

500

1,000

Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

94°22'27"W 38°54'45"N

unmapped and unmodernized areas cannot be used for

regulatory purposes.



Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

# Exhibit D Wetland Inventory Map



Storm Water Memorandum January 24. 2025 100 NE Douglas St Lee's Summit, MO

Exhibit E Soil Map



USDA Natural Resources Conservation Service Web Soil Survey National Cooperative Soil Survey



# Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	с	1.1	63.0%
99012	Urban land, upland, 5 to 9 percent slopes		0.6	37.0%
Totals for Area of Intere	est	1.8	100.0%	

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## **Rating Options**

Aggregation Method: Dominant Condition Component Percent Cutoff: None Specified Tie-break Rule: Higher

