

F. E. Moran, Inc. Fire Protection



16815 College Blvd ♦ Lenexa, Kansas 66219 ♦ (217)356-0700 ♦ Fax (217) 356-0777

HYDRAULIC CALCULATIONS
FOR
LEE'S SUMMIT COMMERCE CENTER
BUILDING 3
NW TUDOR RD & MAIN ST
LEE'S SUMMIT, MO
64086

FEM Job# 21224100

Date: 4/4/2024

Brock Browning



Hydraulic Overview

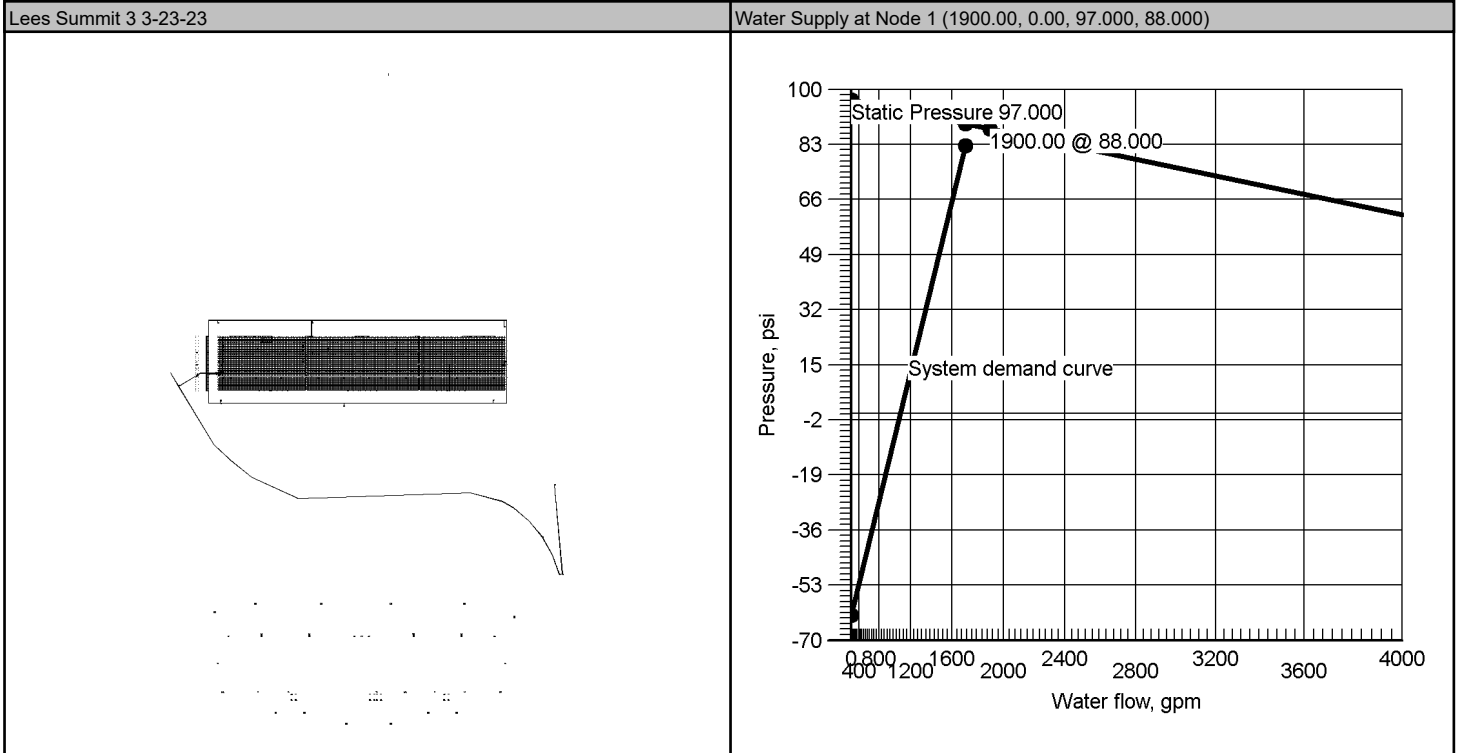
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#1 - System 1)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone: 913-827-8595 FAX:
Address 1	NE Tudor Rd & Main St	
Address 2	Lee's Summit, MO 64086	
Address 3	Building C Lot 3	

System	
Pressure	52.000
Area of Application	NA
Most Demanding Sprinkler Data	Hose Streams
16.80 K-Factor 121.15 at 52.000	250.00
Coverage Per Sprinkler	Number Of Sprinklers Calculated
94 ft ²	12 0
System Pressure Demand	System Flow Demand
82.824	1708.60
Total Demand	Pressure Result
1708.60 @ 82.824	+6.781 (7.6%)

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	63.780	213.94	1708.60
25	Pump	1500.00		79.190	75.000				

Pumps: Static = Churn (Pressure @ Zero Flow)





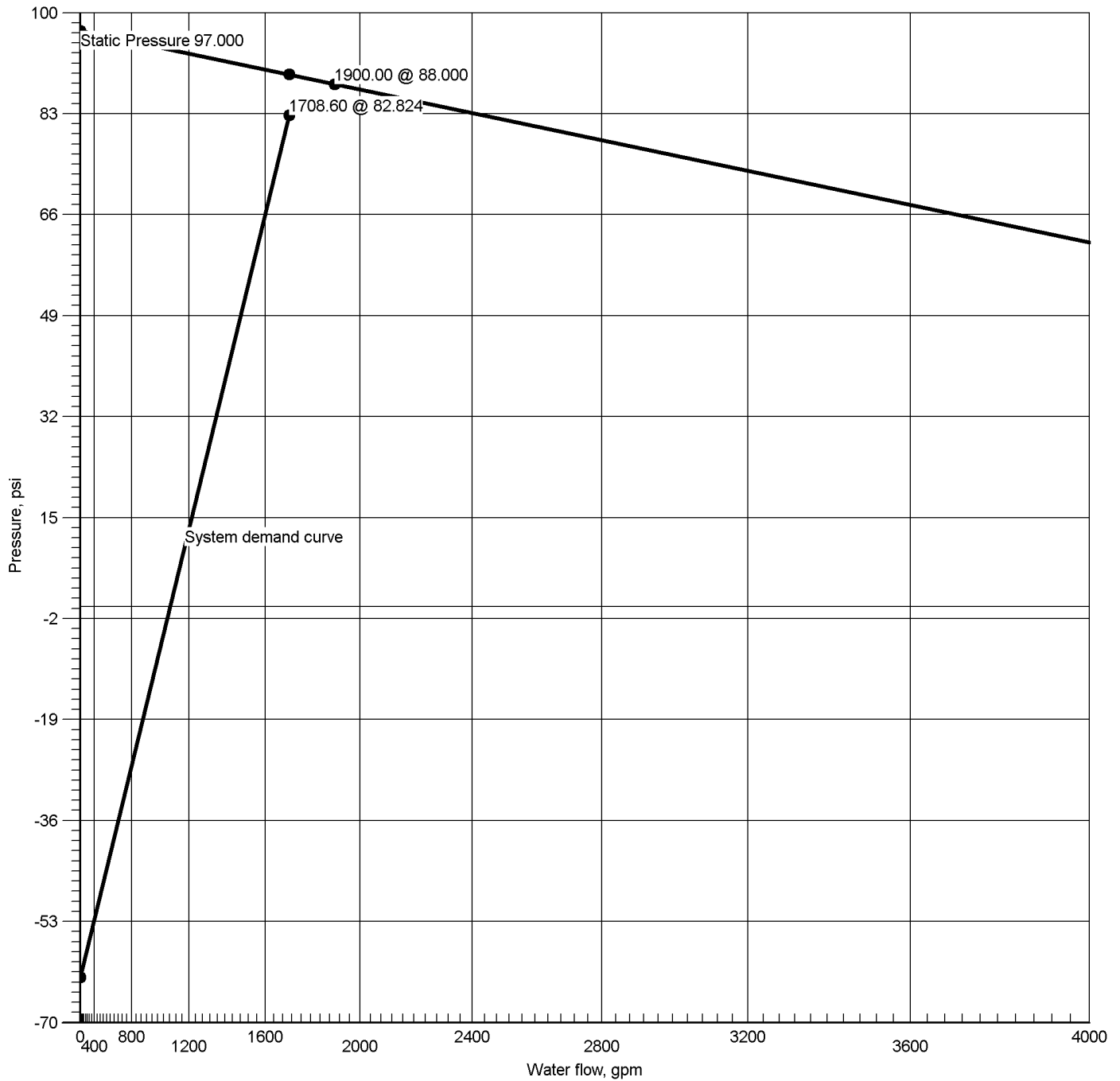
Hydraulic Summary

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#1 - System 1)

Job											
Job Number 21224100				Designer Brock Browning							
Job Name: Lee's Summit				State Certification/License Number 149263							
Address 1 NE Tudor Rd & Main St				AHJ Lee's Summit FM							
Address 2 Lee's Summit, MO 64086				Job Site/Building Building C Lot 3							
Address 3				Drawing Name Lees Summit 3 3-23-23							
System				Remote Area(s)							
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000				Occupancy ESFR			Job Suffix Lees Summit 3				
Hose Allowance At Source 0.00				Pressure 52.000			Area of Application NA				
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u> Hydrant At Node 39 250.00				Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 94 ft ²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 82.763 Right: 82.815							
Total Hose Streams 250.00											
System Flow Demand 1708.60		Total Water Required (Including Hose Allowance) 1708.60									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.08 between nodes 21 and 20											
Maximum Velocity Under Ground 7.87 between nodes 6 and 7											
Volume capacity of Wet Pipes 34639.89 gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.605		1708.60	82.824	6.781
25	Pump		79.190	75.000		1500.00	143.951		1708.60	137.169	6.781
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number 1		Contact Name Brock Browning				Contact Title Designer					
Name of Contractor: F.E. Moran, Inc.				Phone 913-827-8595				Extension			
Address 1 16815 College Blvd				FAX 217-356-0777							
Address 2 Lenexa, KS				E-mail brock.browning@femoran.com							
Address 3 66219				Web-Site https://www.femoran.com/							



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

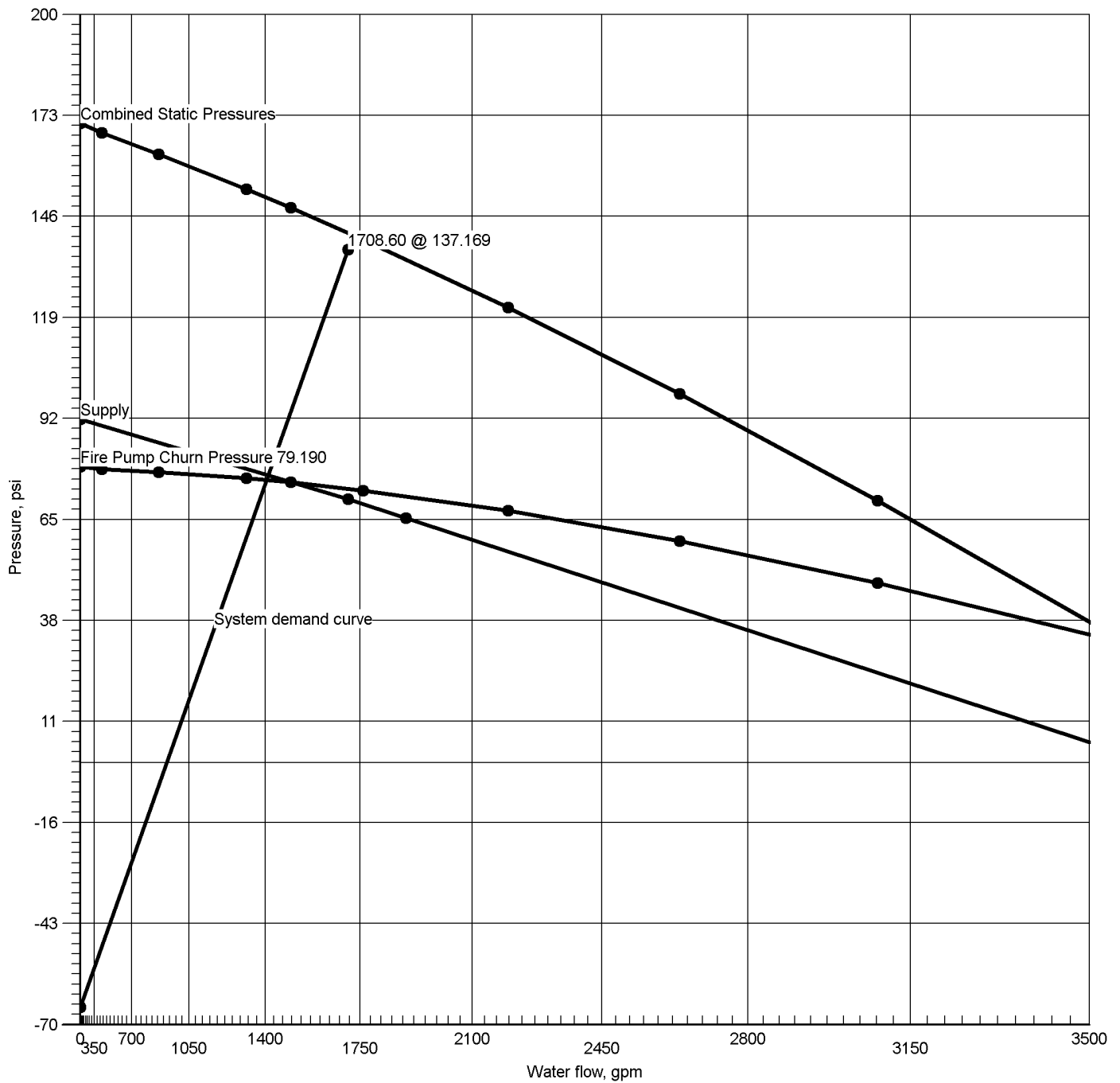
Available Pressure at System Demand
89.605 @ 1708.60

Required Pressure at System Demand
82.824 @ 1708.60

Required Pressure at System Demand (Including Hose Allowance at Source)
82.824 @ 1708.60



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.390 @ 1708.60

Available Pressure at System Demand

143.951 @ 1708.60

Required Pressure at System Demand

137.169 @ 1708.60



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#1 - System 1)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	39	250.00	250.00	0.00	134.847			
⇒ Sprinkler	101	121.15	121.15	16.80	52.000			
Sprinkler	102	121.53	121.15	16.80	52.328			
Sprinkler	103	121.15	121.15	16.80	52.000			
Sprinkler	104	121.55	121.15	16.80	52.350			
Sprinkler	105	121.26	121.15	16.80	52.095			
Sprinkler	106	121.64	121.15	16.80	52.424			
Sprinkler	107	121.26	121.15	16.80	52.095			
Sprinkler	108	121.66	121.15	16.80	52.445			
Sprinkler	109	121.65	121.15	16.80	52.436			
Sprinkler	110	122.04	121.15	16.80	52.767			
Sprinkler	111	121.65	121.15	16.80	52.437			
Sprinkler	112	122.06	121.15	16.80	52.789			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#1 - System 1)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	119.11	6.65	120		0.035033	9'-4½"	Pf 0.328
101	34'-1	121.15	16.80	52.000		Sprinkler		Pe
102	34'-1			52.328			9'-4½"	Pv
BL	2.7050	240.64	13.43	120		0.128681	162'-1	Pf 25.674
102	34'-1	121.53	16.80	52.328		Sprinkler,	37'-5¼"	Pe 0.350
9	33'-3¼"			78.352		2PO(18'-8½")	199'-6¼"	Pv
CM	4.3100	240.64	5.29	120		0.013313	10'-0"	Pf 0.133
9	33'-3¼"			78.352				Pe
10	33'-3¼"			78.485			10'-0"	Pv
CM	4.3100	481.46	10.59	120		0.048028	10'-0"	Pf 0.480
10	33'-3¼"	240.83		78.485		Flow (q) from Route 3		Pe
11	33'-3¼"			78.965			10'-0"	Pv
CM	4.3100	722.98	15.90	120		0.101891	10'-0"	Pf 1.019
11	33'-3¼"	241.52		78.965		Flow (q) from Route 5		Pe
12	33'-3¼"			79.984			10'-0"	Pv
CM	4.3100	778.19	17.11	120		0.116751	10'-0"	Pf 1.168
12	33'-3¼"	55.21		79.984		Flow (q) from Route 15		Pe
13	33'-3¼"			81.152			10'-0"	Pv
CM	4.3100	835.66	18.38	120		0.133200	10'-0"	Pf 1.332
13	33'-3¼"	57.47		81.152		Flow (q) from Route 14		Pe
14	33'-3¼"			82.484			10'-0"	Pv
CM	4.3100	897.79	19.74	120		0.152098	8'-0¼"	Pf 1.219
14	33'-3¼"	62.13		82.484		Flow (q) from Route 16		Pe -0.026
15	33'-4			83.677			8'-0¼"	Pv
CM	4.3100	965.44	21.23	120		0.173977	8'-3"	Pf 1.436
15	33'-4	67.65		83.677		Flow (q) from Route 12		Pe -0.071
2116	33'-6			85.042			8'-3"	Pv
CM	4.3100	1040.43	22.88	120		0.199800	9'-9"	Pf 1.948
2116	33'-6	74.99		85.042		Flow (q) from Route 9		Pe -0.084
17	33'-8¼"			86.906			9'-9"	Pv
CM	4.3100	1125.76	24.76	120		0.231167	10'-0"	Pf 2.312
17	33'-8¼"	85.33		86.906		Flow (q) from Route 10		Pe -0.086
18	33'-10¼"			89.132			10'-0"	Pv
CM	4.3100	1223.15	26.90	120		0.269516	10'-0"	Pf 2.696
18	33'-10¼"	97.38		89.132		Flow (q) from Route 11		Pe -0.086
19	34'-1			91.741			10'-0"	Pv
CM	4.3100	1333.92	29.33	120		0.316402	10'-0"	Pf 3.165
19	34'-1	110.77		91.741		Flow (q) from Route 13		Pe -0.086
20	34'-3½"			94.819			10'-0"	Pv
CM	4.3100	1458.60	32.08	120		0.373276	38'-10¾"	Pf 19.590
20	34'-3½"	124.68		94.819		Flow (q) from Route 2	13'-7"	Pe -0.290
21	34'-11½"			114.120		2fE(6'-9½")	52'-5¾"	Pv
CM	6.3570	1458.60	14.74	120		0.056247	33'-11¾"	Pf 2.474
21	34'-11½"			114.120			10'-0"	Pe 12.961
22	5'-0¼"			129.555		fE(10'-0")	43'-11¾"	Pv
FR	6.0650	1458.60	16.20	120		0.070721	1'-10¾"	Pf 4.942
22	5'-0¼"			129.555			68'-0"	Pe 1.121
23	2'-5¼"			135.618		CV(20'-0), BV(8'-0), f(10'-0), PO (30'-0)	69'-10¾"	Pv
CM	8.2490	1458.60	8.76	120		0.015815	2'-1"	Pf 0.033
23	2'-5¼"			135.618				Pe
24	2'-5¼"			135.651			2'-1"	Pv
DY	8.2490	1708.60	10.26	120		0.021192	0'-0"	Pf 1.518
24	2'-5¼"	250.00		135.651		Flow (q) from Route 7	71'-7¾"	Pe 0.000
25	2'-5¼"			137.169		BV(18'-9½), CV(52'-10¼)	71'-7¾"	Pv
Pump		Velocity						
25		1708.60		137.169		Rating: 75.000 @ 1500.00		
26		Q=1708.60	6.49	63.780		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1708.60	6.49	120		0.006953	1'-8¾"	Pf 0.464
26	2'-8¾"			63.780			65'-0"	Pe 0.752
8	1'-0"			64.996		GV(5'-11), T(59'-1¼)	66'-9"	Pv
UG	10.4000	1708.60	6.45	140		0.005155	13'-11"	Pf 0.253
8	1'-0"			64.996			35'-1"	Pe 2.384
7	-4'-6			67.633		E(35'-1)	48'-11¾"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
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Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
UG	9.4200	1708.60	7.87	150		0.007347	72'-10"	Pf 0.626
7	-4'-6"			67.633			12'-3½"	Pe
6	-4'-6"			68.258		EE(12'-3½")	85'-1¾"	Pv
UG	10.4000	1708.60	6.45	140		0.005155	5'-11¼"	Pf 3.943
6	-4'-6"			68.258				Pe
5	-4'-6"			72.201		BFP(-3.913)	5'-11¼"	Pv
UG	10.4000	1708.60	6.45	140		0.005155	5'-11¼"	Pf 0.031
5	-4'-6"			72.201				Pe
4	-4'-6"			72.232			5'-11¼"	Pv
UG	9.4200	1708.60	7.87	150		0.007347	204'-11½"	Pf 1.917
4	-4'-6"			72.232			55'-10¾"	Pe
3	-4'-6"			74.149		T(55'-10¾")	260'-10¼"	Pv
UG	11.2000	1708.60	5.56	150		0.003163	2459'-6"	Pf 8.237
3	-4'-6"			74.149			144'-11¾"	Pe
2	-4'-6"			82.386		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1708.60	4.50	140		0.002138	204'-11½"	Pf 0.438
2	-4'-6"			82.386				Pe
1	-4'-6"			82.824		Water Supply	204'-11½"	Pv
		0.00				Hose Allowance At Source		
1		1708.60						
Route 2								
BL	2.7050	2.04	0.11	120		0.000019	9'-4½"	Pf 0.000
101	34'-1"	121.15	16.80	52.000		Sprinkler		Pe
103	34'-1"			52.000			9'-4½"	Pv
BL	2.7050	123.19	6.88	120		0.037285	9'-4½"	Pf 0.350
103	34'-1"	121.15	16.80	52.000		Sprinkler		Pe
104	34'-1"			52.350			9'-4½"	Pv
BL	2.7050	244.74	13.66	120		0.132770	130'-2¾"	Pf 22.260
104	34'-1"	121.55	16.80	52.350		Sprinkler,	37'-5¼"	Pe 0.350
27	33'-3¾"			74.960		2PO(18'-8½")	167'-8"	Pv
CM	4.3100	244.74	5.38	120		0.013736	10'-0"	Pf 0.137
27	33'-3¾"			74.960				Pe
28	33'-3¾"			75.097			10'-0"	Pv
CM	4.3100	489.73	10.77	120		0.049564	10'-0"	Pf 0.496
28	33'-3¾"	244.99		75.097		Flow (q) from Route 4		Pe
29	33'-3¾"			75.593			10'-0"	Pv
CM	4.3100	735.61	16.18	120		0.105209	10'-0"	Pf 1.052
29	33'-3¾"	245.89		75.593		Flow (q) from Route 6		Pe
30	33'-3¾"			76.645			10'-0"	Pv
CM	4.3100	680.40	14.96	120		0.091068	10'-0"	Pf 0.911
30	33'-3¾"			76.645				Pe
31	33'-3¾"			77.556			10'-0"	Pv
CM	4.3100	622.94	13.70	120		0.077352	10'-0"	Pf 0.774
31	33'-3¾"			77.556				Pe
32	33'-3¾"			78.329			10'-0"	Pv
CM	4.3100	560.81	12.33	120		0.063688	8'-0¼"	Pf 0.511
32	33'-3¾"			78.329				Pe -0.026
33	33'-4"			78.814			8'-0¼"	Pv
CM	4.3100	493.16	10.84	120		0.050208	8'-3"	Pf 0.414
33	33'-4"			78.814				Pe -0.071
2117	33'-6"			79.157			8'-3"	Pv
CM	4.3100	418.16	9.20	120		0.037003	9'-9"	Pf 0.361
2117	33'-6"			79.157				Pe -0.084
35	33'-8¼"			79.434			9'-9"	Pv
CM	4.3100	332.84	7.32	120		0.024259	10'-0"	Pf 0.243
35	33'-8¼"			79.434				Pe -0.086
36	33'-10¾"			79.590			10'-0"	Pv
CM	4.3100	235.45	5.18	120		0.012787	10'-0"	Pf 0.128
36	33'-10¾"			79.590				Pe -0.086
37	34'-1"			79.631			10'-0"	Pv
CM	4.3100	124.68	2.74	120		0.003944	10'-0"	Pf 0.039
37	34'-1"			79.631				Pe -0.086
38	34'-3½"			79.584			10'-0"	Pv
RN	2.7050	124.68	6.96	120		0.038125	320'-5¼"	Pf 15.235
38	34'-3½"			79.584		PO(18'-8½")	79'-2"	Pe -0.000
20	34'-3½"			94.819		3PO(18'-8½"), Tr(4'-3½")	399'-7¼"	Pv
Route 3								



Hydraulic Analysis

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Report Description: ESFR (#1 - System 1)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	119.19	6.65	120		0.035078	9'-4½"	Pf 0.329
105	34'-1	121.26	16.80	52.095		Sprinkler		Pe
106	34'-1			52.424			9'-4½"	Pv
BL	2.7050	240.83	13.45	120		0.128871	162'-1	Pf 25.712
106	34'-1	121.64	16.80	52.424		Sprinkler,	37'-5¼"	Pe 0.350
10	33'-3¼"			78.485		2PO(18'-8½")	199'-6¼"	Pv
Route 4								
BL	2.7050	2.07	0.12	120		0.000019	9'-4½"	Pf 0.000
105	34'-1	121.26	16.80	52.095		Sprinkler		Pe
107	34'-1			52.095			9'-4½"	Pv
BL	2.7050	123.32	6.89	120		0.037363	9'-4½"	Pf 0.350
107	34'-1	121.26	16.80	52.095		Sprinkler		Pe
108	34'-1			52.445			9'-4½"	Pv
BL	2.7050	244.99	13.68	120		0.133021	130'-2¼"	Pf 22.302
108	34'-1	121.66	16.80	52.445		Sprinkler,	37'-5¼"	Pe 0.350
28	33'-3¼"			75.097		2PO(18'-8½")	167'-8"	Pv
Route 5								
BL	2.7050	119.48	6.67	120		0.035239	9'-4½"	Pf 0.330
109	34'-1	121.65	16.80	52.436		Sprinkler		Pe
110	34'-1			52.767			9'-4½"	Pv
BL	2.7050	241.52	13.48	120		0.129558	162'-1	Pf 25.849
110	34'-1	122.04	16.80	52.767		Sprinkler,	37'-5¼"	Pe 0.350
11	33'-3¼"			78.965		2PO(18'-8½")	199'-6¼"	Pv
Route 6								
BL	2.7050	2.17	0.12	120		0.000021	9'-4½"	Pf 0.000
109	34'-1	121.65	16.80	52.436		Sprinkler		Pe
111	34'-1			52.437			9'-4½"	Pv
BL	2.7050	123.82	6.91	120		0.037643	9'-4½"	Pf 0.353
111	34'-1	121.65	16.80	52.437		Sprinkler		Pe
112	34'-1			52.789			9'-4½"	Pv
BL	2.7050	245.89	13.73	120		0.133923	130'-2¼"	Pf 22.454
112	34'-1	122.06	16.80	52.789		Sprinkler,	37'-5¼"	Pe 0.350
29	33'-3¼"			75.593		2PO(18'-8½")	167'-8"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	18'-4¼"	Pf 0.151
39	3'-6	250.00		134.847		Hydrant,	67'-9½"	Pe 3.035
40	-3'-6			138.033		E(21'-6¼"), PO(46'-2½")	86'-1½"	Pv
UG	7.6800	199.94	1.38	150		0.000375	164'-2¼"	Pf 0.087
40	-3'-6			138.033			66'-4½"	Pe
41	-3'-6			138.120		E(22'-6½"), T(43'-10)	230'-6½"	Pv
UG	7.6800	250.00	1.73	150		0.000567	31'-8½"	Pf 0.018
41	-3'-6	50.06		138.120		Flow (q) from Route 8		Pe 0.000
42	-3'-6			138.138			31'-8½"	Pv
UG	8.3900	250.00	1.45	140		0.000419	12'-11	Pf 0.018
42	-3'-6			138.138			30'-6½"	Pe -1.951
43	1'-0			136.205		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	250.00	1.50	120		0.000605	19'-9¾"	Pf 0.089
43	1'-0			136.205			128'-0¼"	Pe -0.643
24	2'-5¾"			135.651		3fE(15'-3¼"), 2T(41'-1¼")	147'-10"	Pv
Route 8								
UG	7.6800	50.06	0.35	150		0.000029	2876'-4¼"	Pf 0.087
40	-3'-6	199.94		138.033		Flow (q) from Route 7	111'-5¼"	Pe
41	-3'-6			138.120		3E(22'-6½"), T(43'-10)	2987'-9½"	Pv
Route 9								
RN	2.7050	74.99	4.19	120		0.014887	320'-5	Pf 5.885
2117	33'-6			79.157		PO(18'-8½")	74'-10½"	Pe 0.000
2116	33'-6			85.042		3PO(18'-8½")	395'-3½"	Pv
Route 10								
RN	2.7050	85.33	4.76	120		0.018903	320'-5¼"	Pf 7.472
35	33'-8¼"			79.434		PO(18'-8½")	74'-10½"	Pe
17	33'-8¼"			86.906		3PO(18'-8½")	395'-3½"	Pv
Route 11								
RN	2.7050	97.38	5.44	120		0.024138	320'-5¼"	Pf 9.542
36	33'-10¾"			79.590		PO(18'-8½")	74'-10½"	Pe
18	33'-10¾"			89.132		3PO(18'-8½")	395'-3½"	Pv
Route 12								



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
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Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
RN	2.7050	67.65	3.78	120		0.012303	320'-5¼"	Pf 4.863
33	33'-4			78.814		PO(18'-8½")	74'-10½"	Pe 0.000
15	33'-4			83.677		3PO(18'-8½")	395'-3½"	Pv
Route 13								
RN	2.7050	110.77	6.18	120		0.030634	320'-5¼"	Pf 12.110
37	34'-1			79.631		PO(18'-8½")	74'-10½"	Pe
19	34'-1			91.741		3PO(18'-8½")	395'-3½"	Pv
Route 14								
RN	2.7050	57.47	3.21	120		0.009097	320'-5¼"	Pf 3.596
31	33'-3¼"			77.556		PO(18'-8½")	74'-10½"	Pe
13	33'-3¼"			81.152		3PO(18'-8½")	395'-3½"	Pv
Route 15								
RN	2.7050	55.21	3.08	120		0.008448	320'-5¼"	Pf 3.339
30	33'-3¼"			76.645		PO(18'-8½")	74'-10½"	Pe
12	33'-3¼"			79.984		3PO(18'-8½")	395'-3½"	Pv
Route 16								
RN	2.7050	62.13	3.47	120		0.010510	320'-5¼"	Pf 4.155
32	33'-3¼"			78.329		PO(18'-8½")	74'-10½"	Pe
14	33'-3¼"			82.484		3PO(18'-8½")	395'-3½"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

C Value Multiplier

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51



Hydraulic Analysis

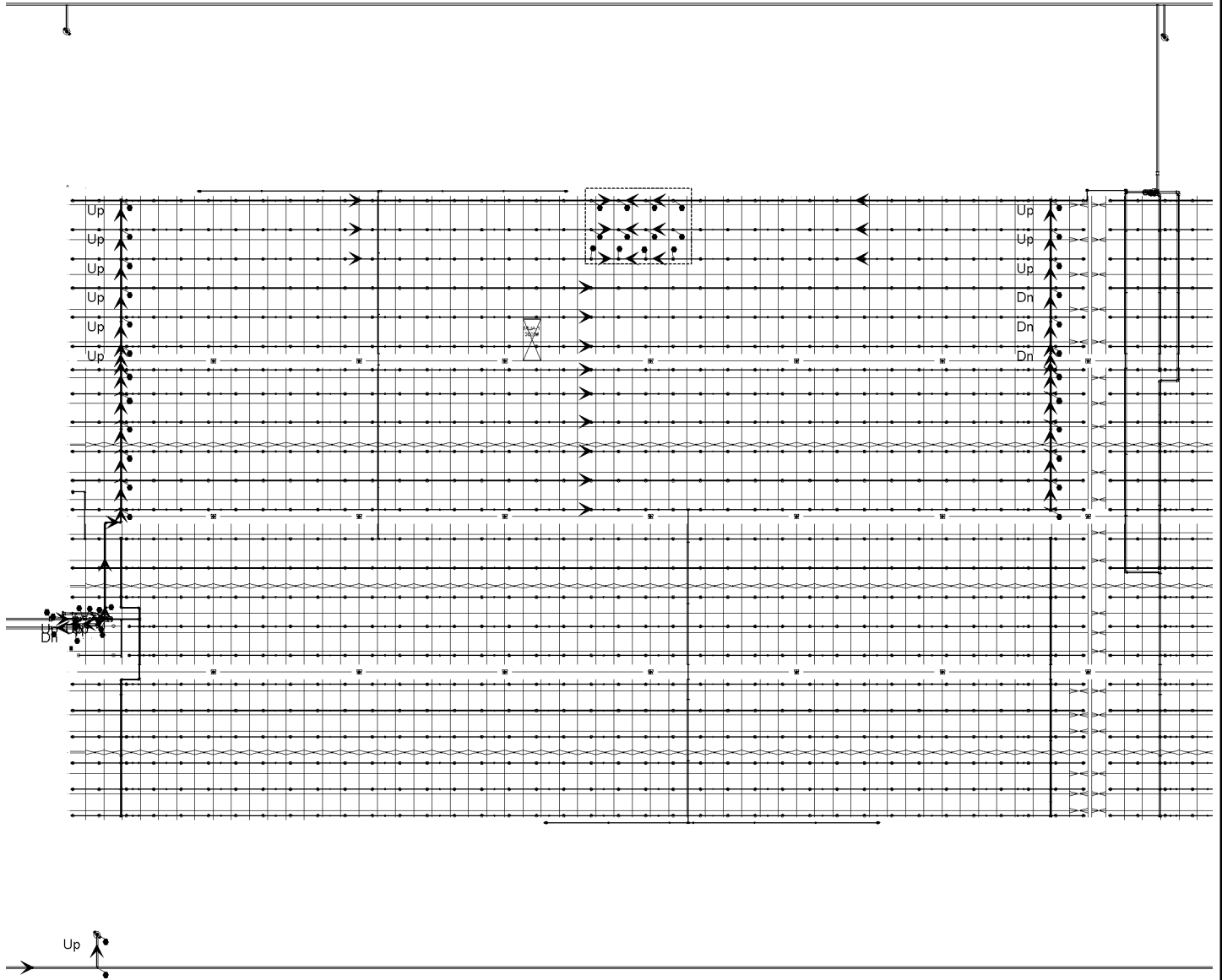
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#1 - System 1)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend	
AO	Arm-Over
BL	Branch Line
CM	Cross Main
DN	Drain
DR	Drop
DY	Dynamic
FM	Feed Main
FR	Feed Riser
MS	Miscellaneous
OR	Outrigger
RN	Riser Nipple
SN	Swing Nipple
SP	Sprig
ST	Stand Pipe
UG	Underground

Units Legend	
Diameter	Inch
Elevation	Foot
Flow	gpm
Discharge	gpm
Velocity	fps
Pressure	psi
Length	Foot
Friction Loss	psi/Foot
HWC	Hazen-Williams Constant
Pt	Total pressure at a point in a pipe
Pn	Normal pressure at a point in a pipe
Pf	Pressure loss due to friction between points
Pe	Pressure due to elevation difference between indicated points
Pv	Velocity pressure at a point in a pipe

Fittings Legend	
ALV	Alarm Valve
AngV	Angle Valve
b	Bushing
BaV	Ball Valve
BFP	Backflow Preventer
BV	Butterfly Valve
C	Cross Flow Turn 90°
cplg	Coupling
Cr	Cross Run
CV	Check Valve
DeV	Deluge Valve
DPV	Dry Pipe Valve
E	90° Elbow
EE	45° Elbow
Ee1	11¼° Elbow
Ee2	22½° Elbow
f	Flow Device
fd	Flex Drop
FDC	Fire Department Connection
fE	90° FireLock(TM) Elbow
fEE	45° FireLock(TM) Elbow
flg	Flange
FN	Floating Node
fT	FireLock(TM) Tee
g	Gauge
GloV	Globe Valve
GV	Gate Valve
Ho	Hose
Hose	Hose
HV	Hose Valve
Hyd	Hydrant
LtE	Long Turn Elbow
mecT	Mechanical Tee
Noz	Nozzle
P1	Pump In
P2	Pump Out
PIV	Post Indicating Valve
PO	Pipe Outlet
PrV	Pressure Relief Valve
PRV	Pressure Reducing Valve
red	Reducer/Adapter
S	Supply
sCV	Swing Check Valve
SFx	Seismic Flex
Spr	Sprinkler
St	Strainer
T	Tee Flow Turn 90°
Tr	Tee Run
U	Union
WirF	Wirsbo
WMV	Water Meter Valve
Z	Cap





Hydraulic Overview

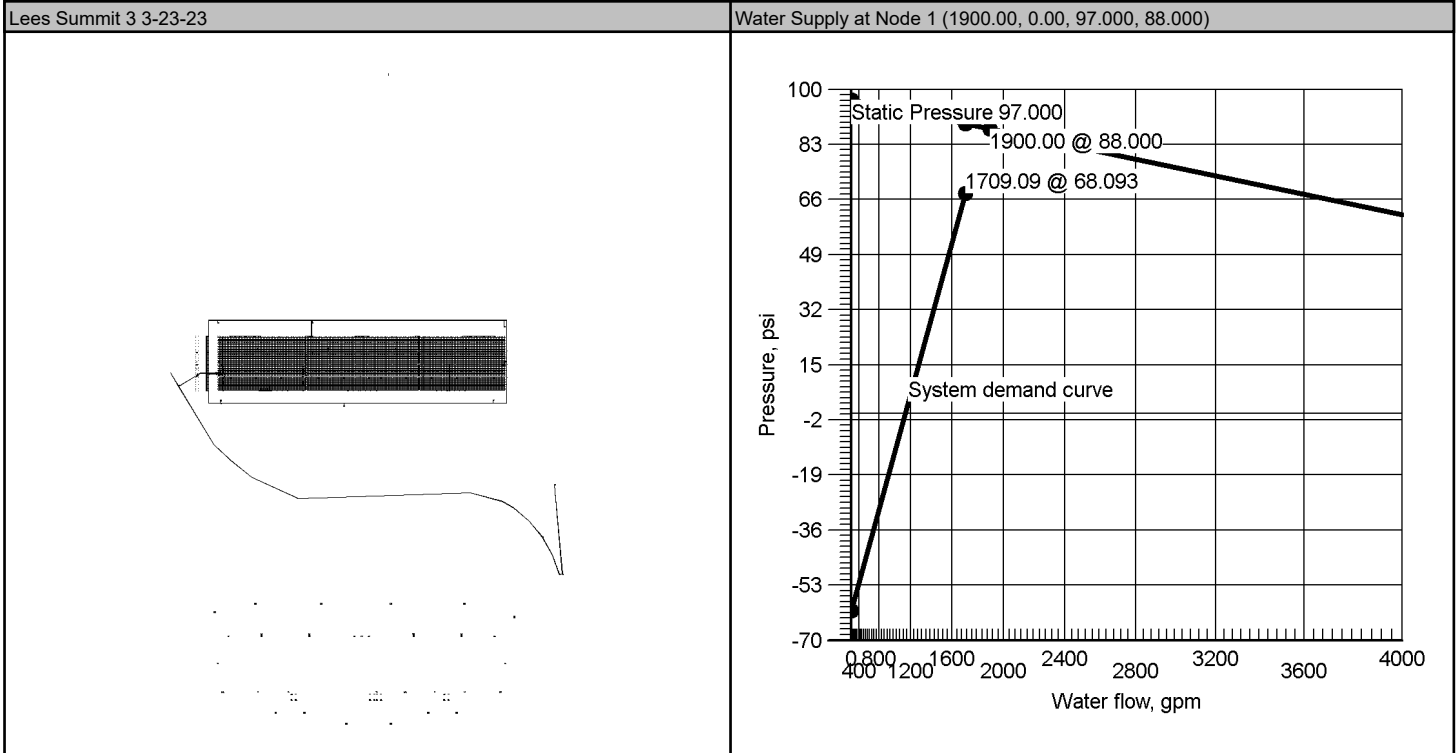
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone 913-827-8595
Address 1	NE Tudor Rd & Main St	FAX
Address 2	Lee's Summit, MO 64086	State Certification/License Number 149263
Address 3		AHJ Lee's Summit FM
		Job Site/Building Building C Lot 3

System	
Pressure	52.000
Area of Application	NA
Most Demanding Sprinkler Data	Hose Streams 250.00
16.80 K-Factor 121.15 at 52.000	
Coverage Per Sprinkler	Number Of Sprinklers Calculated 12 0
94 ft ²	
System Pressure Demand	System Flow Demand 1709.09
68.093	
Total Demand	Pressure Result +21.508 (24.0%)
1709.09 @ 68.093	

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	49.041	244.05	1709.09
25	Pump	1500.00		79.190	75.000				

Pumps: Static = Churn (Pressure @ Zero Flow)





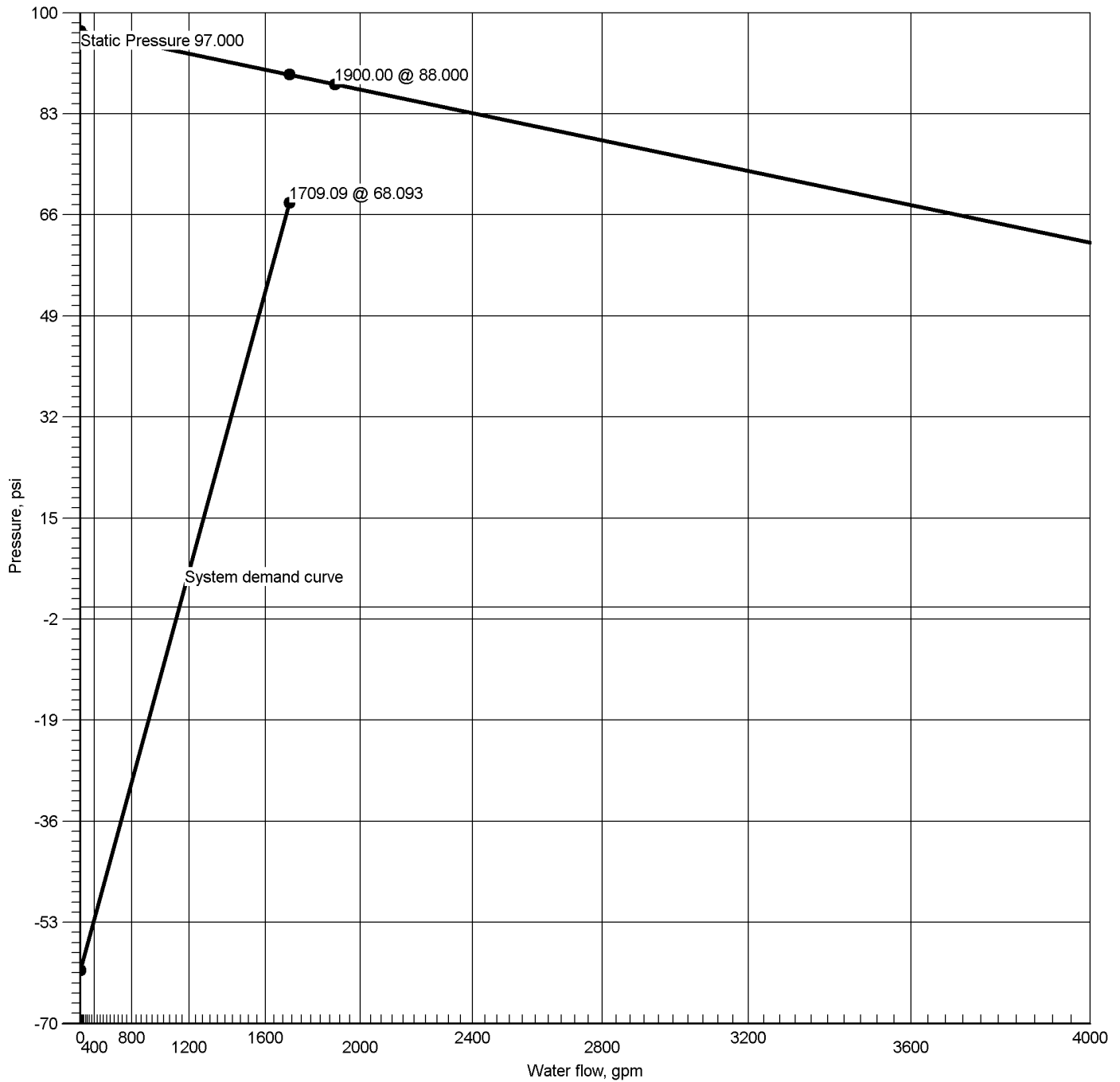
Hydraulic Summary

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Job											
Job Number 21224100					Designer Brock Browning						
Job Name: Lee's Summit					State Certification/License Number 149263						
Address 1 NE Tudor Rd & Main St					AHJ Lee's Summit FM						
Address 2 Lee's Summit, MO 64086					Job Site/Building Building C Lot 3						
Address 3					Drawing Name Lees Summit 3 3-23-23						
System					Remote Area(s)						
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000					Occupancy ESFR			Job Suffix Lees Summit 3			
Hose Allowance At Source 0.00					Pressure 52.000			Area of Application NA			
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u> Hydrant At Node 39 250.00					Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 94 ft²		
					AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 68.121 Right: 67.996						
Total Hose Streams 250.00											
System Flow Demand 1709.09			Total Water Required (Including Hose Allowance) 1709.09								
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.09 between nodes 54 and 53											
Maximum Velocity Under Ground 7.87 between nodes 6 and 7											
Volume capacity of Wet Pipes 34639.89 gal			Volume capacity of Dry Pipes								
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.601		1709.09	68.093	21.508
25	Pump		79.190	75.000		1500.00	143.935		1709.09	122.427	21.508
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number 1		Contact Name Brock Browning					Contact Title Designer				
Name of Contractor: F.E. Moran, Inc.		Phone 913-827-8595					Extension				
Address 1 16815 College Blvd		FAX 217-356-0777									
Address 2 Lenexa, KS		E-mail brock.browning@femoran.com									
Address 3 66219		Web-Site https://www.femoran.com/									



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

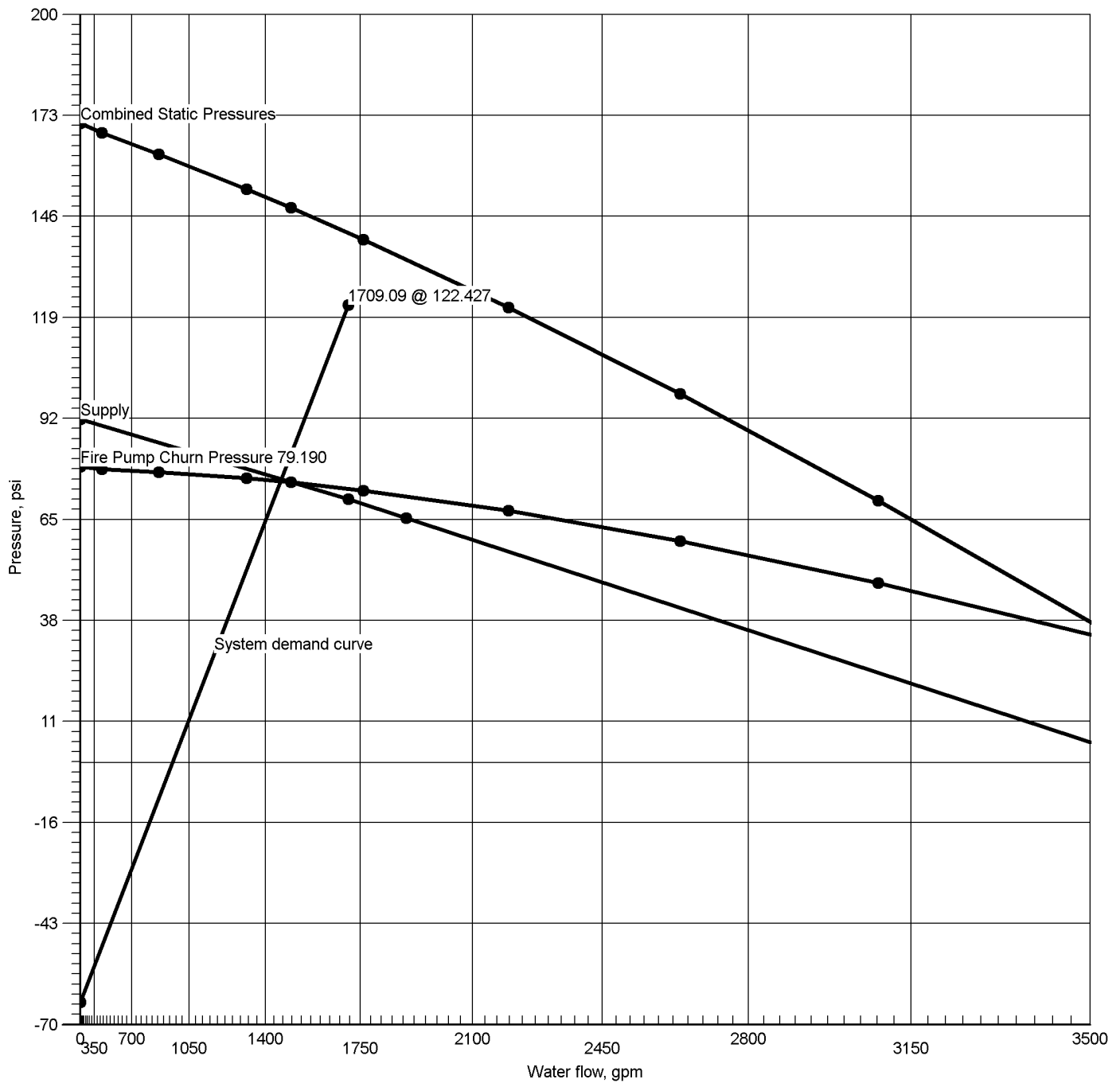
Available Pressure at System Demand
89.601 @ 1709.09

Required Pressure at System Demand
68.093 @ 1709.09

Required Pressure at System Demand (Including Hose Allowance at Source)
68.093 @ 1709.09



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.386 @ 1709.09

Available Pressure at System Demand

143.935 @ 1709.09

Required Pressure at System Demand

122.427 @ 1709.09



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	39	250.00	250.00	0.00	120.104			
⇒ Sprinkler	201	121.15	121.15	16.80	52.000			
Sprinkler	202	121.15	121.15	16.80	52.001			
Sprinkler	203	121.57	121.15	16.80	52.363			
Sprinkler	204	121.51	121.15	16.80	52.316			
Sprinkler	205	121.31	121.15	16.80	52.138			
Sprinkler	206	121.31	121.15	16.80	52.139			
Sprinkler	207	121.73	121.15	16.80	52.502			
Sprinkler	208	121.68	121.15	16.80	52.455			
Sprinkler	209	121.72	121.15	16.80	52.498			
Sprinkler	210	121.73	121.15	16.80	52.499			
Sprinkler	211	122.15	121.15	16.80	52.864			
Sprinkler	212	122.09	121.15	16.80	52.817			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	4.41	0.25	120		0.000079	9'-4½"	Pf 0.001
201	37'-2	121.15	16.80	52.000		Sprinkler		Pe
202	37'-2			52.001			9'-4½"	Pv
BL	2.7050	125.56	7.01	120		0.038627	9'-4½"	Pf 0.362
202	37'-2	121.15	16.80	52.001		Sprinkler		Pe
203	37'-2			52.363			9'-4½"	Pv
BL	2.7050	247.13	13.80	120		0.135180	152'-8½"	Pf 25.703
203	37'-2	121.57	16.80	52.363		Sprinkler,	37'-5¼"	Pe 0.350
45	36'-4¼"			78.416		2PO(18'-8½")	190'-1¼"	Pv
CM	4.3100	247.13	5.43	120		0.013985	9'-0"	Pf 0.126
45	36'-4¼"			78.416				Pe 0.076
46	36'-2¼"			78.618			9'-0"	Pv
CM	4.3100	494.59	10.88	120		0.050478	9'-0"	Pf 0.454
46	36'-2¼"	247.46		78.618		Flow (q) from Route 3		Pe 0.076
47	36'-0¼"			79.148			9'-0"	Pv
CM	4.3100	742.92	16.34	120		0.107150	9'-0"	Pf 0.965
47	36'-0¼"	248.33		79.148		Flow (q) from Route 5		Pe 0.076
48	35'-10			80.189			9'-0"	Pv
CM	4.3100	799.43	17.58	120		0.122714	9'-0"	Pf 1.105
48	35'-10	56.51		80.189		Flow (q) from Route 16		Pe 0.076
49	35'-8			81.370			9'-0"	Pv
CM	4.3100	858.78	18.88	120		0.140096	9'-0"	Pf 1.261
49	35'-8	59.35		81.370		Flow (q) from Route 17		Pe 0.076
50	35'-5¼"			82.707			9'-0"	Pv
CM	4.3100	923.08	20.30	120		0.160119	16'-2¼"	Pf 4.770
50	35'-5¼"	64.30		82.707		Flow (q) from Route 18	13'-7¼"	Pe 0.085
51	35'-3½"			87.562		2fE(6'-9½")	29'-9½"	Pv
CM	4.3100	1016.06	22.34	120		0.191228	10'-0"	Pf 1.913
51	35'-3½"	92.98		87.562		Flow (q) from Route 2		Pe 0.086
52	35'-1			89.561			10'-0"	Pv
CM	4.3100	1117.47	24.57	120		0.228026	2'-5¾"	Pf 4.212
52	35'-1	101.41		89.561		Flow (q) from Route 10	16'-0"	Pe 0.021
53	35'-0½"			93.794		fT(16'-0")	18'-5¾"	Pv
CM	4.3100	1459.09	32.09	120		0.373510	10'-2"	Pf 6.336
53	35'-0½"	341.62		93.794		Flow (q) from Route 9	6'-9½"	Pe 0.217
54	34'-6½"			100.347		fE(6'-9½")	16'-11½"	Pv
CM	6.3570	1459.09	14.75	120		0.056282	29'-5¾"	Pf 1.659
54	34'-6½"			100.347				Pe 12.779
55	5'-0¼"			114.785			29'-5¾"	Pv
FR	6.0650	1459.09	16.20	120		0.070765	1'-10¾"	Pf 4.946
55	5'-0¼"			114.785			68'-0"	Pe 1.121
56	2'-5¾"			120.851		CV(20'-0), BV(8'-0), f(10'-0), PO(30'-0)	69'-10¾"	Pv
CM	8.2490	1459.09	8.76	120		0.015825	3'-7"	Pf 0.057
56	2'-5¾"			120.851				Pe
24	2'-5¾"			120.908			3'-7"	Pv
DY	8.2490	1709.09	10.26	120		0.021203	0'-0"	Pf 1.519
24	2'-5¾"	250.00		120.908		Flow (q) from Route 7	71'-7¾"	Pe 0.000
25	2'-5¾"			122.427		BV(18'-9½), CV(52'-10¼)	71'-7¾"	Pv
Pump								
25		1709.09		122.427		Rating: 75.000 @ 1500.00		
26		Q=1709.09	6.49	49.041		Fire Pump Churn Pressure: 79.190		
CM	10.3700	1709.09	6.49	120		0.006957	1'-8¾"	Pf 0.464
26	2'-8¾"			49.041			65'-0"	Pe 0.752
8	1'-0"			50.257		GV(5'-11), T(59'-1¼)	66'-9"	Pv
UG	10.4000	1709.09	6.45	140		0.005158	13'-11"	Pf 0.253
8	1'-0"			50.257			35'-1"	Pe 2.384
7	-4'-6			52.895		E(35'-1)	48'-11¾"	Pv
UG	9.4200	1709.09	7.87	150		0.007351	72'-10"	Pf 0.626
7	-4'-6			52.895			12'-3½"	Pe
6	-4'-6			53.520		EE(12'-3½)	85'-1¼"	Pv
UG	10.4000	1709.09	6.45	140		0.005158	5'-11¼"	Pf 3.944
6	-4'-6			53.520				Pe
5	-4'-6			57.465		BFP(-3.914)	5'-11¼"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
UG	10.4000	1709.09	6.45	140		0.005158	5'-11¼"	Pf 0.031
5	-4'-6"			57.465				Pe
4	-4'-6"			57.495			5'-11¼"	Pv
UG	9.4200	1709.09	7.87	150		0.007351	204'-11½"	Pf 1.918
4	-4'-6"			57.495			55'-10¾"	Pe
3	-4'-6"			59.413		T(55'-10¾")	260'-10¾"	Pv
UG	11.2000	1709.09	5.57	150		0.003164	2459'-6"	Pf 8.242
3	-4'-6"			59.413			144'-11¾"	Pe
2	-4'-6"			67.655		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1709.09	4.50	140		0.002139	204'-11½"	Pf 0.438
2	-4'-6"			67.655				Pe
1	-4'-6"			68.093		Water Supply	204'-11½"	Pv
		0.00				Hose Allowance At Source		
1		1709.09						
Route 2								
BL	2.7050	116.73	6.52	120		0.033752	9'-4½"	Pf 0.316
201	37'-2"	121.15	16.80	52.000		Sprinkler		Pe
204	37'-2"			52.316			9'-4½"	Pv
BL	2.7050	238.25	13.30	120		0.126327	139'-7¼"	Pf 22.364
204	37'-2"	121.51	16.80	52.316		Sprinkler,	37'-5¼"	Pe 0.350
57	36'-4¼"			75.031		2PO(18'-8½")	177'-0½"	Pv
CM	4.3100	238.25	5.24	120		0.013069	9'-0"	Pf 0.118
57	36'-4¼"			75.031				Pe 0.076
58	36'-2¼"			75.225			9'-0"	Pv
CM	4.3100	476.81	10.49	120		0.047172	9'-0"	Pf 0.425
58	36'-2¼"	238.56		75.225		Flow (q) from Route 4		Pe 0.076
59	36'-0¼"			75.725			9'-0"	Pv
CM	4.3100	716.17	15.75	120		0.100122	9'-0"	Pf 0.901
59	36'-0¼"	239.36		75.725		Flow (q) from Route 6		Pe 0.076
60	35'-10"			76.703			9'-0"	Pv
CM	4.3100	659.66	14.51	120		0.085999	9'-0"	Pf 0.774
60	35'-10"			76.703				Pe 0.076
61	35'-8"			77.553			9'-0"	Pv
CM	4.3100	600.32	13.20	120		0.072236	9'-0"	Pf 0.650
61	35'-8"			77.553				Pe 0.076
62	35'-5¾"			78.280			9'-0"	Pv
CM	4.3100	536.01	11.79	120		0.058576	9'-10½"	Pf 0.579
62	35'-5¾"			78.280				Pe 0.085
63	35'-3½"			78.943			9'-10½"	Pv
RN	2.7050	92.98	5.19	120		0.022157	314'-1¼"	Pf 8.619
63	35'-3½"			78.943		PO(18'-8½")	74'-10½"	Pe
51	35'-3½"			87.562		3PO(18'-8½")	388'-11¾"	Pv
Route 3								
BL	2.7050	4.42	0.25	120		0.000079	9'-4½"	Pf 0.001
205	37'-0"	121.31	16.80	52.138		Sprinkler		Pe
206	37'-0"			52.139			9'-4½"	Pv
BL	2.7050	125.73	7.02	120		0.038721	9'-4½"	Pf 0.363
206	37'-0"	121.31	16.80	52.139		Sprinkler		Pe
207	37'-0"			52.502			9'-4½"	Pv
BL	2.7050	247.46	13.82	120		0.135512	152'-8½"	Pf 25.766
207	37'-0"	121.73	16.80	52.502		Sprinkler,	37'-5¼"	Pe 0.350
46	36'-2¼"			78.618		2PO(18'-8½")	190'-1¼"	Pv
Route 4								
BL	2.7050	116.89	6.53	120		0.033835	9'-4½"	Pf 0.317
205	37'-0"	121.31	16.80	52.138		Sprinkler		Pe
208	37'-0"			52.455			9'-4½"	Pv
BL	2.7050	238.56	13.32	120		0.126638	139'-7¼"	Pf 22.419
208	37'-0"	121.68	16.80	52.455		Sprinkler,	37'-5¼"	Pe 0.350
58	36'-2¼"			75.225		2PO(18'-8½")	177'-0½"	Pv
Route 5								
BL	2.7050	4.46	0.25	120		0.000080	9'-4½"	Pf 0.001
209	36'-9¾"	121.72	16.80	52.498		Sprinkler		Pe
210	36'-9¾"			52.499			9'-4½"	Pv
BL	2.7050	126.18	7.04	120		0.038981	9'-4½"	Pf 0.365
210	36'-9¾"	121.73	16.80	52.499		Sprinkler		Pe
211	36'-9¾"			52.864			9'-4½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	248.33	13.86	120		0.136398	152'-8½"	Pf 25.935
211	36'-9¾"	122.15	16.80	52.864		Sprinkler,	37'-5¼"	Pe 0.350
47	36'-0¼"			79.148		2PO(18'-8½")	190'-1¼"	Pv
Route 6								
BL	2.7050	117.27	6.55	120		0.034039	9'-4½"	Pf 0.319
209	36'-9¾"	121.72	16.80	52.498		Sprinkler		Pe
212	36'-9¾"			52.817			9'-4½"	Pv
BL	2.7050	239.36	13.36	120		0.127424	139'-7¼"	Pf 22.559
212	36'-9¾"	122.09	16.80	52.817		Sprinkler,	37'-5¼"	Pe 0.350
59	36'-0¼"			75.725		2PO(18'-8½")	177'-0"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	18'-4¼"	Pf 0.151
39	3'-6"	250.00		120.104		Hydrant,	67'-9½"	Pe 3.035
40	-3'-6"			123.290		E(21'-6¾"), PO(46'-2½")	86'-1½"	Pv
UG	7.6800	199.94	1.38	150		0.000375	164'-2¼"	Pf 0.087
40	-3'-6"			123.290			66'-4¼"	Pe
41	-3'-6"			123.376		E(22'-6½"), T(43'-10")	230'-6½"	Pv
UG	7.6800	250.00	1.73	150		0.000567	31'-8½"	Pf 0.018
41	-3'-6"	50.06		123.376		Flow (q) from Route 8		Pe 0.000
42	-3'-6"			123.394			31'-8½"	Pv
UG	8.3900	250.00	1.45	140		0.000419	12'-11"	Pf 0.018
42	-3'-6"			123.394			30'-6½"	Pe -1.951
43	1'-0"			121.462		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	250.00	1.50	120		0.000605	19'-9¾"	Pf 0.089
43	1'-0"			121.462			128'-0¼"	Pe -0.643
24	2'-5¾"			120.908		3fE(15'-3¼"), 2T(41'-1¼")	147'-10"	Pv
Route 8								
UG	7.6800	50.06	0.35	150		0.000029	2876'-4¼"	Pf 0.087
40	-3'-6"	199.94		123.290		Flow (q) from Route 7	111'-5¼"	Pe
41	-3'-6"			123.376		3E(22'-6½"), T(43'-10")	2987'-9½"	Pv
Route 9								
CM	4.3100	341.62	7.51	120		0.025457	13'-10¼"	Pf 1.106
70	34'-10¾"	114.97 + 226.66		92.753		Flow (q) from Route 11 and 12	29'-7¼"	Pe -0.065
53	35'-0½"			93.794		2fE(6'-9½"), fT(16'-0")	43'-5¼"	Pv
Route 10								
CM	4.3100	443.03	9.74	120		0.041177	10'-0"	Pf 0.412
63	35'-3½"	92.98		78.943		Flow (q) from Route 2		Pe 0.086
64	35'-1"			79.441			10'-0"	Pv
RN	2.7050	101.41	5.66	120		0.026016	314'-1¼"	Pf 10.120
64	35'-1"			79.441		PO(18'-8½")	74'-10½"	Pe
52	35'-1"			89.561		3PO(18'-8½")	388'-11¼"	Pv
Route 11								
CM	4.3100	341.62	7.51	120		0.025457	10'-0"	Pf 0.255
64	35'-1"	101.41		79.441		Flow (q) from Route 10		Pe 0.086
65	34'-10¾"			79.782			10'-0"	Pv
RN	2.7050	114.97	6.42	120		0.032813	320'-5"	Pf 12.971
65	34'-10¾"			79.782		PO(18'-8½")	74'-10½"	Pe
70	34'-10¾"			92.753		3PO(18'-8½")	395'-3½"	Pv
Route 12								
CM	4.3100	226.66	4.98	120		0.011917	10'-0"	Pf 0.119
69	34'-8¼"	112.84 + 113.82		92.720		Flow (q) from Route 13 and 15		Pe -0.086
70	34'-10¾"			92.753			10'-0"	Pv
Route 13								
CM	4.3100	112.84	2.48	120		0.003279	10'-0"	Pf 0.033
68	34'-6"	112.84		92.774		Flow (q) from Route 14		Pe -0.086
69	34'-8¼"			92.720			10'-0"	Pv
Route 14								
CM	4.3100	112.84	2.48	120		0.003279	10'-0"	Pf 0.033
66	34'-8¼"			79.988				Pe 0.086
67	34'-6"			80.107			10'-0"	Pv
RN	2.7050	112.84	6.30	120		0.031699	320'-5¼"	Pf 12.667
67	34'-6"			80.107		PO(18'-8½")	79'-2"	Pe
68	34'-6"			92.774		3PO(18'-8½"), Tr(4'-3½")	399'-7¼"	Pv
Route 15								
CM	4.3100	226.66	4.98	120		0.011917	10'-0"	Pf 0.119
65	34'-10¾"	114.97		79.782		Flow (q) from Route 11		Pe 0.086
66	34'-8¼"			79.988			10'-0"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
RN	2.7050	113.82	6.35	120		0.032210	320'-5"	Pf 12.733
66	34'-8 1/4"			79.988		PO(18'-8 1/2")	74'-10 1/2"	Pe
69	34'-8 1/4"			92.720		3PO(18'-8 1/2")	395'-3 1/2"	Pv
Route 16								
RN	2.7050	56.51	3.15	120		0.008819	320'-5"	Pf 3.486
60	35'-10"			76.703		PO(18'-8 1/2")	74'-10 1/2"	Pe -0.000
48	35'-10"			80.189		3PO(18'-8 1/2")	395'-3 1/2"	Pv
Route 17								
RN	2.7050	59.35	3.31	120		0.009655	320'-5"	Pf 3.817
61	35'-8"			77.553		PO(18'-8 1/2")	74'-10 1/2"	Pe -0.000
49	35'-8"			81.370		3PO(18'-8 1/2")	395'-3 1/2"	Pv
Route 18								
RN	2.7050	64.30	3.59	120		0.011201	320'-5"	Pf 4.428
62	35'-5 3/4"			78.280		PO(18'-8 1/2")	74'-10 1/2"	Pe
50	35'-5 3/4"			82.707		3PO(18'-8 1/2")	395'-3 1/2"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)				C Value Multiplier			
$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$				Value Of C	100	130	140
				Multiplying Factor	0.713	1.16	1.33
							150
							1.51

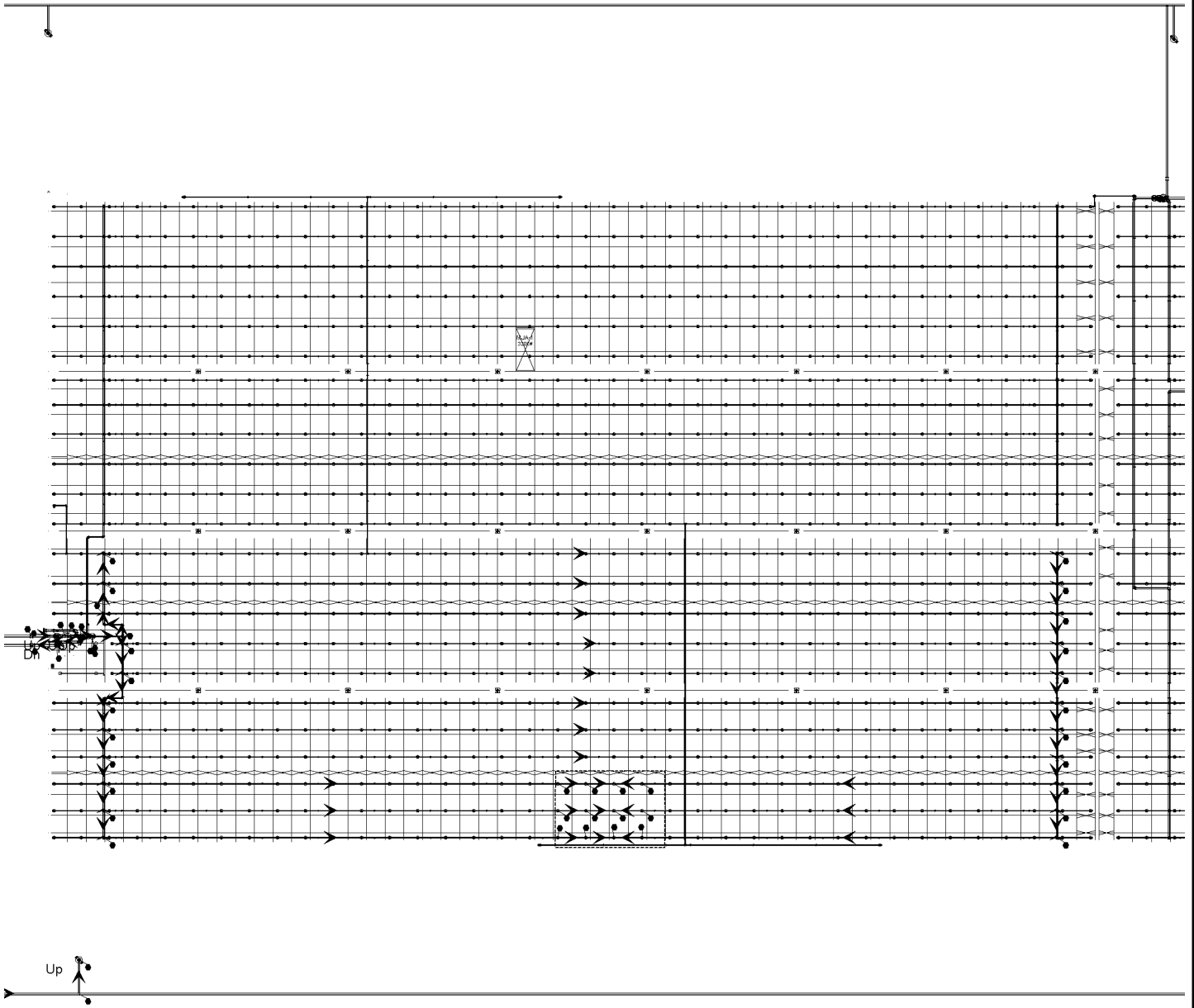


Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#2 - System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend	Units Legend		Fittings Legend	
AO Arm-Over	Diameter	Inch	ALV Alarm Valve	
BL Branch Line	Elevation	Foot	AngV Angle Valve	
CM Cross Main	Flow	gpm	b Bushing	
DN Drain	Discharge	gpm	BaV Ball Valve	
DR Drop	Velocity	fps	BFP Backflow Preventer	
DY Dynamic	Pressure	psi	BV Butterfly Valve	
FM Feed Main	Length	Foot	C Cross Flow Turn 90°	
FR Feed Riser	Friction Loss	psi/Foot	cplg Coupling	
MS Miscellaneous	HWC	Hazen-Williams Constant	Cr Cross Run	
OR Outrigger	Pt	Total pressure at a point in a pipe	CV Check Valve	
RN Riser Nipple	Pn	Normal pressure at a point in a pipe	DeV Deluge Valve	
SN Swing Nipple	Pf	Pressure loss due to friction between points	DPV Dry Pipe Valve	
SP Sprig	Pe	Pressure due to elevation difference between indicated points	E 90° Elbow	
ST Stand Pipe	Pv	Velocity pressure at a point in a pipe	EE 45° Elbow	
UG Underground			Ee1 11¼° Elbow	
			Ee2 22½° Elbow	
			f Flow Device	
			fd Flex Drop	
			FDC Fire Department Connection	
			fE 90° FireLock(TM) Elbow	
			fEE 45° FireLock(TM) Elbow	
			flg Flange	
			FN Floating Node	
			fT FireLock(TM) Tee	
			g Gauge	
			GloV Globe Valve	
			GV Gate Valve	
			Ho Hose	
			Hose Hose	
			HV Hose Valve	
			Hyd Hydrant	
			LtE Long Turn Elbow	
			mecT Mechanical Tee	
			Noz Nozzle	
			P1 Pump In	
			P2 Pump Out	
			PIV Post Indicating Valve	
			PO Pipe Outlet	
			PrV Pressure Relief Valve	
			PRV Pressure Reducing Valve	
			red Reducer/Adapter	
			S Supply	
			sCV Swing Check Valve	
			SFx Seismic Flex	
			Spr Sprinkler	
			St Strainer	
			T Tee Flow Turn 90°	
			Tr Tee Run	
			U Union	
			WirF Wirsbo	
			WMV Water Meter Valve	
			Z Cap	





Hydraulic Overview

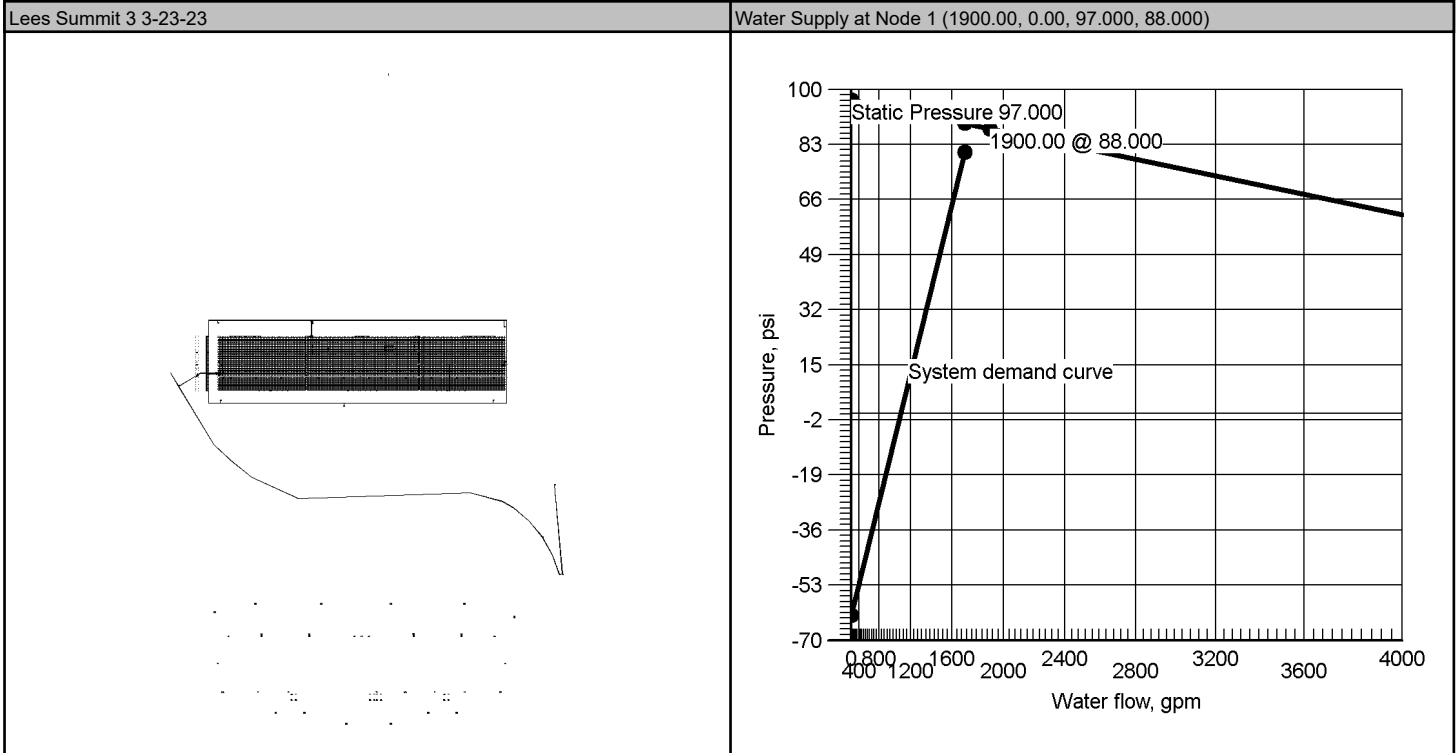
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone 913-827-8595
Address 1	NE Tudor Rd & Main St	FAX
Address 2	Lee's Summit, MO 64086	State Certification/License Number 149263
Address 3		AHJ Lee's Summit FM
		Job Site/Building Building C Lot 3

System	
Pressure	52.000
Area of Application	NA
Most Demanding Sprinkler Data	Hose Streams
16.80 K-Factor 121.15 at 52.000	250.00
Coverage Per Sprinkler	Number Of Sprinklers Calculated
94 ft ²	12 0
System Pressure Demand	System Flow Demand
80.862	1708.00
Total Demand	Pressure Result
1708.00 @ 80.862	+8.748 (9.8%)

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	61.827	217.22	1708.00
25	Pump	1500.00		79.190	75.000				

Pumps: Static = Churn (Pressure @ Zero Flow)





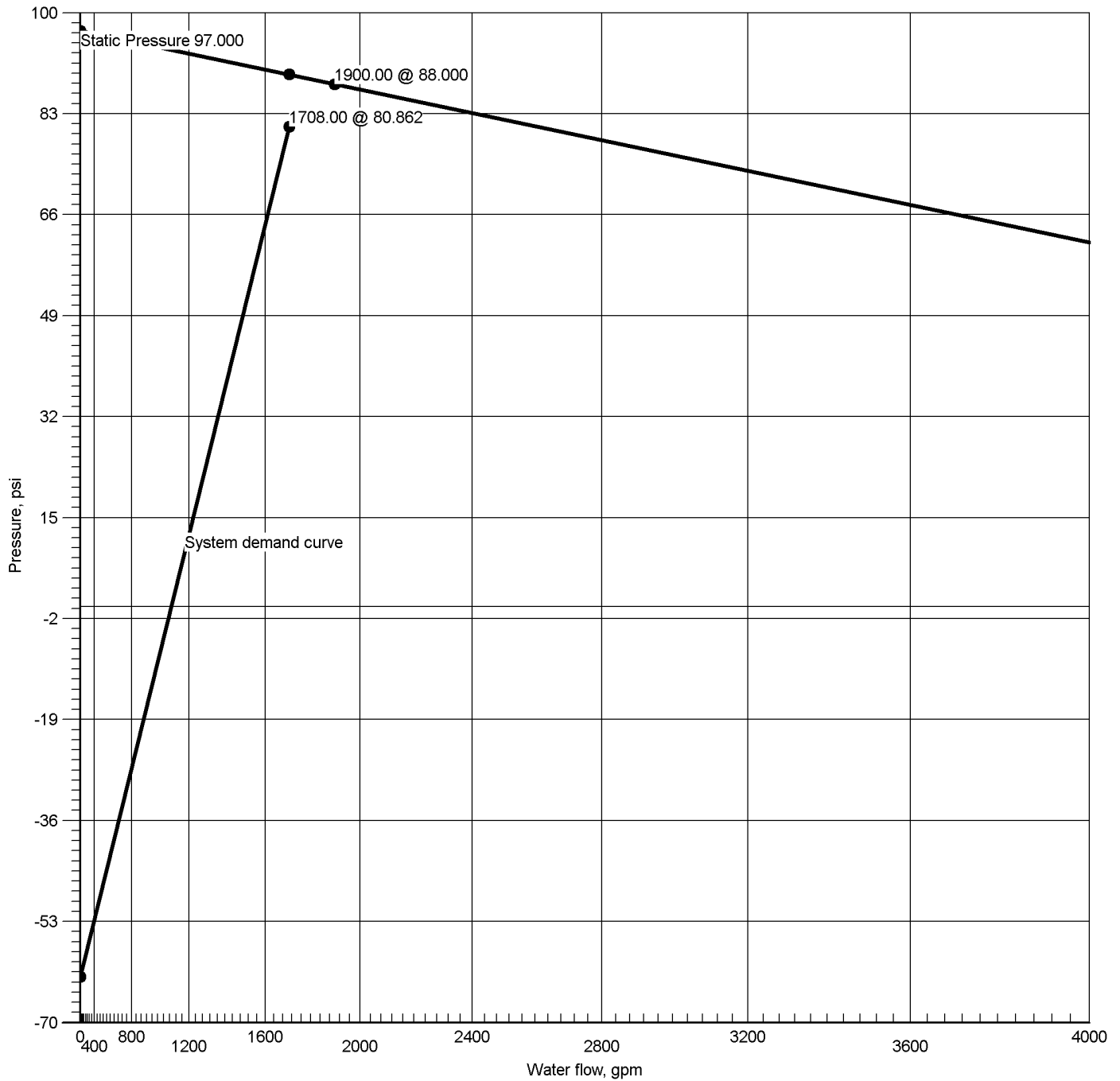
Hydraulic Summary

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Job											
Job Number 21224100				Designer Brock Browning							
Job Name: Lee's Summit				State Certification/License Number 149263							
Address 1 NE Tudor Rd & Main St				AHJ Lee's Summit FM							
Address 2 Lee's Summit, MO 64086				Job Site/Building Building C Lot 3							
Address 3				Drawing Name Lees Summit 3 3-23-23							
System				Remote Area(s)							
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000				Occupancy ESFR			Job Suffix Lees Summit 3				
Hose Allowance At Source 0.00				Pressure 52.000			Area of Application NA				
Additional Hose Supplies <u>Node</u> Hydrant At Node 87				Flow(gpm) 250.00		Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 94 ft ²	
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 81.067 Right: 80.613							
Total Hose Streams 250.00											
System Flow Demand 1708.00		Total Water Required (Including Hose Allowance) 1708.00									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 15.04 between nodes 86 and 85											
Maximum Velocity Under Ground 11.83 between nodes 42 and 41											
Volume capacity of Wet Pipes 34639.89 gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.610		1708.00	80.862	8.748
25	Pump		79.190	75.000		1500.00	143.970		1708.00	135.222	8.748
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number 1		Contact Name Brock Browning				Contact Title Designer					
Name of Contractor: F.E. Moran, Inc.		Phone 913-827-8595				Extension					
Address 1 16815 College Blvd		FAX 217-356-0777									
Address 2 Lenexa, KS		E-mail brock.browning@femoran.com									
Address 3 66219		Web-Site https://www.femoran.com/									



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

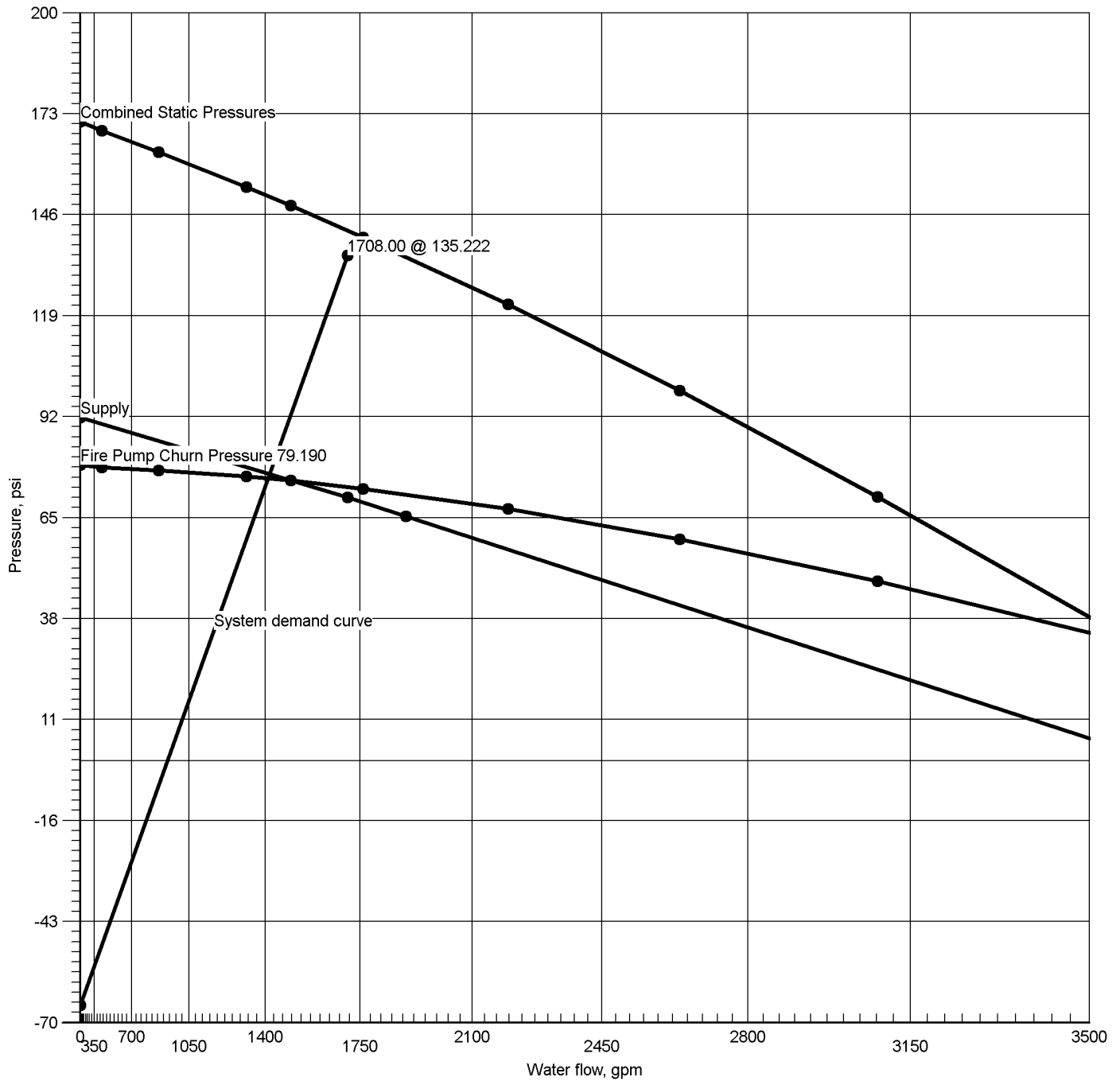
Available Pressure at System Demand
89.610 @ 1708.00

Required Pressure at System Demand
80.862 @ 1708.00

Required Pressure at System Demand (Including Hose Allowance at Source)
80.862 @ 1708.00



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.395 @ 1708.00

Available Pressure at System Demand

143.970 @ 1708.00

Required Pressure at System Demand

135.222 @ 1708.00



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	250.00	250.00	0.00	122.206			
⇒ Sprinkler	301	121.15	121.15	16.80	52.000			
Sprinkler	302	121.16	121.15	16.80	52.008			
Sprinkler	303	121.65	121.15	16.80	52.431			
Sprinkler	304	121.45	121.15	16.80	52.263			
Sprinkler	305	121.23	121.15	16.80	52.072			
Sprinkler	306	121.24	121.15	16.80	52.079			
Sprinkler	307	121.73	121.15	16.80	52.502			
Sprinkler	308	121.54	121.15	16.80	52.337			
Sprinkler	309	121.51	121.15	16.80	52.313			
Sprinkler	310	121.52	121.15	16.80	52.320			
Sprinkler	311	122.00	121.15	16.80	52.738			
Sprinkler	312	121.82	121.15	16.80	52.584			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	15.49	0.86	120		0.000805	9'-4½"	Pf 0.008
301	34'-1¼"	121.15	16.80	52.000		Sprinkler		Pe
302	34'-1¼"			52.008			9'-4½"	Pv
BL	2.7050	136.64	7.63	120		0.045169	9'-4½"	Pf 0.423
302	34'-1¼"	121.16	16.80	52.008		Sprinkler		Pe
303	34'-1¼"			52.431			9'-4½"	Pv
BL	2.7050	258.29	14.42	120		0.146691	293'-5¼"	Pf 48.536
303	34'-1¼"	121.65	16.80	52.431		Sprinkler,	37'-5¼"	Pe 0.388
71	33'-3"			101.355		2PO(18'-8½")	330'-10½"	Pv
CM	6.3570	258.29	2.61	120		0.002287	8'-0¼"	Pf 0.018
71	33'-3"			101.355				Pe 0.026
72	33'-2¼"			101.400			8'-0¼"	Pv
CM	6.3570	516.51	5.22	120		0.008241	10'-0"	Pf 0.082
72	33'-2¼"	258.22		101.400		Flow (q) from Route 3		Pe
73	33'-2¼"			101.482			10'-0"	Pv
CM	6.3570	774.28	7.83	120		0.017429	10'-0"	Pf 0.174
73	33'-2¼"	257.77		101.482		Flow (q) from Route 5		Pe
74	33'-2¼"			101.656			10'-0"	Pv
CM	6.3570	945.43	9.56	120		0.025219	10'-0"	Pf 0.252
74	33'-2¼"	171.15		101.656		Flow (q) from Route 2		Pe
75	33'-2¼"			101.909			10'-0"	Pv
CM	6.3570	1115.77	11.28	120		0.034263	10'-0"	Pf 0.343
75	33'-2¼"	170.35		101.909		Flow (q) from Route 9		Pe
76	33'-2¼"			102.251			10'-0"	Pv
CM	6.3570	1286.36	13.00	120		0.044580	10'-0"	Pf 0.446
76	33'-2¼"	170.59		102.251		Flow (q) from Route 10		Pe
77	33'-2¼"			102.697			10'-0"	Pv
CM	6.3570	1458.00	14.74	120		0.056204	33'-0"	Pf 3.541
77	33'-2¼"	171.64		102.697		Flow (q) from Route 11	30'-0"	Pe 12.004
336	5'-6"			118.243		3fE(10'-0")	63'-0"	Pv
CM	8.2490	1458.00	8.75	120		0.015803	30'-9½"	Pf 1.377
336	5'-6"			118.243			56'-4½"	Pe 1.933
80	1'-0½"			121.553		PO(41'-1¼"), fE(15'-3¼")	87'-2"	Pv
FR	8.4500	1458.00	8.34	140		0.010567	11'-0½"	Pf 0.358
80	1'-0½"			121.553			22'-10"	Pe 1.971
81	-3'-6"			123.881		LtE(22'-10")	33'-10½"	Pv
UG	7.6800	1458.00	10.10	150		0.014812	58'-0¼"	Pf 1.508
81	-3'-6"			123.881			43'-10"	Pe
82	-3'-6"			125.390		PO(43'-10")	101'-10"	Pv
UG	7.6800	1141.25	7.90	150		0.009415	625'-3¾"	Pf 6.512
82	-3'-6"			125.390			66'-4½"	Pe
41	-3'-6"			131.902		E(22'-6½"), T(43'-10")	691'-8¼"	Pv
UG	7.6800	1708.00	11.83	150		0.019850	31'-8½"	Pf 0.629
41	-3'-6"	566.75		131.902		Flow (q) from Route 7		Pe 0.000
42	-3'-6"			132.531			31'-8½"	Pv
UG	8.3900	1708.00	9.91	140		0.014662	12'-11"	Pf 0.637
42	-3'-6"			132.531			30'-6½"	Pe -1.951
43	1'-0"			131.217		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	1708.00	10.25	120		0.021178	19'-9¾"	Pf 4.648
43	1'-0"			131.217			199'-8"	Pe -0.643
25	2'-5¼"			135.222		3fE(15'-3¼"), 2T(41'-1¼"), BV(18'-9½"), CV(52'-10¼")	219'-5¾"	Pv
Pump								
25		1708.00	Velocity	135.222		Rating: 75.000 @ 1500.00		
26		Q=1708.00	6.49	61.827		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1708.00	6.49	120		0.006949	1'-8¾"	Pf 0.464
26	2'-8¾"			61.827			65'-0"	Pe 0.752
8	1'-0"			63.042		GV(5'-11"), T(59'-1¼")	66'-9"	Pv
UG	10.4000	1708.00	6.45	140		0.005152	13'-11"	Pf 0.252
8	1'-0"			63.042			35'-1"	Pe 2.384
7	-4'-6"			65.679		E(35'-1")	48'-11¾"	Pv
UG	9.4200	1708.00	7.86	150		0.007342	72'-10"	Pf 0.625
7	-4'-6"			65.679			12'-3¾"	Pe
6	-4'-6"			66.304		EE(12'-3¾")	85'-1¼"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
UG	10.4000	1708.00	6.45	140		0.005152	5'-11¼"	Pf 3.942
6	-4'-6"			66.304				Pe
5	-4'-6"			70.246		BFP(-3.911)	5'-11¼"	Pv
UG	10.4000	1708.00	6.45	140		0.005152	5'-11¼"	Pf 0.031
5	-4'-6"			70.246				Pe
4	-4'-6"			70.277			5'-11¼"	Pv
UG	9.4200	1708.00	7.86	150		0.007342	204'-11½"	Pf 1.915
4	-4'-6"			70.277			55'-10¾"	Pe
3	-4'-6"			72.192		T(55'-10¾")	260'-10¾"	Pv
UG	11.2000	1708.00	5.56	150		0.003161	2459'-6"	Pf 8.232
3	-4'-6"			72.192			144'-11¾"	Pe
2	-4'-6"			80.424		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1708.00	4.49	140		0.002137	204'-11½"	Pf 0.438
2	-4'-6"			80.424				Pe
1	-4'-6"			80.862		Water Supply	204'-11½"	Pv
		0.00				Hose Allowance At Source		
1		1708.00						
Route 2								
BL	2.7050	105.66	5.90	120		0.028068	9'-4½"	Pf 0.263
301	34'-1¾"	121.15	16.80	52.000		Sprinkler		Pe
304	34'-1¾"			52.263			9'-4½"	Pv
BL	2.7050	227.11	12.68	120		0.115621	87'-1¾"	Pf 14.404
304	34'-1¾"	121.45	16.80	52.263		Sprinkler,	37'-5¼"	Pe 0.350
83	33'-4"			67.017		2PO(18'-8½")	124'-7"	Pv
CM	4.3100	227.11	4.99	120		0.011962	8'-0¼"	Pf 0.096
83	33'-4"			67.017				Pe 0.026
84	33'-3¾"			67.139			8'-0¼"	Pv
CM	4.3100	454.63	10.00	120		0.043194	10'-0"	Pf 0.432
84	33'-3¾"	227.52		67.139		Flow (q) from Route 4		Pe
85	33'-3¾"			67.571			10'-0"	Pv
CM	4.3100	683.72	15.04	120		0.091891	10'-0"	Pf 0.919
85	33'-3¾"	229.09		67.571		Flow (q) from Route 6		Pe
86	33'-3¾"			68.489			10'-0"	Pv
RN	2.7050	171.15	9.55	120		0.068508	408'-8½"	Pf 33.129
86	33'-3¾"			68.489		PO(18'-8½")	74'-10½"	Pe 0.038
74	33'-2¼"			101.656		3PO(18'-8½")	483'-7"	Pv
Route 3								
BL	2.7050	15.25	0.85	120		0.000781	9'-4½"	Pf 0.007
305	34'-1"	121.23	16.80	52.072		Sprinkler		Pe
306	34'-1"			52.079			9'-4½"	Pv
BL	2.7050	136.49	7.62	120		0.045072	9'-4½"	Pf 0.423
306	34'-1"	121.24	16.80	52.079		Sprinkler		Pe
307	34'-1"			52.502			9'-4½"	Pv
BL	2.7050	258.22	14.42	120		0.146610	293'-5¼"	Pf 48.509
307	34'-1"	121.73	16.80	52.502		Sprinkler,	37'-5¼"	Pe 0.388
72	33'-2¼"			101.400		2PO(18'-8½")	330'-10½"	Pv
Route 4								
BL	2.7050	105.98	5.92	120		0.028229	9'-4½"	Pf 0.265
305	34'-1"	121.23	16.80	52.072		Sprinkler		Pe
308	34'-1"			52.337			9'-4½"	Pv
BL	2.7050	227.52	12.70	120		0.116009	87'-1¾"	Pf 14.452
308	34'-1"	121.54	16.80	52.337		Sprinkler,	37'-5¼"	Pe 0.350
84	33'-3¾"			67.139		2PO(18'-8½")	124'-7"	Pv
Route 5								
BL	2.7050	14.25	0.80	120		0.000689	9'-4½"	Pf 0.006
309	34'-1"	121.51	16.80	52.313		Sprinkler		Pe
310	34'-1"			52.320			9'-4½"	Pv
BL	2.7050	135.77	7.58	120		0.044635	9'-4½"	Pf 0.418
310	34'-1"	121.52	16.80	52.320		Sprinkler		Pe
311	34'-1"			52.738			9'-4½"	Pv
BL	2.7050	257.77	14.39	120		0.146144	293'-5¼"	Pf 48.355
311	34'-1"	122.00	16.80	52.738		Sprinkler,	37'-5¼"	Pe 0.388
73	33'-2¼"			101.482		2PO(18'-8½")	330'-10½"	Pv
Route 6								
BL	2.7050	107.26	5.99	120		0.028862	9'-4½"	Pf 0.271
309	34'-1"	121.51	16.80	52.313		Sprinkler		Pe
312	34'-1"			52.584			9'-4½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	229.09	12.79	120		0.117490	87'-1¼"	Pf 14.636
312	34'-1"	121.82	16.80	52.584		Sprinkler,	37'-5¼"	Pe 0.350
85	33'-3¼"			67.571		2PO(18'-8½")	124'-7"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	18'-4¼"	Pf 0.151
87	3'-6"	250.00		122.206		Hydrant,	67'-9½"	Pe 3.035
88	-3'-6"			125.392		E(21'-6¼"), PO(46'-2½")	86'-1½"	Pv
UG	7.6800	566.75	3.93	150		0.002579	2412'-10¼"	Pf 6.510
88	-3'-6"	316.75		125.392		Flow (q) from Route 8	111'-5¼"	Pe
41	-3'-6"			131.902		3E(22'-6½"), T(43'-10")	2524'-4"	Pv
Route 8								
UG	7.6800	316.75	2.19	150		0.000879	2'-3¼"	Pf 0.002
82	-3'-6"	1141.25		125.390		Flow (q) from Route 1		Pe
88	-3'-6"			125.392			2'-3¼"	Pv
Route 9								
CM	4.3100	512.57	11.27	120		0.053925	10'-0"	Pf 0.539
86	33'-3¼"	171.15		68.489		Flow (q) from Route 2		Pe
89	33'-3¼"			69.029			10'-0"	Pv
RN	2.7050	170.35	9.51	120		0.067914	408'-8½"	Pf 32.841
89	33'-3¼"			69.029		PO(18'-8½")	74'-10½"	Pe 0.038
75	33'-2¼"			101.909		3PO(18'-8½")	483'-7"	Pv
Route 10								
CM	4.3100	342.23	7.53	120		0.025540	10'-0"	Pf 0.255
89	33'-3¼"	170.35		69.029		Flow (q) from Route 9		Pe
90	33'-3¼"			69.284			10'-0"	Pv
RN	2.7050	170.59	9.52	120		0.068094	408'-8½"	Pf 32.929
90	33'-3¼"			69.284		PO(18'-8½")	74'-10½"	Pe 0.038
76	33'-2¼"			102.251		3PO(18'-8½")	483'-7"	Pv
Route 11								
CM	4.3100	171.64	3.77	120		0.007125	10'-0"	Pf 0.071
90	33'-3¼"	170.59		69.284		Flow (q) from Route 10		Pe
91	33'-3¼"			69.355			10'-0"	Pv
RN	2.7050	171.64	9.58	120		0.068869	408'-8½"	Pf 33.303
91	33'-3¼"			69.355		PO(18'-8½")	74'-10½"	Pe 0.038
77	33'-2¼"			102.697		3PO(18'-8½")	483'-7"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

C Value Multiplier

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

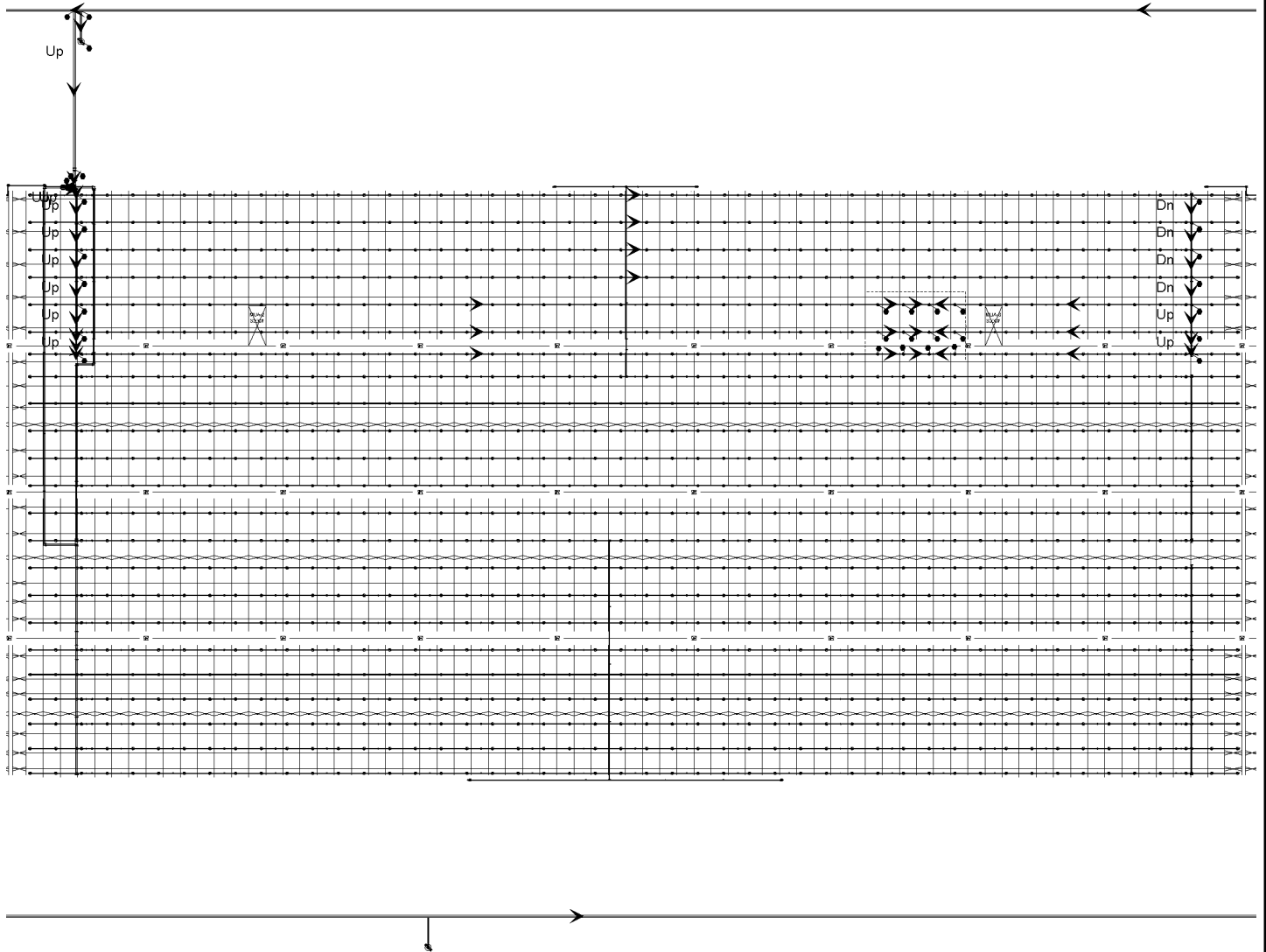


Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#3 - System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

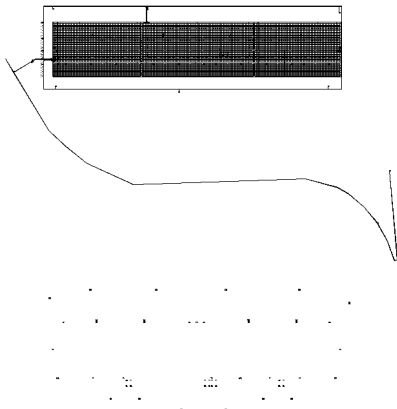
Pipe Type Legend	Units Legend		Fittings Legend	
AO Arm-Over	Diameter	Inch	ALV Alarm Valve	
BL Branch Line	Elevation	Foot	AngV Angle Valve	
CM Cross Main	Flow	gpm	b Bushing	
DN Drain	Discharge	gpm	BaV Ball Valve	
DR Drop	Velocity	fps	BFP Backflow Preventer	
DY Dynamic	Pressure	psi	BV Butterfly Valve	
FM Feed Main	Length	Foot	C Cross Flow Turn 90°	
FR Feed Riser	Friction Loss	psi/Foot	cplg Coupling	
MS Miscellaneous	HWC	Hazen-Williams Constant	Cr Cross Run	
OR Outrigger	Pt	Total pressure at a point in a pipe	CV Check Valve	
RN Riser Nipple	Pn	Normal pressure at a point in a pipe	DeV Deluge Valve	
SN Swing Nipple	Pf	Pressure loss due to friction between points	DPV Dry Pipe Valve	
SP Sprig	Pe	Pressure due to elevation difference between indicated points	E 90° Elbow	
ST Stand Pipe	Pv	Velocity pressure at a point in a pipe	EE 45° Elbow	
UG Underground			Ee1 11¼° Elbow	
			Ee2 22½° Elbow	
			f Flow Device	
			fd Flex Drop	
			FDC Fire Department Connection	
			fE 90° FireLock(TM) Elbow	
			fEE 45° FireLock(TM) Elbow	
			flg Flange	
			FN Floating Node	
			fT FireLock(TM) Tee	
			g Gauge	
			GloV Globe Valve	
			GV Gate Valve	
			Ho Hose	
			Hose Hose	
			HV Hose Valve	
			Hyd Hydrant	
			LtE Long Turn Elbow	
			mecT Mechanical Tee	
			Noz Nozzle	
			P1 Pump In	
			P2 Pump Out	
			PIV Post Indicating Valve	
			PO Pipe Outlet	
			PrV Pressure Relief Valve	
			PRV Pressure Reducing Valve	
			red Reducer/Adapter	
			S Supply	
			sCV Swing Check Valve	
			SFx Seismic Flex	
			Spr Sprinkler	
			St Strainer	
			T Tee Flow Turn 90°	
			Tr Tee Run	
			U Union	
			WirF Wirsbo	
			WMV Water Meter Valve	
			Z Cap	





Hydraulic Overview

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Job									
Job Number 21224100					Designer Brock Browning				
Job Name: Lee's Summit					Phone 913-827-8595			FAX	
Address 1 NE Tudor Rd & Main St					State Certification/License Number 149263				
Address 2 Lee's Summit, MO 64086					AHJ Lee's Summit FM				
Address 3					Job Site/Building Building C Lot 3				
System									
Pressure 52.000					Area of Application NA				
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000					Hose Streams 250.00				
Coverage Per Sprinkler 94ft ²					Number Of Sprinklers Calculated 12			Number Of Nozzles Calculated 0	
System Pressure Demand 84.046					System Flow Demand 1709.87				
Total Demand 1709.87 @ 84.046					Pressure Result +5.549 (6.2%)				
Supplies					Check Point Gauges				
<u>Node</u>	<u>Name</u>	<u>Flow(gpm)</u>	<u>Hose Flow(gpm)</u>	<u>Static(psi)</u>	<u>Residual(psi)</u>	<u>Identifier</u>	<u>Pressure(psi)</u>	<u>K-Factor(K)</u>	<u>Flow(gpm)</u>
1	Water Supply	1900.00		97.000	88.000	BOR (26)	64.983	212.11	1709.87
25	Pump	1500.00		79.190	75.000				
Pumps: Static = Churn (Pressure @ Zero Flow)									
Lees Summit 3 6-28-23					Water Supply at Node 1 (1900.00, 0.00, 97.000, 88.000)				
									



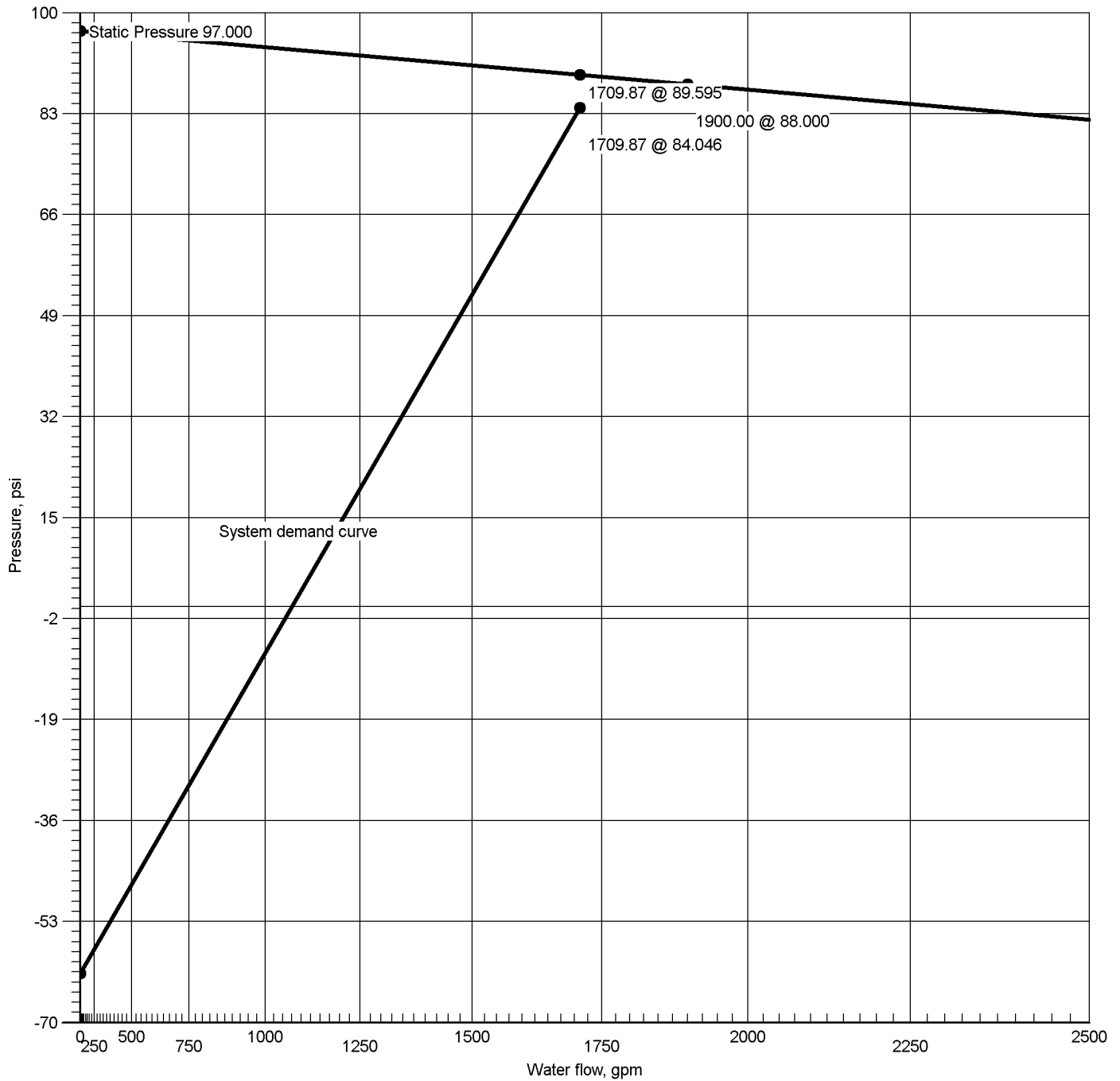
Hydraulic Summary

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Job											
Job Number 21224100				Designer Brock Browning							
Job Name: Lee's Summit				State Certification/License Number 149263							
Address 1 NE Tudor Rd & Main St				AHJ Lee's Summit FM							
Address 2 Lee's Summit, MO 64086				Job Site/Building Building C Lot 3							
Address 3				Drawing Name Lees Summit 3 6-28-23							
System				Remote Area(s)							
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000				Occupancy ESFR			Job Suffix Lees Summit 3				
Hose Allowance At Source 0.00				Pressure 52.000			Area of Application NA				
Additional Hose Supplies NodeFlow(gpm) Hydrant At Node 87250.00				Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 94ft²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 84.238Right: 83.811							
Total Hose Streams 250.00											
System Flow Demand 1709.87		Total Water Required (Including Hose Allowance) 1709.87									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 15.07 between nodes 115 and 114											
Maximum Velocity Under Ground 11.84 between nodes 42 and 41											
Volume capacity of Wet Pipes 34637.45gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.595		1709.87	84.046	5.549
25	Pump		79.190	75.000		1500.00	143.910		1709.87	138.362	5.549
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number 1		Contact Name Brock Browning				Contact Title Designer					
Name of Contractor: F.E. Moran, Inc.				Phone 913-827-8595				Extension			
Address 1 16815 College Blvd				FAX 217-356-0777							
Address 2 Lenexa, KS				E-mail brock.browning@femoran.com							
Address 3 66219				Web-Site https://www.femoran.com/							



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

Available Flow @ 20 PSI:
6055.75

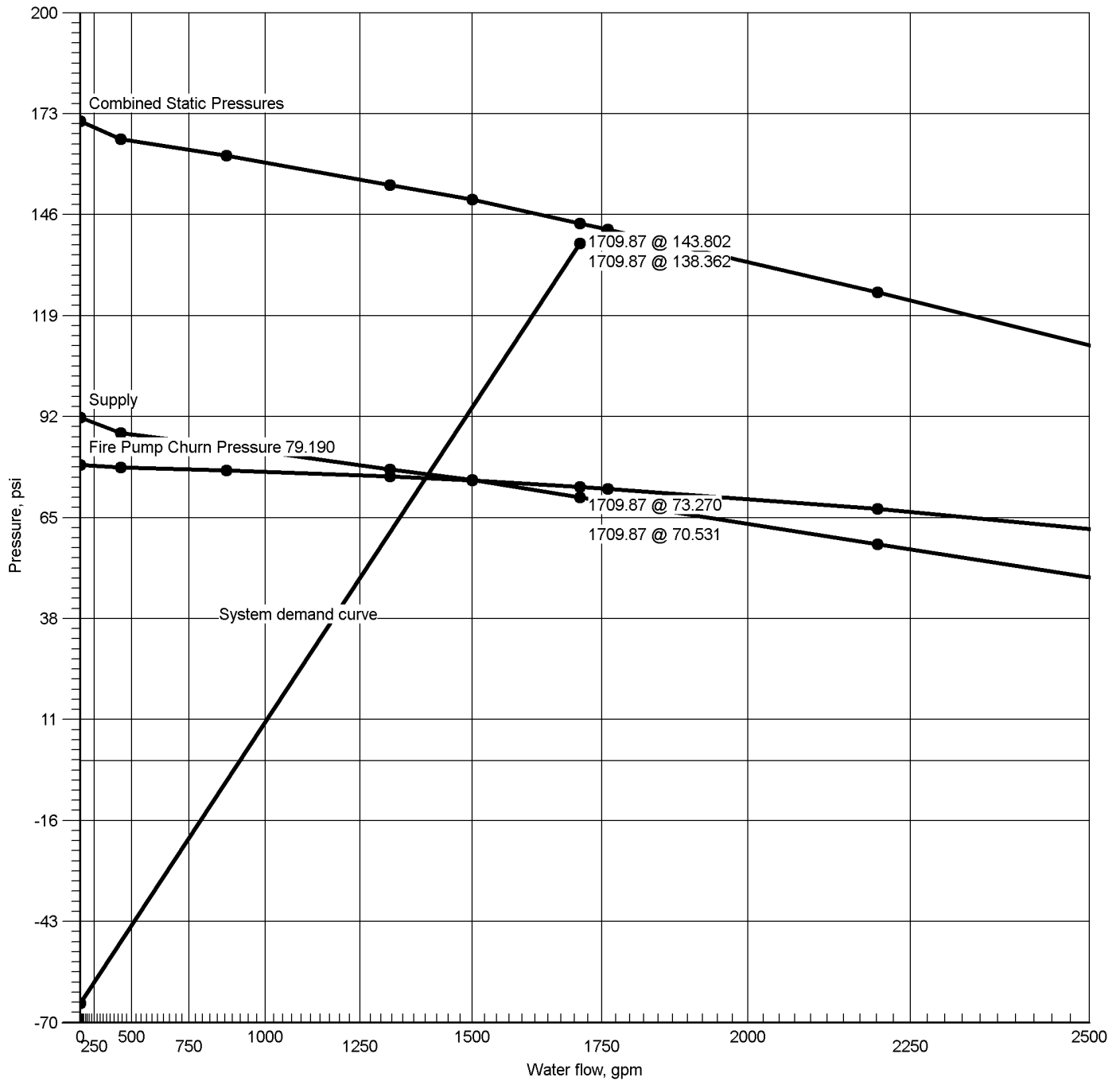
Available Pressure at System Demand
89.595 @ 1709.87

Required Pressure at System Demand
84.046 @ 1709.87

Required Pressure at System Demand (Including Hose Allowance at Source)
84.046 @ 1709.87



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual Pressure

73.379 @ 1709.87

Available Pressure at System Demand

143.910 @ 1709.87

Required Pressure at System Demand

138.362 @ 1709.87



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	250.00	250.00	0.00	125.321			
⇒ Sprinkler	401	121.15	121.15	16.80	52.000			
Sprinkler	402	121.15	121.15	16.80	52.007			
Sprinkler	403	121.64	121.15	16.80	52.425			
Sprinkler	404	121.46	121.15	16.80	52.267			
Sprinkler	405	121.43	121.15	16.80	52.242			
Sprinkler	406	121.44	121.15	16.80	52.249			
Sprinkler	407	121.93	121.15	16.80	52.674			
Sprinkler	408	121.74	121.15	16.80	52.507			
Sprinkler	409	121.78	121.15	16.80	52.546			
Sprinkler	410	121.79	121.15	16.80	52.553			
Sprinkler	411	122.27	121.15	16.80	52.973			
Sprinkler	412	122.10	121.15	16.80	52.818			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	14.55	0.81	120		0.000716	9'-4½"	Pf 0.007
401	35'-6"	121.15	16.80	52.000		Sprinkler		Pe
402	35'-6"			52.007			9'-4½"	Pv
BL	2.7050	135.70	7.58	120		0.044594	9'-4½"	Pf 0.418
402	35'-6"	121.15	16.80	52.007		Sprinkler		Pe
403	35'-6"			52.425			9'-4½"	Pv
BL	2.7050	257.34	14.37	120		0.145694	292'-6½"	Pf 48.702
403	35'-6"	121.64	16.80	52.425		Sprinkler,	41'-8¾"	Pe
92	34'-7¼"			101.127		Tr(4'-3½"), 2PO(18'-8½")	334'-3¼"	Pv
CM	6.3570	257.34	2.60	120		0.002271	10'-0"	Pf 0.023
92	34'-7¼"			101.127				Pe 0.086
93	34'-4¾"			101.236			10'-0"	Pv
CM	6.3570	516.09	5.22	120		0.008229	10'-0"	Pf 0.082
93	34'-4¾"	258.75		101.236		Flow (q) from Route 3		Pe 0.086
94	34'-2½"			101.405			10'-0"	Pv
CM	6.3570	774.46	7.83	120		0.017437	10'-0"	Pf 0.174
94	34'-2½"	258.37		101.405		Flow (q) from Route 5		Pe 0.086
95	34'-0"			101.665			10'-0"	Pv
CM	6.3570	946.24	9.57	120		0.025259	10'-0"	Pf 0.253
95	34'-0"	171.79		101.665		Flow (q) from Route 2		Pe 0.086
96	33'-9¾"			102.004			10'-0"	Pv
CM	6.3570	1117.22	11.29	120		0.034346	10'-0"	Pf 0.344
96	33'-9¾"	170.98		102.004		Flow (q) from Route 9		Pe 0.086
97	33'-7¼"			102.434			10'-0"	Pv
CM	6.3570	1288.44	13.02	120		0.044713	9'-9"	Pf 0.436
97	33'-7¼"	171.22		102.434		Flow (q) from Route 10		Pe 0.084
2123	33'-5"			102.954			9'-9"	Pv
CM	6.3570	1459.87	14.76	120		0.056337	74'-8"	Pf 5.333
2123	33'-5"	171.42		102.954		Flow (q) from Route 11	20'-0"	Pe 0.097
345	33'-2¼"			108.385		2fE(10'-0")	94'-8"	Pv
CM	8.2490	1459.87	8.76	120		0.015840	65'-5"	Pf 2.341
345	33'-2¼"			108.385			82'-4½"	Pe 13.937
80	1'-0½"			124.663		2fE(13'-0"), PO(41'-1¼"), fE(15'-3¼")	147'-9½"	Pv
FR	8.4500	1459.87	8.35	140		0.010592	11'-0½"	Pf 0.359
80	1'-0½"			124.663			22'-10"	Pe 1.971
81	-3'-6"			126.992		LtE(22'-10")	33'-10½"	Pv
UG	7.6800	1459.87	10.11	150		0.014847	58'-0¼"	Pf 1.512
81	-3'-6"			126.992			43'-10"	Pe
82	-3'-6"			128.504		PO(43'-10")	101'-10"	Pv
UG	7.6800	1142.49	7.91	150		0.009434	625'-3¾"	Pf 6.525
82	-3'-6"			128.504			66'-4½"	Pe 0.000
41	-3'-6"			135.030		E(22'-6½"), T(43'-10")	691'-8¾"	Pv
UG	7.6800	1709.87	11.84	150		0.019890	31'-8½"	Pf 0.631
41	-3'-6"	567.37		135.030		Flow (q) from Route 7		Pe
42	-3'-6"			135.660			31'-8½"	Pv
UG	8.3900	1709.87	9.92	140		0.014691	12'-11"	Pf 0.638
42	-3'-6"			135.660			30'-6½"	Pe -1.951
43	1'-0"			134.348		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	1709.87	10.26	120		0.021221	19'-9¾"	Pf 4.658
43	1'-0"			134.348			199'-8"	Pe -0.643
25	2'-5¾"			138.362		3fE(15'-3¼"), 2T(41'-1¼"), BV(18'-9½"), CV(52'-10¼")	219'-5¾"	Pv
Pump								
25		1709.87		138.362		Rating: 75.000 @ 1500.00		
26		Q=1709.87	6.50	64.983		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1709.87	6.50	120		0.006963	1'-8¾"	Pf 0.465
26	2'-8¾"			64.983			65'-0"	Pe 0.752
8	1'-0"			66.199		GV(5'-11"), T(59'-1¼")	66'-9"	Pv
UG	10.4000	1709.87	6.46	140		0.005162	13'-11"	Pf 0.253
8	1'-0"			66.199			35'-1"	Pe 2.384
7	-4'-6"			68.837		E(35'-1")	48'-11¾"	Pv
UG	9.4200	1709.87	7.87	150		0.007357	72'-10"	Pf 0.626
7	-4'-6"			68.837			12'-3½"	Pe
6	-4'-6"			69.463		EE(12'-3½")	85'-1¼"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
UG	10.4000	1709.87	6.46	140		0.005162	5'-11¼"	Pf 3.946
6	-4'-6"			69.463				Pe
5	-4'-6"			73.409		BFP(-3.915)	5'-11¼"	Pv
UG	10.4000	1709.87	6.46	140		0.005162	5'-11¼"	Pf 0.031
5	-4'-6"			73.409				Pe
4	-4'-6"			73.440			5'-11¼"	Pv
UG	9.4200	1709.87	7.87	150		0.007357	204'-11½"	Pf 1.919
4	-4'-6"			73.440			55'-10¾"	Pe
3	-4'-6"			75.359		T(55'-10¾")	260'-10¾"	Pv
UG	11.2000	1709.87	5.57	150		0.003167	2459'-6"	Pf 8.249
3	-4'-6"			75.359			144'-11¾"	Pe
2	-4'-6"			83.608		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1709.87	4.50	140		0.002141	204'-11½"	Pf 0.439
2	-4'-6"			83.608				Pe
1	-4'-6"			84.046		Water Supply	204'-11½"	Pv
		0.00				Hose Allowance At Source		
1		1709.87						
Route 2								
BL	2.7050	106.60	5.95	120		0.028533	9'-4½"	Pf 0.267
401	35'-6"	121.15	16.80	52.000		Sprinkler		Pe
404	35'-6"			52.267			9'-4½"	Pv
BL	2.7050	228.06	12.73	120		0.116515	86'-4"	Pf 14.421
404	35'-6"	121.46	16.80	52.267		Sprinkler,	37'-5¼"	Pe
100	34'-8¾"			66.688		2PO(18'-8½")	123'-9¾"	Pv
CM	4.3100	228.06	5.02	120		0.012054	10'-0"	Pf 0.121
100	34'-8¾"			66.688				Pe 0.086
113	34'-6"			66.895			10'-0"	Pv
CM	4.3100	455.84	10.02	120		0.043406	10'-0"	Pf 0.434
113	34'-6"	227.78		66.895		Flow (q) from Route 4		Pe 0.086
114	34'-3½"			67.416			10'-0"	Pv
CM	4.3100	685.41	15.07	120		0.092312	10'-0"	Pf 0.923
114	34'-3½"	229.57		67.416		Flow (q) from Route 6		Pe 0.086
115	34'-1"			68.426			10'-0"	Pv
RN	2.7050	171.79	9.59	120		0.068981	407'-0"	Pf 33.240
115	34'-1"			68.426		PO(18'-8½")	74'-10½"	Pe
95	34'-0"			101.665		3PO(18'-8½")	481'-10½"	Pv
Route 3								
BL	2.7050	15.38	0.86	120		0.000794	9'-4½"	Pf 0.007
405	35'-3½"	121.43	16.80	52.242		Sprinkler		Pe
406	35'-3½"			52.249			9'-4½"	Pv
BL	2.7050	136.82	7.64	120		0.045275	9'-4½"	Pf 0.424
406	35'-3½"	121.44	16.80	52.249		Sprinkler		Pe
407	35'-3½"			52.674			9'-4½"	Pv
BL	2.7050	258.75	14.45	120		0.147169	292'-6½"	Pf 48.562
407	35'-3½"	121.93	16.80	52.674		Sprinkler,	37'-5¼"	Pe
93	34'-4¾"			101.236		2PO(18'-8½")	329'-11¼"	Pv
Route 4								
BL	2.7050	106.05	5.92	120		0.028260	9'-4½"	Pf 0.265
405	35'-3½"	121.43	16.80	52.242		Sprinkler		Pe
408	35'-3½"			52.507			9'-4½"	Pv
BL	2.7050	227.78	12.72	120		0.116255	86'-4"	Pf 14.389
408	35'-3½"	121.74	16.80	52.507		Sprinkler,	37'-5¼"	Pe
113	34'-6"			66.895		2PO(18'-8½")	123'-9¾"	Pv
Route 5								
BL	2.7050	14.31	0.80	120		0.000695	9'-4½"	Pf 0.007
409	35'-1¼"	121.78	16.80	52.546		Sprinkler		Pe
410	35'-1¼"			52.553			9'-4½"	Pv
BL	2.7050	136.10	7.60	120		0.044834	9'-4½"	Pf 0.420
410	35'-1¼"	121.79	16.80	52.553		Sprinkler		Pe
411	35'-1¼"			52.973			9'-4½"	Pv
BL	2.7050	258.37	14.42	120		0.146773	292'-6½"	Pf 48.432
411	35'-1¼"	122.27	16.80	52.973		Sprinkler,	37'-5¼"	Pe
94	34'-2½"			101.405		2PO(18'-8½")	329'-11¼"	Pv
Route 6								
BL	2.7050	107.47	6.00	120		0.028968	9'-4½"	Pf 0.272
409	35'-1¼"	121.78	16.80	52.546		Sprinkler		Pe
412	35'-1¼"			52.818			9'-4½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	229.57	12.82	120		0.117948	86'-4"	Pf 14.598
412	35'-1¼"	122.10	16.80	52.818		Sprinkler,	37'-5½"	Pe
114	34'-3½"			67.416		2PO(18'-8½")	123'-9¼"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	18'-4¼"	Pf 0.151
87	3'-6"	250.00		125.321		Hydrant,	67'-9½"	Pe 3.035
88	-3'-6"			128.506		E(21'-6¼"), PO(46'-2½")	86'-1½"	Pv
UG	7.6800	567.37	3.93	150		0.002584	2412'-10¾"	Pf 6.523
88	-3'-6"	317.37		128.506		Flow (q) from Route 8	111'-5¼"	Pe 0.000
41	-3'-6"			135.030		3E(22'-6½"), T(43'-10")	2524'-4"	Pv
Route 8								
UG	7.6800	317.37	2.20	150		0.000882	2'-3¾"	Pf 0.002
82	-3'-6"	1142.49		128.504		Flow (q) from Route 1		Pe
88	-3'-6"			128.506			2'-3¾"	Pv
Route 9								
CM	4.3100	513.62	11.29	120		0.054130	10'-0"	Pf 0.541
115	34'-1"	171.79		68.426		Flow (q) from Route 2		Pe 0.086
116	33'-10¾"			69.053			10'-0"	Pv
RN	2.7050	170.98	9.55	120		0.068381	407'-0"	Pf 32.951
116	33'-10¾"			69.053		PO(18'-8½")	74'-10½"	Pe
96	33'-9¾"			102.004		3PO(18'-8½")	481'-10½"	Pv
Route 10								
CM	4.3100	342.65	7.53	120		0.025598	10'-0"	Pf 0.256
116	33'-10¾"	170.98		69.053		Flow (q) from Route 9		Pe 0.086
117	33'-8¾"			69.396			10'-0"	Pv
RN	2.7050	171.22	9.56	120		0.068563	407'-0"	Pf 33.039
117	33'-8¾"			69.396		PO(18'-8½")	74'-10½"	Pe
97	33'-7¾"			102.434		3PO(18'-8½")	481'-10½"	Pv
Route 11								
CM	4.3100	171.42	3.77	120		0.007108	9'-9"	Pf 0.069
117	33'-8¾"	171.22		69.396		Flow (q) from Route 10		Pe 0.084
2120	33'-6"			69.549			9'-9"	Pv
RN	2.7050	171.42	9.57	120		0.068711	407'-0"	Pf 33.405
2120	33'-6"			69.549		PO(18'-8½")	79'-2"	Pe
2123	33'-5"			102.954		3PO(18'-8½"), Tr(4'-3½")	486'-2"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

C Value Multiplier

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

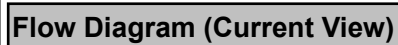


Hydraulic Analysis

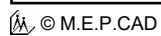
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend		Units Legend		Fittings Legend	
AO	Arm-Over	Diameter	Inch	ALV	Alarm Valve
BL	Branch Line	Elevation	Foot	AngV	Angle Valve
CM	Cross Main	Flow	gpm	b	Bushing
DN	Drain	Discharge	gpm	BaV	Ball Valve
DR	Drop	Velocity	fps	BFP	Backflow Preventer
DY	Dynamic	Pressure	psi	BV	Butterfly Valve
FM	Feed Main	Length	Foot	C	Cross Flow Turn 90°
FR	Feed Riser	Friction Loss	psi/Foot	cplg	Coupling
MS	Miscellaneous	HWC	Hazen-Williams Constant	Cr	Cross Run
OR	Outrigger	Pt	Total pressure at a point in a pipe	CV	Check Valve
RN	Riser Nipple	Pn	Normal pressure at a point in a pipe	DeV	Deluge Valve
SN	Swing Nipple	Pf	Pressure loss due to friction between points	DPV	Dry Pipe Valve
SP	Sprig	Pe	Pressure due to elevation difference between indicated points	E	90° Elbow
ST	Stand Pipe	Pv	Velocity pressure at a point in a pipe	EE	45° Elbow
UG	Underground			Ee1	11¼° Elbow
				Ee2	22½° Elbow
				f	Flow Device
				fd	Flex Drop
				FDC	Fire Department Connection
				fE	90° FireLock(TM) Elbow
				fEE	45° FireLock(TM) Elbow
				flg	Flange
				FN	Floating Node
				fT	FireLock(TM) Tee
				g	Gauge
				GloV	Globe Valve
				GV	Gate Valve
				Ho	Hose
				Hose	Hose
				HV	Hose Valve
				Hyd	Hydrant
				LtE	Long Turn Elbow
				mecT	Mechanical Tee
				Noz	Nozzle
				P1	Pump In
				P2	Pump Out
				PIV	Post Indicating Valve
				PO	Pipe Outlet
				PrV	Pressure Relief Valve
				PRV	Pressure Reducing Valve
				red	Reducer/Adapter
				S	Supply
				sCV	Swing Check Valve
				SFx	Seismic Flex
				Spr	Sprinkler
				St	Strainer
				T	Tee Flow Turn 90°
				Tr	Tee Run
				U	Union
				WirF	Wirsbo
				WMV	Water Meter Valve
				Z	Cap



Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#4 - System 4)





Hydraulic Overview

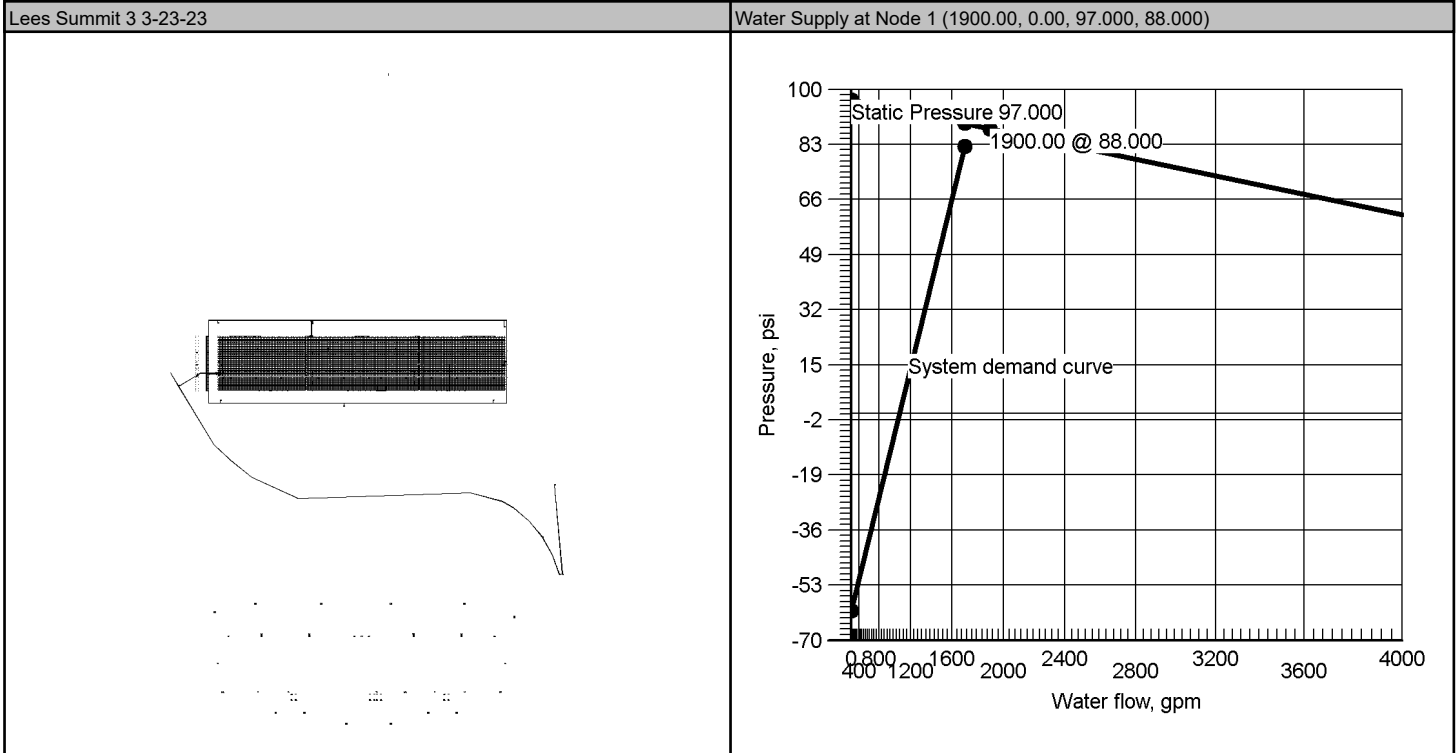
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone 913-827-8595
Address 1	NE Tudor Rd & Main St	FAX
Address 2	Lee's Summit, MO 64086	State Certification/License Number 149263
Address 3		AHJ Lee's Summit FM
		Job Site/Building Building C Lot 3

System	
Pressure	Area of Application
52.000	NA
Most Demanding Sprinkler Data	Hose Streams
16.80 K-Factor 121.15 at 52.000	250.00
Coverage Per Sprinkler	Number Of Sprinklers Calculated
94 ft ²	12 0
System Pressure Demand	System Flow Demand
82.643	1708.38
Total Demand	Pressure Result
1708.38 @ 82.643	+6.964 (7.8%)

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	63.602	214.21	1708.38
25	Pump	1500.00		79.190	75.000				

Pumps: Static = Churn (Pressure @ Zero Flow)



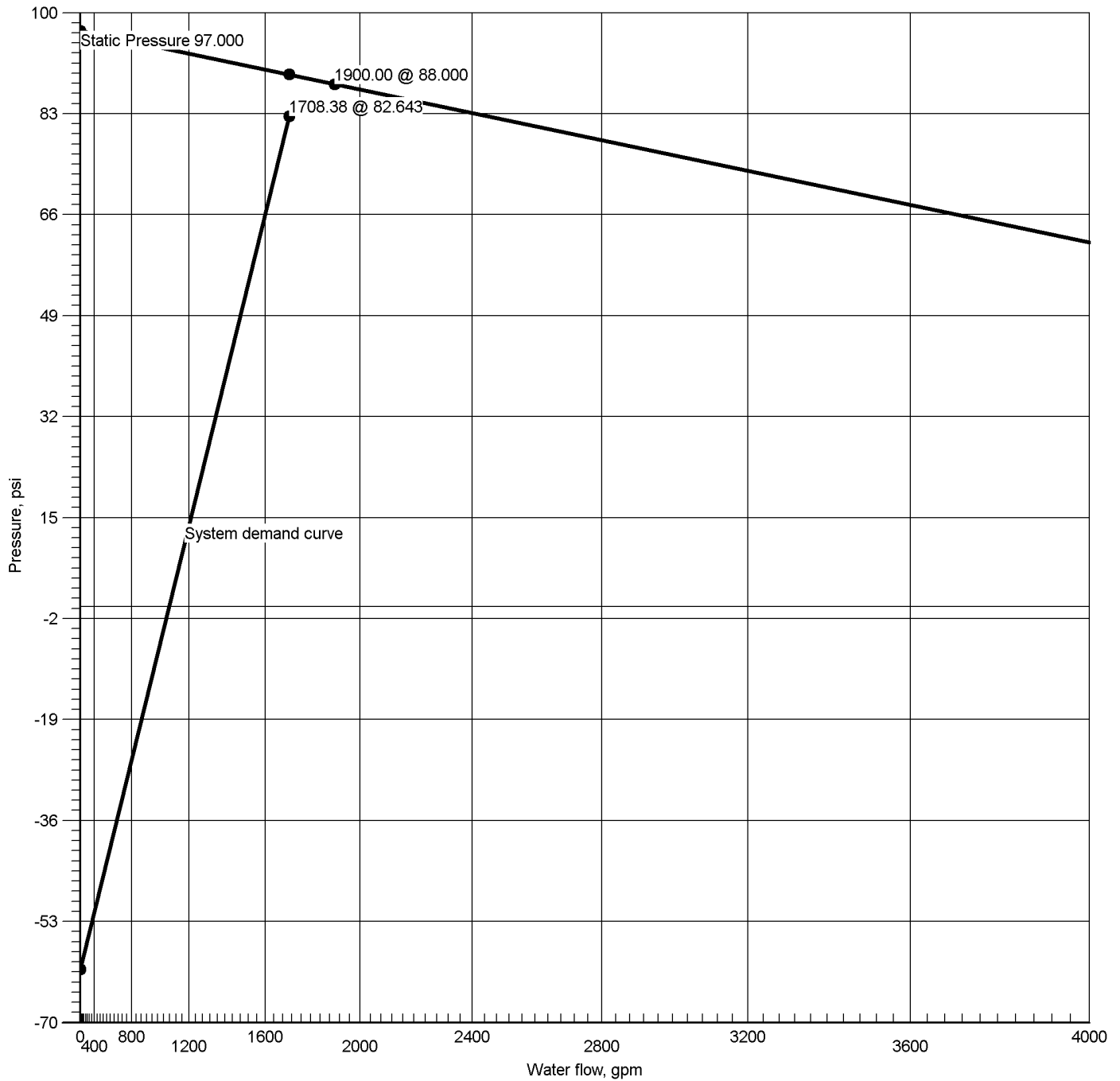


Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

[illegible]



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

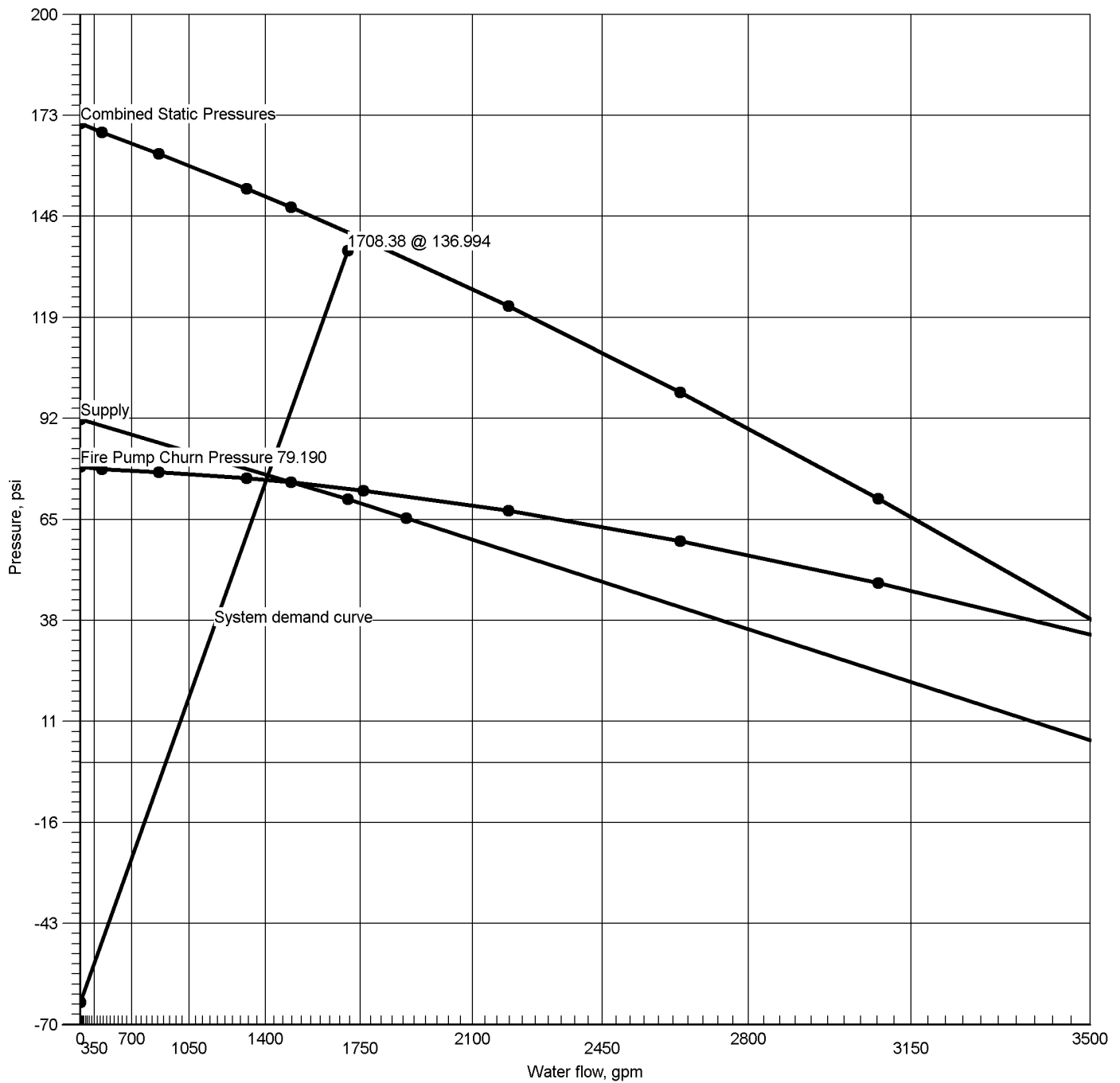
Available Pressure at System Demand
89.607 @ 1708.38

Required Pressure at System Demand
82.643 @ 1708.38

Required Pressure at System Demand (Including Hose Allowance at Source)
82.643 @ 1708.38



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.392 @ 1708.38

Available Pressure at System Demand

143.958 @ 1708.38

Required Pressure at System Demand

136.994 @ 1708.38



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	250.00	250.00	0.00	123.973			
⇒ Sprinkler	501	121.15	121.15	16.80	52.000			
Sprinkler	502	121.54	121.15	16.80	52.336			
Sprinkler	503	121.15	121.15	16.80	52.000			
Sprinkler	504	121.54	121.15	16.80	52.342			
Sprinkler	505	121.27	121.15	16.80	52.110			
Sprinkler	506	121.66	121.15	16.80	52.446			
Sprinkler	507	121.27	121.15	16.80	52.110			
Sprinkler	508	121.67	121.15	16.80	52.454			
Sprinkler	509	121.58	121.15	16.80	52.373			
Sprinkler	510	121.97	121.15	16.80	52.705			
Sprinkler	511	121.58	121.15	16.80	52.374			
Sprinkler	512	121.99	121.15	16.80	52.724			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	120.63	6.73	120		0.035867	9'-4½"	Pf 0.336
501	37'-2	121.15	16.80	52.000		Sprinkler		Pe
502	37'-2			52.336			9'-4½"	Pv
BL	2.7050	242.17	13.52	120		0.130200	265'-2¾"	Pf 39.407
502	37'-2	121.54	16.80	52.336		Sprinkler,	37'-5¼"	Pe 0.388
119	36'-3¼"			92.132		2PO(18'-8½")	302'-8"	Pv
CM	6.3570	242.17	2.45	120		0.002030	9'-0"	Pf 0.018
119	36'-3¼"			92.132				Pe 0.076
120	36'-1¼"			92.226			9'-0"	Pv
CM	6.3570	484.29	4.90	120		0.007316	9'-0"	Pf 0.066
120	36'-1¼"	242.12		92.226		Flow (q) from Route 3		Pe 0.076
121	35'-11"			92.368			9'-0"	Pv
CM	6.3570	726.01	7.34	120		0.015473	9'-0"	Pf 0.139
121	35'-11"	241.73		92.368		Flow (q) from Route 5		Pe 0.076
122	35'-9"			92.584			9'-0"	Pv
CM	6.3570	849.40	8.59	120		0.020686	9'-0"	Pf 0.186
122	35'-9"	123.39		92.584		Flow (q) from Route 12		Pe 0.076
123	35'-6¾"			92.846			9'-0"	Pv
CM	6.3570	971.00	9.82	120		0.026496	9'-0"	Pf 0.239
123	35'-6¾"	121.60		92.846		Flow (q) from Route 10		Pe 0.076
124	35'-4¾"			93.161			9'-0"	Pv
CM	6.3570	1091.84	11.04	120		0.032916	9'-10½"	Pf 0.325
124	35'-4¾"	120.84		93.161		Flow (q) from Route 13		Pe 0.085
125	35'-2½"			93.570			9'-10½"	Pv
CM	6.3570	1212.83	12.26	120		0.039980	10'-0"	Pf 0.400
125	35'-2½"	120.98		93.570		Flow (q) from Route 11		Pe 0.086
126	35'-0"			94.057			10'-0"	Pv
CM	6.3570	1334.79	13.49	120		0.047734	10'-0"	Pf 0.477
126	35'-0"	121.96		94.057		Flow (q) from Route 2		Pe 0.086
127	34'-9½"			94.621			10'-0"	Pv
CM	6.3570	1458.38	14.74	120		0.056231	185'-1¾"	Pf 12.660
127	34'-9½"	123.59		94.621		Flow (q) from Route 9	40'-0"	Pe 12.704
334	5'-6"			119.984		4fE(10'-0")	225'-1¾"	Pv
CM	8.2490	1458.38	8.76	120		0.015810	32'-3¾"	Pf 1.402
334	5'-6"			119.984			56'-4½"	Pe 1.933
80	1'-0½"			123.319		PO(41'-1¼"), fE(15'-3¾")	88'-8"	Pv
FR	8.4500	1458.38	8.34	140		0.010572	11'-0½"	Pf 0.358
80	1'-0½"			123.319			22'-10"	Pe 1.971
81	-3'-6"			125.647		LtE(22'-10")	33'-10½"	Pv
UG	7.6800	1458.38	10.10	150		0.014819	58'-0¼"	Pf 1.509
81	-3'-6"			125.647			43'-10"	Pe
82	-3'-6"			127.157		PO(43'-10")	101'-10"	Pv
UG	7.6800	1141.50	7.91	150		0.009419	625'-3¾"	Pf 6.515
82	-3'-6"			127.157			66'-4½"	Pe
41	-3'-6"			133.671		E(22'-6½"), T(43'-10")	691'-8¼"	Pv
UG	7.6800	1708.38	11.83	150		0.019858	31'-8½"	Pf 0.630
41	-3'-6"	566.88		133.671		Flow (q) from Route 7		Pe 0.000
42	-3'-6"			134.301			31'-8½"	Pv
UG	8.3900	1708.38	9.91	140		0.014668	12'-11"	Pf 0.637
42	-3'-6"			134.301			30'-6½"	Pe -1.951
43	1'-0"			132.987		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	1708.38	10.26	120		0.021186	19'-9¾"	Pf 4.650
43	1'-0"			132.987			199'-8"	Pe -0.643
25	2'-5¾"			136.994		3fE(15'-3¾"), 2T(41'-1¼"), BV(18'-9½"), CV(52'-10¼")	219'-5¾"	Pv
Pump								
25		1708.38		136.994		Rating: 75.000 @ 1500.00		
26		Q=1708.38	6.49	63.602		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1708.38	6.49	120		0.006952	1'-8¾"	Pf 0.464
26	2'-8¾"			63.602			65'-0"	Pe 0.752
8	1'-0"			64.818		GV(5'-11"), T(59'-1¼")	66'-9"	Pv
UG	10.4000	1708.38	6.45	140		0.005154	13'-11"	Pf 0.252
8	1'-0"			64.818			35'-1"	Pe 2.384
7	-4'-6"			67.455		E(35'-1")	48'-11¾"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
UG	9.4200	1708.38	7.86	150		0.007346	72'-10"	Pf 0.625
7	-4'-6"			67.455			12'-3½"	Pe
6	-4'-6"			68.080		EE(12'-3½")	85'-1¼"	Pv
UG	10.4000	1708.38	6.45	140		0.005154	5'-11¼"	Pf 3.943
6	-4'-6"			68.080				Pe
5	-4'-6"			72.023		BFP(-3.912)	5'-11¼"	Pv
UG	10.4000	1708.38	6.45	140		0.005154	5'-11¼"	Pf 0.031
5	-4'-6"			72.023				Pe
4	-4'-6"			72.054			5'-11¼"	Pv
UG	9.4200	1708.38	7.86	150		0.007346	204'-11½"	Pf 1.916
4	-4'-6"			72.054			55'-10¾"	Pe
3	-4'-6"			73.970		T(55'-10¾")	260'-10¼"	Pv
UG	11.2000	1708.38	5.56	150		0.003162	2459'-6"	Pf 8.235
3	-4'-6"			73.970			144'-11¼"	Pe
2	-4'-6"			82.205		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1708.38	4.50	140		0.002138	204'-11½"	Pf 0.438
2	-4'-6"			82.205				Pe
1	-4'-6"			82.643		Water Supply	204'-11½"	Pv
		0.00				Hose Allowance At Source		
1		1708.38						
Route 2								
BL	2.7050	0.52	0.03	120		0.000001	9'-4½"	Pf 0.000
501	37'-2"	121.15	16.80	52.000		Sprinkler		Pe
503	37'-2"			52.000			9'-4½"	Pv
BL	2.7050	121.66	6.79	120		0.036437	9'-4½"	Pf 0.342
503	37'-2"	121.15	16.80	52.000		Sprinkler		Pe
504	37'-2"			52.342			9'-4½"	Pv
BL	2.7050	243.21	13.58	120		0.131236	115'-3¼"	Pf 20.040
504	37'-2"	121.54	16.80	52.342		Sprinkler,	37'-5¼"	Pe 0.350
130	36'-4¼"			72.732		2PO(18'-8½")	152'-8½"	Pv
CM	4.3100	243.21	5.35	120		0.013577	9'-0"	Pf 0.122
130	36'-4¼"			72.732				Pe 0.076
131	36'-2¼"			72.930			9'-0"	Pv
CM	4.3100	486.98	10.71	120		0.049050	9'-0"	Pf 0.442
131	36'-2¼"	243.77		72.930		Flow (q) from Route 4		Pe 0.076
132	36'-0¼"			73.448			9'-0"	Pv
CM	4.3100	732.36	16.11	120		0.104350	9'-0"	Pf 0.939
132	36'-0¼"	245.39		73.448		Flow (q) from Route 6		Pe 0.076
133	35'-10"			74.463			9'-0"	Pv
CM	4.3100	608.98	13.39	120		0.074175	9'-0"	Pf 0.668
133	35'-10"			74.463				Pe 0.076
134	35'-8"			75.207			9'-0"	Pv
CM	4.3100	487.37	10.72	120		0.049124	9'-0"	Pf 0.442
134	35'-8"			75.207				Pe 0.076
135	35'-5¾"			75.726			9'-0"	Pv
CM	4.3100	366.53	8.06	120		0.028997	9'-10½"	Pf 0.286
135	35'-5¾"			75.726				Pe 0.085
136	35'-3½"			76.097			9'-10½"	Pv
CM	4.3100	245.55	5.40	120		0.013820	10'-0"	Pf 0.138
136	35'-3½"			76.097				Pe 0.086
137	35'-1"			76.321		Z	10'-0"	Pv
RN	2.7050	121.96	6.81	120		0.036603	408'-7½"	Pf 17.697
137	35'-1"			76.321		PO(18'-8½")	74'-10½"	Pe 0.038
126	35'-0"			94.057		3PO(18'-8½")	483'-6"	Pv
Route 3								
BL	2.7050	120.45	6.72	120		0.035770	9'-4½"	Pf 0.335
505	37'-0"	121.27	16.80	52.110		Sprinkler		Pe
506	37'-0"			52.446			9'-4½"	Pv
BL	2.7050	242.12	13.52	120		0.130151	265'-2¾"	Pf 39.392
506	37'-0"	121.66	16.80	52.446		Sprinkler,	37'-5¼"	Pe 0.388
120	36'-1¼"			92.226		2PO(18'-8½")	302'-8"	Pv
Route 4								
BL	2.7050	0.82	0.05	120		0.000004	9'-4½"	Pf 0.000
505	37'-0"	121.27	16.80	52.110		Sprinkler		Pe
507	37'-0"			52.110			9'-4½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	122.10	6.82	120		0.036677	9'-4½"	Pf 0.344
507	37'-0"	121.27	16.80	52.110		Sprinkler		Pe
508	37'-0"			52.454			9'-4½"	Pv
BL	2.7050	243.77	13.61	120		0.131799	115'-3¼"	Pf 20.126
508	37'-0"	121.67	16.80	52.454		Sprinkler,	37'-5¼"	Pe 0.350
131	36'-2¼"			72.930		2PO(18'-8½")	152'-8½"	Pv
Route 5								
BL	2.7050	119.76	6.69	120		0.035391	9'-4½"	Pf 0.332
509	36'-9¼"	121.58	16.80	52.373		Sprinkler		Pe
510	36'-9¼"			52.705			9'-4½"	Pv
BL	2.7050	241.73	13.50	120		0.129763	265'-2¼"	Pf 39.275
510	36'-9¼"	121.97	16.80	52.705		Sprinkler,	37'-5¼"	Pe 0.388
121	35'-11"			92.368		2PO(18'-8½")	302'-8"	Pv
Route 6								
BL	2.7050	1.82	0.10	120		0.000015	9'-4½"	Pf 0.000
509	36'-9¼"	121.58	16.80	52.373		Sprinkler		Pe
511	36'-9¼"			52.374			9'-4½"	Pv
BL	2.7050	123.40	6.89	120		0.037405	9'-4½"	Pf 0.351
511	36'-9¼"	121.58	16.80	52.374		Sprinkler		Pe
512	36'-9¼"			52.724			9'-4½"	Pv
BL	2.7050	245.39	13.70	120		0.133421	115'-3¼"	Pf 20.374
512	36'-9¼"	121.99	16.80	52.724		Sprinkler,	37'-5¼"	Pe 0.350
132	36'-0¼"			73.448		2PO(18'-8½")	152'-8½"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	18'-4¼"	Pf 0.151
87	3'-6"	250.00		123.973		Hydrant,	67'-9½"	Pe 3.035
88	-3'-6"			127.159		E(21'-6¼"), PO(46'-2½")	86'-1½"	Pv
UG	7.6800	566.88	3.93	150		0.002580	2412'-10¼"	Pf 6.513
88	-3'-6"	316.88		127.159		Flow (q) from Route 8	111'-5¼"	Pe
41	-3'-6"			133.671		3E(22'-6½"), T(43'-10")	2524'-4"	Pv
Route 8								
UG	7.6800	316.88	2.19	150		0.000880	2'-3¾"	Pf 0.002
82	-3'-6"	1141.50		127.157		Flow (q) from Route 1		Pe
88	-3'-6"			127.159			2'-3¾"	Pv
Route 9								
CM	4.3100	123.59	2.72	120		0.003881	10'-0"	Pf 0.039
137	35'-1"	121.96		76.321		Flow (q) from Route 2		Pe 0.086
138	34'-10¾"			76.446			10'-0"	Pv
RN	2.7050	123.59	6.90	120		0.037510	408'-7½"	Pf 18.136
138	34'-10¾"			76.446		PO(18'-8½")	74'-10½"	Pe 0.038
127	34'-9½"			94.621		3PO(18'-8½")	483'-6"	Pv
Route 10								
RN	2.7050	121.60	6.79	120		0.036403	408'-7½"	Pf 17.601
134	35'-8"			75.207		PO(18'-8½")	74'-10½"	Pe 0.038
123	35'-6¼"			92.846		3PO(18'-8½")	483'-6"	Pv
Route 11								
RN	2.7050	120.98	6.75	120		0.036062	408'-7½"	Pf 17.436
136	35'-3½"			76.097		PO(18'-8½")	74'-10½"	Pe 0.038
125	35'-2½"			93.570		3PO(18'-8½")	483'-6"	Pv
Route 12								
RN	2.7050	123.39	6.89	120		0.037399	408'-7½"	Pf 18.082
133	35'-10"			74.463		PO(18'-8½")	74'-10½"	Pe 0.038
122	35'-9"			92.584		3PO(18'-8½")	483'-6"	Pv
Route 13								
RN	2.7050	120.84	6.75	120		0.035982	408'-7½"	Pf 17.397
135	35'-5¼"			75.726		PO(18'-8½")	74'-10½"	Pe 0.038
124	35'-4¼"			93.161		3PO(18'-8½")	483'-6"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

C Value Multiplier

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

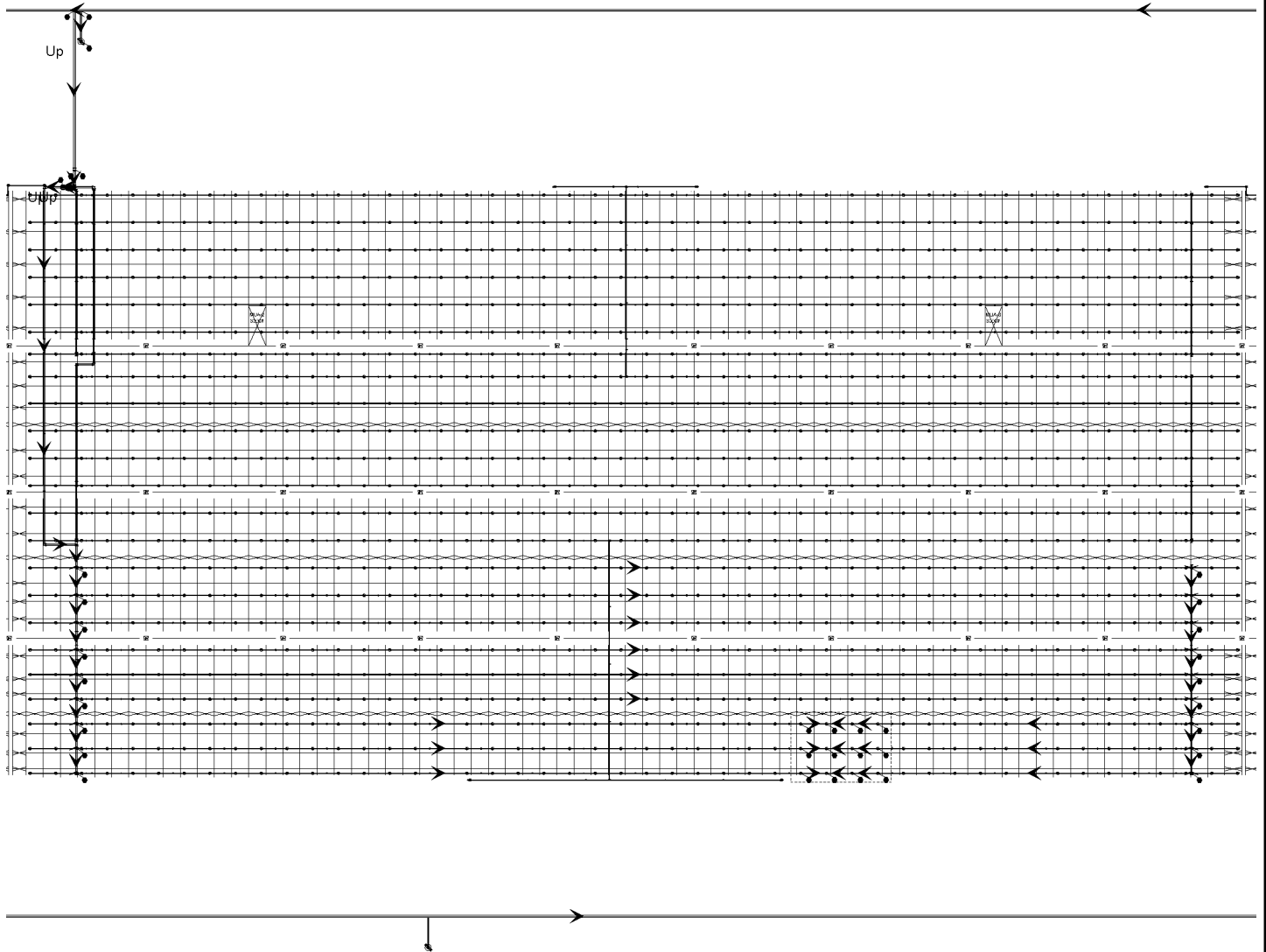


Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#5 - System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend	Units Legend		Fittings Legend	
AO Arm-Over	Diameter	Inch	ALV Alarm Valve	
BL Branch Line	Elevation	Foot	AngV Angle Valve	
CM Cross Main	Flow	gpm	b Bushing	
DN Drain	Discharge	gpm	BaV Ball Valve	
DR Drop	Velocity	fps	BFP Backflow Preventer	
DY Dynamic	Pressure	psi	BV Butterfly Valve	
FM Feed Main	Length	Foot	C Cross Flow Turn 90°	
FR Feed Riser	Friction Loss	psi/Foot	cplg Coupling	
MS Miscellaneous	HWC	Hazen-Williams Constant	Cr Cross Run	
OR Outrigger	Pt	Total pressure at a point in a pipe	CV Check Valve	
RN Riser Nipple	Pn	Normal pressure at a point in a pipe	DeV Deluge Valve	
SN Swing Nipple	Pf	Pressure loss due to friction between points	DPV Dry Pipe Valve	
SP Sprig	Pe	Pressure due to elevation difference between indicated points	E 90° Elbow	
ST Stand Pipe	Pv	Velocity pressure at a point in a pipe	EE 45° Elbow	
UG Underground			Ee1 11¼° Elbow	
			Ee2 22½° Elbow	
			f Flow Device	
			fd Flex Drop	
			FDC Fire Department Connection	
			fE 90° FireLock(TM) Elbow	
			fEE 45° FireLock(TM) Elbow	
			flg Flange	
			FN Floating Node	
			fT FireLock(TM) Tee	
			g Gauge	
			GloV Globe Valve	
			GV Gate Valve	
			Ho Hose	
			Hose Hose	
			HV Hose Valve	
			Hyd Hydrant	
			LtE Long Turn Elbow	
			mecT Mechanical Tee	
			Noz Nozzle	
			P1 Pump In	
			P2 Pump Out	
			PIV Post Indicating Valve	
			PO Pipe Outlet	
			PrV Pressure Relief Valve	
			PRV Pressure Reducing Valve	
			red Reducer/Adapter	
			S Supply	
			sCV Swing Check Valve	
			SFx Seismic Flex	
			Spr Sprinkler	
			St Strainer	
			T Tee Flow Turn 90°	
			Tr Tee Run	
			U Union	
			WirF Wirsbo	
			WMV Water Meter Valve	
			Z Cap	





Hydraulic Overview

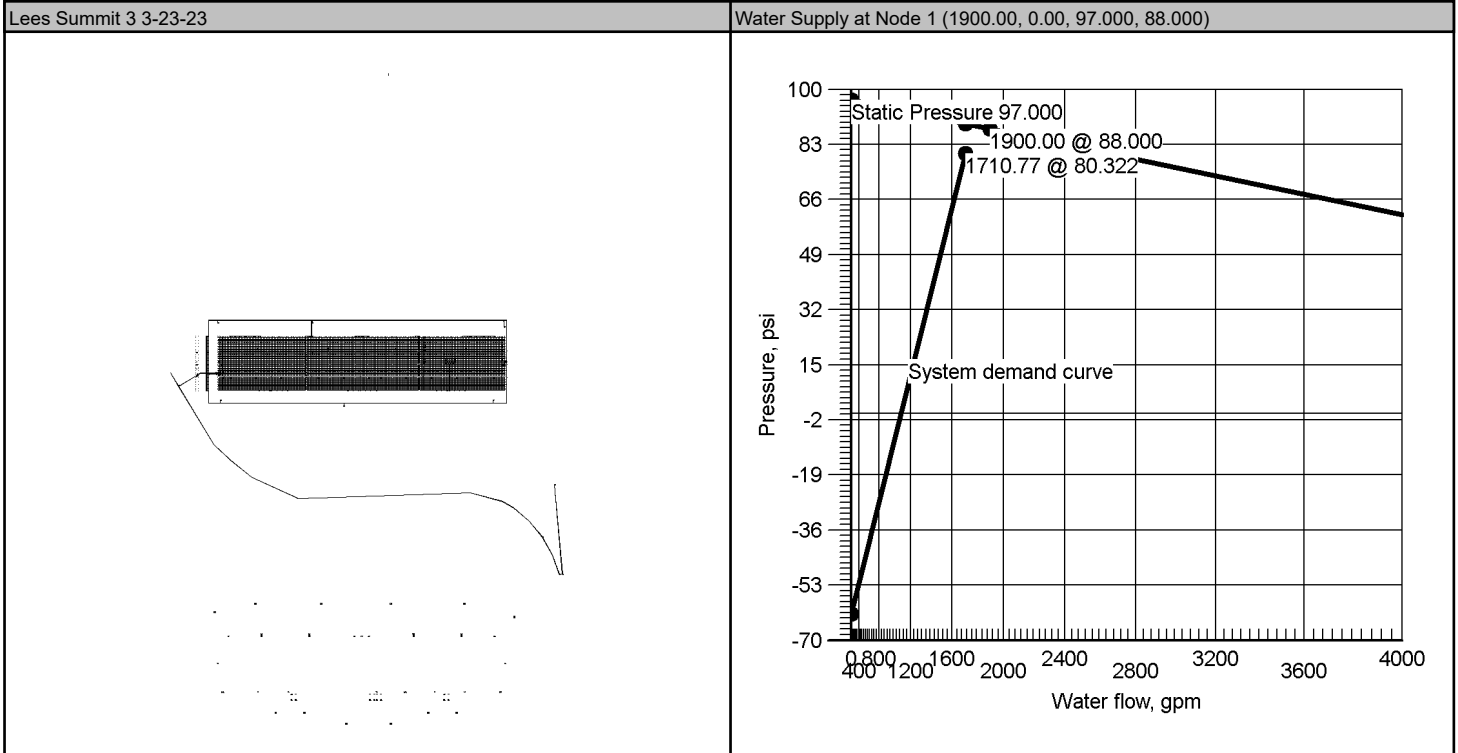
Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone 913-827-8595
Address 1	NE Tudor Rd & Main St	FAX
Address 2	Lee's Summit, MO 64086	State Certification/License Number 149263
Address 3		AHJ Lee's Summit FM
		Job Site/Building Building C Lot 3

System	
Pressure	52.000
Area of Application	NA
Most Demanding Sprinkler Data	Hose Streams
16.80 K-Factor 121.15 at 52.000	250.00
Coverage Per Sprinkler	Number Of Sprinklers Calculated
94 ft ²	12 0
System Pressure Demand	System Flow Demand
80.322	1710.77
Total Demand	Pressure Result
1710.77 @ 80.322	+9.266 (10.3%)

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	61.245	218.60	1710.77
25	Pump	1500.00		79.190	75.000				

Pumps: Static = Churn (Pressure @ Zero Flow)





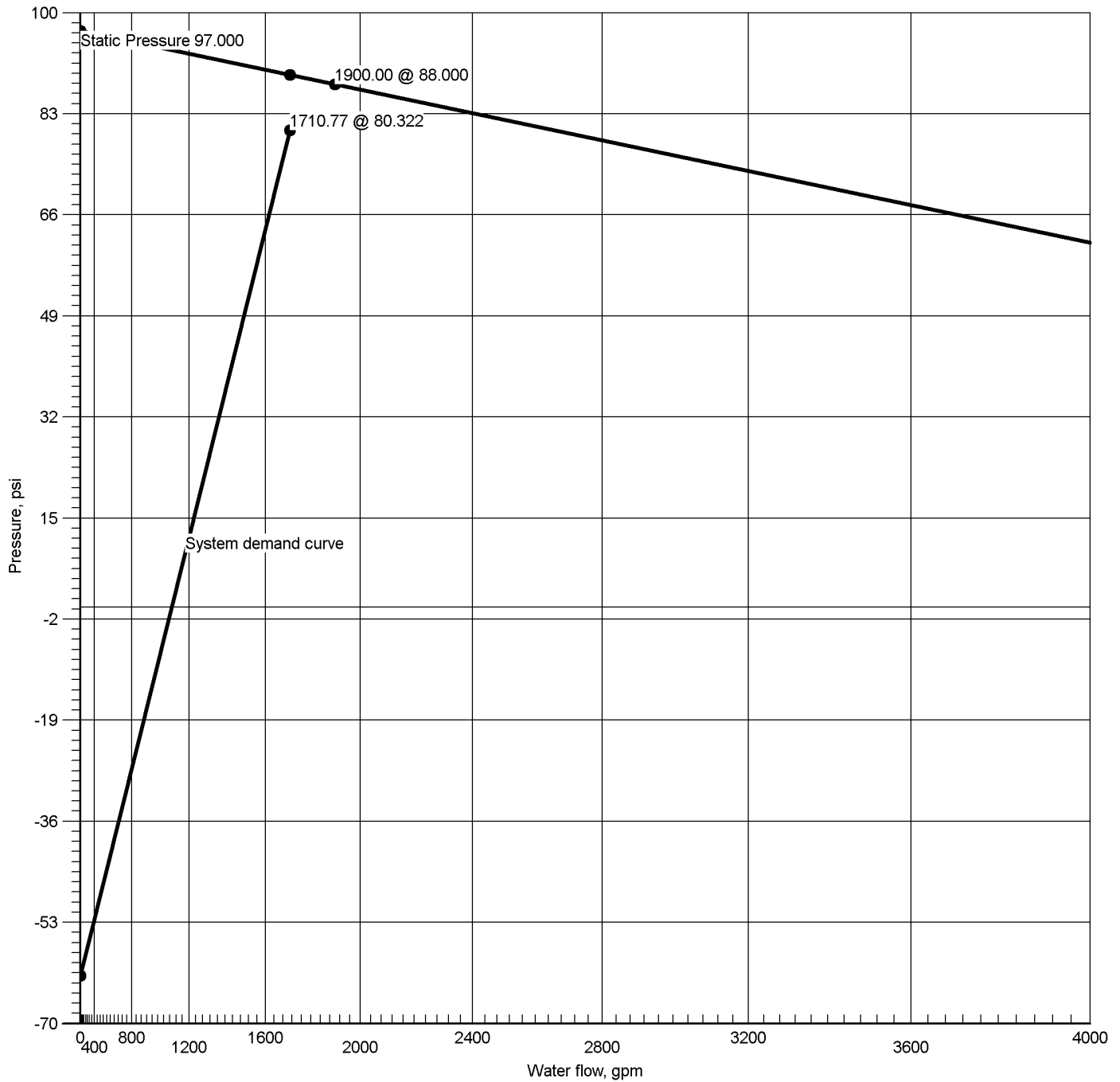
Job Number: 21224100 - Lees Summit 3

Report Description: ESFR (#6 - System 6)

Job											
Job Number 21224100						Designer Brock Browning					
Job Name: Lee's Summit						State Certification/License Number 149263					
Address 1 NE Tudor Rd & Main St						AHJ Lee's Summit FM					
Address 2 Lee's Summit, MO 64086						Job Site/Building Building C Lot 3					
Address 3						Drawing Name Lees Summit 3 3-23-23					
System						Remote Area(s)					
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000						Occupancy ESFR		Job Suffix Lees Summit 3			
Hose Allowance At Source 0.00						Pressure 52.000		Area of Application NA			
Additional Hose Supplies Node Hydrant At Node 153 Flow(gpm) 250.00						Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0			
						Coverage Per Sprinkler 94 ft²					
						AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 80.256 Right: 80.296					
Total Hose Streams 250.00											
System Flow Demand 1710.77				Total Water Required (Including Hose Allowance) 1710.77							
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.12 between nodes 2762 and 2548											
Maximum Velocity Under Ground 11.85 between nodes 42 and 41											
Volume capacity of Wet Pipes 34639.89 gal				Volume capacity of Dry Pipes							
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.588		1710.77	80.322	9.266
25	Pump		79.190	75.000		1500.00	143.882		1710.77	134.616	9.266
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
		Contractor Number 1				Contact Name Brock Browning				Contact Title Designer	
Name of Contractor: F.E. Moran, Inc.						Phone 913-827-8595				Extension	
Address 1 16815 College Blvd						FAX 217-356-0777					
Address 2 Lenexa, KS						E-mail brock.browning@femoran.com					
Address 3 66219						Web-Site https://www.femoran.com/					



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure
97.000

Residual: Pressure
88.000 @ 1900.00

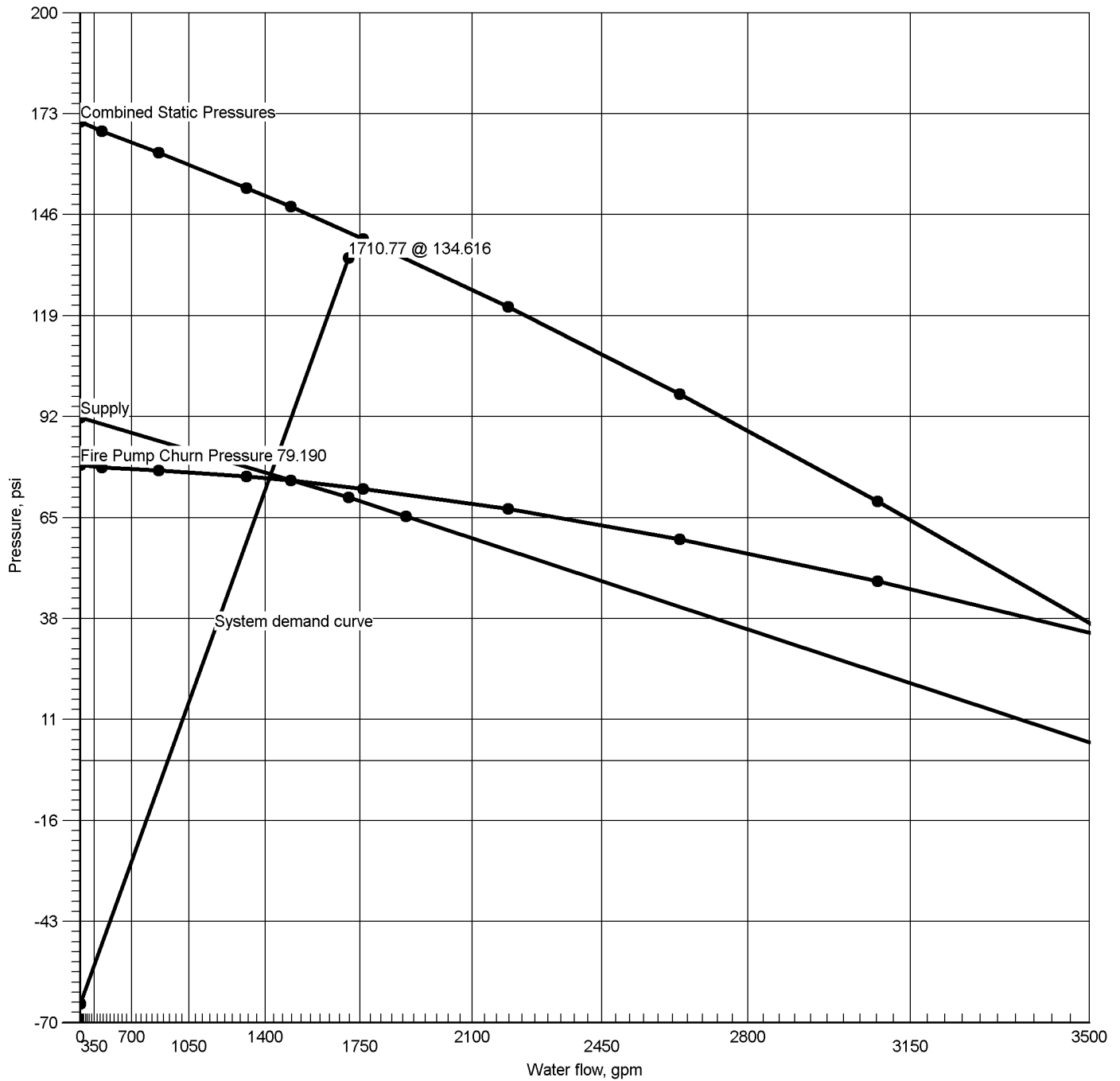
Available Pressure at System Demand
89.588 @ 1710.77

Required Pressure at System Demand
80.322 @ 1710.77

Required Pressure at System Demand (Including Hose Allowance at Source)
80.322 @ 1710.77



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.371 @ 1710.77

Available Pressure at System Demand

143.882 @ 1710.77

Required Pressure at System Demand

134.616 @ 1710.77



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	153	250.00	250.00	0.00	120.007			
⇒ Sprinkler	601	121.15	121.15	16.80	52.000			
Sprinkler	602	121.52	121.15	16.80	52.320			
Sprinkler	603	121.15	121.15	16.80	52.001			
Sprinkler	604	121.56	121.15	16.80	52.359			
Sprinkler	605	121.82	121.15	16.80	52.577			
Sprinkler	606	121.82	121.15	16.80	52.578			
Sprinkler	607	122.25	121.15	16.80	52.952			
Sprinkler	608	122.18	121.15	16.80	52.889			
Sprinkler	609	121.63	121.15	16.80	52.418			
Sprinkler	610	121.63	121.15	16.80	52.420			
Sprinkler	611	122.07	121.15	16.80	52.793			
Sprinkler	612	121.99	121.15	16.80	52.729			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	117.35	6.55	120		0.034081	9'-4½"	Pf 0.320
601	34'-8½"	121.15	16.80	52.000		Sprinkler		Pe
602	34'-8½"			52.320			9'-4½"	Pv
BL	2.7050	238.86	13.34	120		0.126934	193'-5¾"	Pf 29.310
602	34'-8½"	121.52	16.80	52.320		Sprinkler,	37'-5¼"	Pe 0.350
139	33'-10¾"			81.980		2PO(18'-8½")	230'-11"	Pv
CM	4.3100	961.16	21.14	120		0.172553	8'-3¾"	Pf 4.195
139	33'-10¾"	722.30		81.980		Flow (q) from Route 2	16'-0"	Pe -0.072
2548	34'-0¾"			86.103		ft(16'-0")	24'-3¾"	Pv
CM	4.3100	1460.77	32.12	120		0.374302	19'-6½"	Pf 12.404
2548	34'-0¾"	499.60		86.103		Flow (q) from Route 3	13'-7¼"	Pe 0.217
2762	33'-6¾"			98.723		2fE(6'-9½")	33'-1¾"	Pv
CM	6.3570	1460.77	14.77	120		0.056401	28'-10½"	Pf 1.628
2762	33'-6¾"			98.723				Pe 12.515
143	4'-8¾"			112.866			28'-10½"	Pv
FR	6.0650	1460.77	16.22	120		0.070915	1'-10¾"	Pf 4.956
143	4'-8¾"			112.866			68'-0"	Pe 1.121
144	2'-1¼"			118.943		CV(20'-0), BV(8'-0), f(10'-0), PO (30'-0)	69'-10¾"	Pv
CM	8.2490	1460.77	8.77	120		0.015858	2'-3¾"	Pf 0.278
144	2'-1¼"			118.943			15'-3¾"	Pe 0.463
145	1'-0½"			119.684		fE(15'-3¾")	17'-6¾"	Pv
FR	8.4500	1460.77	8.36	140		0.010604	9'-2¾"	Pf 0.992
145	1'-0½"			119.684			84'-3¾"	Pe 1.971
146	-3'-6"			122.647		LtE(22'-10), PO(61'-5¾")	93'-6½"	Pv
UG	7.6800	855.69	5.93	150		0.005526	1472'-10¾"	Pf 8.631
146	-3'-6"			122.647			88'-10¾"	Pe
41	-3'-6"			131.278		2E(22'-6½"), T(43'-10)	1561'-9¾"	Pv
UG	7.6800	1710.77	11.85	150		0.019910	31'-8½"	Pf 0.631
41	-3'-6"	855.08		131.278		Flow (q) from Route 7		Pe 0.000
42	-3'-6"			131.909			31'-8½"	Pv
UG	8.3900	1710.77	9.93	140		0.014706	12'-11"	Pf 0.639
42	-3'-6"			131.909			30'-6½"	Pe -1.951
43	1'-0"			130.597		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	1710.77	10.27	120		0.021241	19'-9¾"	Pf 4.662
43	1'-0"			130.597			199'-8"	Pe -0.643
25	2'-5¾"			134.616		3fE(15'-3¾"), 2T(41'-1¼"), BV(18'-9½"), CV(52'-10¾")	219'-5¾"	Pv
Pump								
25		1710.77		134.616		Rating: 75.000 @ 1500.00		
26		Q=1710.77	6.50	61.245		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1710.77	6.50	120		0.006970	1'-8¾"	Pf 0.465
26	2'-8¾"			61.245			65'-0"	Pe 0.752
8	1'-0"			62.462		GV(5'-11), T(59'-1¼")	66'-9"	Pv
UG	10.4000	1710.77	6.46	140		0.005167	13'-11"	Pf 0.253
8	1'-0"			62.462			35'-1"	Pe 2.384
7	-4'-6"			65.099		E(35'-1)	48'-11¾"	Pv
UG	9.4200	1710.77	7.88	150		0.007365	72'-10"	Pf 0.627
7	-4'-6"			65.099			12'-3¾"	Pe
6	-4'-6"			65.726		EE(12'-3½")	85'-1¾"	Pv
UG	10.4000	1710.77	6.46	140		0.005167	5'-11¼"	Pf 3.948
6	-4'-6"			65.726				Pe
5	-4'-6"			69.674		BFP(-3.917)	5'-11¼"	Pv
UG	10.4000	1710.77	6.46	140		0.005167	5'-11¼"	Pf 0.031
5	-4'-6"			69.674				Pe
4	-4'-6"			69.705			5'-11¼"	Pv
UG	9.4200	1710.77	7.88	150		0.007365	204'-11½"	Pf 1.921
4	-4'-6"			69.705			55'-10¾"	Pe
3	-4'-6"			71.626		T(55'-10¾")	260'-10¾"	Pv
UG	11.2000	1710.77	5.57	150		0.003170	2459'-6"	Pf 8.257
3	-4'-6"			71.626			144'-11¾"	Pe
2	-4'-6"			79.882		8EE(14'-4¾"), E(29'-10½")	2604'-5¾"	Pv
UG	12.4600	1710.77	4.50	140		0.002143	204'-11½"	Pf 0.439
2	-4'-6"			79.882				Pe
1	-4'-6"			80.322		Water Supply	204'-11½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
		0.00				Hose Allowance At Source		
1		1710.77						
Route 2								
BL	2.7050	3.80	0.21	120		0.000060	9'-4½"	Pf 0.001
601	34'-8½"	121.15	16.80	52.000		Sprinkler	9'-4½"	Pe
603	34'-8½"			52.001				Pv
BL	2.7050	124.95	6.98	120		0.038278	9'-4½"	Pf 0.359
603	34'-8½"	121.15	16.80	52.001		Sprinkler	9'-4½"	Pe
604	34'-8½"			52.359				Pv
BL	2.7050	246.51	13.76	120		0.134555	92'-6¼"	Pf 17.486
604	34'-8½"	121.56	16.80	52.359		Sprinkler,	37'-5¼"	Pe 0.350
147	33'-10¾"			70.195		2PO(18'-8½")	129'-11½"	Pv
CM	4.3100	722.30	15.88	120		0.101712	10'-0"	Pf 1.017
147	33'-10¾"	475.78		70.195		Flow (q) from Route 4	10'-0"	Pe 0.086
148	33'-8¼"			71.299				Pv
RN	2.7050	99.39	5.55	120		0.025066	314'-1¼"	Pf 9.750
148	33'-8¼"			71.299		PO(18'-8½")	74'-10½"	Pe -0.000
149	33'-8¼"			81.049		3PO(18'-8½")	388'-11¼"	Pv
CM	4.3100	722.30	15.88	120		0.101712	10'-0"	Pf 1.017
149	33'-8¼"	622.91		81.049		Flow (q) from Route 9	10'-0"	Pe -0.086
139	33'-10¾"			81.980				Pv
Route 3								
BL	2.7050	5.95	0.33	120		0.000137	9'-4½"	Pf 0.002
609	35'-1¼"	121.63	16.80	52.418		Sprinkler,	4'-3½"	Pe
610	35'-1¼"			52.420		Tr(4'-3½")	13'-8"	Pv
BL	2.7050	127.59	7.12	120		0.039787	9'-4½"	Pf 0.373
610	35'-1¼"	121.63	16.80	52.420		Sprinkler	9'-4½"	Pe
611	35'-1¼"			52.793				Pv
BL	2.7050	249.65	13.94	120		0.137745	193'-5¼"	Pf 31.807
611	35'-1¼"	122.07	16.80	52.793		Sprinkler,	37'-5¼"	Pe 0.350
141	34'-3½"			84.949		2PO(18'-8½")	230'-11"	Pv
CM	4.3100	249.65	5.49	120		0.014250	10'-0"	Pf 0.143
141	34'-3½"			84.949			10'-0"	Pe 0.086
140	34'-1"			85.178				Pv
CM	4.3100	499.60	10.99	120		0.051429	1'-8¼"	Pf 0.910
140	34'-1"	249.95		85.178		Flow (q) from Route 5	16'-0"	Pe 0.015
2548	34'-0¼"			86.103		ft(16'-0")	17'-8¼"	Pv
Route 4								
BL	2.7050	115.68	6.46	120		0.033191	9'-4½"	Pf 0.311
609	35'-1¼"	121.63	16.80	52.418		Sprinkler	9'-4½"	Pe
612	35'-1¼"			52.729				Pv
BL	2.7050	237.67	13.27	120		0.125764	92'-6¼"	Pf 16.343
612	35'-1¼"	121.99	16.80	52.729		Sprinkler,	37'-5¼"	Pe 0.350
152	34'-3½"			69.422		2PO(18'-8½")	129'-11½"	Pv
CM	4.3100	237.67	5.23	120		0.013011	10'-0"	Pf 0.130
152	34'-3½"			69.422			10'-0"	Pe 0.086
150	34'-1"			69.639				Pv
CM	4.3100	475.78	10.46	120		0.046985	10'-0"	Pf 0.470
150	34'-1"	238.11		69.639		Flow (q) from Route 6	10'-0"	Pe 0.086
147	33'-10¾"			70.195				Pv
Route 5								
BL	2.7050	5.88	0.33	120		0.000134	9'-4½"	Pf 0.001
605	34'-10¾"	121.82	16.80	52.577		Sprinkler	9'-4½"	Pe
606	34'-10¾"			52.578				Pv
BL	2.7050	127.70	7.13	120		0.039852	9'-4½"	Pf 0.374
606	34'-10¾"	121.82	16.80	52.578		Sprinkler	9'-4½"	Pe
607	34'-10¾"			52.952				Pv
BL	2.7050	249.95	13.95	120		0.138047	193'-5¼"	Pf 31.876
607	34'-10¾"	122.25	16.80	52.952		Sprinkler,	37'-5¼"	Pe 0.350
140	34'-1"			85.178		2PO(18'-8½")	230'-11"	Pv
Route 6								
BL	2.7050	115.93	6.47	120		0.033327	9'-4½"	Pf 0.312
605	34'-10¾"	121.82	16.80	52.577		Sprinkler	9'-4½"	Pe
608	34'-10¾"			52.889				Pv
BL	2.7050	238.11	13.29	120		0.126196	92'-6¼"	Pf 16.399
608	34'-10¾"	122.18	16.80	52.889		Sprinkler,	37'-5¼"	Pe 0.350
150	34'-1"			69.639		2PO(18'-8½")	129'-11½"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	32'-4 1/4"	Pf 0.176
153	3'-6"	250.00		120.007		Hydrant,	67'-9 1/2"	Pe 3.035
154	3'-6"			123.218		E(21'-6 3/4"), PO(46'-2 1/2")	100'-1 1/2"	Pv
UG	7.6800	855.08	5.92	150		0.005519	1393'-11 1/4"	Pf 8.060
154	3'-6"	605.08		123.218		Flow (q) from Route 8	66'-4 1/2"	Pe
41	3'-6"			131.278		E(22'-6 1/2"), T(43'-10")	1460'-4 1/4"	Pv
Route 8								
UG	7.6800	605.08	4.19	150		0.002911	173'-8 1/4"	Pf 0.571
146	3'-6"	855.69		122.647		Flow (q) from Route 1	22'-6 1/2"	Pe
154	3'-6"			123.218		E(22'-6 1/2")	196'-2 3/4"	Pv
Route 9								
CM	4.3100	622.91	13.70	120		0.077345	9'-9"	Pf 0.754
2122	33'-6"	532.15 + 90.76		80.379		Flow (q) from Route 10 and 12		Pe -0.084
149	33'-8 1/4"			81.049			9'-9"	Pv
Route 10								
CM	4.3100	532.15	11.70	120		0.057798	8'-3"	Pf 0.477
156	33'-4"	447.23 + 84.92		79.973		Flow (q) from Route 11 and 13		Pe -0.071
2122	33'-6"			80.379			8'-3"	Pv
Route 11								
CM	4.3100	71.57	1.57	120		0.001413	10'-0"	Pf 0.014
157	33'-3 1/4"	71.57		79.011		Flow (q) from Route 14		Pe
158	33'-3 1/4"			79.025			10'-0"	Pv
CM	4.3100	143.35	3.15	120		0.005106	10'-0"	Pf 0.051
158	33'-3 1/4"	71.78		79.025		Flow (q) from Route 17		Pe
159	33'-3 1/4"			79.076			10'-0"	Pv
CM	4.3100	215.87	4.75	120		0.010890	10'-0"	Pf 0.109
159	33'-3 1/4"	72.52		79.076		Flow (q) from Route 16		Pe
160	33'-3 1/4"			79.185			10'-0"	Pv
CM	4.3100	289.94	6.38	120		0.018795	10'-0"	Pf 0.188
160	33'-3 1/4"	74.07		79.185		Flow (q) from Route 18		Pe
161	33'-3 1/4"			79.373			10'-0"	Pv
CM	4.3100	366.64	8.06	120		0.029013	10'-0"	Pf 0.290
161	33'-3 1/4"	76.69		79.373		Flow (q) from Route 19		Pe
162	33'-3 1/4"			79.663			10'-0"	Pv
CM	4.3100	447.23	9.83	120		0.041902	8'-0 1/4"	Pf 0.336
162	33'-3 1/4"	80.59		79.663		Flow (q) from Route 15		Pe -0.026
156	33'-4"			79.973			8'-0 1/4"	Pv
Route 12								
CM	4.3100	622.91	13.70	120		0.077345	9'-9"	Pf 0.754
148	33'-8 1/4"	99.39		71.299		Flow (q) from Route 2		Pe 0.084
2121	33'-6"			72.137			9'-9"	Pv
RN	2.7050	90.76	5.07	120		0.021187	314'-1 1/4"	Pf 8.242
2121	33'-6"			72.137		PO(18'-8 1/2")	74'-10 1/2"	Pe -0.000
2122	33'-6"			80.379		3PO(18'-8 1/2")	388'-11 1/4"	Pv
Route 13								
CM	4.3100	532.15	11.70	120		0.057798	8'-3"	Pf 0.477
2121	33'-6"	90.76		72.137		Flow (q) from Route 12		Pe 0.071
164	33'-4"			72.685			8'-3"	Pv
RN	2.7050	84.92	4.74	120		0.018735	314'-1 1/4"	Pf 7.288
164	33'-4"			72.685		PO(18'-8 1/2")	74'-10 1/2"	Pe -0.000
156	33'-4"			79.973		3PO(18'-8 1/2")	388'-11 1/4"	Pv
Route 14								
CM	4.3100	366.64	8.06	120		0.029013	10'-0"	Pf 0.290
165	33'-3 1/4"			73.047				Pe
166	33'-3 1/4"			73.337			10'-0"	Pv
CM	4.3100	289.94	6.38	120		0.018795	10'-0"	Pf 0.188
166	33'-3 1/4"			73.337				Pe
167	33'-3 1/4"			73.525			10'-0"	Pv
CM	4.3100	215.87	4.75	120		0.010890	10'-0"	Pf 0.109
167	33'-3 1/4"			73.525				Pe
168	33'-3 1/4"			73.634			10'-0"	Pv
CM	4.3100	143.35	3.15	120		0.005106	10'-0"	Pf 0.051
168	33'-3 1/4"			73.634				Pe
169	33'-3 1/4"			73.685			10'-0"	Pv
CM	4.3100	71.57	1.57	120		0.001413	10'-0"	Pf 0.014
169	33'-3 1/4"			73.685				Pe
170	33'-3 1/4"			73.699			10'-0"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Pipe Type	Diameter	Flow	Velocity	HWC		Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
RN	2.7050	71.57	4.00	120		0.013655	314'-1¼"	Pf 5.312
170	33'-3¼"			73.699		PO(18'-8½")	74'-10½"	Pe
157	33'-3¼"			79.011		3PO(18'-8½")	388'-11¼"	Pv
Route 15								
CM	4.3100	447.23	9.83	120		0.041902	8'-0¼"	Pf 0.336
164	33'-4"	84.92		72.685		Flow (q) from Route 13		Pe 0.026
165	33'-3¼"			73.047			8'-0¼"	Pv
RN	2.7050	80.59	4.50	120		0.017008	314'-1¼"	Pf 6.616
165	33'-3¼"			73.047		PO(18'-8½")	74'-10½"	Pe
162	33'-3¼"			79.663		3PO(18'-8½")	388'-11¼"	Pv
Route 16								
RN	2.7050	72.52	4.05	120		0.013990	314'-1¼"	Pf 5.442
168	33'-3¼"			73.634		PO(18'-8½")	74'-10½"	Pe
159	33'-3¼"			79.076		3PO(18'-8½")	388'-11¼"	Pv
Route 17								
RN	2.7050	71.78	4.01	120		0.013728	314'-1¼"	Pf 5.340
169	33'-3¼"			73.685		PO(18'-8½")	74'-10½"	Pe
158	33'-3¼"			79.025		3PO(18'-8½")	388'-11¼"	Pv
Route 18								
RN	2.7050	74.07	4.14	120		0.014550	314'-1¼"	Pf 5.660
167	33'-3¼"			73.525		PO(18'-8½")	74'-10½"	Pe
160	33'-3¼"			79.185		3PO(18'-8½")	388'-11¼"	Pv
Route 19								
RN	2.7050	76.69	4.28	120		0.015516	314'-1¼"	Pf 6.036
166	33'-3¼"			73.337		PO(18'-8½")	74'-10½"	Pe
161	33'-3¼"			79.373		3PO(18'-8½")	388'-11¼"	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

C Value Multiplier

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

Value Of C	100	130	140	150
Multipling Factor	0.713	1.16	1.33	1.51

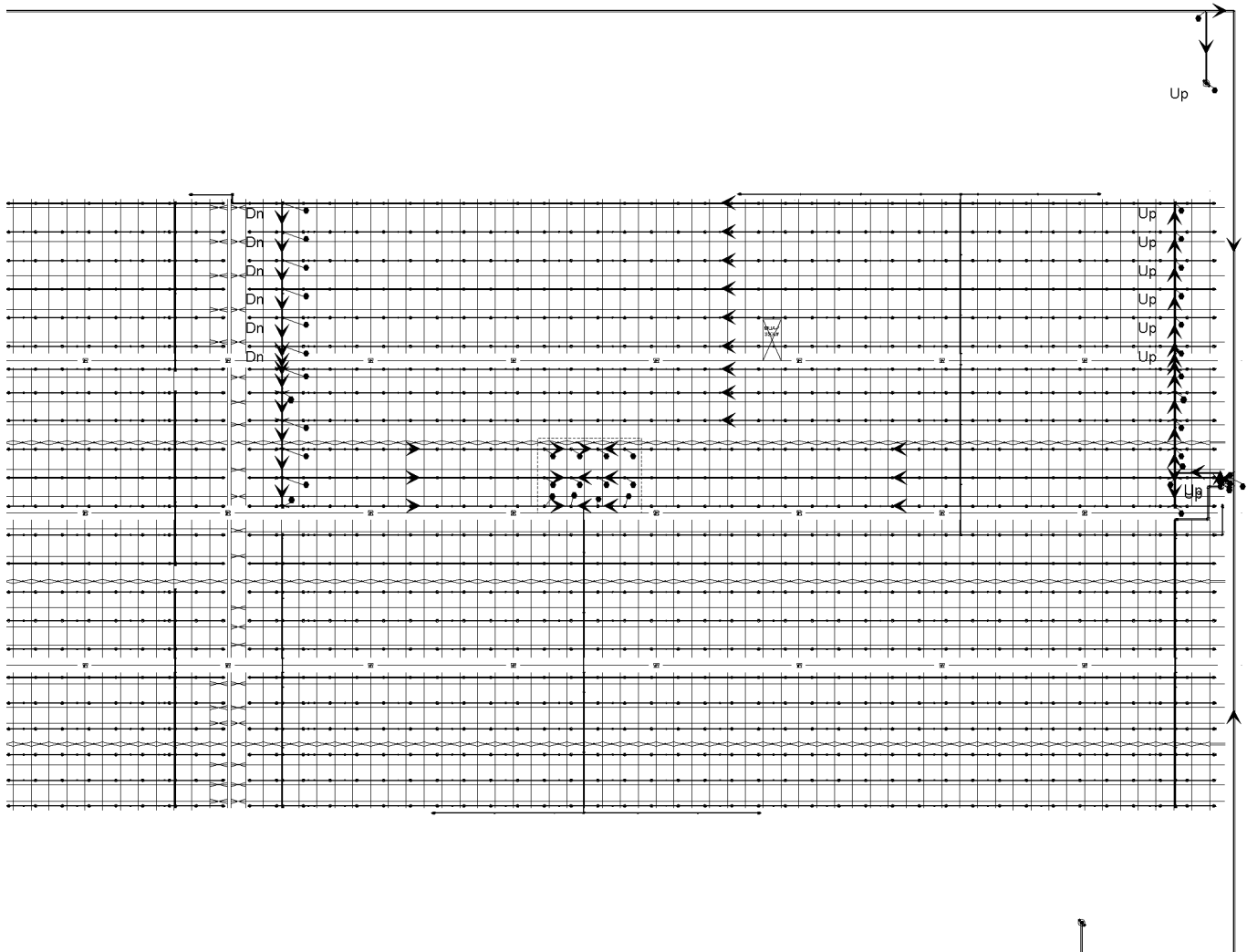


Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#6 - System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	

Pipe Type Legend	Units Legend		Fittings Legend	
AO Arm-Over	Diameter	Inch	ALV Alarm Valve	
BL Branch Line	Elevation	Foot	AngV Angle Valve	
CM Cross Main	Flow	gpm	b Bushing	
DN Drain	Discharge	gpm	BaV Ball Valve	
DR Drop	Velocity	fps	BFP Backflow Preventer	
DY Dynamic	Pressure	psi	BV Butterfly Valve	
FM Feed Main	Length	Foot	C Cross Flow Turn 90°	
FR Feed Riser	Friction Loss	psi/Foot	cplg Coupling	
MS Miscellaneous	HWC	Hazen-Williams Constant	Cr Cross Run	
OR Outrigger	Pt	Total pressure at a point in a pipe	CV Check Valve	
RN Riser Nipple	Pn	Normal pressure at a point in a pipe	DeV Deluge Valve	
SN Swing Nipple	Pf	Pressure loss due to friction between points	DPV Dry Pipe Valve	
SP Sprig	Pe	Pressure due to elevation difference between indicated points	E 90° Elbow	
ST Stand Pipe	Pv	Velocity pressure at a point in a pipe	EE 45° Elbow	
UG Underground			Ee1 11¼° Elbow	
			Ee2 22½° Elbow	
			f Flow Device	
			fd Flex Drop	
			FDC Fire Department Connection	
			fE 90° FireLock(TM) Elbow	
			fEE 45° FireLock(TM) Elbow	
			flg Flange	
			FN Floating Node	
			fT FireLock(TM) Tee	
			g Gauge	
			GloV Globe Valve	
			GV Gate Valve	
			Ho Hose	
			Hose Hose	
			HV Hose Valve	
			Hyd Hydrant	
			LtE Long Turn Elbow	
			mecT Mechanical Tee	
			Noz Nozzle	
			P1 Pump In	
			P2 Pump Out	
			PIV Post Indicating Valve	
			PO Pipe Outlet	
			PrV Pressure Relief Valve	
			PRV Pressure Reducing Valve	
			red Reducer/Adapter	
			S Supply	
			sCV Swing Check Valve	
			SFx Seismic Flex	
			Spr Sprinkler	
			St Strainer	
			T Tee Flow Turn 90°	
			Tr Tee Run	
			U Union	
			WirF Wirsbo	
			WMV Water Meter Valve	
			Z Cap	





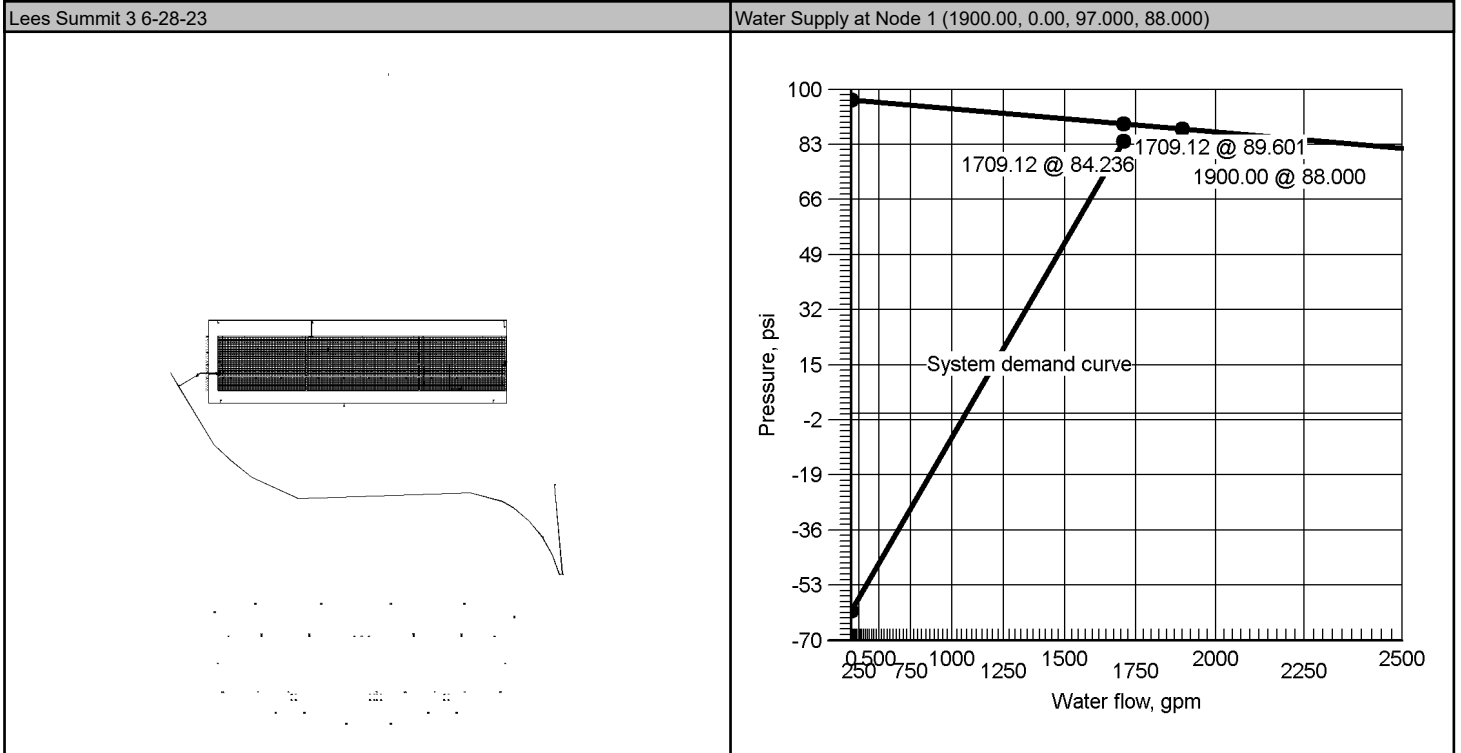
Hydraulic Overview

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Job		
Job Number	21224100	
Designer	Brock Browning	
Job Name:	Lee's Summit	Phone 913-827-8595
Address 1	NE Tudor Rd & Main St	FAX
Address 2	Lee's Summit, MO 64086	State Certification/License Number 149263
Address 3		AHJ Lee's Summit FM
		Job Site/Building Building C Lot 3

System	
Pressure	52.000
Area of Application	NA
Most Demanding Sprinkler Data	Hose Streams 250.00
16.80 K-Factor 121.15 at 52.000	
Coverage Per Sprinkler	Number Of Sprinklers Calculated 12
94ft ²	Number Of Nozzles Calculated 0
System Pressure Demand	System Flow Demand 1709.12
84.236	
Total Demand	Pressure Result +5.365 (6.0%)
1709.12 @ 84.236	

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	1900.00		97.000	88.000	BOR (26)	65.184	211.69	1709.12
25	Pump	1500.00		79.190	75.000				
Pumps: Static = Churn (Pressure @ Zero Flow)									





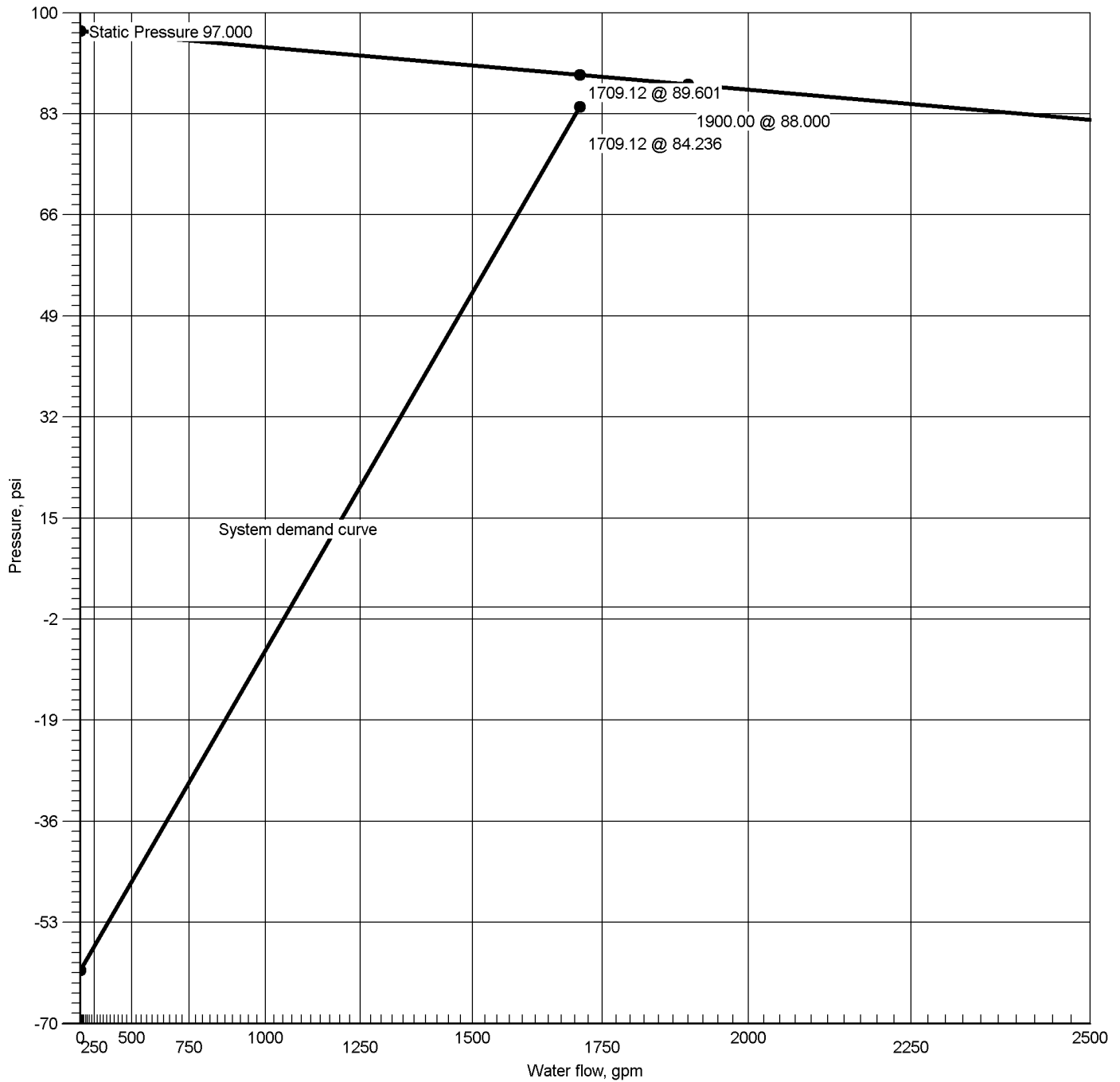
Hydraulic Summary

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Job											
Job Number 21224100					Designer Brock Browning						
Job Name: Lee's Summit					State Certification/License Number 149263						
Address 1 NE Tudor Rd & Main St					AHJ Lee's Summit FM						
Address 2 Lee's Summit, MO 64086					Job Site/Building Building C Lot 3						
Address 3					Drawing Name Lees Summit 3 6-28-23						
System					Remote Area(s)						
Most Demanding Sprinkler Data 16.80 K-Factor 121.15 at 52.000					Occupancy ESFR			Job Suffix Lees Summit 3			
Hose Allowance At Source 0.00					Pressure 52.000			Area of Application NA			
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u> Hydrant At Node 153 250.00					Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 94ft ²		
					AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 84.232 Right: 84.170						
Total Hose Streams 250.00											
System Flow Demand 1709.12			Total Water Required (Including Hose Allowance) 1709.12								
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.09 between nodes 182 and 181											
Maximum Velocity Under Ground 11.84 between nodes 42 and 41											
Volume capacity of Wet Pipes 34637.45gal			Volume capacity of Dry Pipes								
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply		97.000	88.000		1900.00	89.601		1709.12	84.236	5.365
25	Pump		79.190	75.000		1500.00	143.934		1709.12	138.569	5.365
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number 1		Contact Name Brock Browning				Contact Title Designer					
Name of Contractor: F.E. Moran, Inc.				Phone 913-827-8595				Extension			
Address 1 16815 College Blvd				FAX 217-356-0777							
Address 2 Lenexa, KS				E-mail brock.browning@femoran.com							
Address 3 66219				Web-Site https://www.femoran.com/							



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure

97.000

Residual: Pressure

88.000 @ 1900.00

Available Flow @ 20 PSI:

6055.75

Available Pressure at System Demand

89.601 @ 1709.12

Required Pressure at System Demand

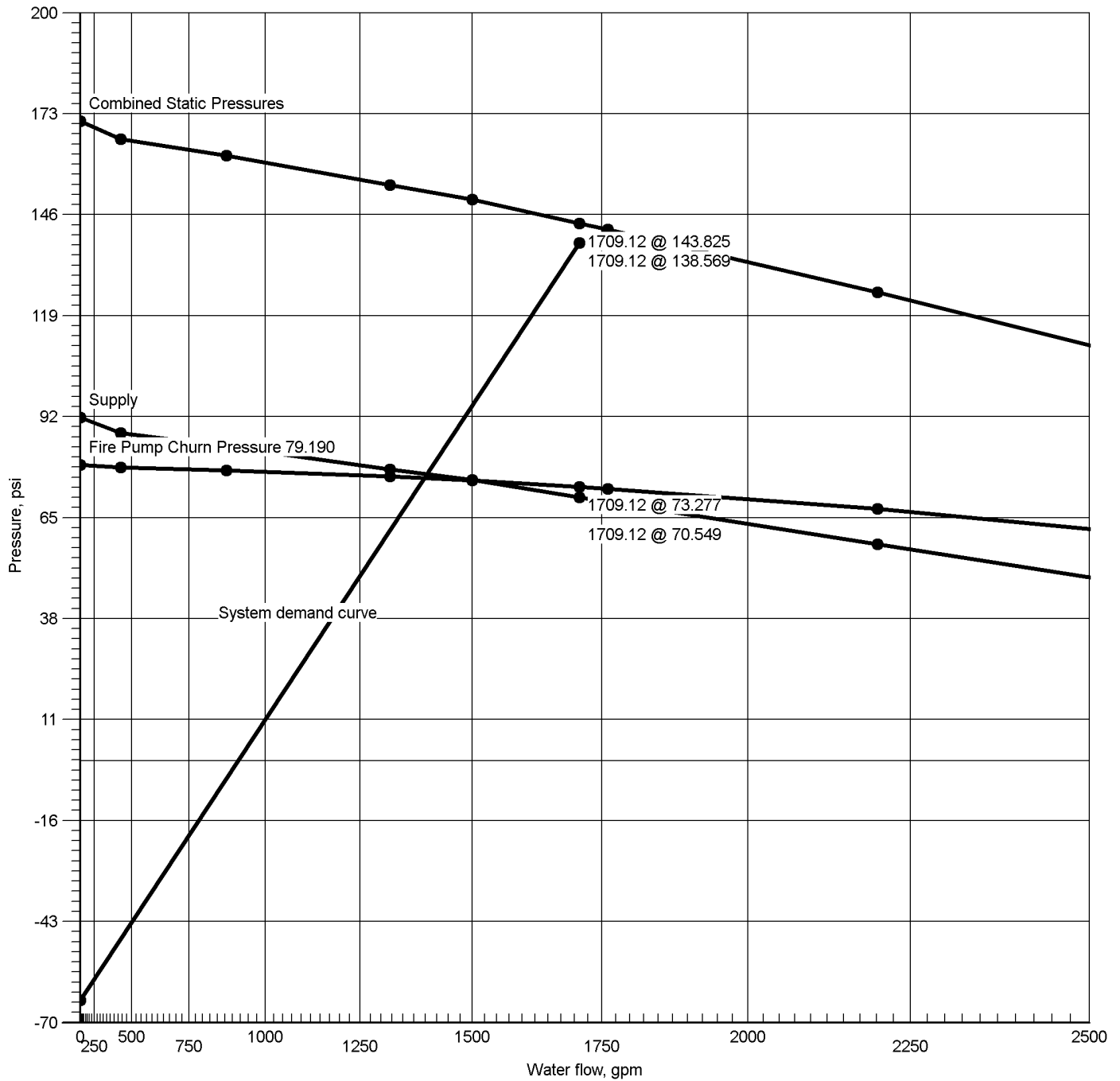
84.236 @ 1709.12

Required Pressure at System Demand (Including Hose Allowance at Source)

84.236 @ 1709.12



Pump at Node 25



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 25

171.054

75.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

171.054

79.190

Residual: Pressure

73.385 @ 1709.12

Available Pressure at System Demand

143.934 @ 1709.12

Required Pressure at System Demand

138.569 @ 1709.12



Summary Of Outflowing Devices

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	153	250.00	250.00	0.00	123.985			
⇒ Sprinkler	701	121.15	121.15	16.80	52.000			
Sprinkler	702	121.53	121.15	16.80	52.326			
Sprinkler	703	121.15	121.15	16.80	52.000			
Sprinkler	704	121.56	121.15	16.80	52.352			
Sprinkler	705	121.31	121.15	16.80	52.140			
Sprinkler	706	121.69	121.15	16.80	52.467			
Sprinkler	707	121.31	121.15	16.80	52.140			
Sprinkler	708	121.72	121.15	16.80	52.493			
Sprinkler	709	121.73	121.15	16.80	52.504			
Sprinkler	710	122.11	121.15	16.80	52.833			
Sprinkler	711	121.73	121.15	16.80	52.504			
Sprinkler	712	122.14	121.15	16.80	52.860			

⇒ Most Demanding Sprinkler Data



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	2.7050	118.70	6.63	120		0.034811	9'-4½"	Pf 0.326
701	37'-2	121.15	16.80	52.000		Sprinkler		Pe
702	37'-2			52.326			9'-4½"	Pv
BL	2.7050	240.22	13.41	120		0.128274	164'-7½"	Pf 25.919
702	37'-2	121.53	16.80	52.326		Sprinkler,	37'-5¼"	Pe
171	36'-4¼"			78.245		2PO(18'-8½")	202'-0¾"	Pv
CM	4.3100	240.22	5.28	120		0.013271	9'-0"	Pf 0.119
171	36'-4¼"			78.245				Pe 0.076
172	36'-2¼"			78.441			9'-0"	Pv
CM	4.3100	480.72	10.57	120		0.047891	9'-0"	Pf 0.431
172	36'-2¼"	240.50		78.441		Flow (q) from Route 3		Pe 0.076
173	36'-0¼"			78.948			9'-0"	Pv
CM	4.3100	721.93	15.88	120		0.101617	9'-0"	Pf 0.915
173	36'-0¼"	241.21		78.948		Flow (q) from Route 5		Pe 0.076
174	35'-10			79.939			9'-0"	Pv
CM	4.3100	790.53	17.38	120		0.120197	9'-0"	Pf 1.082
174	35'-10	68.59		79.939		Flow (q) from Route 2		Pe 0.076
175	35'-8			81.098			9'-0"	Pv
CM	4.3100	861.28	18.94	120		0.140852	9'-0"	Pf 1.268
175	35'-8	70.75		81.098		Flow (q) from Route 9		Pe 0.076
176	35'-5¼"			82.442			9'-0"	Pv
CM	4.3100	936.51	20.59	120		0.164454	9'-10½"	Pf 1.624
176	35'-5¼"	75.23		82.442		Flow (q) from Route 10		Pe 0.085
177	35'-3½"			84.151			9'-10½"	Pv
CM	4.3100	1018.96	22.41	120		0.192238	10'-0"	Pf 1.923
177	35'-3½"	82.45		84.151		Flow (q) from Route 11		Pe 0.086
178	35'-1			86.160			10'-0"	Pv
CM	4.3100	1110.79	24.43	120		0.225510	10'-0"	Pf 2.256
178	35'-1	91.83		86.160		Flow (q) from Route 12		Pe 0.086
179	34'-10¾"			88.502			10'-0"	Pv
CM	4.3100	1213.82	26.69	120		0.265727	10'-0"	Pf 2.658
179	34'-10¾"	103.03		88.502		Flow (q) from Route 13		Pe 0.086
180	34'-8¼"			91.246			10'-0"	Pv
CM	4.3100	1329.70	29.24	120		0.314552	10'-0"	Pf 3.146
180	34'-8¼"	115.88		91.246		Flow (q) from Route 14		Pe 0.086
181	34'-6			94.478			10'-0"	Pv
CM	4.3100	1459.12	32.09	120		0.373525	5'-5¾"	Pf 4.583
181	34'-6	129.43		94.478		Flow (q) from Route 15	6'-9½"	Pe 0.047
182	34'-4½"			99.109		fE(6'-9½")	12'-3¼"	Pv
CM	6.3570	1459.12	14.75	120		0.056284	56'-3¾"	Pf 4.858
182	34'-4½"			99.109			30'-0"	Pe 12.872
183	4'-8¼"			116.839		3fE(10'-0")	86'-3¾"	Pv
FR	6.0650	1459.12	16.20	120		0.070768	1'-10¾"	Pf 4.946
183	4'-8¼"			116.839			68'-0"	Pe 1.121
184	2'-1¼"			122.905		CV(20'-0), BV(8'-0), f(10'-0), PO(30'-0)	69'-10¾"	Pv
CM	8.2490	1459.12	8.76	120		0.015825	3'-6½"	Pf 0.298
184	2'-1¼"			122.905			15'-3¾"	Pe 0.463
145	1'-0½"			123.666		fE(15'-3¾")	18'-9¾"	Pv
FR	8.4500	1459.12	8.35	140		0.010582	9'-2¾"	Pf 0.990
145	1'-0½"			123.666			84'-3¾"	Pe 1.971
146	-3'-6			126.626		LtE(22'-10), PO(61'-5¾")	93'-6½"	Pv
UG	7.6800	854.86	5.92	150		0.005517	1472'-10¾"	Pf 8.615
146	-3'-6			126.626			88'-10¾"	Pe 0.000
41	-3'-6			135.242		2E(22'-6½), T(43'-10)	1561'-9¾"	Pv
UG	7.6800	1709.12	11.84	150		0.019874	31'-8½"	Pf 0.630
41	-3'-6	854.27		135.242		Flow (q) from Route 7		Pe
42	-3'-6			135.872			31'-8½"	Pv
UG	8.3900	1709.12	9.92	140		0.014680	12'-11	Pf 0.638
42	-3'-6			135.872			30'-6½"	Pe -1.951
43	1'-0			134.558		E(30'-6½")	43'-5¼"	Pv
CM	8.2490	1709.12	10.26	120		0.021204	19'-9¾"	Pf 4.654
43	1'-0			134.558			199'-8	Pe -0.643
25	2'-5¾"			138.569		3fE(15'-3¾), 2T(41'-1¼), BV(18'-9½), CV(52'-10¼)	219'-5¾"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss		Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Fittings	Eq. Length	Summary
Upstream							Total Length	
Pump		Velocity						
25		1709.12		138.569		Rating: 75.000 @ 1500.00		
26		Q=1709.12	6.49	65.184		Fire Pump Churn Pressure: 79.19 0		
CM	10.3700	1709.12	6.49	120		0.006957	1'-8 3/4"	Pf 0.464
26	2'-8 3/4"			65.184			65'-0"	Pe 0.752
8	1'-0"			66.400		GV(5'-11"), T(59'-1 1/4")	66'-9"	Pv
UG	10.4000	1709.12	6.46	140		0.005158	13'-11"	Pf 0.253
8	1'-0"			66.400			35'-1"	Pe 2.384
7	-4'-6"			69.037		E(35'-1")	48'-11 1/4"	Pv
UG	9.4200	1709.12	7.87	150		0.007351	72'-10"	Pf 0.626
7	-4'-6"			69.037			12'-3 1/2"	Pe
6	-4'-6"			69.663		EE(12'-3 1/2")	85'-1 1/4"	Pv
UG	10.4000	1709.12	6.46	140		0.005158	5'-11 1/4"	Pf 3.944
6	-4'-6"			69.663				Pe
5	-4'-6"			73.607		BFP(-3.914)	5'-11 1/4"	Pv
UG	10.4000	1709.12	6.46	140		0.005158	5'-11 1/4"	Pf 0.031
5	-4'-6"			73.607				Pe
4	-4'-6"			73.638			5'-11 1/4"	Pv
UG	9.4200	1709.12	7.87	150		0.007351	204'-11 1/2"	Pf 1.918
4	-4'-6"			73.638			55'-10 3/4"	Pe
3	-4'-6"			75.555		T(55'-10 3/4")	260'-10 1/4"	Pv
UG	11.2000	1709.12	5.57	150		0.003165	2459'-6"	Pf 8.242
3	-4'-6"			75.555			144'-11 3/4"	Pe
2	-4'-6"			83.797		8EE(14'-4 3/4"), E(29'-10 1/2")	2604'-5 3/4"	Pv
UG	12.4600	1709.12	4.50	140		0.002139	204'-11 1/2"	Pf 0.438
2	-4'-6"			83.797				Pe
1	-4'-6"			84.236		Water Supply	204'-11 1/2"	Pv
		0.00				Hose Allowance At Source		
1		1709.12						
Route 2								
BL	2.7050	2.45	0.14	120		0.000027	9'-4 1/2"	Pf 0.000
701	37'-2"	121.15	16.80	52.000		Sprinkler		Pe
703	37'-2"			52.000			9'-4 1/2"	Pv
BL	2.7050	123.60	6.90	120		0.037515	9'-4 1/2"	Pf 0.352
703	37'-2"	121.15	16.80	52.000		Sprinkler		Pe
704	37'-2"			52.352			9'-4 1/2"	Pv
BL	2.7050	245.15	13.69	120		0.133184	119'-10"	Pf 20.946
704	37'-2"	121.56	16.80	52.352		Sprinkler,	37'-5 1/4"	Pe
185	36'-4 1/4"			73.298		2PO(18'-8 1/2")	157'-3 1/4"	Pv
CM	4.3100	245.15	5.39	120		0.013779	9'-0"	Pf 0.124
185	36'-4 1/4"			73.298				Pe 0.076
186	36'-2 1/4"			73.498			9'-0"	Pv
CM	4.3100	490.68	10.79	120		0.049742	9'-0"	Pf 0.448
186	36'-2 1/4"	245.53		73.498		Flow (q) from Route 4		Pe 0.076
187	36'-0 1/4"			74.022			9'-0"	Pv
CM	4.3100	737.19	16.21	120		0.105627	9'-0"	Pf 0.951
187	36'-0 1/4"	246.51		74.022		Flow (q) from Route 6		Pe 0.076
188	35'-10"			75.049			9'-0"	Pv
RN	2.7050	68.59	3.83	120		0.012622	312'-7"	Pf 4.890
188	35'-10"			75.049		PO(18'-8 1/2")	74'-10 1/2"	Pe
174	35'-10"			79.939		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 3								
BL	2.7050	118.81	6.63	120		0.034873	9'-4 1/2"	Pf 0.327
705	37'-0"	121.31	16.80	52.140		Sprinkler		Pe
706	37'-0"			52.467			9'-4 1/2"	Pv
BL	2.7050	240.50	13.43	120		0.128548	164'-7 1/2"	Pf 25.974
706	37'-0"	121.69	16.80	52.467		Sprinkler,	37'-5 1/4"	Pe
172	36'-2 1/4"			78.441		2PO(18'-8 1/2")	202'-0 3/4"	Pv
Route 4								
BL	2.7050	2.50	0.14	120		0.000028	9'-4 1/2"	Pf 0.000
705	37'-0"	121.31	16.80	52.140		Sprinkler		Pe
707	37'-0"			52.140			9'-4 1/2"	Pv
BL	2.7050	123.81	6.91	120		0.037634	9'-4 1/2"	Pf 0.353
707	37'-0"	121.31	16.80	52.140		Sprinkler		Pe
708	37'-0"			52.493			9'-4 1/2"	Pv



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
BL	2.7050	245.53	13.71	120		0.133561	119'-10"	Pf 21.005
708	37'-0"	121.72	16.80	52.493		Sprinkler,	37'-5 1/4"	Pe
186	36'-2 1/4"			73.498		2PO(18'-8 1/2")	157'-3 1/4"	Pv
Route 5								
BL	2.7050	119.10	6.65	120		0.035027	9'-4 1/2"	Pf 0.328
709	36'-9 3/4"	121.73	16.80	52.504		Sprinkler		Pe
710	36'-9 3/4"			52.833			9'-4 1/2"	Pv
BL	2.7050	241.21	13.47	120		0.129248	164'-7 1/2"	Pf 26.116
710	36'-9 3/4"	122.11	16.80	52.833		Sprinkler,	37'-5 1/4"	Pe
173	36'-0 1/4"			78.948		2PO(18'-8 1/2")	202'-0 3/4"	Pv
Route 6								
BL	2.7050	2.64	0.15	120		0.000030	9'-4 1/2"	Pf 0.000
709	36'-9 3/4"	121.73	16.80	52.504		Sprinkler		Pe
711	36'-9 3/4"			52.504			9'-4 1/2"	Pv
BL	2.7050	124.37	6.94	120		0.037951	9'-4 1/2"	Pf 0.356
711	36'-9 3/4"	121.73	16.80	52.504		Sprinkler		Pe
712	36'-9 3/4"			52.860			9'-4 1/2"	Pv
BL	2.7050	246.51	13.76	120		0.134557	119'-10"	Pf 21.162
712	36'-9 3/4"	122.14	16.80	52.860		Sprinkler,	37'-5 1/4"	Pe
187	36'-0 1/4"			74.022		2PO(18'-8 1/2")	157'-3 1/4"	Pv
Route 7								
UG	6.0900	250.00	2.75	150		0.001756	32'-4 1/4"	Pf 0.176
153	3'-6"	250.00		123.985		Hydrant,	67'-9 1/2"	Pe 3.035
154	-3'-6"			127.196		E(21'-6 3/4"), PO(46'-2 1/2")	100'-1 1/2"	Pv
UG	7.6800	854.27	5.92	150		0.005509	1393'-11 1/4"	Pf 8.046
154	-3'-6"	604.27		127.196		Flow (q) from Route 8	66'-4 1/2"	Pe 0.000
41	-3'-6"			135.242		E(22'-6 1/2"), T(43'-10")	1460'-4 1/4"	Pv
Route 8								
UG	7.6800	604.27	4.19	150		0.002904	173'-8 1/4"	Pf 0.570
146	-3'-6"	854.86		126.626		Flow (q) from Route 1	22'-6 1/2"	Pe
154	-3'-6"			127.196		E(22'-6 1/2")	196'-2 3/4"	Pv
Route 9								
CM	4.3100	668.60	14.70	120		0.088167	9'-0"	Pf 0.794
188	35'-10"	68.59		75.049		Flow (q) from Route 2		Pe 0.076
189	35'-8"			75.919			9'-0"	Pv
RN	2.7050	70.75	3.95	120		0.013366	312'-7"	Pf 5.179
189	35'-8"			75.919		PO(18'-8 1/2")	74'-10 1/2"	Pe
175	35'-8"			81.098		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 10								
CM	4.3100	597.85	13.15	120		0.071687	9'-0"	Pf 0.645
189	35'-8"	70.75		75.919		Flow (q) from Route 9		Pe 0.076
190	35'-5 1/4"			76.640			9'-0"	Pv
RN	2.7050	75.23	4.20	120		0.014973	312'-7"	Pf 5.801
190	35'-5 1/4"			76.640		PO(18'-8 1/2")	74'-10 1/2"	Pe
176	35'-5 1/4"			82.442		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 11								
CM	4.3100	522.62	11.49	120		0.055897	9'-10 1/2"	Pf 0.552
190	35'-5 1/4"	75.23		76.640		Flow (q) from Route 10		Pe 0.085
191	35'-3 1/2"			77.277			9'-10 1/2"	Pv
RN	2.7050	82.45	4.60	120		0.017740	312'-7"	Pf 6.874
191	35'-3 1/2"			77.277		PO(18'-8 1/2")	74'-10 1/2"	Pe
177	35'-3 1/2"			84.151		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 12								
CM	4.3100	440.17	9.68	120		0.040685	10'-0"	Pf 0.407
191	35'-3 1/2"	82.45		77.277		Flow (q) from Route 11		Pe 0.086
192	35'-1"			77.770			10'-0"	Pv
RN	2.7050	91.83	5.13	120		0.021653	312'-7"	Pf 8.389
192	35'-1"			77.770		PO(18'-8 1/2")	74'-10 1/2"	Pe
178	35'-1"			86.160		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 13								
CM	4.3100	348.34	7.66	120		0.026391	10'-0"	Pf 0.264
192	35'-1"	91.83		77.770		Flow (q) from Route 12		Pe 0.086
193	34'-10 3/4"			78.121			10'-0"	Pv
RN	2.7050	103.03	5.75	120		0.026793	312'-7"	Pf 10.381
193	34'-10 3/4"			78.121		PO(18'-8 1/2")	74'-10 1/2"	Pe
179	34'-10 3/4"			88.502		3PO(18'-8 1/2")	387'-5 1/2"	Pv
Route 14								



Hydraulic Analysis

Job Number: 21224100 - Lees Summit 3
Report Description: ESFR (#7- System 7)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream					Fittings	Total Length	
CM	4.3100	245.30	5.39	120	0.013794	10'-0	Pf 0.138
193	34'-10¾	103.03		78.121	Flow (q) from Route 13		Pe 0.086
194	34'-8¾			78.345		10'-0	Pv
RN	2.7050	115.88	6.47	120	0.033296	312'-7	Pf 12.901
194	34'-8¾			78.345	PO(18'-8½)	74'-10½	Pe
180	34'-8¾			91.246	3PO(18'-8½)	387'-5½	Pv
***** Route 15 *****							
CM	4.3100	129.43	2.85	120	0.004227	10'-0	Pf 0.042
194	34'-8¾	115.88		78.345	Flow (q) from Route 14		Pe 0.086
195	34'-6			78.474		10'-0	Pv
RN	2.7050	129.43	7.23	120	0.040854	312'-7	Pf 16.005
195	34'-6			78.474	PO(18'-8½)	79'-2	Pe
181	34'-6			94.478	3PO(18'-8½), Tr(4'-3½)	391'-9	Pv

Equivalent Pipe Lengths of Valves and Fittings (C=120 only)

C Value Multiplier

$$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$$

Value Of C	100	130	140	150
Multiplying Factor	0.713	1.16	1.33	1.51

Pipe Type Legend

AO Arm-Over
BL Branch Line
CM Cross Main
DN Drain
DR Drop
DY Dynamic
FM Feed Main
FR Feed Riser
MS Miscellaneous
OR Outrigger
RN Riser Nipple
SN Swing Nipple
SP Sprig
ST Stand Pipe
UG Underground

Units Legend

Diameter Inch
Elevation Foot
Flow gpm
Discharge gpm
Velocity fps
Pressure psi
Length Foot
Friction Loss psi/Foot
HWC Hazen-Williams Constant
Pt Total pressure at a point in a pipe
Pn Normal pressure at a point in a pipe
Pf Pressure loss due to friction between points
Pe Pressure due to elevation difference between indicated points
Pv Velocity pressure at a point in a pipe

Fittings Legend

ALV Alarm Valve
AngV Angle Valve
b Bushing
BaV Ball Valve
BFP Backflow Preventer
BV Butterfly Valve
C Cross Flow Turn 90°
cplg Coupling
Cr Cross Run
CV Check Valve
DelV Deluge Valve
DPV Dry Pipe Valve
E 90° Elbow
EE 45° Elbow
Ee1 11¼° Elbow
Ee2 22½° Elbow
f Flow Device
fd Flex Drop
FDC Fire Department Connection
fE 90° FireLock(TM) Elbow
fEE 45° FireLock(TM) Elbow
flg Flange
FN Floating Node
fT FireLock(TM) Tee
g Gauge
GloV Globe Valve
GV Gate Valve
Ho Hose
Hose Hose
HV Hose Valve
Hyd Hydrant
LtE Long Turn Elbow
mecT Mechanical Tee
Noz Nozzle
P1 Pump In
P2 Pump Out
PIV Post Indicating Valve
PO Pipe Outlet
PRV Pressure Reducing Valve
PrV Pressure Relief Valve
red Reducer/Adapter
S Supply
sCV Swing Check Valve
Spr Sprinkler
St Strainer
T Tee Flow Turn 90°
Tr Tee Run
U Union
WirF Wirsbo
WMV Water Meter Valve
Z Cap

