

F. E. Moran, Inc. Fire Protection



3001 Research Road, Suite A ♦ Champaign, Illinois 61822 ♦ (217)356-0700 ♦ Fax (217) 356-0777

Hydraulic Calculations

For

Lee's Summit Commerce Center
Building 2

NW Corner of Tudor Rd & Main St.
Lee's Summit, MO 64086

FEM Job # 212240000

Date: 08/12/2022

Jay Colbert

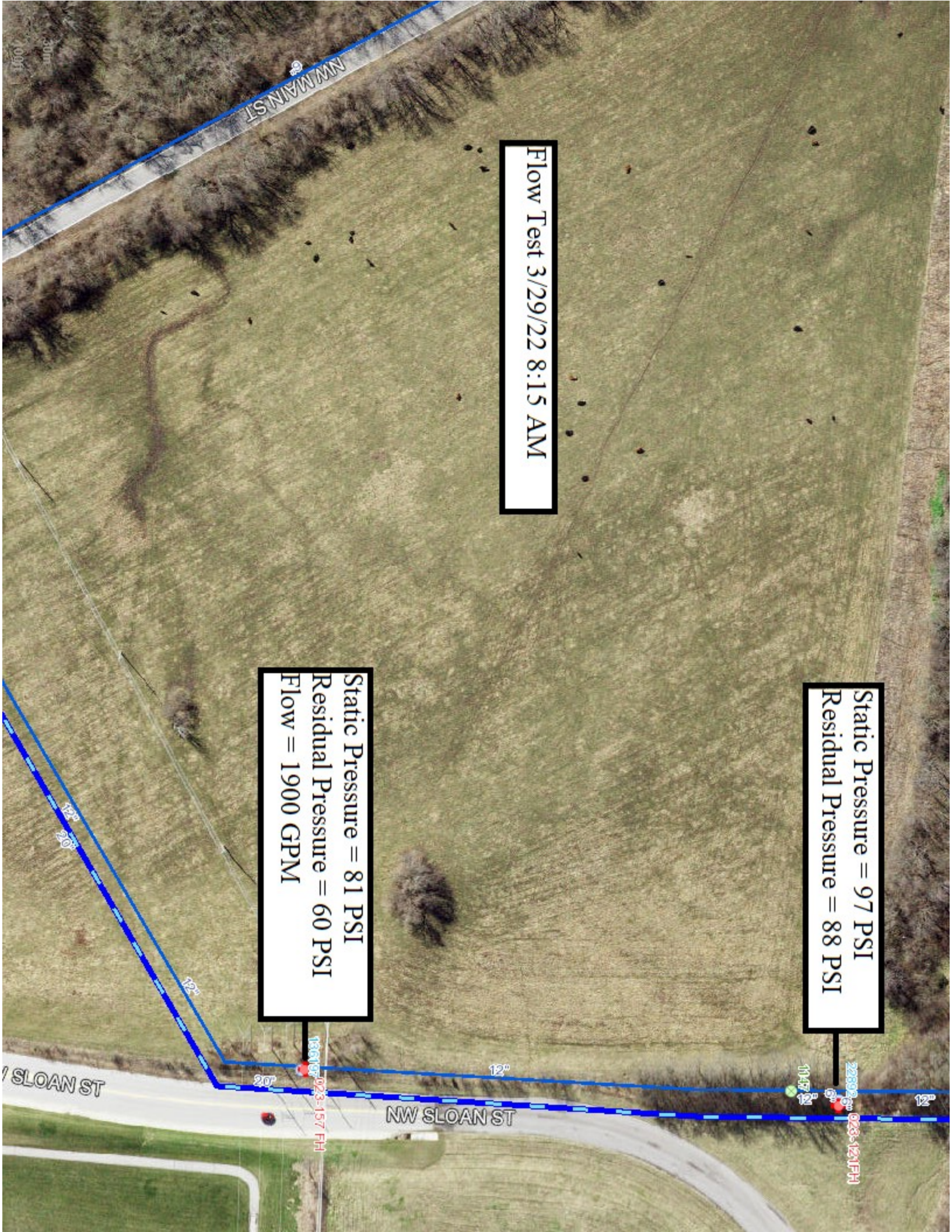
F.E. MORAN, INC. FIRE PROTECTION
COA # E2022012018



Flow Test 3/29/22 8:15 AM

Static Pressure = 97 PSI
Residual Pressure = 88 PSI

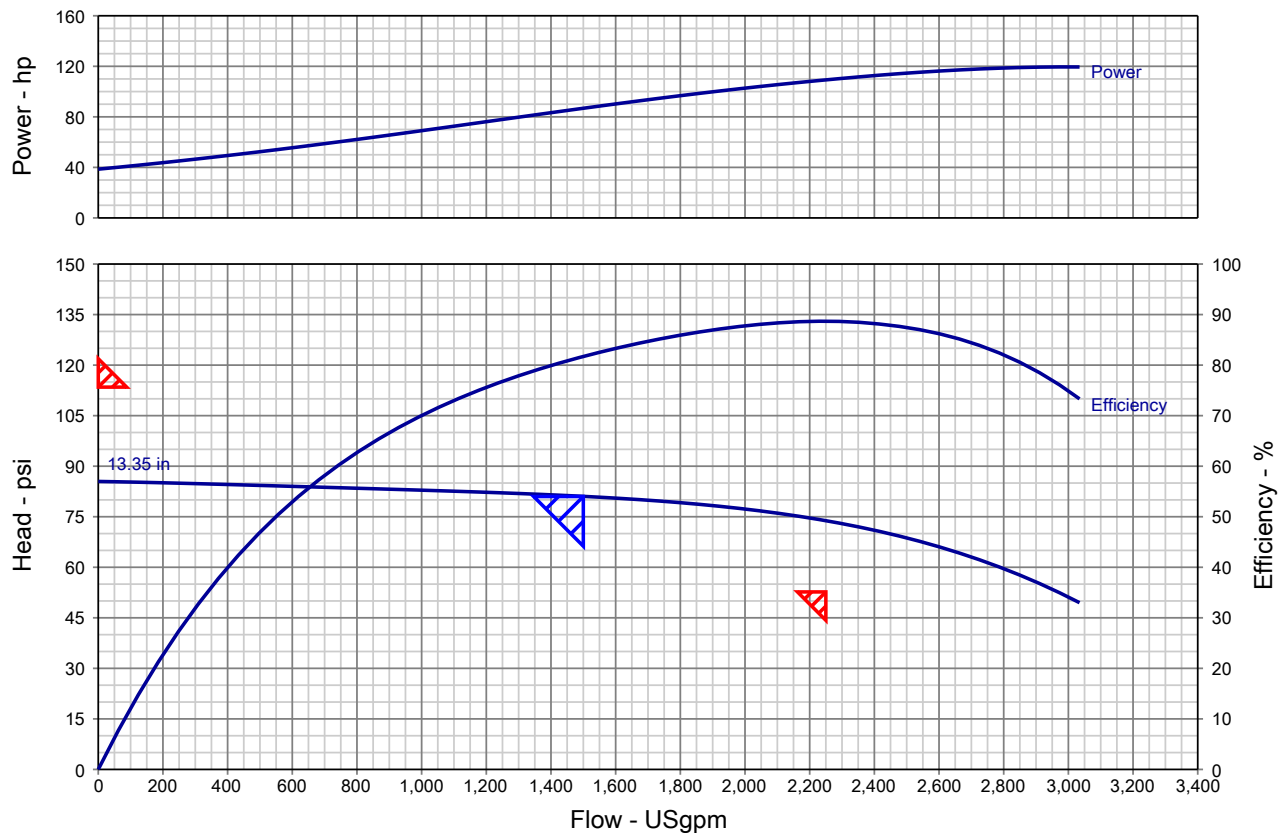
Static Pressure = 81 PSI
Residual Pressure = 60 PSI
Flow = 1900 GPM



Pump Performance Datasheet

Customer	: FFF - Missouri	Quote number	: 465059
Customer enquiry	: FE MORAN	Pump Size	: TE15G
Item number	: 001	Stages	: 1
Usage - Tertiary	:	Based on curve number	: TE15G Rev 0
Quantity	: 1	Date last saved	: 04 Aug 2022 2:42 PM

Operating Conditions		Liquid	
Flow, rated	: 1,500.0 USgpm	Liquid Type/ Application	: Water
Differential Head (requested)	: 81.00 psi	Additional liquid description	:
Suction pressure, rated / max	: 89.00 / 89.00 psi.g	Temperature, max	: 68.00 deg F
NPSH available, rated	: Ample	Fluid density, rated / max	: 1.000 / 1.000 SG
Site Supply Frequency	: 60 Hz	Viscosity, rated	: 1.00 cP
NFPA Limits		Performance	
Flow, rated	: 1,500.0 USgpm	Speed, rated	: 1760 rpm
Head, rated	: 81.05 psi	Impeller diameter, rated (approx.)	: 13.35 in
Power, rated	: 86.79 hp	Impeller diameter, maximum	: 15.26 in
NPSHr, rated	: -	Impeller diameter, minimum	: 12.40 in
Efficiency, rated	: 81.71 %	Efficiency	: 81.71 %
Flow at 150%	: 2,250.0 USgpm	NPSH required / margin required	: - / 0.00 ft
Head at 150%, actual/limit	: 73.83 psi	Head, maximum, rated diameter (approx.)	: 85.47 psi
Efficiency at 150%	: 88.69 %	Diameter ratio (rated / max)	: 87.48 %
NPSHr at 150% flow	: -	Driver & Power Data (@Max density)	
Power required at 150% flow	: 109 hp	Power, hydraulic	: 70.92 hp
Peak power	: 120 hp	Power, rated	: 86.79 hp
Closed valve pressure	: 174.5 psi.g	Power, maximum, rated diameter	: 120 hp
140% Head at shutoff	: 113.5 psi	Material	
65% Head at 150% flow	: 52.68 psi	Material selected	: CI / Br / CS (Standard)
Cooling flow (None)	: 0.00 USgpm	Selection status	
Pressure Data		FM/UL/cUL approved	: FM/UL
Maximum working pressure	: 174.5 psi.g	Near miss reasons	:
Maximum allowable working pressure	: 225.0 psi.g		
Maximum allowable suction pressure	: 139.5 psi.g		
Hydrostatic test pressure	: 261.7 psi.g		





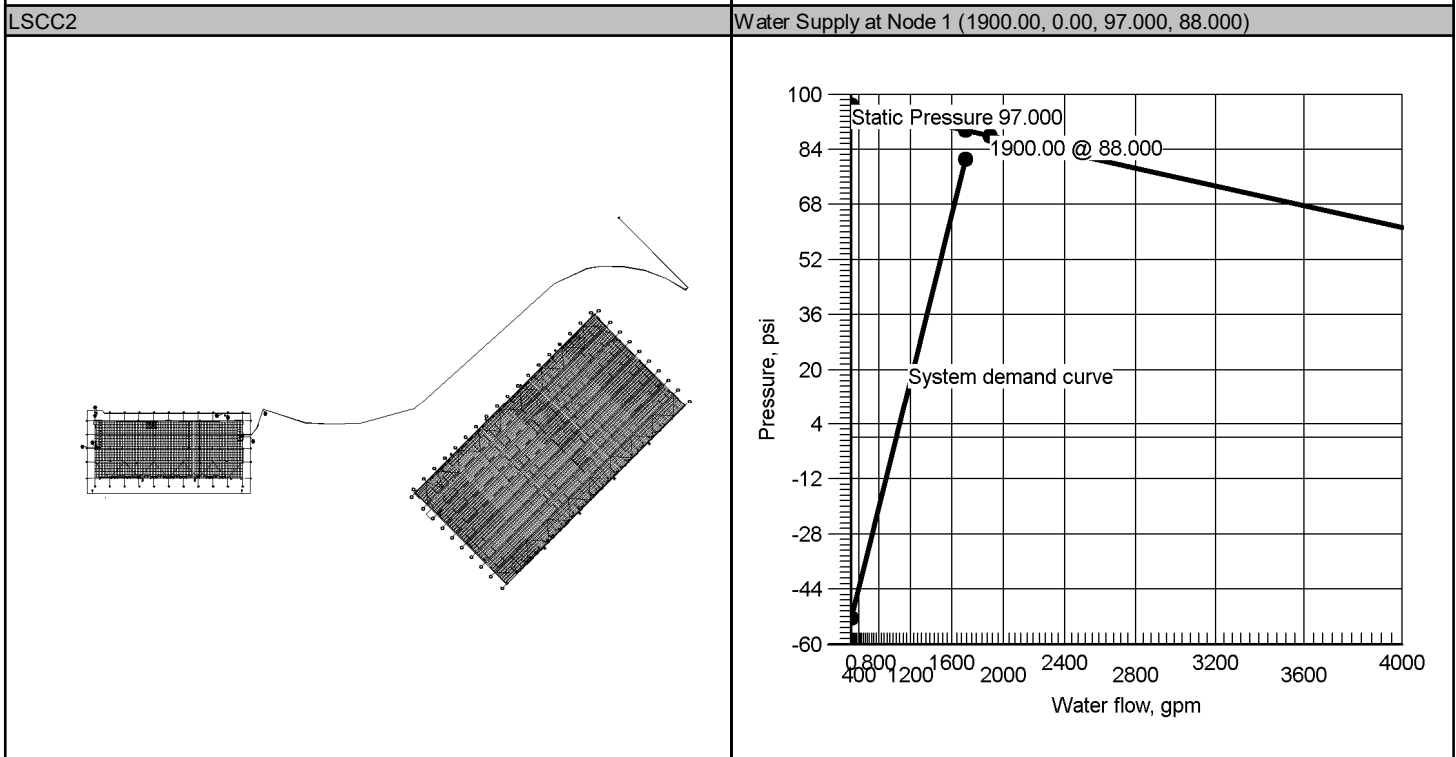
Hydraulic Overview

Job Number: 212240000
Report Description: FP Overhead System 1

Job		
Job Number 212240000	Design Engineer J. Colbert	
Job Name: Lee's Summit Commerce Center II	Phone 913-242-0057	FAX
Address 1 NW Tudor Rd & NW Main St	State Certification/License Number	
Address 2	AHJ Lee's Summit Permits & Licensing	
Address 3 Lee's Summit, MO 34086	Job Site/Building Building II	

System	
Pressure 52.000	Area of Application NA
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000	Hose Streams 250.00
Coverage Per Sprinkler 100 ft ²	Number Of Sprinklers Calculated 12 0
System Pressure Demand 81.376	System Flow Demand 1709.74
Total Demand 1709.74 @ 81.376	Pressure Result +8.220 (9.2%)

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	Gauge 4 (4)	62.077	217	1709.74
5	Pump	1500.00		73.670	70.000				
Pumps: Static = Churn (Pressure @ Zero Flow)									





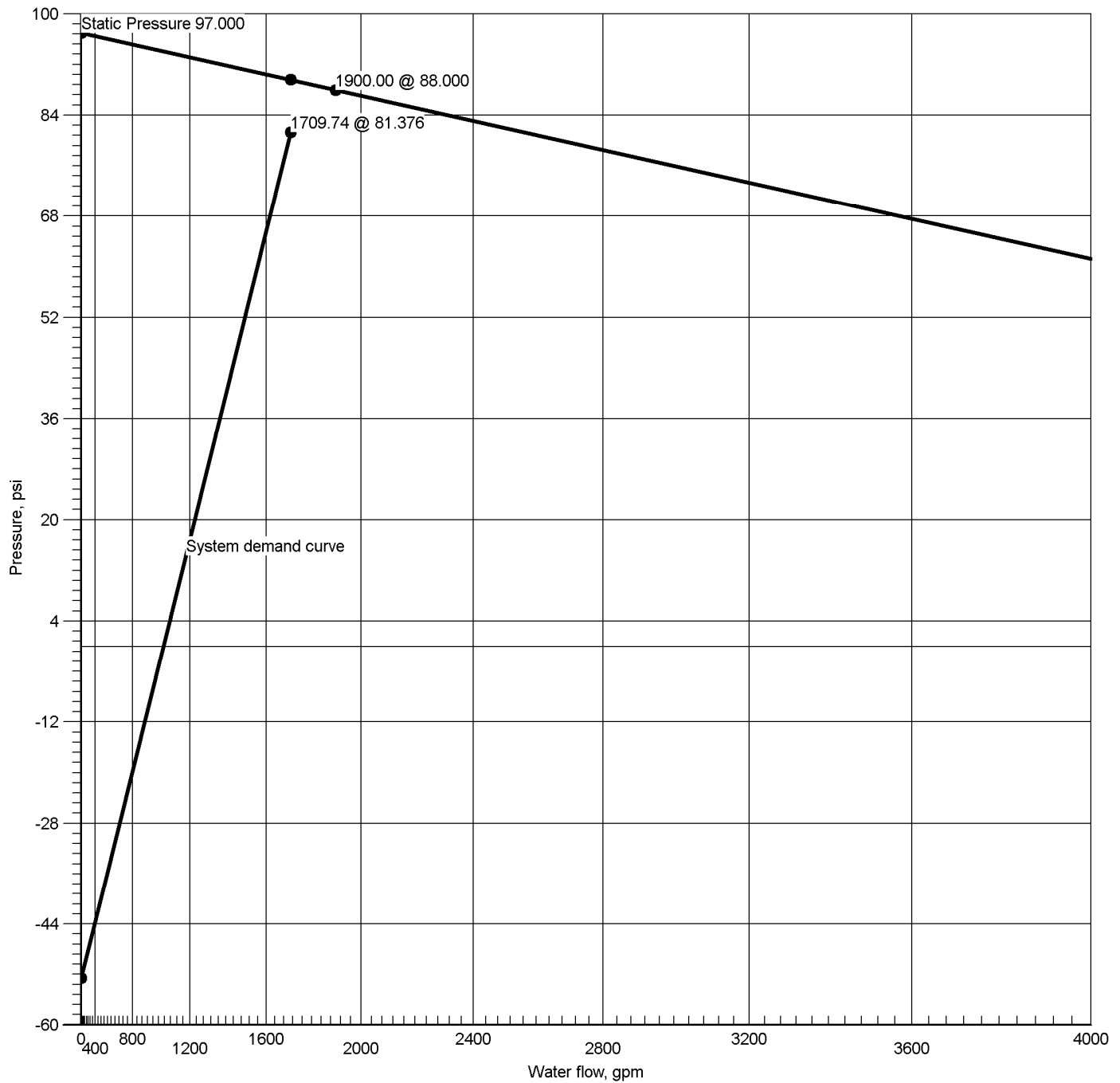
Hydraulic Summary

Job Number: 212240000
Report Description: FP Overhead System 1

Job											
Job Number 212240000					Design Engineer J. Colbert						
Job Name: Lee's Summit Commerce Center II					State Certification/License Number						
Address 1 NW Tudor Rd & NW Main St					AHJ Lee's Summit Permits & Licensing						
Address 2					Job Site/Building Building II						
Address 3 Lee's Summit, MO 34086					Drawing Name LSCC2						
System					Remote Area(s)						
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000					Occupancy ESFR			Job Suffix			
Hose Allowance At Source 0.00					Pressure 52.000			Area of Application NA			
Additional Hose Supplies Node Hydrant At Node 53					Flow(gpm) 250.00		Number Of Sprinklers Calculated 12		Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100 ft ²	
					AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 81.345 Right: 81.241						
Total Hose Streams 250.00											
System Flow Demand 1709.74				Total Water Required (Including Hose Allowance) 1709.74							
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.10 between nodes 120 and 118											
Maximum Velocity Under Ground 11.84 between nodes 8 and 9											
Volume capacity of Wet Pipes 38256.16 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	89.596		1709.74	81.376	8.220
5	Pump		73.670	70.000		1500.00	138.323		1709.74	130.103	8.220
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number -				Contact Name Jay Colbert				Contact Title Designer			
Name of Contractor: F.E. Moran Fire Protection Inc.				Phone 913.242.0057				Extension			
Address 1 16815 College Blvd.				FAX							
Address 2				E-mail jay.colbert@femoran.com							
Address 3 Lenexa, KS 66219				Web-Site femoranfp.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

89.596 @ 1709.74

Required Pressure at System Demand

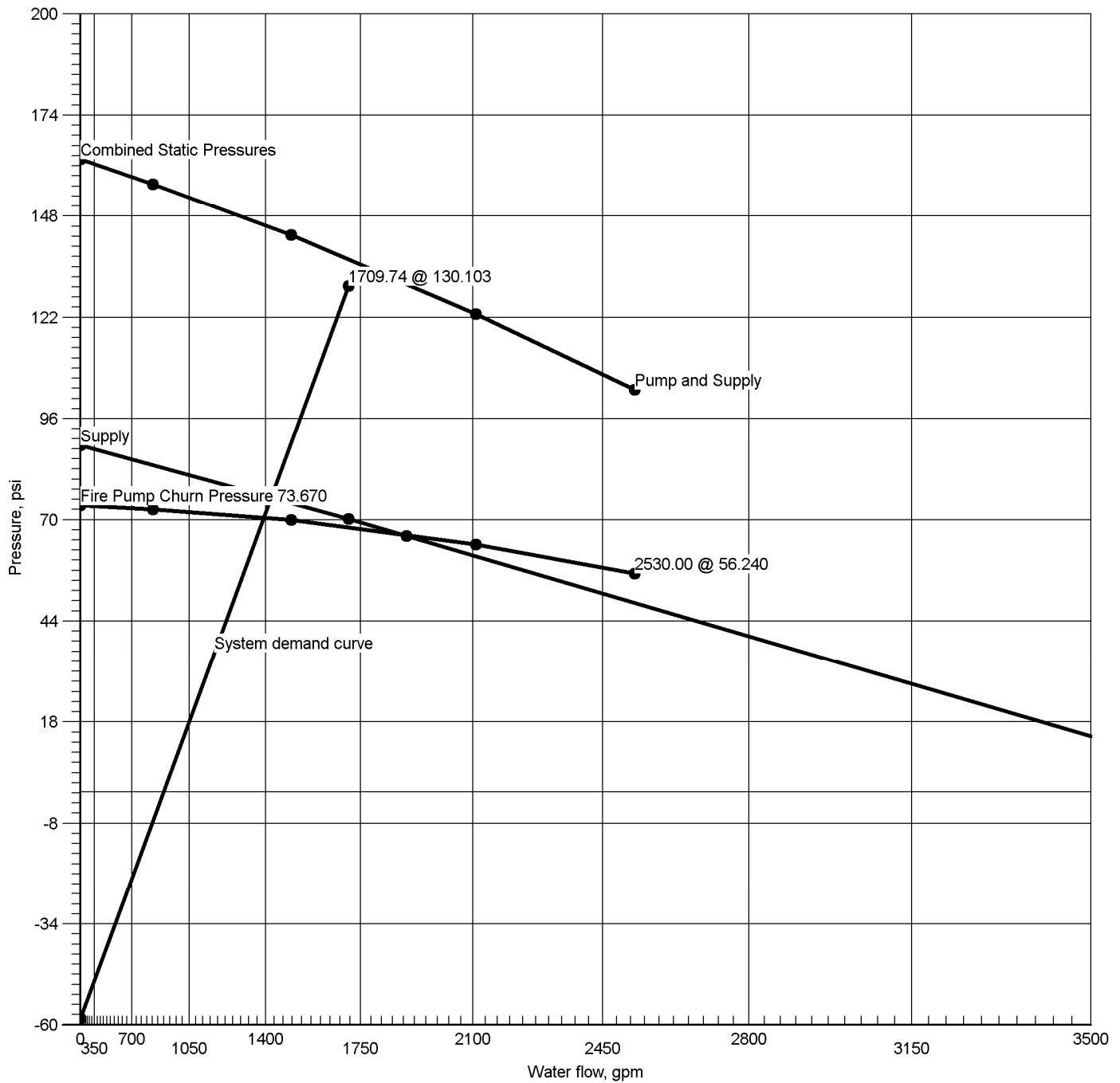
81.376 @ 1709.74

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

81.376 @ 1709.74



Pump at Node 5



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 5

162.747

70.000 @ 1500.00

Static: Pressure

Fire Pump Churn Pressure

162.747

73.670

Residual: Pressure

68.026 @ 1709.74

Available Pressure at System Demand

138.323 @ 1709.74

Required Pressure at System Demand

130.103 @ 1709.74



Summary Of Outflowing Devices

Job Number: 212240000
Report Description: FP Overhead System 1

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	53	250.00	250.00	0	120.039			
⇒ Sprinkler	1111	121.15	121.15	16.8	52.000			
Sprinkler	1113	121.15	121.15	16.8	52.000			
Sprinkler	1115	121.63	121.15	16.8	52.412			
Sprinkler	1117	121.55	121.15	16.8	52.349			
Sprinkler	1119	121.33	121.15	16.8	52.156			
Sprinkler	1121	121.33	121.15	16.8	52.156			
Sprinkler	1123	121.81	121.15	16.8	52.569			
Sprinkler	1125	121.73	121.15	16.8	52.506			
Sprinkler	1127	121.80	121.15	16.8	52.559			
Sprinkler	1129	121.80	121.15	16.8	52.559			
Sprinkler	1131	122.28	121.15	16.8	52.974			
Sprinkler	1133	122.20	121.15	16.8	52.912			

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: 212240000
Report Description: FP Overhead System 1

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
1	-11'-6	S	81.376	1709.74
53	1'-0	Hyd	120.039	250.00
1111	37'-1½	Spr(-52.000)	52.000	121.15
1113	37'-1½	Spr(-52.000)	52.000	121.15
1115	37'-1½	Spr(-52.412)	52.412	121.63
1117	37'-1½	Spr(-52.349)	52.349	121.55
1119	36'-11½	Spr(-52.156)	52.156	121.33
1121	36'-11½	Spr(-52.156)	52.156	121.33
1123	36'-11½	Spr(-52.569)	52.569	121.81
1125	36'-11½	Spr(-52.506)	52.506	121.73
1127	36'-9	Spr(-52.559)	52.559	121.80
1129	36'-9	Spr(-52.559)	52.559	121.80
1131	36'-9	Spr(-52.974)	52.974	122.28
1133	36'-9	Spr(-52.912)	52.912	122.20
2	-8'-0	E(24'-7)	72.715	
3	1'-3½		63.376	
4	2'-2	P1, Gauge 4	62.077	
5	2'-2	P2(-68.034)	130.103	
6	2'-2		130.103	
7	2'-2	ft(38'-9)	128.307	
8	1'-0		125.968	
9	-5'-0	T(43'-10)	127.349	
10	-5'-0	T(43'-10)	122.147	
11	-5'-0	T(38'-4)	122.795	
12	-5'-0	T(38'-4)	125.839	
40	1'-0		118.045	
100	36'-3½	PO(18'-8½)	80.600	
102	36'-1½	PO(18'-8½)	80.826	
104	35'-11	PO(18'-8½)	81.411	
106	35'-8½	PO(18'-8½)	82.555	
108	35'-6	PO(18'-8½)	83.929	
110	35'-3½	PO(18'-8½)	85.564	
112	35'-1	PO(18'-8½)	87.501	
114	34'-10½	PO(18'-8½)	89.791	
116	34'-8	PO(18'-8½)	92.504	
118	34'-5½	PO(18'-8½)	95.724	
120	34'-5½		96.262	
122	1'-8½	PO(41'-1½)	117.743	
124	36'-3½	PO(18'-8½)	73.452	
126	36'-1½	PO(18'-8½)	73.674	
128	35'-11	PO(18'-8½)	74.242	
130	35'-8½	PO(18'-8½)	75.349	
132	35'-6	PO(18'-8½)	76.250	
134	35'-3½	PO(18'-8½)	76.961	
136	35'-1	PO(18'-8½)	77.495	
138	34'-10½	PO(18'-8½)	77.868	
140	34'-8	PO(18'-8½)	78.104	
142	34'-5½	PO(18'-8½)	78.237	



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 1

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	2.33	0.13	120		0.000024	9'-0	Pf 0.000
1111	37'-1½	121.15	16.8	52.000		Sprinkler		Pe
1113	37'-1½			52.000			9'-0	Pv
BL	2.7050	123.47	6.89	120		0.037445	11'-0	Pf 0.412
1113	37'-1½	121.15	16.8	52.000		Sprinkler		Pe
1115	37'-1½			52.412			11'-0	Pv
BL	2.7050	245.10	13.68	120		0.133130	171'-7	Pf 27.827
1115	37'-1½	121.63	16.8	52.412		Sprinkler,	37'-5	Pe 0.361
100	36'-3½			80.600		2PO(18'-8½)	209'-0	Pv
CM	4.3100	245.10	5.39	120		0.013773	10'-0	Pf 0.138
100	36'-3½			80.600				Pe 0.088
102	36'-1½			80.826			10'-0	Pv
CM	4.3100	490.52	10.79	120		0.049713	10'-0	Pf 0.497
102	36'-1½	245.43		80.826		Flow (q) from Route 3		Pe 0.088
104	35'-11			81.411			10'-0	Pv
CM	4.3100	736.81	16.20	120		0.105524	10'-0	Pf 1.055
104	35'-11	246.28		81.411		Flow (q) from Route 5		Pe 0.088
106	35'-8½			82.555			10'-0	Pv
CM	4.3100	819.89	18.03	120		0.128586	10'-0	Pf 1.286
106	35'-8½	83.08		82.555		Flow (q) from Route 2		Pe 0.088
108	35'-6			83.929			10'-0	Pv
CM	4.3100	905.87	19.92	120		0.154640	10'-0	Pf 1.547
108	35'-6	85.98		83.929		Flow (q) from Route 9		Pe 0.088
110	35'-3½			85.564			10'-0	Pv
CM	4.3100	997.30	21.93	120		0.184748	10'-0	Pf 1.848
110	35'-3½	91.43		85.564		Flow (q) from Route 10		Pe 0.088
112	35'-1			87.501			10'-0	Pv
CM	4.3100	1096.51	24.11	120		0.220177	10'-0	Pf 2.202
112	35'-1	99.21		87.501		Flow (q) from Route 11		Pe 0.088
114	34'-10½			89.791			10'-0	Pv
CM	4.3100	1205.58	26.51	120		0.262397	10'-0	Pf 2.625
114	34'-10½	109.07		89.791		Flow (q) from Route 12		Pe 0.088
116	34'-8			92.504			10'-0	Pv
CM	4.3100	1326.36	29.17	120		0.313092	10'-0	Pf 3.132
116	34'-8	120.78		92.504		Flow (q) from Route 13		Pe 0.088
118	34'-5½			95.724			10'-0	Pv
CM	4.3100	1459.74	32.10	120		0.373817	1'-5	Pf 0.526
118	34'-5½	133.38		95.724		Flow (q) from Route 14		Pe 0.012
120	34'-5½			96.262			1'-5	Pv
DY	6.3570	1459.74	14.76	120		0.056328	46'-3½	Pf 7.283
120	34'-5½			96.262			83'-0	Pe 14.198
122	1'-8½			117.743		fE(12'-7), E(17'-7), 2f(-0.000), CV(40'-3), BV(12'-7)	129'-3½	Pv
DY	8.2490	1459.74	8.76	120		0.015838	0'-0	Pf 0.000
122	1'-8½			117.743				Pe 0.303
40	1'-0			118.045			0'-0	Pv
UG	7.6800	1459.74	10.11	150		0.014845	34'-8½	Pf 1.501
40	1'-0			118.045			66'-4½	Pe 2.601
10	-5'-0			122.147		E(22'-6½), T(43'-10)	101'-1	Pv
UG	7.6800	802.80	5.56	150		0.004911	970'-3½	Pf 5.202
10	-5'-0			122.147			88'-11	Pe
9	-5'-0			127.349		2E(22'-6½), T(43'-10)	1059'-2½	Pv
UG	7.6800	1709.74	11.84	150		0.019888	38'-10	Pf 1.220
9	-5'-0	906.94		127.349		Flow (q) from Route 7	22'-6½	Pe -2.601
8	1'-0			125.968		E(22'-6½)	61'-4½	Pv
FR	8.2490	1709.74	10.26	120		0.021218	11'-0½	Pf 2.851
8	1'-0			125.968			123'-4	Pe -0.512
7	2'-2			128.307		3fE(15'-3), 2fT(38'-9)	134'-4½	Pv
DY	8.2490	1709.74	10.26	120		0.021218	0'-0	Pf 1.796
7	2'-2			128.307			84'-7½	Pe 0.000
6	2'-2			130.103		BV(18'-9½), Tr(13'-0), CV(52'-1 0)	84'-7½	Pv
DY	6.0650	1709.74	18.99	120		0.094883	0'-0	Pf 0.000
6	2'-2			130.103				Pe 0.000
5	2'-2			130.103			0'-0	Pv



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 1

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Pump		Velocity						
5		1709.74		130.103		Rating: 70.000 @ 1500.00		
4		Q=1709.74	10.26	62.077		Fire Pump Churn Pressure: 73.67 0		
DY	8.2490	1709.74	10.26	120		0.021218	0'-0	Pf 0.922
4	2'-2			62.077			43'-5½	Pe 0.377
3	1'-3½			63.376		GV(4'-8½), FT(38'-9)	43'-5½	Pv
UG	9.4200	1709.74	7.87	150		0.007356	150'-0	Pf 5.311
3	1'-3½			63.376			73'-9½	Pe 4.028
2	-8'-0			72.715		2E(24'-7), 2EE(12'-3½), BFP(-3.6 65)	223'-9	Pv
UG	11.2000	1709.74	5.57	150		0.003167	2139'-5½	Pf 7.143
2	-8'-0			72.715			116'-2½	Pe 1.517
1	-11'-6			81.376		6EE(14'-4½), E(29'-10½), S	2255'-8	Pv
		0.00				Hose Allowance At Source		
1		1709.74						
Route 2								
BL	2.7050	118.82	6.63	120		0.034878	10'-0	Pf 0.349
1111	37'-1½	121.15	16.8	52.000		Sprinkler		Pe
1117	37'-1½			52.349			10'-0	Pv
BL	2.7050	240.37	13.42	120		0.128422	124'-1	Pf 20.743
1117	37'-1½	121.55	16.8	52.349		Sprinkler,	37'-5	Pe 0.361
124	36'-3½			73.452		2PO(18'-8½)	161'-6	Pv
CM	4.3100	240.37	5.29	120		0.013286	10'-0	Pf 0.133
124	36'-3½			73.452				Pe 0.088
126	36'-1½			73.674			10'-0	Pv
CM	4.3100	481.15	10.58	120		0.047969	10'-0	Pf 0.480
126	36'-1½	240.77		73.674		Flow (q) from Route 4		Pe 0.088
128	35'-11			74.242			10'-0	Pv
CM	4.3100	722.93	15.90	120		0.101878	10'-0	Pf 1.019
128	35'-11	241.79		74.242		Flow (q) from Route 6		Pe 0.088
130	35'-8½			75.349			10'-0	Pv
RN	2.7050	83.08	4.64	120		0.017991	325'-8	Pf 7.206
130	35'-8½			75.349		PO(18'-8½)	74'-10½	Pe
106	35'-8½			82.555		3PO(18'-8½)	400'-6½	Pv
Route 3								
BL	2.7050	2.29	0.13	120		0.000023	9'-0	Pf 0.000
1119	36'-11½	121.33	16.8	52.156		Sprinkler		Pe
1121	36'-11½			52.156			9'-0	Pv
BL	2.7050	123.62	6.90	120		0.037528	11'-0	Pf 0.413
1121	36'-11½	121.33	16.8	52.156		Sprinkler		Pe
1123	36'-11½			52.569			11'-0	Pv
BL	2.7050	245.43	13.70	120		0.133460	171'-7	Pf 27.896
1123	36'-11½	121.81	16.8	52.569		Sprinkler,	37'-5	Pe 0.361
102	36'-1½			80.826		2PO(18'-8½)	209'-0	Pv
Route 4								
BL	2.7050	119.04	6.65	120		0.034996	10'-0	Pf 0.350
1119	36'-11½	121.33	16.8	52.156		Sprinkler		Pe
1125	36'-11½			52.506			10'-0	Pv
BL	2.7050	240.77	13.44	120		0.128817	124'-1	Pf 20.806
1125	36'-11½	121.73	16.8	52.506		Sprinkler,	37'-5	Pe 0.361
126	36'-1½			73.674		2PO(18'-8½)	161'-6	Pv
Route 5								
BL	2.7050	2.21	0.12	120		0.000022	9'-0	Pf 0.000
1127	36'-9	121.80	16.8	52.559		Sprinkler		Pe
1129	36'-9			52.559			9'-0	Pv
BL	2.7050	124.01	6.92	120		0.037746	11'-0	Pf 0.415
1129	36'-9	121.80	16.8	52.559		Sprinkler		Pe
1131	36'-9			52.974			11'-0	Pv
BL	2.7050	246.28	13.75	120		0.134324	171'-7	Pf 28.076
1131	36'-9	122.28	16.8	52.974		Sprinkler,	37'-5	Pe 0.361
104	35'-11			81.411		2PO(18'-8½)	209'-0	Pv
Route 6								
BL	2.7050	119.58	6.68	120		0.035294	10'-0	Pf 0.353
1127	36'-9	121.80	16.8	52.559		Sprinkler		Pe
1133	36'-9			52.912			10'-0	Pv



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 1

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	241.79	13.50	120		0.129823	124'-1	Pf 20.969
1133	36'-9	122.20	16.8	52.912		Sprinkler,	37'-5	Pe 0.361
128	35'-11			74.242		2PO(18'-8½)	161'-6	Pv
Route 7								
UG	5.8600	250.00	2.97	150		0.002118	16'-9	Pf 0.155
53	1'-0	250.00		120.039		Hydrant,	56'-2½	Pe 2.601
11	-5'-0			122.795		E(17'-10½), T(38'-4)	72'-11½	Pv
UG	7.6800	906.94	6.28	150		0.006154	472'-1	Pf 3.044
11	-5'-0	656.94		122.795		Flow (q) from Route 8	22'-6½	Pe
12	-5'-0			125.839		2EE(11'-3)	494'-7½	Pv
UG	7.6800	906.94	6.28	150		0.006154	178'-11½	Pf 1.510
12	-5'-0	417.97		125.839		Flow (q) from Route 1	66'-4½	Pe
9	-5'-0			127.349		E(22'-6½), T(43'-10)	245'-4	Pv
Route 8								
UG	7.6800	656.94	4.55	150		0.003389	168'-8½	Pf 0.648
10	-5'-0	417.97		122.147		Flow (q) from Route 1	22'-6½	Pe
11	-5'-0			122.795		E(22'-6½)	191'-3	Pv
Route 9								
CM	4.3100	639.86	14.07	120		0.081283	10'-0	Pf 0.813
130	35'-8½	83.08		75.349		Flow (q) from Route 2		Pe 0.088
132	35'-6			76.250			10'-0	Pv
RN	2.7050	85.98	4.80	120		0.019172	325'-8	Pf 7.679
132	35'-6			76.250		PO(18'-8½)	74'-10½	Pe
108	35'-6			83.929		3PO(18'-8½)	400'-6½	Pv
Route 10								
CM	4.3100	553.87	12.18	120		0.062238	10'-0	Pf 0.623
132	35'-6	85.98		76.250		Flow (q) from Route 9		Pe 0.088
134	35'-3½			76.961			10'-0	Pv
RN	2.7050	91.43	5.10	120		0.021480	325'-8	Pf 8.604
134	35'-3½			76.961		PO(18'-8½)	74'-10½	Pe
110	35'-3½			85.564		3PO(18'-8½)	400'-6½	Pv
Route 11								
CM	4.3100	462.44	10.17	120		0.044576	10'-0	Pf 0.446
134	35'-3½	91.43		76.961		Flow (q) from Route 10		Pe 0.088
136	35'-1			77.495			10'-0	Pv
RN	2.7050	99.21	5.54	120		0.024980	325'-8	Pf 10.006
136	35'-1			77.495		PO(18'-8½)	74'-10½	Pe
112	35'-1			87.501		3PO(18'-8½)	400'-6½	Pv
Route 12								
CM	4.3100	363.23	7.99	120		0.028516	10'-0	Pf 0.285
136	35'-1	99.21		77.495		Flow (q) from Route 11		Pe 0.088
138	34'-10½			77.868			10'-0	Pv
RN	2.7050	109.07	6.09	120		0.029766	325'-8	Pf 11.923
138	34'-10½			77.868		PO(18'-8½)	74'-10½	Pe
114	34'-10½			89.791		3PO(18'-8½)	400'-6½	Pv
Route 13								
CM	4.3100	254.17	5.59	120		0.014730	10'-0	Pf 0.147
138	34'-10½	109.07		77.868		Flow (q) from Route 12		Pe 0.088
140	34'-8			78.104			10'-0	Pv
RN	2.7050	120.78	6.74	120		0.035951	325'-8	Pf 14.400
140	34'-8			78.104		PO(18'-8½)	74'-10½	Pe
116	34'-8			92.504		3PO(18'-8½)	400'-6½	Pv
Route 14								
CM	4.3100	133.38	2.93	120		0.004469	10'-0	Pf 0.045
140	34'-8	120.78		78.104		Flow (q) from Route 13		Pe 0.088
142	34'-5½			78.237			10'-0	Pv
RN	2.7050	133.38	7.45	120		0.043195	325'-8	Pf 17.487
142	34'-5½			78.237		PO(18'-8½)	79'-2	Pe
118	34'-5½			95.724		3PO(18'-8½), Tr(4'-3½)	404'-10	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

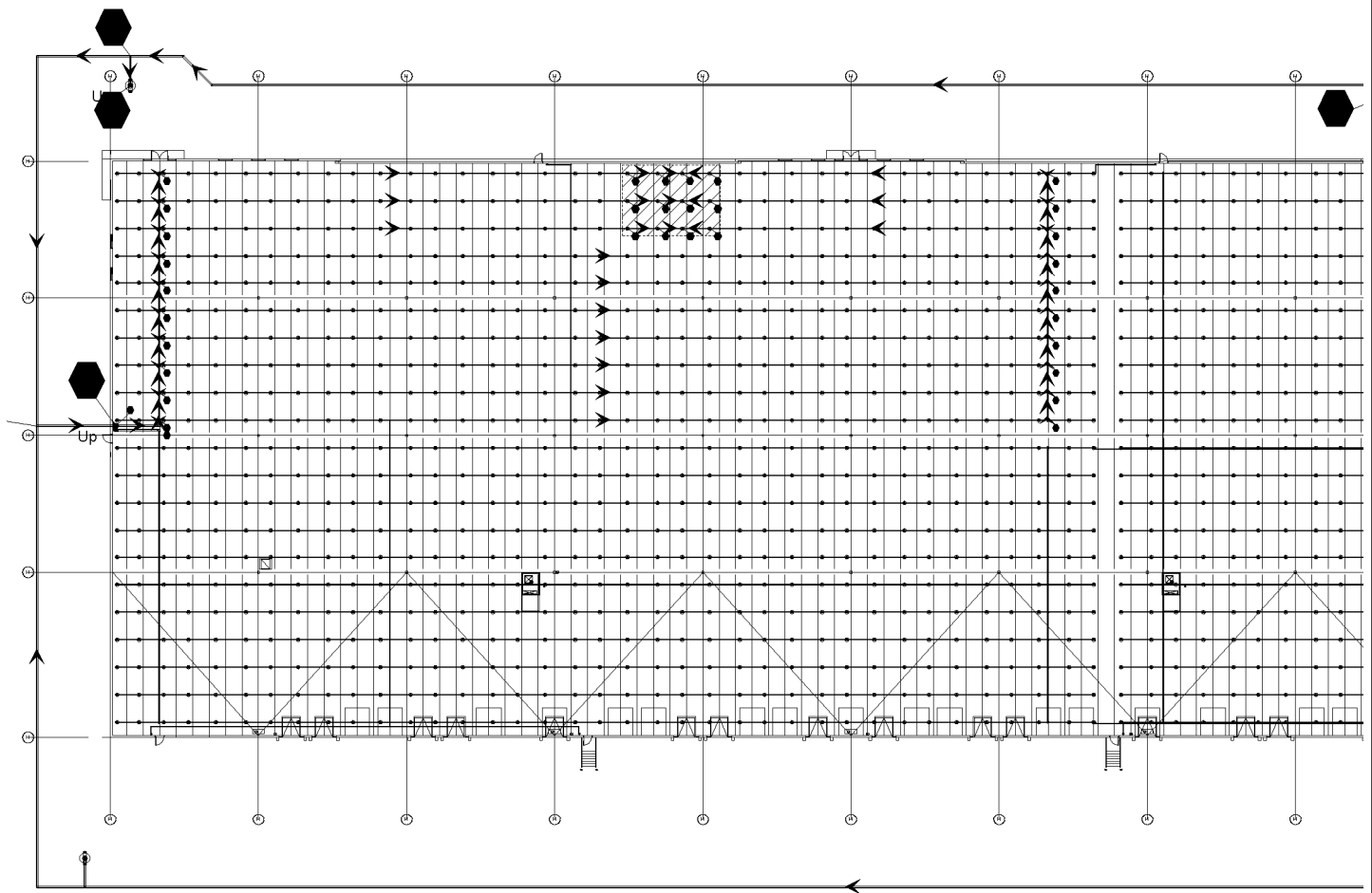


Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead 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	Units Legend	Fittings 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	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	ALV Alarm Valve AngV Angle Valve b Bushing BalV 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 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





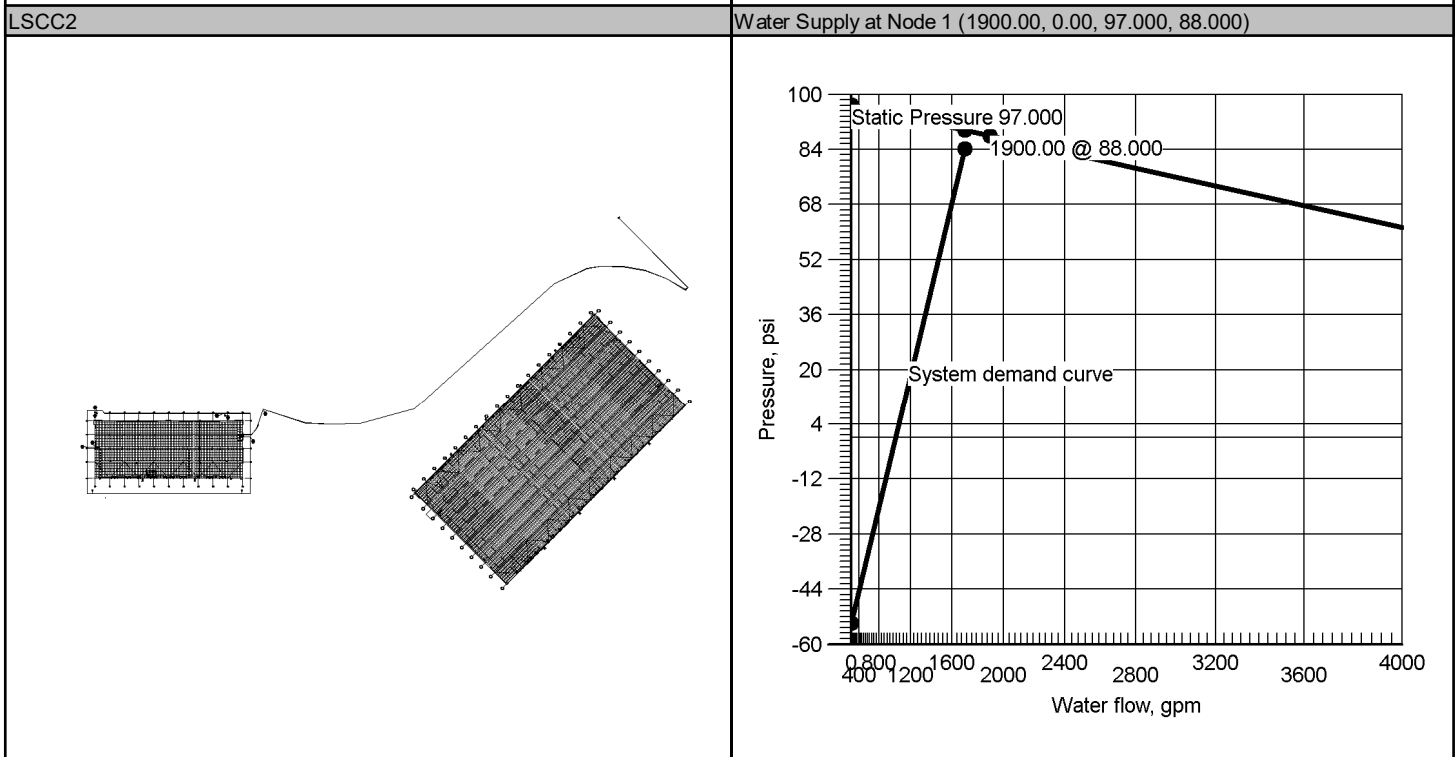
Hydraulic Overview

Job Number: 212240000
Report Description: FP Overhead System 2

Job		
Job Number 212240000	Design Engineer J. Colbert	
Job Name: Lee's Summit Commerce Center II	Phone 913-242-0057	FAX
Address 1 NW Tudor Rd & NW Main St	State Certification/License Number	
Address 2	AHJ Lee's Summit Permits & Licensing	
Address 3 Lee's Summit, MO 34086	Job Site/Building Building II	

System	
Pressure 52.000	Area of Application NA
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000	Hose Streams 250.00
Coverage Per Sprinkler 100 ft²	Number Of Sprinklers Calculated 12 0
System Pressure Demand 84.395	System Flow Demand 1708.02
Total Demand 1708.02 @ 84.395	Pressure Result +5.215 (5.8%)

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	Gauge 4 (4)	65.118	211.66	1708.02
5	Pump	1500.00		73.670	70.000				
Pumps: Static = Churn (Pressure @ Zero Flow)									





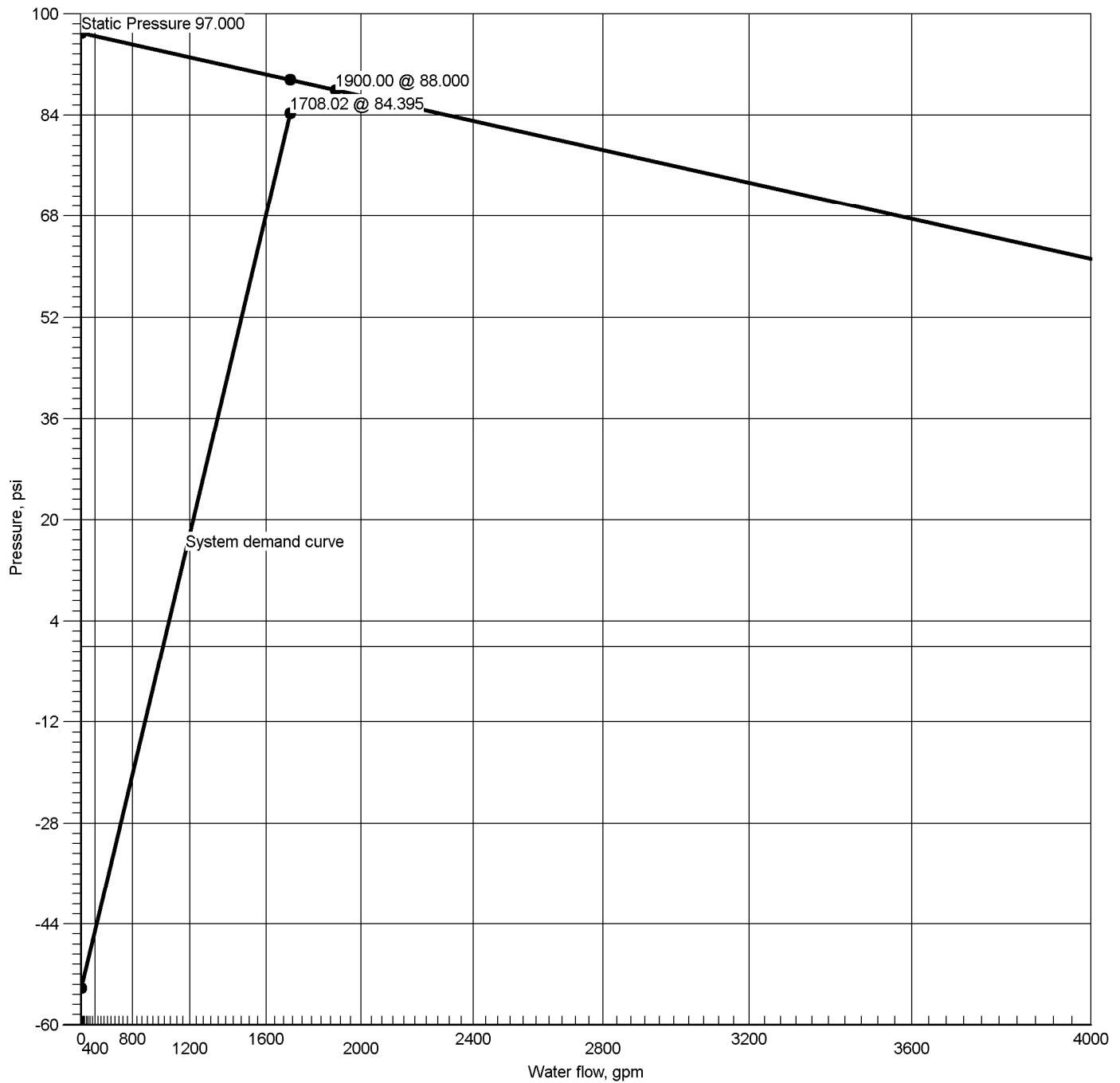
Hydraulic Summary

Job Number: 212240000
Report Description: FP Overhead System 2

Job											
Job Number 212240000				Design Engineer J. Colbert							
Job Name: Lee's Summit Commerce Center II				State Certification/License Number							
Address 1 NW Tudor Rd & NW Main St				AHJ Lee's Summit Permits & Licensing							
Address 2				Job Site/Building Building II							
Address 3 Lee's Summit, MO 34086				Drawing Name LSCC2							
System				Remote Area(s)							
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000				Occupancy ESFR			Job Suffix				
Hose Allowance At Source 0.00				Pressure 52.000			Area of Application NA				
Additional Hose Supplies Node Hydrant At Node 53				Flow(gpm) 250.00			Number Of Sprinklers Calculated 12				
				Number Of Nozzles Calculated 0			Coverage Per Sprinkler 100 ft²				
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 84.286 Right: 84.334							
Total Hose Streams 250.00											
System Flow Demand 1708.02			Total Water Required (Including Hose Allowance) 1708.02								
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.06 between nodes 222 and 220											
Maximum Velocity Under Ground 11.83 between nodes 8 and 9											
Volume capacity of Wet Pipes 38256.17 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		1708.02	84.395	5.215
5	Pump		73.670	70.000		1500.00	138.376		1708.02	133.161	5.215
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number -		Contact Name Jay Colbert					Contact Title Designer				
Name of Contractor: F.E. Moran Fire Protection Inc.		Phone 913.242.0057					Extension				
Address 1 16815 College Blvd.		FAX									
Address 2		E-mail jay.colbert@femoran.com									
Address 3 Lenexa, KS 66219		Web-Site femoranfp.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 @ 1708.02

Required Pressure at System Demand

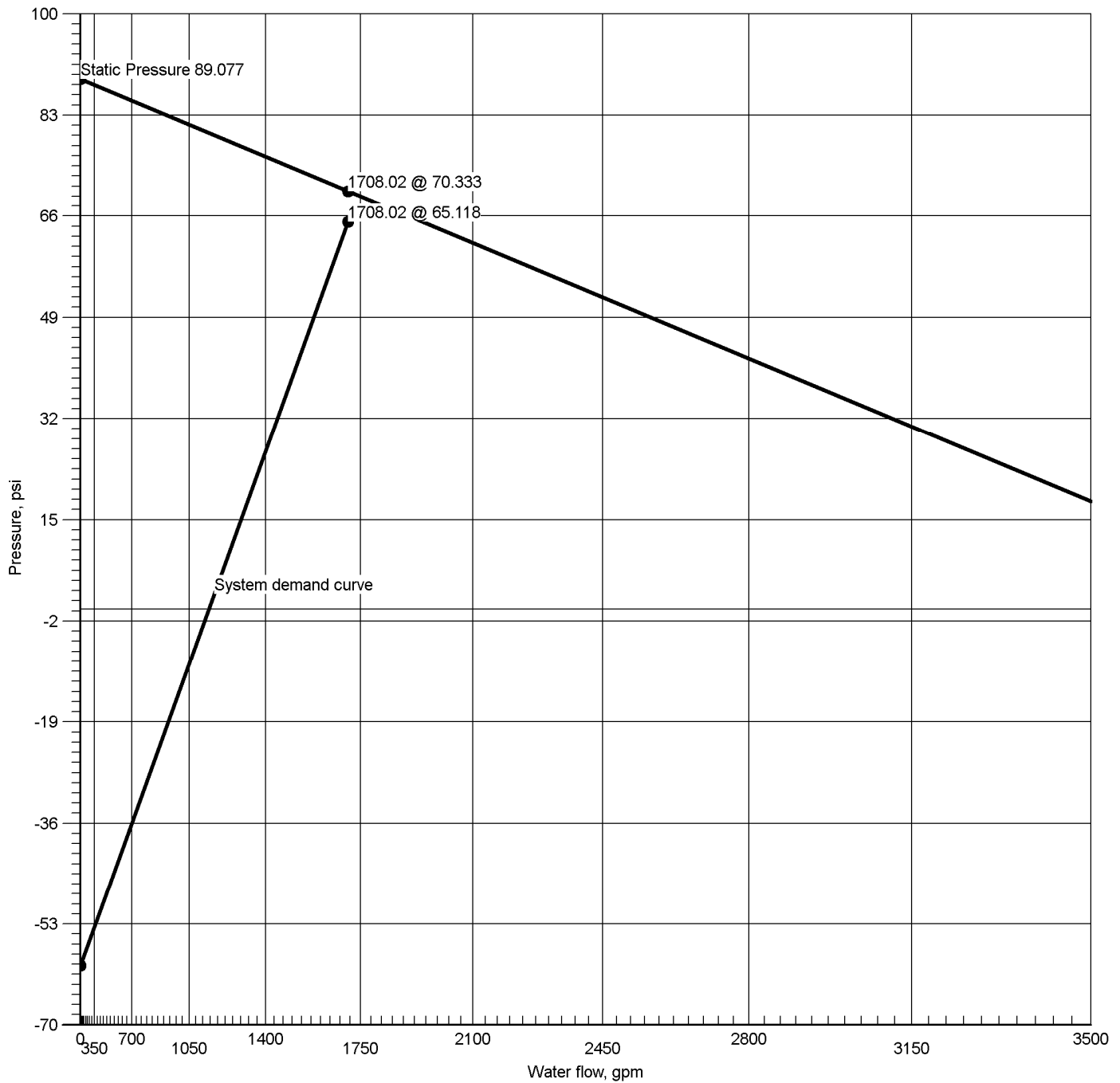
84.395 @ 1708.02

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

84.395 @ 1708.02



Gauge 4 at Node 4



Hydraulic Graph

Gauge 4 at Node 4

Static: Pressure

89.077

Residual: Pressure

N/A

Available Pressure at System Demand

70.333 @ 1708.02

Required Pressure at System Demand

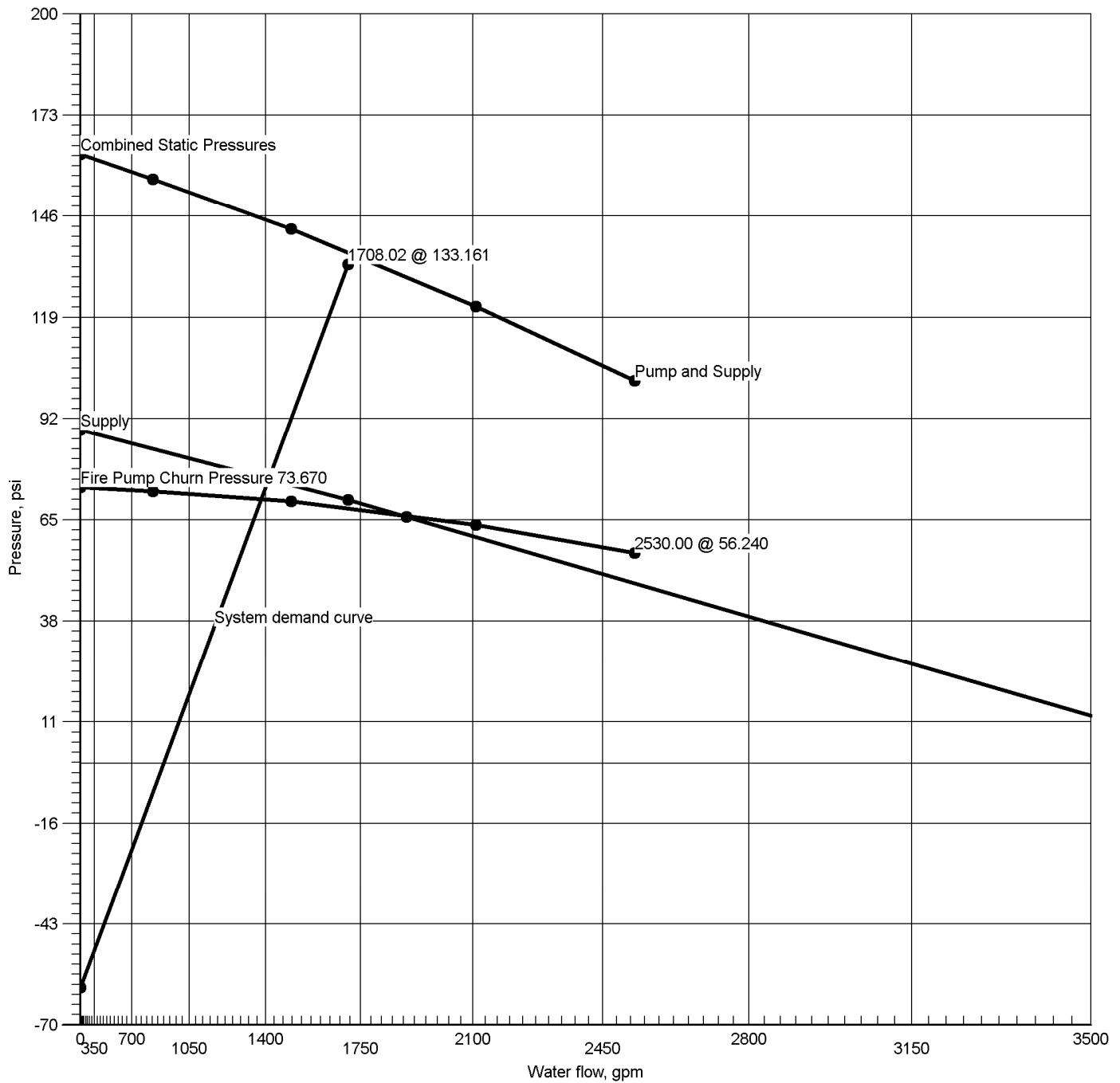
65.118 @ 1708.02

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

N/A



Pump at Node 5



Hydraulic Graph

Static + Churn Pressure

Fire Pump Rating

Pump at Node 5

162.747

70.000 @ 1500.00

Static Pressure

Fire Pump Churn Pressure

162.747

73.670

Residual Pressure

68.043 @ 1708.02

Available Pressure at System Demand

138.376 @ 1708.02

Required Pressure at System Demand

133.161 @ 1708.02



Summary Of Outflowing Devices

Job Number: 212240000
Report Description: FP Overhead System 2

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	53	250.00	250.00	0	123.116			
⇒ Sprinkler	2111	121.15	121.15	16.8	52.000			
Sprinkler	2113	121.59	121.15	16.8	52.381			
Sprinkler	2115	121.15	121.15	16.8	52.000			
Sprinkler	2117	121.59	121.15	16.8	52.378			
Sprinkler	2119	121.19	121.15	16.8	52.033			
Sprinkler	2121	121.63	121.15	16.8	52.414			
Sprinkler	2123	121.19	121.15	16.8	52.033			
Sprinkler	2125	121.62	121.15	16.8	52.411			
Sprinkler	2127	121.51	121.15	16.8	52.313			
Sprinkler	2129	121.95	121.15	16.8	52.695			
Sprinkler	2131	121.51	121.15	16.8	52.314			
Sprinkler	2133	121.95	121.15	16.8	52.694			

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: 212240000
Report Description: FP Overhead System 2

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
1	-11'-6	S	84.395	1708.02
53	1'-0	Hyd	123.116	250.00
2111	33'-1	Spr(-52.000)	52.000	121.15
2113	33'-1	Spr(-52.381)	52.381	121.59
2115	33'-1	Spr(-52.000)	52.000	121.15
2117	33'-1	Spr(-52.378)	52.378	121.59
2119	33'-3½	Spr(-52.033)	52.033	121.19
2121	33'-3½	Spr(-52.414)	52.414	121.63
2123	33'-3½	Spr(-52.033)	52.033	121.19
2125	33'-3½	Spr(-52.411)	52.411	121.62
2127	33'-5½	Spr(-52.313)	52.313	121.51
2129	33'-5½	Spr(-52.695)	52.695	121.95
2131	33'-5½	Spr(-52.314)	52.314	121.51
2133	33'-5½	Spr(-52.694)	52.694	121.95
2	-8'-0	E(24'-7)	75.748	
3	1'-3½		66.415	
4	2'-2	P1, Gauge 4	65.118	
5	2'-2	P2(-68.052)	133.161	
6	2'-2		133.161	
7	2'-2	ft(38'-9)	131.368	
8	1'-0		129.034	
9	-5'-0	T(43'-10)	130.418	
10	-5'-0	T(43'-10)	125.226	
11	-5'-0	T(38'-4)	125.872	
12	-5'-0	T(38'-4)	128.911	
40	1'-0		121.127	
200	32'-3	PO(18'-8½)	79.490	
202	32'-5½	PO(18'-8½)	79.534	
204	32'-7½	PO(18'-8½)	79.924	
206	32'-10	PO(18'-8½)	80.848	
208	33'-0½	PO(18'-8½)	81.958	
210	33'-3	PO(18'-8½)	83.277	
212	33'-5½	PO(18'-8½)	84.832	
214	33'-8	PO(18'-8½)	86.667	
216	33'-10½	PO(18'-8½)	88.836	
218	34'-1	PO(18'-8½)	91.406	
220	34'-3½	PO(18'-8½)	94.463	
222	34'-4½		96.592	
224	1'-8½	PO(37'-8½)	120.151	
226	32'-3	PO(18'-8½)	74.316	
228	32'-5½	PO(18'-8½)	74.366	
230	32'-7½	PO(18'-8½)	74.776	
232	32'-10	PO(18'-8½)	75.745	
234	33'-0½	PO(18'-8½)	76.539	
236	33'-3	PO(18'-8½)	77.167	
238	33'-5½	PO(18'-8½)	77.637	
240	33'-8	PO(18'-8½)	77.953	
242	33'-10½	PO(18'-8½)	78.127	
244	34'-1	PO(18'-8½)	78.175	
246	34'-3½	PO(18'-8½)	78.129	



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead 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	118.33	6.61	120		0.034611	11'-0	Pf 0.381
2111	33'-1	121.15	16.8	52.000		Sprinkler		Pe
2113	33'-1			52.381			11'-0	Pv
BL	2.7050	239.92	13.39	120		0.127971	171'-7	Pf 26.748
2113	33'-1	121.59	16.8	52.381		Sprinkler,	37'-5	Pe 0.361
200	32'-3			79.490		2PO(18'-8½)	209'-0	Pv
CM	4.3100	239.92	5.28	120		0.013239	10'-0	Pf 0.132
200	32'-3			79.490				Pe -0.088
202	32'-5½			79.534			10'-0	Pv
CM	4.3100	479.89	10.55	120		0.047737	10'-0	Pf 0.477
202	32'-5½	239.97		79.534		Flow (q) from Route 3		Pe -0.088
204	32'-7½			79.924			10'-0	Pv
CM	4.3100	720.38	15.84	120		0.101213	10'-0	Pf 1.012
204	32'-7½	240.49		79.924		Flow (q) from Route 5		Pe -0.088
206	32'-10			80.848			10'-0	Pv
CM	4.3100	789.32	17.36	120		0.119857	10'-0	Pf 1.199
206	32'-10	68.94		80.848		Flow (q) from Route 2		Pe -0.088
208	33'-0½			81.958			10'-0	Pv
CM	4.3100	860.53	18.92	120		0.140628	10'-0	Pf 1.407
208	33'-0½	71.22		81.958		Flow (q) from Route 9		Pe -0.088
210	33'-3			83.277			10'-0	Pv
CM	4.3100	936.09	20.58	120		0.164317	10'-0	Pf 1.644
210	33'-3	75.55		83.277		Flow (q) from Route 10		Pe -0.088
212	33'-5½			84.832			10'-0	Pv
CM	4.3100	1019.10	22.41	120		0.192286	10'-0	Pf 1.923
212	33'-5½	83.01		84.832		Flow (q) from Route 11		Pe -0.088
214	33'-8			86.667			10'-0	Pv
CM	4.3100	1111.16	24.43	120		0.225651	10'-0	Pf 2.257
214	33'-8	92.06		86.667		Flow (q) from Route 12		Pe -0.088
216	33'-10½			88.836			10'-0	Pv
CM	4.3100	1214.08	26.70	120		0.265831	10'-0	Pf 2.659
216	33'-10½	102.92		88.836		Flow (q) from Route 13		Pe -0.088
218	34'-1			91.406			10'-0	Pv
CM	4.3100	1329.46	29.24	120		0.314448	10'-0	Pf 3.145
218	34'-1	115.38		91.406		Flow (q) from Route 14		Pe -0.088
220	34'-3½			94.463			10'-0	Pv
CM	4.3100	1458.02	32.06	120		0.373002	5'-10	Pf 2.181
220	34'-3½	128.56		94.463		Flow (q) from Route 15		Pe -0.052
222	34'-4½			96.592			5'-10	Pv
DY	6.3570	1458.02	14.74	120		0.056205	46'-3½	Pf 9.385
222	34'-4½			96.592			120'-8½	Pe 14.174
224	1'-8½			120.151		fE(12'-7), E(17'-7), 2f(-0.000), CV(40'-3), BV(12'-7), PO(37'-8½)	167'-0	Pv
CM	8.2490	1458.02	8.75	120		0.015803	1'-6	Pf 0.673
224	1'-8½			120.151			41'-1½	Pe 0.303
40	1'-0			121.127		PO(41'-1½)	42'-7½	Pv
UG	7.6800	1458.02	10.10	150		0.014812	34'-8½	Pf 1.497
40	1'-0			121.127			66'-4½	Pe 2.601
10	-5'-0			125.226		E(22'-6½), T(43'-10)	101'-1	Pv
UG	7.6800	801.98	5.55	150		0.004902	970'-3½	Pf 5.192
10	-5'-0			125.226			88'-11	Pe
9	-5'-0			130.418		2E(22'-6½), T(43'-10)	1059'-2½	Pv
UG	7.6800	1708.02	11.83	150		0.019851	38'-10	Pf 1.218
9	-5'-0	906.04		130.418		Flow (q) from Route 7	22'-6½	Pe -2.601
8	1'-0			129.034		E(22'-6½)	61'-4½	Pv
FR	8.2490	1708.02	10.25	120		0.021178	11'-0½	Pf 2.846
8	1'-0			129.034			123'-4	Pe -0.512
7	2'-2			131.368		3fE(15'-3), 2fT(38'-9)	134'-4½	Pv
DY	8.2490	1708.02	10.25	120		0.021178	0'-0	Pf 1.793
7	2'-2			131.368			84'-7½	Pe 0.000
6	2'-2			133.161		BV(18'-9½), Tr(13'-0), CV(52'-1 0)	84'-7½	Pv
DY	6.0650	1708.02	18.97	120		0.094706	0'-0	Pf 0.000
6	2'-2			133.161				Pe 0.000
5	2'-2			133.161			0'-0	Pv



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead 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	
Pump		Velocity						
5		1708.02		133.161		Rating: 70.000 @ 1500.00		
4		Q=1708.02	10.25	65.118		Fire Pump Churn Pressure: 73.67 0		
DY	8.2490	1708.02	10.25	120		0.021178	0'-0	Pf 0.920
4	2'-2			65.118			43'-5½	Pe 0.377
3	1'-3½			66.415		GV(4'-8½), FT(38'-9)	43'-5½	Pv
UG	9.4200	1708.02	7.86	150		0.007343	150'-0	Pf 5.304
3	1'-3½			66.415			73'-9½	Pe 4.028
2	-8'-0			75.748		2E(24'-7), 2EE(12'-3½), BFP(-3.6 61)	223'-9	Pv
UG	11.2000	1708.02	5.56	150		0.003161	2139'-5½	Pf 7.130
2	-8'-0			75.748			116'-2½	Pe 1.517
1	-11'-6			84.395		6EE(14'-4½), E(29'-10½), S	2255'-8	Pv
		0.00				Hose Allowance At Source		
1		1708.02						
Route 2								
BL	2.7050	2.82	0.16	120		0.000034	9'-0	Pf 0.000
2111	33'-1	121.15	16.8	52.000		Sprinkler		Pe
2115	33'-1			52.000			9'-0	Pv
BL	2.7050	123.97	6.92	120		0.037723	10'-0	Pf 0.377
2115	33'-1	121.15	16.8	52.000		Sprinkler		Pe
2117	33'-1			52.378			10'-0	Pv
BL	2.7050	245.55	13.71	120		0.133586	124'-1	Pf 21.577
2117	33'-1	121.59	16.8	52.378		Sprinkler,	37'-5	Pe 0.361
226	32'-3			74.316		2PO(18'-8½)	161'-6	Pv
CM	4.3100	245.55	5.40	120		0.013820	10'-0	Pf 0.138
226	32'-3			74.316				Pe -0.088
228	32'-5½			74.366			10'-0	Pv
CM	4.3100	491.20	10.80	120		0.049841	10'-0	Pf 0.499
228	32'-5½	245.65		74.366		Flow (q) from Route 4		Pe -0.088
230	32'-7½			74.776			10'-0	Pv
CM	4.3100	737.64	16.22	120		0.105745	10'-0	Pf 1.058
230	32'-7½	246.44		74.776		Flow (q) from Route 6		Pe -0.088
232	32'-10			75.745			10'-0	Pv
RN	2.7050	68.94	3.85	120		0.012739	325'-8	Pf 5.103
232	32'-10			75.745		PO(18'-8½)	74'-10½	Pe -0.000
206	32'-10			80.848		3PO(18'-8½)	400'-6½	Pv
Route 3								
BL	2.7050	118.34	6.61	120		0.034618	11'-0	Pf 0.381
2119	33'-3½	121.19	16.8	52.033		Sprinkler		Pe
2121	33'-3½			52.414			11'-0	Pv
BL	2.7050	239.97	13.40	120		0.128023	171'-7	Pf 26.759
2121	33'-3½	121.63	16.8	52.414		Sprinkler,	37'-5	Pe 0.361
202	32'-5½			79.534		2PO(18'-8½)	209'-0	Pv
Route 4								
BL	2.7050	2.84	0.16	120		0.000035	9'-0	Pf 0.000
2119	33'-3½	121.19	16.8	52.033		Sprinkler		Pe
2123	33'-3½			52.033			9'-0	Pv
BL	2.7050	124.03	6.92	120		0.037758	10'-0	Pf 0.378
2123	33'-3½	121.19	16.8	52.033		Sprinkler		Pe
2125	33'-3½			52.411			10'-0	Pv
BL	2.7050	245.65	13.71	120		0.133688	124'-1	Pf 21.593
2125	33'-3½	121.62	16.8	52.411		Sprinkler,	37'-5	Pe 0.361
228	32'-5½			74.366		2PO(18'-8½)	161'-6	Pv
Route 5								
BL	2.7050	118.54	6.62	120		0.034725	11'-0	Pf 0.382
2127	33'-5½	121.51	16.8	52.313		Sprinkler		Pe
2129	33'-5½			52.695			11'-0	Pv
BL	2.7050	240.49	13.43	120		0.128539	171'-7	Pf 26.867
2129	33'-5½	121.95	16.8	52.695		Sprinkler,	37'-5	Pe 0.361
204	32'-7½			79.924		2PO(18'-8½)	209'-0	Pv
Route 6								
BL	2.7050	2.97	0.17	120		0.000038	9'-0	Pf 0.000
2127	33'-5½	121.51	16.8	52.313		Sprinkler		Pe
2131	33'-5½			52.314			9'-0	Pv



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead 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	124.48	6.95	120		0.038015	10'-0	Pf 0.380
2131	33'-5½	121.51	16.8	52.314		Sprinkler		Pe
2133	33'-5½			52.694			10'-0	Pv
BL	2.7050	246.44	13.76	120		0.134478	124'-1	Pf 21.721
2133	33'-5½	121.95	16.8	52.694		Sprinkler,	37'-5	Pe 0.361
230	32'-7½			74.776		2PO(18'-8½)	161'-6	Pv
Route 7								
UG	5.8600	250.00	2.97	150		0.002118	16'-9	Pf 0.155
53	1'-0	250.00		123.116		Hydrant,	56'-2½	Pe 2.601
11	-5'-0			125.872		E(17'-10½), T(38'-4)	72'-11½	Pv
UG	7.6800	906.04	6.28	150		0.006143	472'-1	Pf 3.038
11	-5'-0	656.04		125.872		Flow (q) from Route 8	22'-6½	Pe
12	-5'-0			128.911		2EE(11'-3)	494'-7½	Pv
UG	7.6800	906.04	6.28	150		0.006143	178'-11½	Pf 1.507
12	-5'-0	417.97		128.911		Flow (q) from Route 1	66'-4½	Pe
9	-5'-0			130.418		E(22'-6½), T(43'-10)	245'-4	Pv
Route 8								
UG	7.6800	656.04	4.54	150		0.003381	168'-8½	Pf 0.647
10	-5'-0	417.97		125.226		Flow (q) from Route 1	22'-6½	Pe
11	-5'-0			125.872		E(22'-6½)	191'-3	Pv
Route 9								
CM	4.3100	668.70	14.71	120		0.088192	10'-0	Pf 0.882
232	32'-10	68.94		75.745		Flow (q) from Route 2		Pe -0.088
234	33'-0½			76.539			10'-0	Pv
RN	2.7050	71.22	3.98	120		0.013530	325'-8	Pf 5.419
234	33'-0½			76.539		PO(18'-8½)	74'-10½	Pe -0.000
208	33'-0½			81.958		3PO(18'-8½)	400'-6½	Pv
Route 10								
CM	4.3100	597.48	13.14	120		0.071607	10'-0	Pf 0.716
234	33'-0½	71.22		76.539		Flow (q) from Route 9		Pe -0.088
236	33'-3			77.167			10'-0	Pv
RN	2.7050	75.55	4.22	120		0.015092	325'-8	Pf 6.110
236	33'-3			77.167		PO(18'-8½)	79'-2	Pe -0.000
210	33'-3			83.277		3PO(18'-8½), Tr(4'-3½)	404'-10	Pv
Route 11								
CM	4.3100	521.93	11.48	120		0.055762	10'-0	Pf 0.558
236	33'-3	75.55		77.167		Flow (q) from Route 10		Pe -0.088
238	33'-5½			77.637			10'-0	Pv
RN	2.7050	83.01	4.63	120		0.017964	325'-8	Pf 7.195
238	33'-5½			77.637		PO(18'-8½)	74'-10½	Pe -0.000
212	33'-5½			84.832		3PO(18'-8½)	400'-6½	Pv
Route 12								
CM	4.3100	438.92	9.65	120		0.040473	10'-0	Pf 0.405
238	33'-5½	83.01		77.637		Flow (q) from Route 11		Pe -0.088
240	33'-8			77.953			10'-0	Pv
RN	2.7050	92.06	5.14	120		0.021755	325'-8	Pf 8.714
240	33'-8			77.953		PO(18'-8½)	74'-10½	Pe -0.000
214	33'-8			86.667		3PO(18'-8½)	400'-6½	Pv
Route 13								
CM	4.3100	346.86	7.63	120		0.026184	10'-0	Pf 0.262
240	33'-8	92.06		77.953		Flow (q) from Route 12		Pe -0.088
242	33'-10½			78.127			10'-0	Pv
RN	2.7050	102.92	5.75	120		0.026736	325'-8	Pf 10.709
242	33'-10½			78.127		PO(18'-8½)	74'-10½	Pe -0.000
216	33'-10½			88.836		3PO(18'-8½)	400'-6½	Pv
Route 14								
CM	4.3100	243.94	5.36	120		0.013653	10'-0	Pf 0.137
242	33'-10½	102.92		78.127		Flow (q) from Route 13		Pe -0.088
244	34'-1			78.175			10'-0	Pv
RN	2.7050	115.38	6.44	120		0.033034	325'-8	Pf 13.231
244	34'-1			78.175		PO(18'-8½)	74'-10½	Pe -0.000
218	34'-1			91.406		3PO(18'-8½)	400'-6½	Pv
Route 15								
CM	4.3100	128.56	2.83	120		0.004174	10'-0	Pf 0.042
244	34'-1	115.38		78.175		Flow (q) from Route 14		Pe -0.088
246	34'-3½			78.129			10'-0	Pv



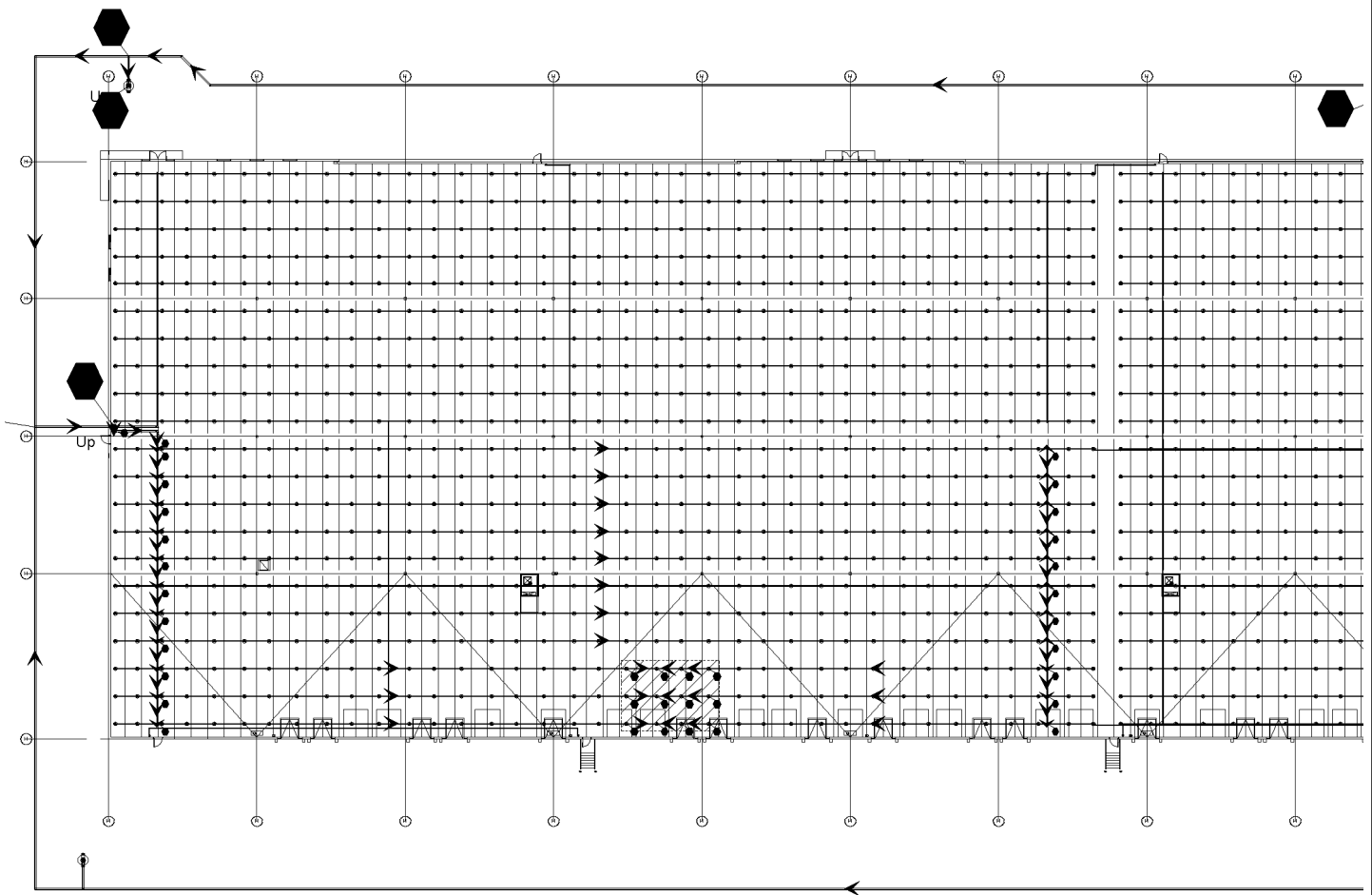
Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 2

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream					Fittings	Total Length	
RN	2.7050	128.56	7.18	120	0.040349	325'-8	Pf 16.335
246	34'-3½			78.129	PO(18'-8½)	79'-2	Pe -0.000
220	34'-3½			94.463	3PO(18'-8½), Tr(4'-3½)	404'-10	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	Units Legend	Fittings 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	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	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





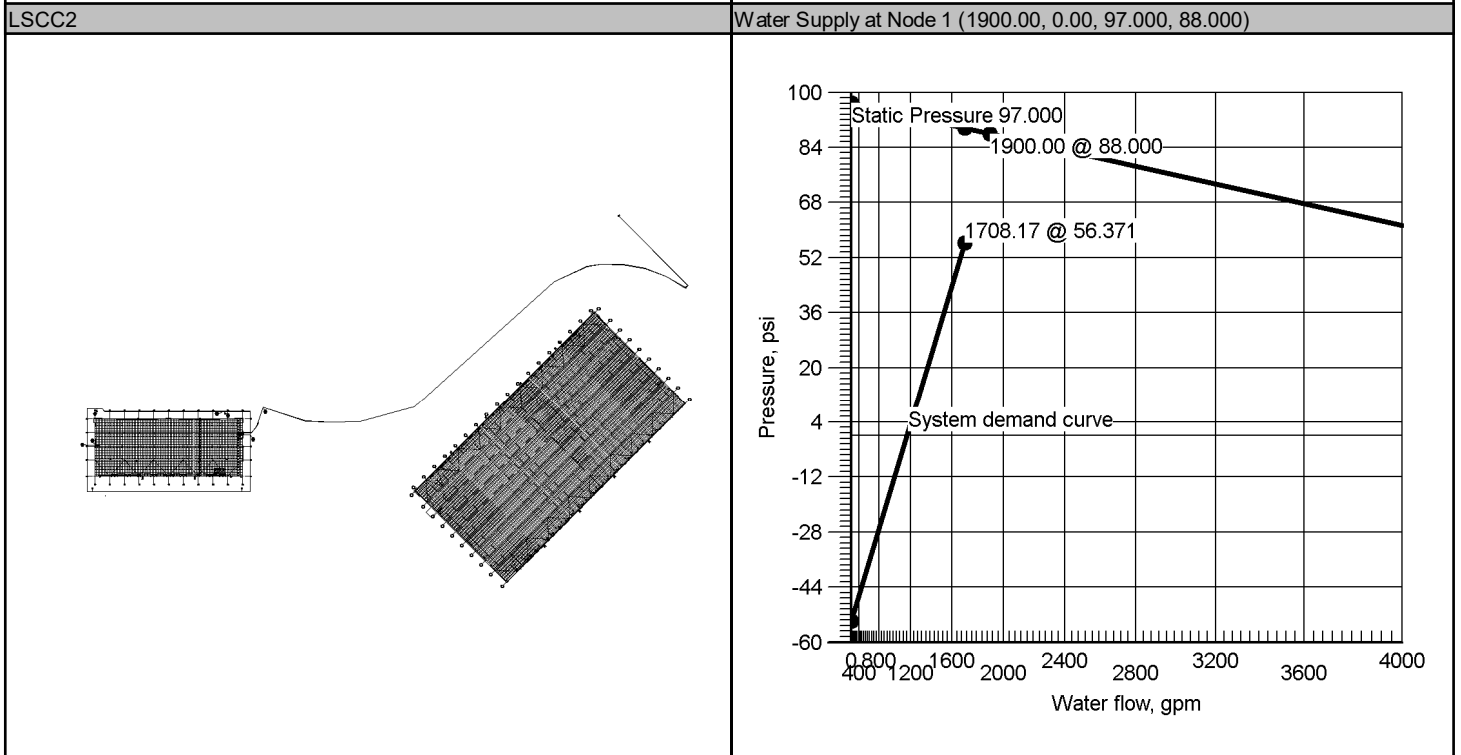
Hydraulic Overview

Job Number: 212240000
Report Description: FP Overhead System 3

Job		
Job Number 212240000	Design Engineer J. Colbert	
Job Name: Lee's Summit Commerce Center II	Phone 913-242-0057	FAX
Address 1 NW Tudor Rd & NW Main St	State Certification/License Number	
Address 2	AHJ Lee's Summit Permits & Licensing	
Address 3 Lee's Summit, MO 34086	Job Site/Building Building II	

System	
Pressure 52.000	Area of Application NA
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000	Hose Streams 250.00
Coverage Per Sprinkler 100 ft ²	Number Of Sprinklers Calculated 12 0
System Pressure Demand 56.371	System Flow Demand 1708.17
Total Demand 1708.17 @ 56.371	Pressure Result +33.238 (37.1%)

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	Gauge 4 (4)	37.092	280.47	1708.17
5	Pump	1500.00		73.670	70.000				
Pumps: Static = Churn (Pressure @ Zero Flow)									





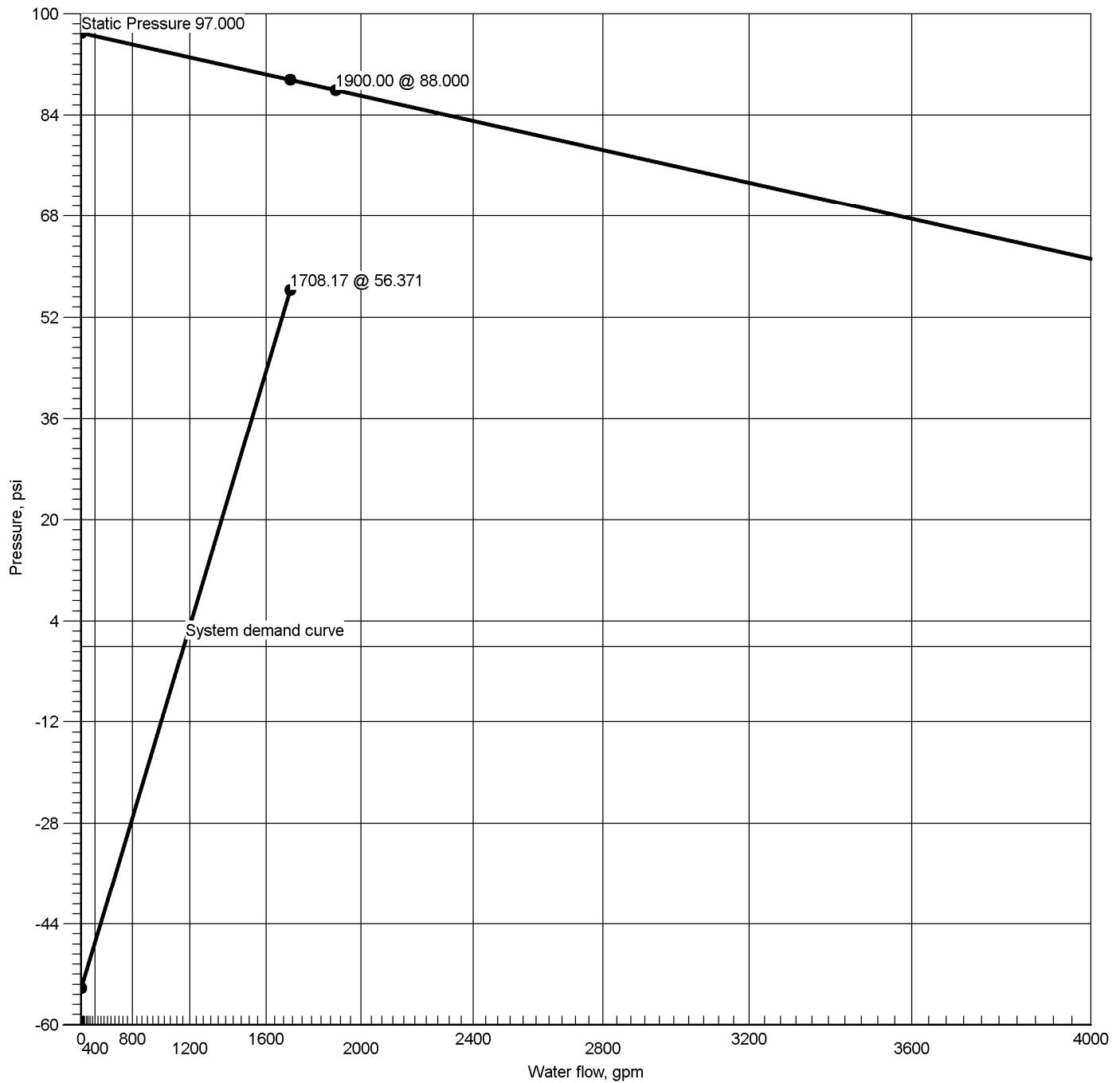
Hydraulic Summary

Job Number: 212240000
Report Description: FP Overhead System 3

Job											
Job Number 212240000				Design Engineer J. Colbert							
Job Name: Lee's Summit Commerce Center II				State Certification/License Number							
Address 1 NW Tudor Rd & NW Main St				AHJ Lee's Summit Permits & Licensing							
Address 2				Job Site/Building Building II							
Address 3 Lee's Summit, MO 34086				Drawing Name LSCC2							
System				Remote Area(s)							
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000				Occupancy ESFR			Job Suffix				
Hose Allowance At Source 0.00				Pressure 52.000			Area of Application NA				
Additional Hose Supplies Node Hydrant At Node 54				Flow(gpm) 250.00			Number Of Sprinklers Calculated 12				
				Number Of Nozzles Calculated 0			Coverage Per Sprinkler 100 ft²				
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 56.249 Right: 56.337							
Total Hose Streams 250.00											
System Flow Demand 1708.17			Total Water Required (Including Hose Allowance) 1708.17								
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.07 between nodes 330 and 5479											
Maximum Velocity Under Ground 7.86 between nodes 2 and 3											
Volume capacity of Wet Pipes 38256.17 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	89.609		1708.17	56.371	33.238
5	Pump		73.670	70.000		1500.00	138.371		1708.17	105.133	33.238
Pumps: Static = Churn (Pressure @ Zero Flow)											
Contractor											
Contractor Number -		Contact Name Jay Colbert				Contact Title Designer					
Name of Contractor: F.E. Moran Fire Protection Inc.				Phone 913.242.0057				Extension			
Address 1 16815 College Blvd.				FAX							
Address 2				E-mail jay.colbert@femoran.com							
Address 3 Lenexa, KS 66219				Web-Site femoranfp.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

89.609 @ 1708.17

Required Pressure at System Demand

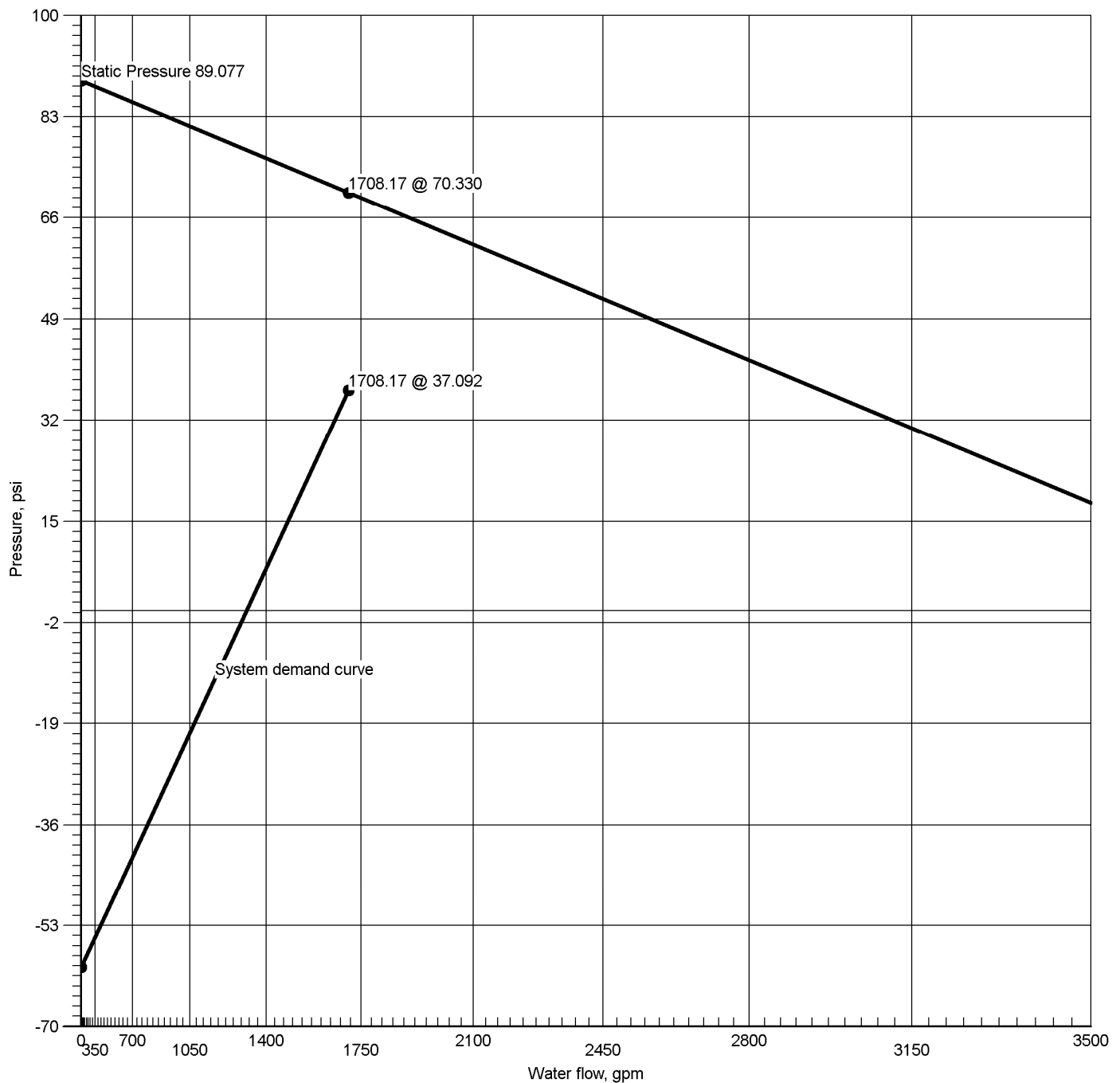
56.371 @ 1708.17

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

56.371 @ 1708.17



Gauge 4 at Node 4



Hydraulic Graph

Gauge 4 at Node 4

Static: Pressure

89.077

Residual: Pressure

N/A

Available Pressure at System Demand

70.330 @ 1708.17

Required Pressure at System Demand

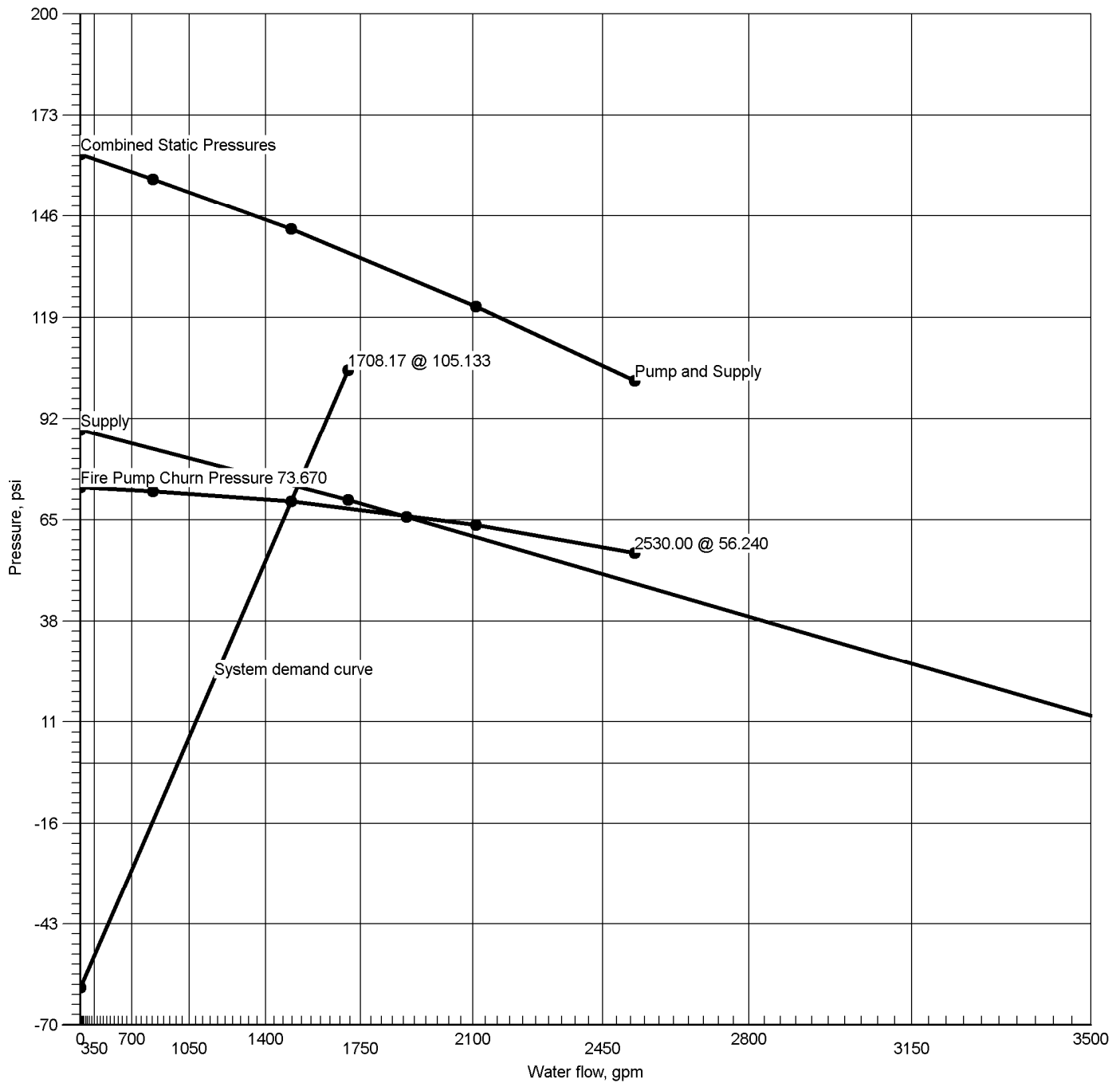
37.092 @ 1708.17

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

N/A



Pump at Node 5



Hydraulic Graph
Pump at Node 5

Static + Churn Pressure
162.747
Fire Pump Churn Pressure
73.670

Fire Pump Rating
70.000 @ 1500.00

Static: Pressure
162.747

Residual: Pressure
68.042 @ 1708.17

Available Pressure at System Demand
138.371 @ 1708.17

Required Pressure at System Demand
105.133 @ 1708.17



Summary Of Outflowing Devices

Job Number: 212240000
Report Description: FP Overhead System 3

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	54	250.00	250.00	0	103.508			
⇒ Sprinkler	3111	121.15	121.15	16.8	52.000			
Sprinkler	3113	121.15	121.15	16.8	52.000			
Sprinkler	3115	121.62	121.15	16.8	52.408			
Sprinkler	3117	121.52	121.15	16.8	52.317			
Sprinkler	3119	121.19	121.15	16.8	52.039			
Sprinkler	3121	121.19	121.15	16.8	52.039			
Sprinkler	3123	121.67	121.15	16.8	52.447			
Sprinkler	3125	121.56	121.15	16.8	52.356			
Sprinkler	3127	121.57	121.15	16.8	52.366			
Sprinkler	3129	121.57	121.15	16.8	52.366			
Sprinkler	3131	122.05	121.15	16.8	52.777			
Sprinkler	3133	121.94	121.15	16.8	52.685			

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
342	33'-0½	PO(18'-8½)	67.126	
344	33'-3	PO(18'-8½)	68.072	
348	35'-3½	PO(18'-8½)	80.812	
350	35'-6	PO(18'-8½)	80.377	
352	35'-8½	PO(18'-8½)	80.068	
354	35'-11	PO(18'-8½)	79.853	
356	36'-1½	PO(18'-8½)	79.705	
358	36'-3½	PO(18'-8½)	79.601	
360	33'-5½	PO(18'-8½)	69.017	
362	33'-8	PO(18'-8½)	69.958	
364	33'-10½	PO(18'-8½)	70.887	
366	34'-1	PO(18'-8½)	71.795	
368	34'-3½	PO(18'-8½)	72.669	
370	34'-5½	PO(18'-8½)	73.492	
372	34'-8	PO(18'-8½)	74.246	
374	34'-10½	PO(18'-8½)	74.911	
376	35'-1	PO(18'-8½)	75.464	
378	35'-3½	PO(18'-8½)	75.889	
380	35'-6	PO(18'-8½)	76.147	
382	35'-8½	PO(18'-8½)	76.280	
384	35'-11	PO(18'-8½)	76.319	
386	36'-1½	PO(18'-8½)	76.290	
388	36'-3½	PO(18'-8½)	76.218	
5479	35'-2	ft(22'-3½)	82.333	
1	-11'-6	S	56.371	1708.17
54	1'-0	Hyd	103.508	250.00
3111	33'-1	Spr(-52.000)	52.000	121.15
3113	33'-1	Spr(-52.000)	52.000	121.15
3115	33'-1	Spr(-52.408)	52.408	121.62
3117	33'-1	Spr(-52.317)	52.317	121.52
3119	33'-3½	Spr(-52.039)	52.039	121.19
3121	33'-3½	Spr(-52.039)	52.039	121.19
3123	33'-3½	Spr(-52.447)	52.447	121.67
3125	33'-3½	Spr(-52.356)	52.356	121.56
3127	33'-5½	Spr(-52.366)	52.366	121.57
3129	33'-5½	Spr(-52.366)	52.366	121.57
3131	33'-5½	Spr(-52.777)	52.777	122.05
3133	33'-5½	Spr(-52.685)	52.685	121.94
2	-8'-0	E(24'-7)	47.723	
3	1'-3½		38.390	
4	2'-2	P1, Gauge 4	37.092	
5	2'-2	P2(-68.050)	105.133	
6	2'-2		105.133	
7	2'-2	ft(38'-9), Tr(13'-0)	103.341	
8	1'-0		103.771	
9	-5'-0	T(43'-10)	106.338	
10	-5'-0	T(43'-10)	106.289	
12	-5'-0	T(38'-4)	106.257	
40	1'-0		102.190	
300	32'-3	PO(18'-8½)	64.758	
302	32'-5½	PO(18'-8½)	64.806	
304	32'-7½	PO(18'-8½)	65.212	
306	32'-10	PO(18'-8½)	66.173	
308	33'-0½	PO(18'-8½)	67.124	
310	33'-3	PO(18'-8½)	68.072	
312	33'-5½	PO(18'-8½)	69.021	
314	33'-8	PO(18'-8½)	69.974	
316	33'-10½	PO(18'-8½)	70.939	
318	34'-1	PO(18'-8½)	71.925	
320	34'-3½	PO(18'-8½)	72.948	
322	34'-5½	PO(18'-8½)	74.025	
324	34'-8	PO(18'-8½)	75.182	



Node Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
326	34'-10½	PO(18'-8½)	76.453	
328	35'-1	PO(18'-8½)	77.877	
330	35'-2		82.329	
332	2'-11½		102.555	
334	32'-3	PO(18'-8½)	64.812	
336	32'-5½	PO(18'-8½)	64.857	
338	32'-7½	PO(18'-8½)	65.251	
340	32'-10	PO(18'-8½)	66.184	



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

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	1.65	0.09	120		0.000013	10'-0	Pf 0.000
3111	33'-1	121.15	16.8	52.000		Sprinkler		Pe
3113	33'-1			52.000			10'-0	Pv
BL	2.7050	122.79	6.86	120		0.037066	11'-0	Pf 0.408
3113	33'-1	121.15	16.8	52.000		Sprinkler		Pe
3115	33'-1			52.408			11'-0	Pv
BL	2.7050	244.41	13.65	120		0.132444	53'-1	Pf 11.989
3115	33'-1	121.62	16.8	52.408		Sprinkler,	37'-5	Pe 0.361
300	32'-3			64.758		2PO(18'-8½)	90'-6	Pv
CM	4.3100	244.41	5.37	120		0.013702	10'-0	Pf 0.137
300	32'-3			64.758				Pe -0.088
302	32'-5½			64.806			10'-0	Pv
CM	4.3100	488.94	10.75	120		0.049416	10'-0	Pf 0.494
302	32'-5½	244.52		64.806		Flow (q) from Route 3		Pe -0.088
304	32'-7½			65.212			10'-0	Pv
CM	4.3100	734.29	16.15	120		0.104860	10'-0	Pf 1.049
304	32'-7½	245.36		65.212		Flow (q) from Route 5		Pe -0.088
306	32'-10			66.173			10'-0	Pv
CM	4.3100	730.81	16.07	120		0.103941	10'-0	Pf 1.040
306	32'-10			66.173				Pe -0.088
308	33'-0½			67.124			10'-0	Pv
CM	4.3100	729.46	16.04	120		0.103586	10'-0	Pf 1.036
308	33'-0½			67.124				Pe -0.088
310	33'-3			68.072			10'-0	Pv
CM	4.3100	729.71	16.05	120		0.103653	10'-0	Pf 1.037
310	33'-3	0.25		68.072		Flow (q) from Route 2		Pe -0.088
312	33'-5½			69.021			10'-0	Pv
CM	4.3100	731.56	16.09	120		0.104139	10'-0	Pf 1.042
312	33'-5½	1.85		69.021		Flow (q) from Route 11		Pe -0.088
314	33'-8			69.974			10'-0	Pv
CM	4.3100	735.90	16.18	120		0.105283	10'-0	Pf 1.053
314	33'-8	4.34		69.974		Flow (q) from Route 12		Pe -0.088
316	33'-10½			70.939			10'-0	Pv
CM	4.3100	744.01	16.36	120		0.107440	10'-0	Pf 1.075
316	33'-10½	8.11		70.939		Flow (q) from Route 13		Pe -0.088
318	34'-1			71.925			10'-0	Pv
CM	4.3100	757.32	16.65	120		0.111025	10'-0	Pf 1.110
318	34'-1	13.32		71.925		Flow (q) from Route 14		Pe -0.088
320	34'-3½			72.948			10'-0	Pv
CM	4.3100	777.40	17.10	120		0.116531	10'-0	Pf 1.166
320	34'-3½	20.07		72.948		Flow (q) from Route 16		Pe -0.088
322	34'-5½			74.025			10'-0	Pv
CM	4.3100	805.88	17.72	120		0.124551	10'-0	Pf 1.246
322	34'-5½	28.48		74.025		Flow (q) from Route 17		Pe -0.088
324	34'-8			75.182			10'-0	Pv
CM	4.3100	844.50	18.57	120		0.135820	10'-0	Pf 1.358
324	34'-8	38.63		75.182		Flow (q) from Route 18		Pe -0.088
326	34'-10½			76.453			10'-0	Pv
CM	4.3100	895.10	19.68	120		0.151254	10'-0	Pf 1.513
326	34'-10½	50.59		76.453		Flow (q) from Route 19		Pe -0.088
328	35'-1			77.877			10'-0	Pv
CM	4.3100	959.54	21.10	120		0.172016	3'-9½	Pf 4.485
328	35'-1	64.45		77.877		Flow (q) from Route 20	22'-3½	Pe -0.029
5479	35'-2			82.333		fT(22'-3½)	26'-1	Pv
DY	4.3100	1458.17	32.07	120		0.373074	0'-0	Pf 0.000
5479	35'-2	498.63		82.333		Flow (q) from Route 15		Pe -0.004
330	35'-2			82.329			0'-0	Pv
CM	6.3570	1458.17	14.74	120		0.056216	46'-1	Pf 6.266
330	35'-2			82.329			65'-4½	Pe 13.960
332	2'-11½			102.555		fE(12'-7), 2f(-0.000), CV(40'-3), BV(12'-7)	111'-5½	Pv
DY	8.2490	1458.17	8.75	120		0.015806	0'-0	Pf 0.447
332	2'-11½			102.555			28'-3	Pe 0.339
7	2'-2			103.341		fE(15'-3), Tr(13'-0)	28'-3	Pv



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
DY	8.2490	1708.17	10.25	120		0.021182	0'-0	Pf 1.793
7	2'-2	250.00		103.341		Flow (q) from Route 7	84'-7½	Pe 0.000
6	2'-2			105.133		BV(18'-9½), Tr(13'-0), CV(52'-10)	84'-7½	Pv
DY	6.0650	1708.17	18.97	120		0.094722	0'-0	Pf 0.000
6	2'-2			105.133				Pe 0.000
5	2'-2			105.133			0'-0	Pv
Pump		Velocity						
5		1708.17		105.133		Rating: 70.000 @ 1500.00		
4		Q=1708.17	10.25	37.092		Fire Pump Churn Pressure: 73.670		
DY	8.2490	1708.17	10.25	120		0.021182	0'-0	Pf 0.920
4	2'-2			37.092			43'-5½	Pe 0.377
3	1'-3½			38.390		GV(4'-8½), fT(38'-9)	43'-5½	Pv
UG	9.4200	1708.17	7.86	150		0.007344	150'-0	Pf 5.305
3	1'-3½			38.390			73'-9½	Pe 4.028
2	-8'-0			47.723		2E(24'-7), 2EE(12'-3½), BFP(-3.662)	223'-9	Pv
UG	11.2000	1708.17	5.56	150		0.003161	2139'-5½	Pf 7.131
2	-8'-0			47.723			116'-2½	Pe 1.517
1	-11'-6			56.371		6EE(14'-4½), E(29'-10½), S	2255'-8	Pv
		0.00				Hose Allowance At Source		
1		1708.17						
***** Route 2 *****								
BL	2.7050	119.50	6.67	120		0.035247	9'-0	Pf 0.317
3111	33'-1	121.15	16.8	52.000		Sprinkler		Pe
3117	33'-1			52.317			9'-0	Pv
BL	2.7050	241.02	13.46	120		0.129057	56'-7	Pf 12.134
3117	33'-1	121.52	16.8	52.317		Sprinkler,	37'-5	Pe 0.361
334	32'-3			64.812		2PO(18'-8½)	94'-0	Pv
CM	4.3100	241.02	5.30	120		0.013352	10'-0	Pf 0.134
334	32'-3			64.812				Pe -0.088
336	32'-5½			64.857			10'-0	Pv
CM	4.3100	482.10	10.60	120		0.048145	10'-0	Pf 0.482
336	32'-5½	241.09		64.857		Flow (q) from Route 4		Pe -0.088
338	32'-7½			65.251			10'-0	Pv
CM	4.3100	723.88	15.92	120		0.102125	10'-0	Pf 1.021
338	32'-7½	241.78		65.251		Flow (q) from Route 6		Pe -0.088
340	32'-10			66.184			10'-0	Pv
CM	4.3100	727.36	16.00	120		0.103036	10'-0	Pf 1.031
340	32'-10	3.49		66.184		Flow (q) from Route 9		Pe -0.088
342	33'-0½			67.126			10'-0	Pv
CM	4.3100	728.71	16.02	120		0.103390	10'-0	Pf 1.034
342	33'-0½	1.35		67.126		Flow (q) from Route 10		Pe -0.088
344	33'-3			68.072			10'-0	Pv
RN	2.7050	0.25	0.01	120		0.000000	139'-8	Pf 0.000
344	33'-3			68.072		PO(18'-8½)	79'-2	Pe
310	33'-3			68.072		3PO(18'-8½), Tr(4'-3½)	218'-10	Pv
***** Route 3 *****								
BL	2.7050	1.67	0.09	120		0.000013	10'-0	Pf 0.000
3119	33'-3½	121.19	16.8	52.039		Sprinkler		Pe
3121	33'-3½			52.039			10'-0	Pv
BL	2.7050	122.86	6.86	120		0.037101	11'-0	Pf 0.408
3121	33'-3½	121.19	16.8	52.039		Sprinkler		Pe
3123	33'-3½			52.447			11'-0	Pv
BL	2.7050	244.52	13.65	120		0.132553	53'-1	Pf 11.999
3123	33'-3½	121.67	16.8	52.447		Sprinkler,	37'-5	Pe 0.361
302	32'-5½			64.806		2PO(18'-8½)	90'-6	Pv
***** Route 4 *****								
BL	2.7050	119.53	6.67	120		0.035262	9'-0	Pf 0.317
3119	33'-3½	121.19	16.8	52.039		Sprinkler		Pe
3125	33'-3½			52.356			9'-0	Pv
BL	2.7050	241.09	13.46	120		0.129127	56'-7	Pf 12.140
3125	33'-3½	121.56	16.8	52.356		Sprinkler,	37'-5	Pe 0.361
336	32'-5½			64.857		2PO(18'-8½)	94'-0	Pv
***** Route 5 *****								



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

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	1.74	0.10	120		0.000014	10'-0	Pf 0.000
3127	33'-5½	121.57	16.8	52.366		Sprinkler		Pe
3129	33'-5½			52.366			10'-0	Pv
BL	2.7050	123.31	6.88	120		0.037354	11'-0	Pf 0.411
3129	33'-5½	121.57	16.8	52.366		Sprinkler		Pe
3131	33'-5½			52.777			11'-0	Pv
BL	2.7050	245.36	13.70	120		0.133391	53'-1	Pf 12.074
3131	33'-5½	122.05	16.8	52.777		Sprinkler,	37'-5	Pe 0.361
304	32'-7½			65.212		2PO(18'-8½)	90'-6	Pv
Route 6								
BL	2.7050	119.84	6.69	120		0.035431	9'-0	Pf 0.319
3127	33'-5½	121.57	16.8	52.366		Sprinkler		Pe
3133	33'-5½			52.685			9'-0	Pv
BL	2.7050	241.78	13.50	120		0.129812	56'-7	Pf 12.205
3133	33'-5½	121.94	16.8	52.685		Sprinkler,	37'-5	Pe 0.361
338	32'-7½			65.251		2PO(18'-8½)	94'-0	Pv
Route 7								
UG	5.8600	250.00	2.97	150		0.002118	13'-10	Pf 0.148
54	1'-0	250.00		103.508		Hydrant,	56'-2½	Pe 2.601
12	-5'-0			106.257		E(17'-10½), T(38'-4)	70'-0½	Pv
UG	7.6800	185.70	1.29	150		0.000327	178'-11½	Pf 0.080
12	-5'-0	417.97		106.257		Flow (q) from Route 1	66'-4½	Pe
9	-5'-0			106.338		E(22'-6½), T(43'-10)	245'-4	Pv
UG	7.6800	250.00	1.73	150		0.000567	38'-10	Pf 0.035
9	-5'-0	64.30		106.338		Flow (q) from Route 8	22'-6½	Pe -2.601
8	1'-0			103.771		E(22'-6½)	61'-4½	Pv
FR	8.2490	250.00	1.50	120		0.000605	11'-0½	Pf 0.081
8	1'-0	741.02		103.771		Flow (q) from Route 1	123'-4	Pe -0.512
7	2'-2			103.341		3fE(15'-3), 2fT(38'-9)	134'-4½	Pv
Route 8								
UG	7.6800	64.30	0.45	150		0.000046	640'-9½	Pf 0.032
12	-5'-0	417.97		106.257		Flow (q) from Route 1	45'-1	Pe
10	-5'-0			106.289		2EE(11'-3), E(22'-6½)	685'-10½	Pv
UG	7.6800	64.30	0.45	150		0.000046	970'-3½	Pf 0.049
10	-5'-0	417.97		106.289		Flow (q) from Route 1	88'-11	Pe
9	-5'-0			106.338		2E(22'-6½), T(43'-10)	1059'-2½	Pv
Route 9								
RN	2.7050	3.49	0.19	120		0.000051	139'-8	Pf 0.011
306	32'-10			66.173		PO(18'-8½)	74'-10½	Pe
340	32'-10			66.184		3PO(18'-8½)	214'-6½	Pv
Route 10								
RN	2.7050	1.35	0.08	120		0.000009	139'-8	Pf 0.002
308	33'-0½			67.124		PO(18'-8½)	74'-10½	Pe
342	33'-0½			67.126		3PO(18'-8½)	214'-6½	Pv
Route 11								
CM	4.3100	728.46	16.02	120		0.103323	10'-0	Pf 1.033
344	33'-3	0.25		68.072		Flow (q) from Route 2		Pe -0.088
360	33'-5½			69.017			10'-0	Pv
RN	2.7050	1.85	0.10	120		0.000016	139'-8	Pf 0.003
360	33'-5½			69.017		PO(18'-8½)	74'-10½	Pe 0.000
312	33'-5½			69.021		3PO(18'-8½)	214'-6½	Pv
Route 12								
CM	4.3100	726.61	15.98	120		0.102839	10'-0	Pf 1.029
360	33'-5½	1.85		69.017		Flow (q) from Route 11		Pe -0.088
362	33'-8			69.958			10'-0	Pv
RN	2.7050	4.34	0.24	120		0.000076	139'-8	Pf 0.016
362	33'-8			69.958		PO(18'-8½)	74'-10½	Pe
314	33'-8			69.974		3PO(18'-8½)	214'-6½	Pv
Route 13								
CM	4.3100	722.28	15.88	120		0.101707	10'-0	Pf 1.017
362	33'-8	4.34		69.958		Flow (q) from Route 12		Pe -0.088
364	33'-10½			70.887			10'-0	Pv
RN	2.7050	8.11	0.45	120		0.000243	139'-8	Pf 0.052
364	33'-10½			70.887		PO(18'-8½)	74'-10½	Pe 0.000
316	33'-10½			70.939		3PO(18'-8½)	214'-6½	Pv
Route 14								



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
CM	4.3100	714.17	15.70	120		0.099604	10'-0	Pf 0.996
364	33'-10½	8.11		70.887		Flow (q) from Route 13		Pe -0.088
366	34'-1			71.795			10'-0	Pv
RN	2.7050	13.32	0.74	120		0.000608	139'-8	Pf 0.131
366	34'-1			71.795		PO(18'-8½)	74'-10½	Pe
318	34'-1			71.925		3PO(18'-8½)	214'-6½	Pv
Route 15								
CM	4.3100	77.36	1.70	120		0.001631	10'-0	Pf 0.016
358	36'-3½	77.36		79.601		Flow (q) from Route 22		Pe 0.088
356	36'-1½			79.705			10'-0	Pv
CM	4.3100	155.13	3.41	120		0.005909	10'-0	Pf 0.059
356	36'-1½	77.77		79.705		Flow (q) from Route 26		Pe 0.088
354	35'-11			79.853			10'-0	Pv
CM	4.3100	234.34	5.15	120		0.012675	10'-0	Pf 0.127
354	35'-11	79.21		79.853		Flow (q) from Route 25		Pe 0.088
352	35'-8½			80.068			10'-0	Pv
CM	4.3100	316.57	6.96	120		0.022112	10'-0	Pf 0.221
352	35'-8½	82.23		80.068		Flow (q) from Route 24		Pe 0.088
350	35'-6			80.377			10'-0	Pv
CM	4.3100	403.86	8.88	120		0.034696	10'-0	Pf 0.347
350	35'-6	87.29		80.377		Flow (q) from Route 23		Pe 0.088
348	35'-3½			80.812			10'-0	Pv
CM	4.3100	498.63	10.97	120		0.051243	6'-2½	Pf 1.462
348	35'-3½	94.76		80.812		Flow (q) from Route 21	22'-3½	Pe 0.059
5479	35'-2			82.333		ft(22'-3½)	28'-6½	Pv
Route 16								
CM	4.3100	700.85	15.41	120		0.096195	10'-0	Pf 0.962
366	34'-1	13.32		71.795		Flow (q) from Route 14		Pe -0.088
368	34'-3½			72.669			10'-0	Pv
RN	2.7050	20.07	1.12	120		0.001300	139'-8	Pf 0.279
368	34'-3½			72.669		PO(18'-8½)	74'-10½	Pe
320	34'-3½			72.948		3PO(18'-8½)	214'-6½	Pv
Route 17								
CM	4.3100	680.77	14.97	120		0.091160	10'-0	Pf 0.912
368	34'-3½	20.07		72.669		Flow (q) from Route 16		Pe -0.088
370	34'-5½			73.492			10'-0	Pv
RN	2.7050	28.48	1.59	120		0.002483	139'-8	Pf 0.533
370	34'-5½			73.492		PO(18'-8½)	74'-10½	Pe
322	34'-5½			74.025		3PO(18'-8½)	214'-6½	Pv
Route 18								
CM	4.3100	652.29	14.34	120		0.084230	10'-0	Pf 0.842
370	34'-5½	28.48		73.492		Flow (q) from Route 17		Pe -0.088
372	34'-8			74.246			10'-0	Pv
RN	2.7050	38.63	2.16	120		0.004362	139'-8	Pf 0.936
372	34'-8			74.246		PO(18'-8½)	74'-10½	Pe
324	34'-8			75.182		3PO(18'-8½)	214'-6½	Pv
Route 19								
CM	4.3100	613.67	13.49	120		0.075236	10'-0	Pf 0.753
372	34'-8	38.63		74.246		Flow (q) from Route 18		Pe -0.088
374	34'-10½			74.911			10'-0	Pv
RN	2.7050	50.59	2.82	120		0.007187	139'-8	Pf 1.542
374	34'-10½			74.911		PO(18'-8½)	74'-10½	Pe
326	34'-10½			76.453		3PO(18'-8½)	214'-6½	Pv
Route 20								
CM	4.3100	563.08	12.38	120		0.064165	10'-0	Pf 0.642
374	34'-10½	50.59		74.911		Flow (q) from Route 19		Pe -0.088
376	35'-1			75.464			10'-0	Pv
RN	2.7050	64.45	3.60	120		0.011247	139'-8	Pf 2.413
376	35'-1			75.464		PO(18'-8½)	74'-10½	Pe
328	35'-1			77.877		3PO(18'-8½)	214'-6½	Pv
Route 21								
CM	4.3100	498.63	10.97	120		0.051243	10'-0	Pf 0.513
376	35'-1	64.45		75.464		Flow (q) from Route 20		Pe -0.088
378	35'-3½			75.889			10'-0	Pv
RN	2.7050	94.76	5.29	120		0.022950	139'-8	Pf 4.924
378	35'-3½			75.889		PO(18'-8½)	74'-10½	Pe
348	35'-3½			80.812		3PO(18'-8½)	214'-6½	Pv
Route 22								



Hydraulic Analysis

Job Number: 212240000
Report Description: FP Overhead System 3

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
CM	4.3100	403.86	8.88	120	0.034696	10'-0	Pf 0.347
378	35'-3½	94.76		75.889	Flow (q) from Route 21		Pe -0.088
380	35'-6			76.147		10'-0	Pv
CM	4.3100	316.57	6.96	120	0.022112	10'-0	Pf 0.221
380	35'-6			76.147			Pe -0.088
382	35'-8½			76.280		10'-0	Pv
CM	4.3100	234.34	5.15	120	0.012675	10'-0	Pf 0.127
382	35'-8½			76.280			Pe -0.088
384	35'-11			76.319		10'-0	Pv
CM	4.3100	155.13	3.41	120	0.005909	10'-0	Pf 0.059
384	35'-11			76.319			Pe -0.088
386	36'-1½			76.290		10'-0	Pv
CM	4.3100	77.36	1.70	120	0.001631	10'-0	Pf 0.016
386	36'-1½			76.290			Pe -0.088
388	36'-3½			76.218		10'-0	Pv
RN	2.7050	77.36	4.32	120	0.015768	139'-8	Pf 3.383
388	36'-3½			76.218	PO(18'-8½)	74'-10½	Pe
358	36'-3½			79.601	3PO(18'-8½)	214'-6½	Pv
Route 23							
RN	2.7050	87.29	4.87	120	0.019715	139'-8	Pf 4.230
380	35'-6			76.147	PO(18'-8½)	74'-10½	Pe
350	35'-6			80.377	3PO(18'-8½)	214'-6½	Pv
Route 24							
RN	2.7050	82.23	4.59	120	0.017653	139'-8	Pf 3.787
382	35'-8½			76.280	PO(18'-8½)	74'-10½	Pe
352	35'-8½			80.068	3PO(18'-8½)	214'-6½	Pv
Route 25							
RN	2.7050	79.21	4.42	120	0.016472	139'-8	Pf 3.534
384	35'-11			76.319	PO(18'-8½)	74'-10½	Pe
354	35'-11			79.853	3PO(18'-8½)	214'-6½	Pv
Route 26							
RN	2.7050	77.77	4.34	120	0.015921	139'-8	Pf 3.416
386	36'-1½			76.290	PO(18'-8½)	74'-10½	Pe
356	36'-1½			79.705	3PO(18'-8½)	214'-6½	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: 212240000
Report Description: FP Overhead 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 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	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	ALV Alarm Valve AngV Angle Valve b Bushing BalV 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 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

