



Hydraulic Summary

Job Number: NC-1403
Report Description: ESFR (NW System 1)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

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	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²								
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 191</td> <td>50.00</td> </tr> <tr> <td>Hose At Node 194</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>150.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 191	50.00	Hose At Node 194	50.00	Hydrant At Node 87	150.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)										
Hose At Node 191	50.00										
Hose At Node 194	50.00										
Hydrant At Node 87	150.00										
Total Hose Streams 250.00	<p style="text-align: center;">11-17-23</p>										
System Flow Demand 1718.05				Total Water Required (Including Hose Allowance) 1718.05							
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 34.48 between nodes 72 and 71											
Maximum Velocity Under Ground 9.10 between nodes 9 and 8											
Volume capacity of Wet Pipes 21151.20 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)
10	Water Supply		82.000	50.000	1900.00	55.437	1718.05	46.040	9.397
91	Pump		147.000	130.000	1500.00	168.014	1568.05	158.618	9.397

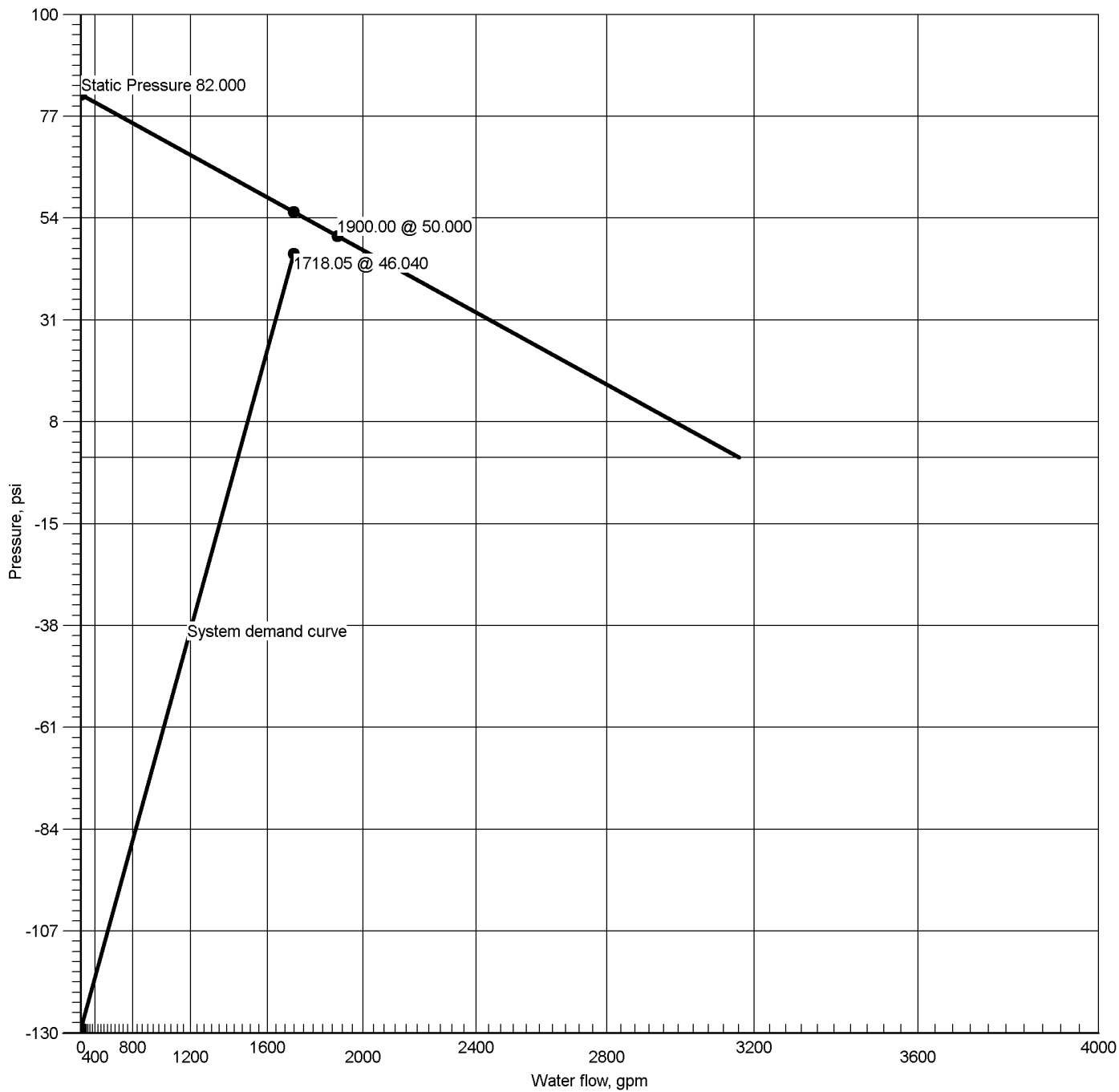
Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension
Address 1 130 w 9th Ave. Suite 100	FAX	
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com	
Address 3	Web-Site	



Water Supply at Node 10



Hydraulic Graph

Water Supply at Node 10

Static: Pressure
82.000

Residual: Pressure
50.000 @ 1900.00

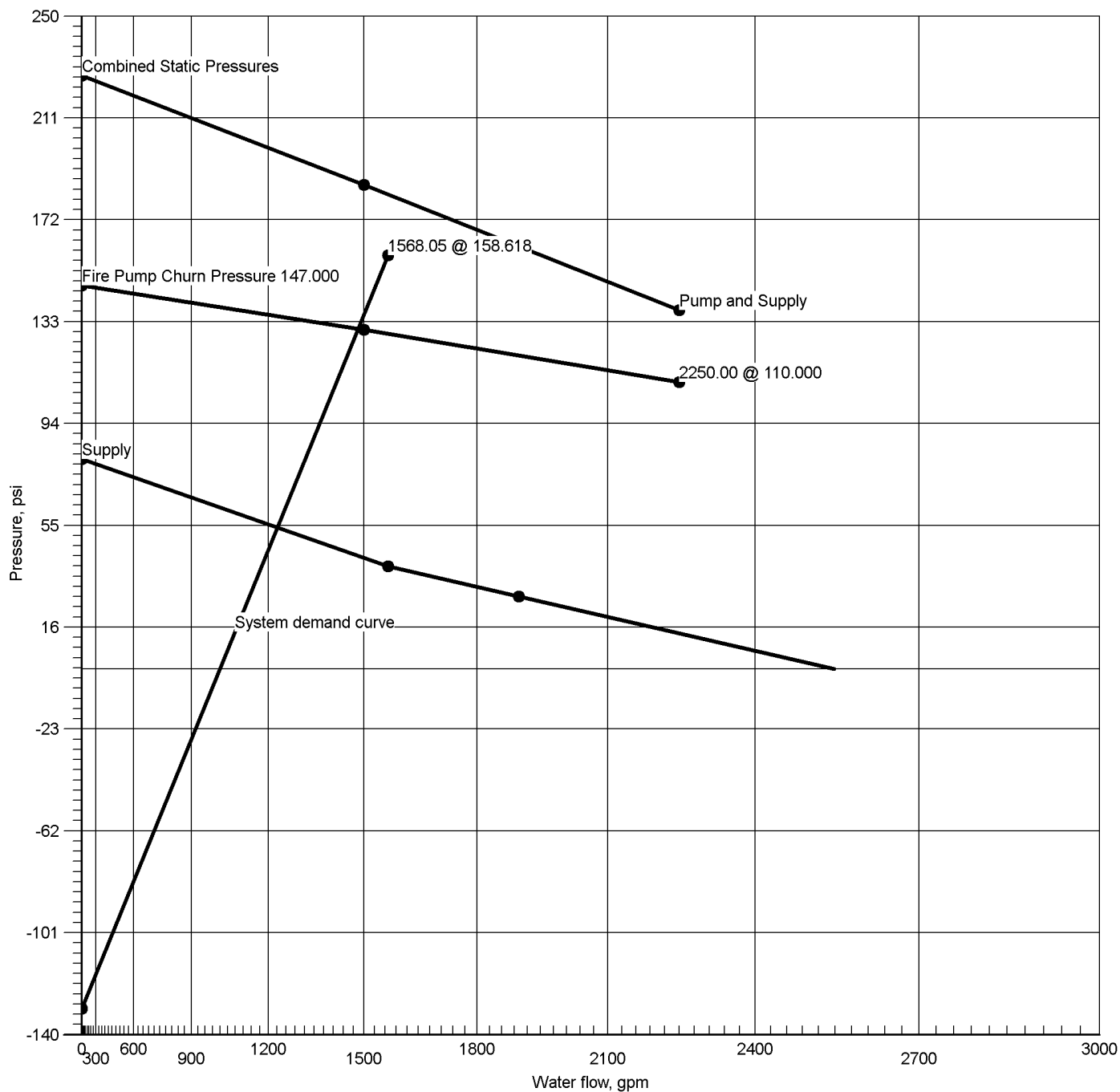
Available Pressure at System Demand
55.437 @ 1718.05

Required Pressure at System Demand
46.040 @ 1718.05

Required Pressure at System Demand (Including Hose Allowance at Source)
46.040 @ 1718.05



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static: Pressure	227.555	Fire Pump Churn Pressure
Residual: Pressure	128.559 @ 1568.05	147.000
Available Pressure at System Demand	168.014 @ 1568.05	
Required Pressure at System Demand	158.618 @ 1568.05	



Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	150.00	150.00	0	32.833			
Hose	191	50.00	50.00	0	74.299			
Hose	194	50.00	50.00	0	83.373			
⇒ Sprinkler	401	121.15	121.15	16.8	52.000			
Sprinkler	402	121.42	121.15	16.8	52.231			
Sprinkler	403	121.17	121.15	16.8	52.018			
Sprinkler	404	121.77	121.15	16.8	52.536			
Sprinkler	405	121.70	121.15	16.8	52.479			
Sprinkler	406	121.97	121.15	16.8	52.707			
Sprinkler	407	121.73	121.15	16.8	52.499			
Sprinkler	408	122.34	121.15	16.8	53.030			
Sprinkler	409	123.27	121.15	16.8	53.839			
Sprinkler	410	123.30	121.15	16.8	53.862			
Sprinkler	411	123.51	121.15	16.8	54.046			

⇒ Most Demanding Sprinkler Data



Node Analysis

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
10	-4'-0	S, E(27'-2)	46.040	1718.05
87	0'-0	Hyd	32.833	150.00
191	3'-0	Hose(42'-3½)	74.299	50.00
194	3'-0	Hose(42'-3½)	83.373	50.00
401	37'-7	Spr(-52.000)	52.000	121.15
402	37'-7	Spr(-52.231)	52.231	121.42
403	37'-7	Spr(-52.018)	52.018	121.17
404	37'-7	Spr(-52.536)	52.536	121.77
405	37'-9½	Spr(-52.479)	52.479	121.70
406	37'-9½	Spr(-52.707)	52.707	121.97
407	37'-9½	Spr(-52.499)	52.499	121.73
408	37'-9½	Spr(-53.030)	53.030	122.34
409	37'-4½	Spr(-53.839)	53.839	123.27
410	37'-4½	Spr(-53.862)	53.862	123.30
411	37'-4½	Spr(-54.046)	54.046	123.51
412	37'-4½	Spr(-55.134)	55.134	124.74
8	0'-8		30.448	
9	-4'-0	T(59'-4½)	34.437	
56	35'-5	PO(18'-8½)	101.640	
57	35'-7½	PO(18'-8½)	102.004	
58	35'-10	PO(18'-8½)	102.831	
67	36'-0½	PO(18'-8½)	104.129	
69	36'-3	PO(18'-8½)	105.989	
70	36'-5½	PO(18'-8½)	108.504	
71	36'-8	PO(18'-8½)	111.786	
72	36'-8		112.602	
73	34'-6		129.894	
76	7'-2½	PO(12'-3½), BOR 1	142.222	
78	37'-4½	PO(13'-7½)	61.469	
79	37'-4½	PO(13'-7½)	70.543	
80	35'-2½	PO(18'-8½)	101.588	
81	37'-4½		56.227	
88	-4'-0	E(22'-1)	34.590	
89	-4'-0	T(59'-4½)	34.603	
90	-0'-10½		158.618	
91	-0'-10½	P2(-128.469)	158.618	
123	36'-8	PO(18'-8½)	67.440	
373	35'-2½	PO(22'-6)	62.974	
578	35'-5	PO(18'-8½)	63.143	
771	35'-7½	PO(18'-8½)	63.804	
949	35'-10	PO(18'-8½)	65.194	
1129	36'-0½	PO(18'-8½)	66.098	
1310	36'-3	PO(18'-8½)	67.246	
1490	36'-5½	PO(18'-8½)	67.447	
5003	-0'-8	P1	30.059	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (NW System 1)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
Route 1							
CM	2.7050	95.16	5.31	120	0.023129	10'-0"	Pf 0.231
401	37'-7"	121.15	16.8	52.000	Sprinkler	10'-0"	Pe 0.000
402	37'-7"			52.231			Pv
CM	2.7050	216.58	12.09	120	0.105898	420'-3"	Pf 48.470
402	37'-7"	121.42	16.8	52.231	Sprinkler,	37'-5"	Pe 0.939
56	35'-5"			101.640	2PO(18'-8½")	457'-8½"	Pv
CM	4.3100	466.89	10.27	120	0.045372	10'-0"	Pf 0.454
56	35'-5"	250.31		101.640	Flow (q) from Route 5	10'-0"	Pe -0.090
57	35'-7½"			102.004			Pv
CM	4.3100	683.19	15.02	120	0.091760	10'-0"	Pf 0.917
57	35'-7½"	216.31		102.004	Flow (q) from Route 3	10'-0"	Pe -0.090
58	35'-10"			102.831			Pv
CM	4.3100	854.64	18.79	120	0.138850	10'-0"	Pf 1.388
58	35'-10"	171.45		102.831	Flow (q) from Route 13	10'-0"	Pe -0.090
67	36'-0½"			104.129			Pv
CM	4.3100	1027.05	22.59	120	0.195072	10'-0"	Pf 1.950
67	36'-0½"	172.41		104.129	Flow (q) from Route 2	10'-0"	Pe -0.090
69	36'-3"			105.989			Pv
CM	4.3100	1201.14	26.41	120	0.260614	10'-0"	Pf 2.606
69	36'-3"	174.09		105.989	Flow (q) from Route 10	10'-0"	Pe -0.090
70	36'-5½"			108.504			Pv
CM	4.3100	1380.78	30.36	120	0.337271	10'-0"	Pf 3.372
70	36'-5½"	179.64		108.504	Flow (q) from Route 11	10'-0"	Pe -0.090
71	36'-8"			111.786			Pv
CM	4.3100	1568.05	34.48	120	0.426744	1'-11½"	Pf 0.834
71	36'-8"	187.28		111.786	Flow (q) from Route 12	1'-11½"	Pe -0.018
72	36'-8"			112.602			Pv
DY	6.3570	1568.05	15.85	120	0.064303	183'-9"	Pf 16.343
72	36'-8"			112.602		70'-5"	Pe 0.949
73	34'-6"			129.894	4E(17'-7")	254'-2"	Pv
FR	8.2490	1568.05	9.41	120	0.018080	27'-3½"	Pf 0.494
73	34'-6"			129.894		27'-3½"	Pe 11.835
76	7'-2½"			142.222	f(-0.000), BOR 1		Pv
FR	8.2490	1568.05	9.41	120	0.018080	135'-5"	Pf 12.894
76	7'-2½"			142.222		328'-10½"	Pe 3.501
90	-0'-10½"			158.618	4BV(14'-1), PO(41'-1½), 4E(21'-1½), 2sCV(52'-10), T(41'-1½), PRV(-4.500)	464'-3½"	Pv
DY	6.0650	1568.05	17.41	120	0.080851	0'-0"	Pf 0.000
90	-0'-10½"			158.618		0'-0"	Pe -0.000
91	-0'-10½"			158.618			Pv
Pump							
91		1568.05	Velocity	158.618	Rating: 130.000 @ 1500.00		
5003		Q=1568.05	9.41	30.059	Fire Pump Churn Pressure: 147.000		
FR	8.2490	1568.05	9.41	120	0.018080	7'-8½"	Pf 0.967
5003	-0'-8"			30.059		45'-9½"	Pe -0.578
8	0'-8"			30.448	GV(4'-8½), T(41'-1½)	53'-6"	Pv
UG	8.3900	1568.05	9.10	140	0.012517	67'-2"	Pf 1.966
8	0'-8"			30.448		89'-11"	Pe 2.023
9	-4'-0"			34.437	E(30'-6½), T(59'-4½)	157'-1"	Pv
CM	7.9800	671.09	4.30	150	0.002925	2123'-0½"	Pf 11.603
9	-4'-0"			34.437		134'-3½"	Pe
10	-4'-0"			46.040	6EE(13'-7), BFP(-5.000), T(52'-10)	2257'-4½"	Pv
		0.00			Hose Allowance At Source		
10		1718.05					
Route 2							
CM	2.7050	25.98	1.45	120	0.002095	8'-9"	Pf 0.018
401	37'-7"	121.15	16.8	52.000	Sprinkler	8'-9"	Pe -0.000
403	37'-7"			52.018			Pv
CM	2.7050	147.15	8.22	120	0.051804	10'-0"	Pf 0.518
403	37'-7"	121.17	16.8	52.018	Sprinkler	10'-0"	Pe -0.000
404	37'-7"			52.536			Pv



Hydraulic Analysis

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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	
CM	2.7050	268.92	15.01	120		0.158054		Pf 9.667
404	37'-7	121.77	16.8	52.536		Sprinkler,		Pe 0.939
578	35'-5			63.143		2PO(18'-8½)		Pv 61'-2
CM	4.3100	613.43	13.49	120		0.075182	10'-0	Pf 0.752
578	35'-5	344.51		63.143		Flow (q) from Route 6		Pe -0.090
771	35'-7½			63.804			10'-0	Pv 10'-0
CM	4.3100	884.86	19.46	120		0.148070	10'-0	Pf 1.480
771	35'-7½	271.43		63.804		Flow (q) from Route 4		Pe -0.090
949	35'-10			65.194			10'-0	Pv 10'-0
CM	4.3100	713.42	15.69	120		0.099411	10'-0	Pf 0.994
949	35'-10			65.194				Pe -0.090
1129	36'-0½			66.098			10'-0	Pv 10'-0
RN	2.7050	172.41	9.63	120		0.069447	472'-9	Pf 38.031
1129	36'-0½			66.098		PO(18'-8½)	74'-10½	Pe 0.000
67	36'-0½			104.129		3PO(18'-8½)	547'-7½	Pv 547'-7½
Route 3								
CM	2.7050	94.34	5.27	120		0.022761	10'-0	Pf 0.228
405	37'-9½	121.70	16.8	52.479		Sprinkler		Pe 0.000
406	37'-9½			52.707			10'-0	Pv 10'-0
CM	2.7050	216.31	12.08	120		0.105653	420'-3	Pf 48.358
406	37'-9½	121.97	16.8	52.707		Sprinkler,	37'-5	Pe 0.939
57	35'-7½			102.004		2PO(18'-8½)	457'-8½	Pv 457'-8½
Route 4								
CM	2.7050	27.36	1.53	120		0.002305	8'-9	Pf 0.020
405	37'-9½	121.70	16.8	52.479		Sprinkler		Pe -0.000
407	37'-9½			52.499			8'-9	Pv 8'-9
CM	2.7050	149.09	8.32	120		0.053074	10'-0	Pf 0.531
407	37'-9½	121.73	16.8	52.499		Sprinkler		Pe -0.000
408	37'-9½			53.030			10'-0	Pv 10'-0
CM	2.7050	271.43	15.15	120		0.160793	23'-9	Pf 9.835
408	37'-9½	122.34	16.8	53.030		Sprinkler,	37'-5	Pe 0.939
771	35'-7½			63.804		2PO(18'-8½)	61'-2	Pv 61'-2
Route 5								
CM	2.7050	27.01	1.51	120		0.002251	10'-0	Pf 0.023
409	37'-4½	123.27	16.8	53.839		Sprinkler		Pe 0.000
410	37'-4½			53.862			10'-0	Pv 10'-0
CM	2.7050	150.31	8.39	120		0.053879	141'-2½	Pf 7.608
410	37'-4½	123.30	16.8	53.862		Sprinkler		Pe 0.000
78	37'-4½			61.469			141'-2½	Pv 141'-2½
CM	2.7050	200.31	11.18	120		0.091652	99'-0	Pf 9.074
78	37'-4½	50.00		61.469		Flow (q) from Route 8		Pe 0.000
79	37'-4½			70.543			99'-0	Pv 99'-0
CM	2.7050	250.31	13.97	120		0.138413	180'-1	Pf 30.106
79	37'-4½	50.00		70.543		Flow (q) from Route 9	37'-5	Pe 0.939
80	35'-2½			101.588		2PO(18'-8½)	217'-6	Pv 217'-6
CM	4.3100	250.31	5.50	120		0.014319	10'-0	Pf 0.143
80	35'-2½			101.588				Pe -0.090
56	35'-5			101.640			10'-0	Pv 10'-0
Route 6								
CM	2.7050	96.26	5.37	120		0.023624	8'-9	Pf 0.207
409	37'-4½	123.27	16.8	53.839		Sprinkler		Pe -0.000
411	37'-4½			54.046			8'-9	Pv 8'-9
CM	2.7050	219.76	12.27	120		0.108798	10'-0	Pf 1.088
411	37'-4½	123.51	16.8	54.046		Sprinkler		Pe -0.000
412	37'-4½			55.134			10'-0	Pv 10'-0
CM	2.7050	344.51	19.23	120		0.249930	4'-4½	Pf 1.093
412	37'-4½	124.74	16.8	55.134		Sprinkler		Pe -0.000
81	37'-4½			56.227			4'-4½	Pv 4'-4½
CM	3.3340	344.51	12.66	120		0.090288	19'-4½	Pf 5.808
81	37'-4½			56.227			44'-11½	Pe 0.939
373	35'-2½			62.974		2PO(22'-6)	64'-4	Pv 64'-4
CM	4.3100	344.51	7.58	120		0.025856	10'-0	Pf 0.259
373	35'-2½			62.974				Pe -0.090
578	35'-5			63.143			10'-0	Pv 10'-0
Route 7								
FR	6.2800	150.00	1.55	140		0.000668	4'-0	Pf 0.017
87	0'-0	150.00		32.833		Hydrant,	22'-1	Pe 1.739
88	-4'-0			34.590		E(22'-1)	26'-1	Pv 26'-1



Hydraulic Analysis

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Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
UG	8.3900	150.00	0.87	140	0.000163	22'-5"	Pf 0.013
88	-4'-0"			34.590		59'-4½"	Pe
89	-4'-0"			34.603	T(59'-4½")	81'-9½"	Pv
CM	7.9800	1046.97	6.72	150	0.006660	885'-0½"	Pf 11.437
89	-4'-0"	896.97		34.603	Flow (q) from Route 14	81'-6"	Pe
10	-4'-0"			46.040	4EE(13'-7"), BFP(-5.000), S, E(27'-2)	966'-6½"	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	38'-5"	Pf 2.064
191	3'-0"	50.00		74.299	Hose(42'-3½")	69'-6½"	Pe -14.894
78	37'-4½"			61.469	2E(6'-10"), PO(13'-7½")	108'-0"	Pv
Route 9							
CM	2.2030	50.00	4.21	120	0.019110	38'-5"	Pf 2.064
194	3'-0"	50.00		83.373	Hose(42'-3½")	69'-6½"	Pe -14.894
79	37'-4½"			70.543	2E(6'-10"), PO(13'-7½")	108'-0"	Pv
Route 10							
CM	4.3100	541.00	11.90	120	0.059589	9'-7½"	Pf 1.239
1129	36'-0½"	172.41		66.098	Flow (q) from Route 2	11'-2"	Pe -0.090
1310	36'-3"			67.246	2EE(5'-7")	20'-9½"	Pv
RN	2.7050	174.09	9.72	120	0.070701	473'-1"	Pf 38.742
1310	36'-3"			67.246	PO(18'-8½")	74'-10½"	Pe 0.000
69	36'-3"			105.989	3PO(18'-8½")	547'-11½"	Pv
Route 11							
CM	4.3100	366.91	8.07	120	0.029053	10'-0"	Pf 0.291
1310	36'-3"	174.09		67.246	Flow (q) from Route 10	10'-0"	Pe -0.090
1490	36'-5½"			67.447		10'-0"	Pv
RN	2.7050	179.64	10.03	120	0.074926	473'-1"	Pf 41.057
1490	36'-5½"			67.447	PO(18'-8½")	74'-10½"	Pe 0.000
70	36'-5½"			108.504	3PO(18'-8½")	547'-11½"	Pv
Route 12							
CM	4.3100	187.28	4.12	120	0.008372	10'-0"	Pf 0.084
1490	36'-5½"	179.64		67.447	Flow (q) from Route 11	10'-0"	Pe -0.090
123	36'-8"			67.440		10'-0"	Pv
RN	2.7050	187.28	10.46	120	0.080926	473'-1"	Pf 44.346
123	36'-8"			67.440	PO(18'-8½")	74'-10½"	Pe 0.000
71	36'-8"			111.786	3PO(18'-8½")	547'-11½"	Pv
Route 13							
RN	2.7050	171.45	9.57	120	0.068727	472'-9"	Pf 37.637
949	35'-10"			65.194	PO(18'-8½")	74'-10½"	Pe 0.000
58	35'-10"			102.831	3PO(18'-8½")	547'-7½"	Pv
Route 14							
CM	7.9800	896.97	5.75	150	0.005003	33'-2"	Pf 0.166
9	-4'-0"	671.09		34.437	Flow (q) from Route 1	33'-2"	Pe
89	-4'-0"			34.603		33'-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

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
BalV	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
LiE	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



Hydraulic Summary

Job Number: NC-1403
Report Description: ESFR (W System 2)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

System		Remote Area(s)							
Most Demanding Sprinkler Data 22.4 K-Factor 141.67 at 40.000	Occupancy ESFR	Job Suffix							
Hose Allowance At Source 0.00	Pressure 40.000	Area of Application NA							
Additional Hose Supplies	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²						
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 2763</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>200.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 2763	50.00	Hydrant At Node 87	200.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)								
Hose At Node 2763	50.00								
Hydrant At Node 87	200.00								
<p>11-17-23</p>									
Total Hose Streams 250.00									
System Flow Demand 1955.40	Total Water Required (Including Hose Allowance) 1955.40								
Maximum Pressure Unbalance In Loops 0.000									
Maximum Velocity Above Ground 39.51 between nodes 3503 and 3139									
Maximum Velocity Under Ground 10.19 between nodes 9 and 8									
Volume capacity of Wet Pipes 21197.62 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)
10	Water Supply		82.000	50.000	1900.00	48.252	1955.40	41.931	6.322
91	Pump		147.000	130.000	1500.00	153.857	1755.40	147.536	6.322

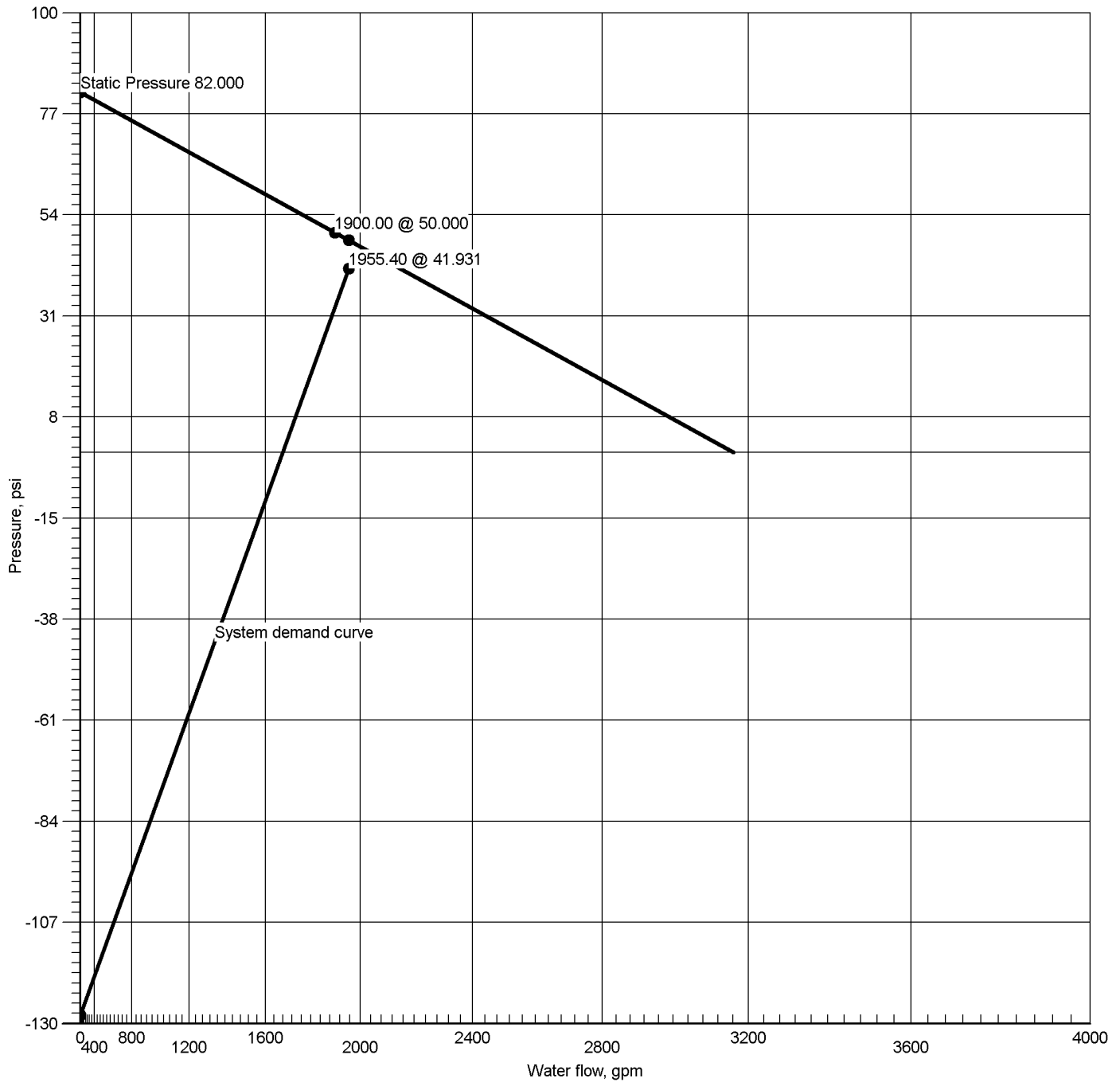
Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension
Address 1 130 w 9th Ave. Suite 100	FAX	
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com	
Address 3	Web-Site	



Water Supply at Node 10



Hydraulic Graph

Water Supply at Node 10

Static Pressure
82.000

Residual Pressure
50.000 @ 1900.00

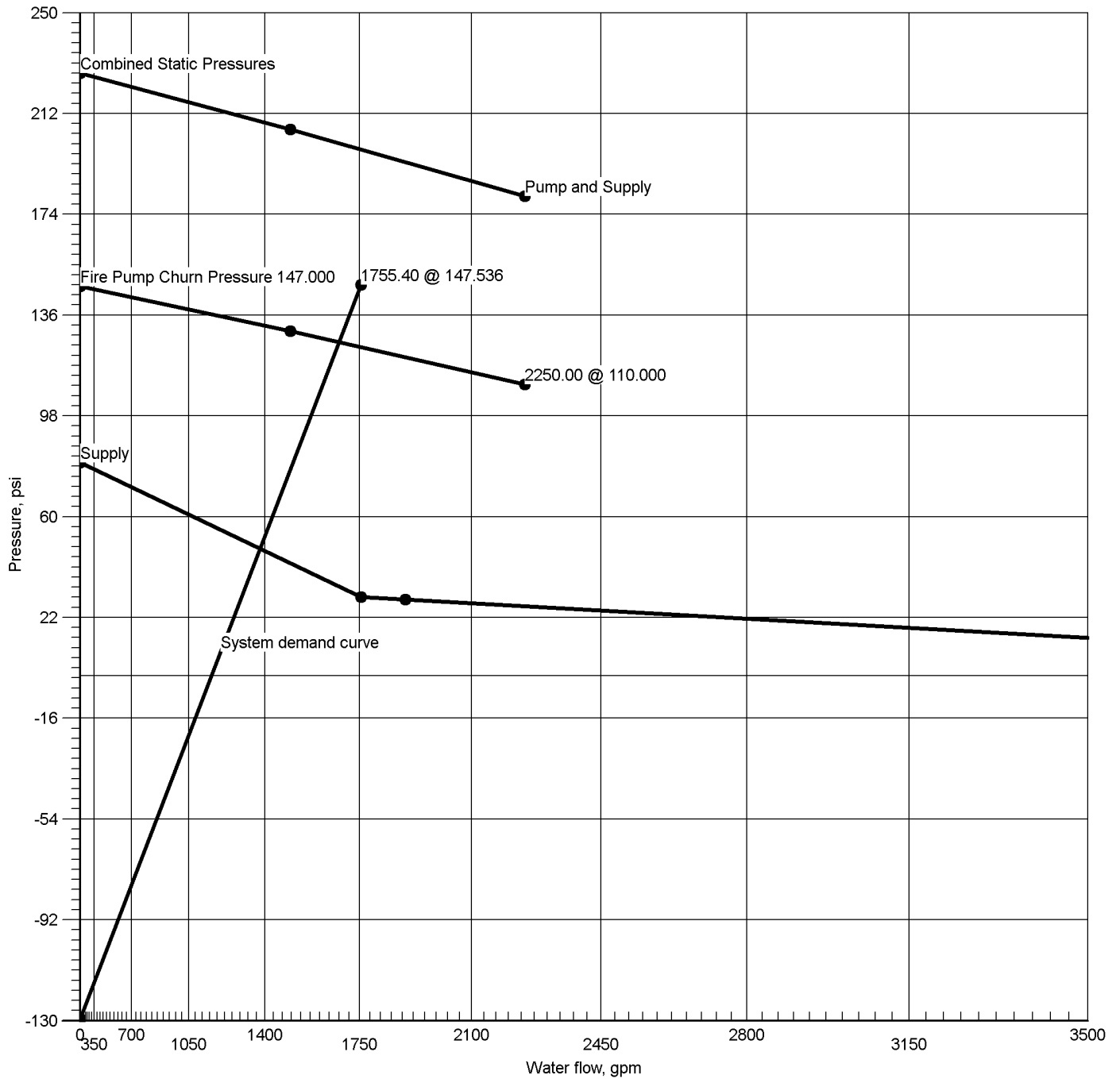
Available Pressure at System Demand
48.252 @ 1955.40

Required Pressure at System Demand
41.931 @ 1955.40

Required Pressure at System Demand (Including Hose Allowance at Source)
41.931 @ 1955.40



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static: Pressure	Fire Pump Churn Pressure	
227.555	147.000	
Residual: Pressure		
124.047 @ 1755.40		
Available Pressure at System Demand		
153.857 @ 1755.40		
Required Pressure at System Demand		
147.536 @ 1755.40		



Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	200.00	200.00	0	26.956			
⇒ Sprinkler	201	141.67	141.67	22.4	40.000			
Sprinkler	202	141.67	141.67	22.4	40.001			
Sprinkler	203	142.01	141.67	22.4	40.191			
Sprinkler	204	141.95	141.67	22.4	40.159			
Sprinkler	205	141.78	141.67	22.4	40.061			
Sprinkler	206	141.78	141.67	22.4	40.061			
Sprinkler	207	142.12	141.67	22.4	40.255			
Sprinkler	208	142.05	141.67	22.4	40.217			
Sprinkler	209	142.44	141.67	22.4	40.433			
Sprinkler	210	142.44	141.67	22.4	40.435			
Sprinkler	211	142.79	141.67	22.4	40.636			
Sprinkler	212	142.70	141.67	22.4	40.586			

⇒ Most Demanding Sprinkler Data



Node Analysis

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
2765	37'-6	PO(22'-6)	68.789	
2766	37'-5½	PO(22'-6)	54.886	
2775	39'-5	PO(13'-7½)	55.132	
2784	39'-5½	PO(22'-6)	55.155	
2954	37'-3½	PO(22'-6)	72.112	
2955	37'-3	PO(22'-6)	55.252	
3134	37'-1	PO(22'-6)	76.343	
3135	37'-0½	PO(22'-6)	55.449	
3139	37'-0½	E(13'-11)	84.650	
3503	36'-7		107.244	
4875	7'-2½	PO(12'-3½), BOR 2	129.126	
4880	34'-5½		116.702	
5003	-0'-8	P1	23.489	
10	-4'-0	S, E(27'-2)	41.931	1955.40
87	0'-0	Hyd	26.956	200.00
201	39'-3	Spr(-40.000)	40.000	141.67
202	39'-3	Spr(-40.001)	40.001	141.67
203	39'-3	Spr(-40.191)	40.191	142.01
204	39'-3	Spr(-40.159)	40.159	141.95
205	39'-5½	Spr(-40.061)	40.061	141.78
206	39'-5½	Spr(-40.061)	40.061	141.78
207	39'-5½	Spr(-40.255)	40.255	142.12
208	39'-5½	Spr(-40.217)	40.217	142.05
209	39'-8	Spr(-40.433)	40.433	142.44
210	39'-8	Spr(-40.435)	40.435	142.44
211	39'-8	Spr(-40.636)	40.636	142.79
212	39'-8	Spr(-40.586)	40.586	142.70
2763	3'-0	Hose(42'-3½)	68.653	50.00
8	0'-8		24.102	
9	-4'-0	T(59'-4½)	28.548	
88	-4'-0	E(22'-1)	28.726	
89	-4'-0	T(59'-4½)	28.748	
90	-0'-10½		147.536	
91	-0'-10½	P2(-123.956)	147.536	
1858	36'-10½	PO(22'-6)	63.155	
1859	36'-10	PO(22'-6)	53.321	
2040	37'-1	PO(22'-6)	63.115	
2041	37'-1	PO(22'-6)	53.172	
2222	37'-3½	PO(22'-6)	63.418	
2223	37'-3½	PO(22'-6)	53.127	
2401	37'-6	PO(22'-6)	64.348	
2402	37'-6	PO(22'-6)	53.395	
2583	37'-8	PO(22'-6)	66.189	
2584	37'-8	PO(22'-6)	54.232	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (W System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
Route 1							
CM	3.3340	6.73	0.25	120	0.000062	8'-9"	Pf 0.001
201	39'-3"	141.67	22.4	40.000	Sprinkler		Pe 0.000
202	39'-3"			40.001		8'-9"	Pv
CM	3.3340	148.40	5.45	120	0.019010	10'-0"	Pf 0.190
202	39'-3"	141.67	22.4	40.001	Sprinkler		Pe 0.000
203	39'-3"			40.191		10'-0"	Pv
CM	3.3340	290.41	10.67	120	0.065824	289'-0"	Pf 21.985
203	39'-3"	142.01	22.4	40.191	Sprinkler,	44'-11½"	Pe 0.939
2040	37'-1"			63.115	2PO(22'-6")	334'-0"	Pv
CM	4.3100	432.23	9.51	120	0.039340	10'-0"	Pf 0.393
2040	37'-1"	141.82		63.115	Flow (q) from Route 9		Pe -0.090
2222	37'-3½"			63.418		10'-0"	Pv
CM	4.3100	724.34	15.93	120	0.102246	10'-0"	Pf 1.023
2222	37'-3½"	292.11		63.418	Flow (q) from Route 3		Pe -0.092
2401	37'-6"			64.348		10'-0"	Pv
CM	4.3100	1020.35	22.44	120	0.192724	10'-0"	Pf 1.928
2401	37'-6"	296.01		64.348	Flow (q) from Route 5		Pe -0.087
2583	37'-8"			66.189		10'-0"	Pv
CM	4.3100	1177.93	25.90	120	0.251373	10'-0"	Pf 2.514
2583	37'-8"	157.58		66.189	Flow (q) from Route 2		Pe 0.086
2765	37'-6"			68.789		10'-0"	Pv
CM	4.3100	1348.88	29.66	120	0.323000	10'-0"	Pf 3.231
2765	37'-6"	170.95		68.789	Flow (q) from Route 13		Pe 0.092
2954	37'-3½"			72.112		10'-0"	Pv
CM	4.3100	1542.36	33.92	120	0.413896	10'-0"	Pf 4.140
2954	37'-3½"	193.47		72.112	Flow (q) from Route 8		Pe 0.092
3134	37'-1"			76.343		10'-0"	Pv
CM	4.3100	1755.40	38.60	120	0.525829	1'-10"	Pf 8.289
3134	37'-1"	213.04		76.343	Flow (q) from Route 11	13'-11"	Pe 0.017
3139	37'-0½"			84.650	E(13'-11")	15'-9"	Pv
CM	4.2600	1755.40	39.51	120	0.556576	27'-1"	Pf 22.401
3139	37'-0½"			84.650		13'-2"	Pe 0.194
3503	36'-7"			107.244	E(13'-2")	40'-3"	Pv
CM	6.3570	1755.40	17.74	120	0.079234	72'-6½"	Pf 8.539
3503	36'-7"			107.244		35'-2½"	Pe 0.919
4880	34'-5½"			116.702	2E(17'-7")	107'-9"	Pv
FR	8.2490	1755.40	10.54	120	0.022278	27'-3"	Pf 0.607
4880	34'-5½"			116.702			Pe 11.817
4875	7'-2½"			129.126	f(-0.000), BOR 2	27'-3"	Pv
FR	8.2490	1755.40	10.54	120	0.022278	138'-4½"	Pf 14.909
4875	7'-2½"			129.126		328'-10½"	Pe 3.501
90	-0'-10½"			147.536	4BV(14'-1), 2T(41'-1½), 4E(21'-1½), 2sCV(52'-10), PRV(-4.500)	467'-2½"	Pv
DY	6.0650	1755.40	19.49	120	0.099624	0'-0"	Pf 0.000
90	-0'-10½"			147.536			Pe -0.000
91	-0'-10½"			147.536		0'-0"	Pv
Pump			Velocity				
91		1755.40		147.536	Rating: 130.000 @ 1500.00		
5003		Q=1755.40	10.54	23.489	Fire Pump Churn Pressure: 147.000		
FR	8.2490	1755.40	10.54	120	0.022278	7'-8½"	Pf 1.192
5003	-0'-8"			23.489		45'-9½"	Pe -0.578
8	0'-8"			24.102	GV(4'-8½"), T(41'-1½")	53'-6"	Pv
UG	8.3900	1755.40	10.19	140	0.015423	67'-2"	Pf 2.423
8	0'-8"			24.102		89'-11"	Pe 2.023
9	-4'-0"			28.548	E(30'-6½"), T(59'-4½")	157'-1"	Pv
CM	7.9800	763.46	4.90	150	0.003713	2123'-0½"	Pf 13.383
9	-4'-0"			28.548		134'-3½"	Pe
10	-4'-0"			41.931	6EE(13'-7), BFP(-5.000), T(52'-10)	2257'-4½"	Pv
		0.00			Hose Allowance At Source		
10		1955.40					
Route 2							
CM	3.3340	134.94	4.96	120	0.015942	10'-0"	Pf 0.159
201	39'-3"	141.67	22.4	40.000	Sprinkler		Pe -0.000
204	39'-3"			40.159		10'-0"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (W System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
CM	3.3340	276.89	10.18	120	0.060267	155'-4"	Pf 12.073
204	39'-3"	141.95	22.4	40.159	Sprinkler,	44'-11½"	Pe 0.939
2041	37'-1"			53.172	2PO(22'-6")	200'-4"	Pv
CM	4.3100	135.07	2.97	120	0.004574	10'-0"	Pf 0.046
2041	37'-1"			53.172			Pe -0.090
2223	37'-3½"			53.127		10'-0"	Pv
CM	4.3100	410.69	9.03	120	0.035788	10'-0"	Pf 0.358
2223	37'-3½"	275.62		53.127	Flow (q) from Route 4		Pe -0.090
2402	37'-6"			53.395		10'-0"	Pv
CM	4.3100	685.05	15.06	120	0.092222	10'-0"	Pf 0.922
2402	37'-6"	274.36		53.395	Flow (q) from Route 6		Pe -0.085
2584	37'-8"			54.232		10'-0"	Pv
RN	3.3340	157.58	5.79	120	0.021241	473'-2"	Pf 11.961
2584	37'-8"			54.232	PO(22'-6")	89'-11½"	Pe -0.004
2583	37'-8"			66.189	3PO(22'-6")	563'-1"	Pv
Route 3							
CM	3.3340	8.21	0.30	120	0.000090	8'-9"	Pf 0.001
205	39'-5½"	141.78	22.4	40.061	Sprinkler		Pe 0.000
206	39'-5½"			40.061		8'-9"	Pv
CM	3.3340	149.99	5.51	120	0.019388	10'-0"	Pf 0.194
206	39'-5½"	141.78	22.4	40.061	Sprinkler		Pe 0.000
207	39'-5½"			40.255		10'-0"	Pv
CM	3.3340	292.11	10.74	120	0.066539	289'-0"	Pf 22.224
207	39'-5½"	142.12	22.4	40.255	Sprinkler,	44'-11½"	Pe 0.939
2222	37'-3½"			63.418	2PO(22'-6")	334'-0"	Pv
Route 4							
CM	3.3340	133.57	4.91	120	0.015644	10'-0"	Pf 0.156
205	39'-5½"	141.78	22.4	40.061	Sprinkler		Pe -0.000
208	39'-5½"			40.217		10'-0"	Pv
CM	3.3340	275.62	10.13	120	0.059757	155'-4"	Pf 11.971
208	39'-5½"	142.05	22.4	40.217	Sprinkler,	44'-11½"	Pe 0.939
2223	37'-3½"			53.127	2PO(22'-6")	200'-4"	Pv
Route 5							
CM	3.3340	10.78	0.40	120	0.000149	8'-9"	Pf 0.001
209	39'-8"	142.44	22.4	40.433	Sprinkler		Pe 0.000
210	39'-8"			40.435		8'-9"	Pv
CM	3.3340	153.21	5.63	120	0.020166	10'-0"	Pf 0.202
210	39'-8"	142.44	22.4	40.435	Sprinkler		Pe 0.000
211	39'-8"			40.636		10'-0"	Pv
CM	3.3340	296.01	10.88	120	0.068190	289'-0"	Pf 22.775
211	39'-8"	142.79	22.4	40.636	Sprinkler,	44'-11½"	Pe 0.937
2401	37'-6"			64.348	2PO(22'-6")	334'-0"	Pv
Route 6							
CM	3.3340	131.66	4.84	120	0.015233	10'-0"	Pf 0.152
209	39'-8"	142.44	22.4	40.433	Sprinkler		Pe -0.000
212	39'-8"			40.586		10'-0"	Pv
CM	3.3340	274.36	10.08	120	0.059253	155'-4"	Pf 11.870
212	39'-8"	142.70	22.4	40.586	Sprinkler,	44'-11½"	Pe 0.939
2402	37'-6"			53.395	2PO(22'-6")	200'-4"	Pv
Route 7							
FR	6.2800	200.00	2.07	140	0.001137	4'-0"	Pf 0.030
87	0'-0"	200.00		26.956	Hydrant,	22'-1"	Pe 1.739
88	-4'-0"			28.726	E(22'-1")	26'-1"	Pv
UG	8.3900	200.00	1.16	140	0.000277	22'-5"	Pf 0.023
88	-4'-0"			28.726		59'-4½"	Pe
89	-4'-0"			28.748	T(59'-4½")	81'-9½"	Pv
CM	7.9800	1191.94	7.65	150	0.008466	885'-0½"	Pf 13.183
89	-4'-0"	991.94		28.748	Flow (q) from Route 16	81'-6"	Pe
10	-4'-0"			41.931	4EE(13'-7"), BFP(-5.000), S, E(27'-2)	966'-6½"	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	42'-8"	Pf 2.275
2763	3'-0"	50.00		68.653	Hose(42'-3½")	76'-4½"	Pe -15.797
2775	39'-5"			55.132	3E(6'-10"), PO(13'-7½")	119'-0½"	Pv
CM	3.3340	50.00	1.84	120	0.002540	9'-1½"	Pf 0.023
2775	39'-5"			55.132			Pe -0.000
2784	39'-5½"			55.155		9'-1½"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (W System 2)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
CM	3.3340	193.47	7.11	120	0.031050	470'-11½"	Pf 16.020
2784	39'-5½"	143.47		55.155	Flow (q) from Route 10	44'-11½"	Pe 0.937
2954	37'-3½"			72.112	2PO(22'-6)	515'-11"	Pv
Route 9							
CM	4.3100	141.82	3.12	120	0.005006	10'-0"	Pf 0.050
1858	36'-10½"	141.82		63.155	Flow (q) from Route 14	10'-0"	Pe -0.090
2040	37'-1"			63.115			Pv
Route 10							
RN	3.3340	143.47	5.27	120	0.017858	2'-2"	Pf 0.842
2955	37'-3"	356.52		55.252	PO(22'-6), Flow (q) from Route	44'-11½"	Pe -0.939
2784	39'-5½"			55.155	12	47'-1½"	Pv
					PO(22'-6)		
Route 11							
CM	4.3100	213.04	4.68	120	0.010627	10'-0"	Pf 0.106
2955	37'-3"	356.52		55.252	Flow (q) from Route 12	10'-0"	Pe 0.090
3135	37'-0½"			55.449			Pv
RN	3.3340	213.04	7.83	120	0.037109	473'-1½"	Pf 20.895
3135	37'-0½"			55.449	PO(22'-6)	89'-11½"	Pe -0.000
3134	37'-1"			76.343	3PO(22'-6)	563'-1"	Pv
Route 12							
CM	4.3100	356.52	7.84	120	0.027548	10'-0"	Pf 0.276
2766	37'-5½"	527.47		54.886	Flow (q) from Route 15	10'-0"	Pe 0.090
2955	37'-3"			55.252			Pv
Route 13							
RN	3.3340	170.95	6.28	120	0.024697	473'-1½"	Pf 13.906
2766	37'-5½"	527.47		54.886	PO(22'-6), Flow (q) from Route	89'-11½"	Pe -0.003
2765	37'-6"			68.789	15	563'-1"	Pv
					3PO(22'-6)		
Route 14							
CM	4.3100	141.82	3.12	120	0.005006	10'-0"	Pf 0.050
2041	37'-1"	135.07		53.172	Flow (q) from Route 2	10'-0"	Pe 0.099
1859	36'-10"			53.321			Pv
RN	3.3340	141.82	5.21	120	0.017480	473'-1½"	Pf 9.843
1859	36'-10"			53.321	PO(22'-6)	89'-11½"	Pe -0.009
1858	36'-10½"			63.155	3PO(22'-6)	563'-1"	Pv
Route 15							
CM	4.3100	527.47	11.60	120	0.056861	10'-0"	Pf 0.569
2584	37'-8"	157.58		54.232	Flow (q) from Route 2	10'-0"	Pe 0.085
2766	37'-5½"			54.886			Pv
Route 16							
CM	7.9800	991.94	6.36	150	0.006027	33'-2"	Pf 0.200
9	-4'-0"	763.46		28.548	Flow (q) from Route 1	33'-2"	Pe
89	-4'-0"			28.748			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

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
BalV	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 Summary

Job Number: NC-1403
Report Description: ESFR (SW System 3)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

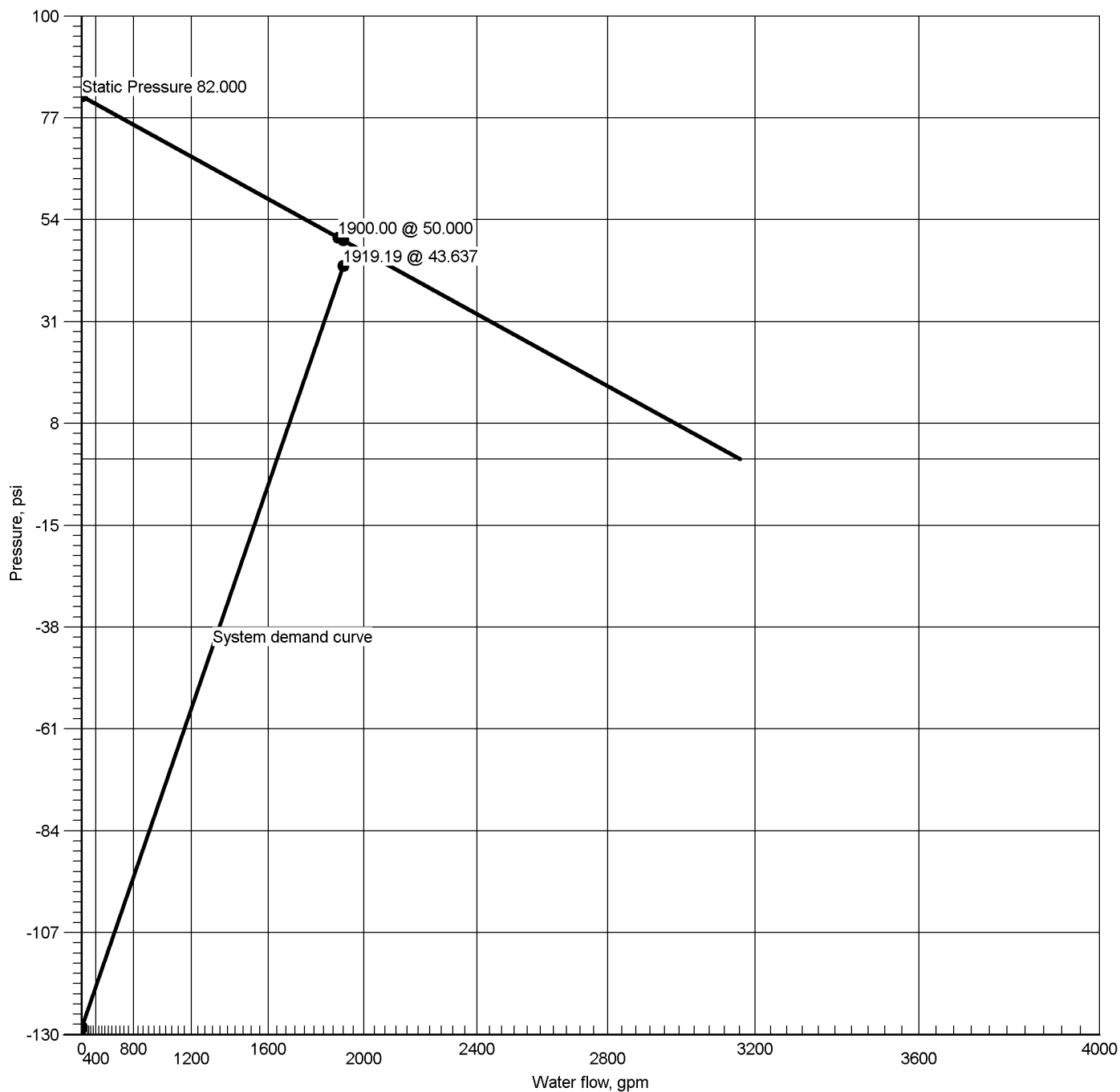
System		Remote Area(s)									
Most Demanding Sprinkler Data 16.8 K-Factor 121.15 at 52.000	Occupancy ESFR	Job Suffix									
Hose Allowance At Source 0.00	Pressure 52.000	Area of Application NA									
Additional Hose Supplies	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²								
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 4850</td> <td>50.00</td> </tr> <tr> <td>Hose At Node 4853</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>150.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 4850	50.00	Hose At Node 4853	50.00	Hydrant At Node 87	150.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)										
Hose At Node 4850	50.00										
Hose At Node 4853	50.00										
Hydrant At Node 87	150.00										
<p>11-17-23</p>											
Total Hose Streams 250.00											
System Flow Demand 1919.19	Total Water Required (Including Hose Allowance) 1919.19										
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 32.95 between nodes 47 and 46											
Maximum Velocity Under Ground 10.27 between nodes 9 and 8											
Volume capacity of Wet Pipes 21151.20 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)
10	Water Supply		82.000	50.000	1900.00	49.399	1919.19	43.637	5.763
91	Pump		147.000	130.000	1500.00	154.877	1769.19	149.114	5.763
Pumps: Static = Churn (Pressure @ Zero Flow)									

Contractor			
Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design	
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension	
Address 1 130 w 9th Ave. Suite 100	FAX		
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com		
Address 3	Web-Site		



Water Supply at Node 10



Hydraulic Graph
Water Supply at Node 10

Static Pressure
82.000

Residual Pressure
50.000 @ 1900.00

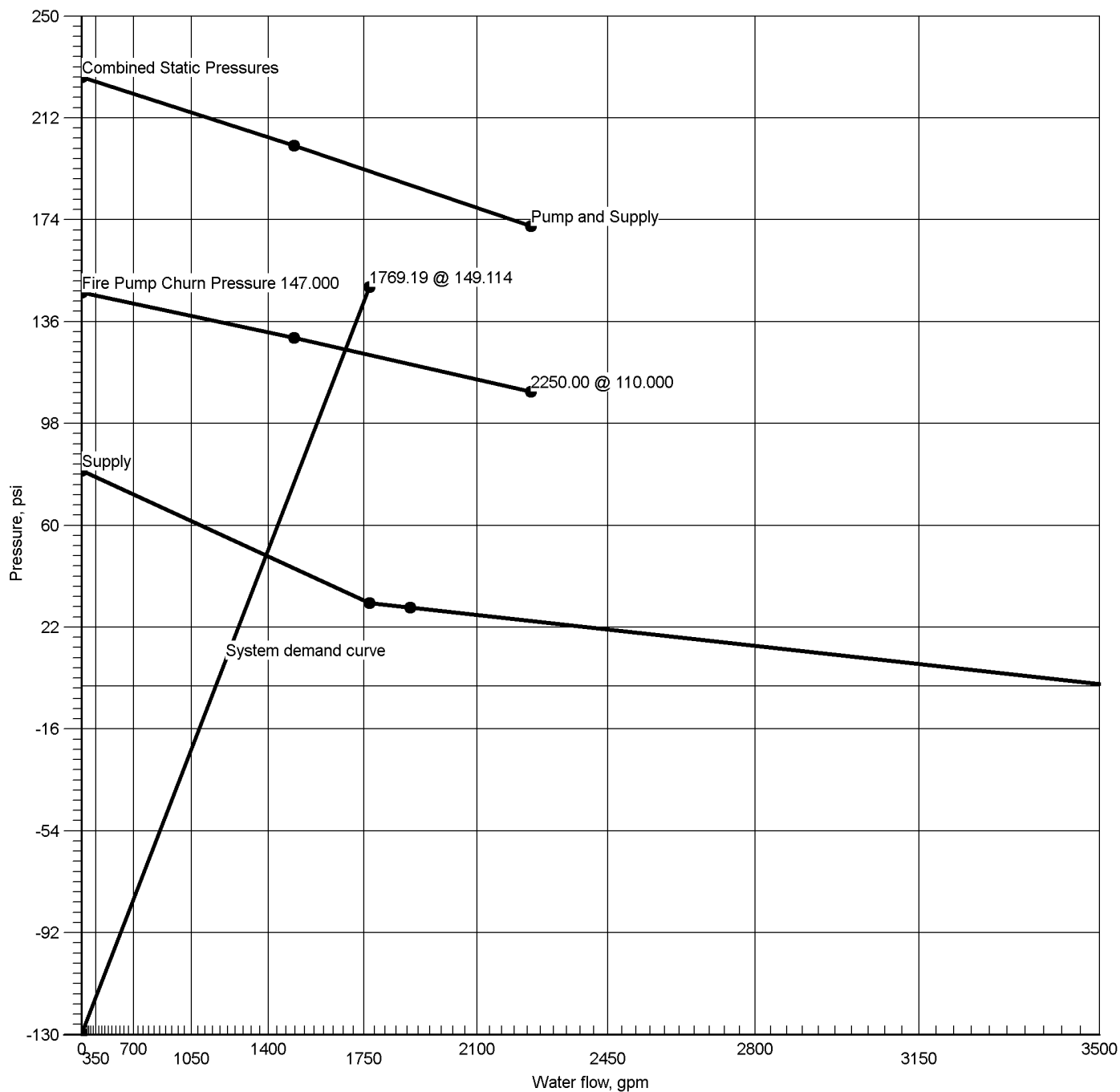
Available Pressure at System Demand
49.399 @ 1919.19

Required Pressure at System Demand
43.637 @ 1919.19

Required Pressure at System Demand (Including Hose Allowance at Source)
43.637 @ 1919.19



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static: Pressure	Fire Pump Churn Pressure	
227.555	147.000	
Residual: Pressure		
123.698 @ 1769.19		
Available Pressure at System Demand		
154.877 @ 1769.19		
Required Pressure at System Demand		
149.114 @ 1769.19		



Summary Of Outflowing Devices

Device	Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant 87	150.00	150.00	0	28.968			
⇒ Sprinkler 501	121.15	121.15	16.8	52.000			
Sprinkler 502	121.49	121.15	16.8	52.297			
Sprinkler 503	121.15	121.15	16.8	52.001			
Sprinkler 504	121.54	121.15	16.8	52.337			
Sprinkler 505	121.74	121.15	16.8	52.513			
Sprinkler 506	122.09	121.15	16.8	52.812			
Sprinkler 507	121.74	121.15	16.8	52.514			
Sprinkler 508	122.14	121.15	16.8	52.854			
Sprinkler 509	173.88	141.67	22.4	60.254			
Sprinkler 510	173.88	141.67	22.4	60.256			
Sprinkler 511	174.25	141.67	22.4	60.512			
Sprinkler 512	174.15	141.67	22.4	60.445			
Hose 4850	50.00	50.00	0	104.610			

⇒ Most Demanding Sprinkler Data



Node Analysis

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
10	-4'-0	S, E(27'-2)	43.637	1919.19
87	0'-0	Hyd	28.968	150.00
501	38'-9½	Spr(-52.000)	52.000	121.15
502	38'-9½	Spr(-52.297)	52.297	121.49
503	38'-9½	Spr(-52.001)	52.001	121.15
504	38'-9½	Spr(-52.337)	52.337	121.54
505	38'-7	Spr(-52.513)	52.513	121.74
506	38'-7	Spr(-52.812)	52.812	122.09
507	38'-7	Spr(-52.514)	52.514	121.74
508	38'-7	Spr(-52.854)	52.854	122.14
509	39'-0	Spr(-60.254)	60.254	173.88
510	39'-0	Spr(-60.256)	60.256	173.88
511	39'-0	Spr(-60.512)	60.512	174.25
512	39'-0	Spr(-60.445)	60.445	174.15
4850	3'-0	Hose(42'-3½)	104.610	50.00
4853	3'-0	Hose(42'-3½)	107.825	50.00
8	0'-8		26.047	
9	-4'-0	T(59'-4½)	30.528	
40	36'-8	PO(18'-8½)	95.834	
41	36'-5½	PO(18'-8½)	96.688	
42	36'-3	PO(18'-8½)	98.201	
43	36'-0½	PO(18'-8½)	100.095	
44	35'-10	PO(18'-8½)	102.420	
45	35'-7½	PO(18'-8½)	105.249	
46	35'-4½	PO(18'-8½)	108.675	
47	35'-2½		112.333	
48	35'-2	PO(22'-6)	112.400	
49	35'-1		114.959	
51	36'-8	PO(18'-8½)	78.092	
52	36'-5½	PO(18'-8½)	78.862	
53	36'-3	PO(18'-8½)	80.266	
54	36'-0½	PO(18'-8½)	81.353	
55	35'-10	PO(18'-8½)	82.158	
83	36'-10½	PO(22'-6)	95.444	
85	36'-10	PO(22'-6)	77.757	
88	-4'-0	E(22'-1)	30.725	
89	-4'-0	T(59'-4½)	30.739	
90	-0'-10½		149.114	
91	-0'-10½	P2(-123.607)	149.114	
124	35'-4½	PO(18'-8½)	83.067	
125	35'-2	PO(22'-6)	83.257	
126	35'-7½	PO(18'-8½)	82.716	
4696	37'-4	PO(13'-7½)	91.778	
4707	37'-4	PO(13'-7½)	94.994	
4894	6'-2½	PO(12'-3½), BOR 3	129.098	
5003	-0'-8	P1	25.416	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SW System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
Route 1							
CM	2.7050	117.04	6.53	120	0.033917	8'-9"	Pf 0.297
501	38'-9½"	121.15	16.8	52.000	Sprinkler		Pe -0.000
502	38'-9½"			52.297		8'-9"	Pv
CM	2.7050	238.53	13.32	120	0.126608	299'-0"	Pf 42.598
502	38'-9½"	121.49	16.8	52.297	Sprinkler,	37'-5"	Pe 0.939
40	36'-8"			95.834	2PO(18'-8½")	336'-5½"	Pv
CM	4.2600	600.27	13.51	120	0.076448	10'-0"	Pf 0.764
40	36'-8"	361.73		95.834	Flow (q) from Route 5		Pe 0.090
41	36'-5½"			96.688		10'-0"	Pv
CM	4.2600	839.82	18.90	120	0.142291	10'-0"	Pf 1.423
41	36'-5½"	239.56		96.688	Flow (q) from Route 3		Pe 0.090
42	36'-3"			98.201		10'-0"	Pv
CM	4.2600	954.63	21.49	120	0.180353	10'-0"	Pf 1.803
42	36'-3"	114.81		98.201	Flow (q) from Route 10		Pe 0.090
43	36'-0½"			100.095		10'-0"	Pv
CM	4.2600	1072.20	24.13	120	0.223583	10'-0"	Pf 2.235
43	36'-0½"	117.57		100.095	Flow (q) from Route 11		Pe 0.090
44	35'-10"			102.420		10'-0"	Pv
CM	4.2600	1194.83	26.90	120	0.273178	10'-0½"	Pf 2.738
44	35'-10"	122.63		102.420	Flow (q) from Route 13		Pe 0.091
45	35'-7½"			105.249		10'-0½"	Pv
CM	4.2600	1324.71	29.82	120	0.330639	10'-1"	Pf 3.335
45	35'-7½"	129.88		105.249	Flow (q) from Route 2		Pe 0.091
46	35'-4½"			108.675		10'-1"	Pv
CM	4.2600	1463.89	32.95	120	0.397758	9'-0"	Pf 3.577
46	35'-4½"	139.18		108.675	Flow (q) from Route 12		Pe 0.081
47	35'-2½"			112.333		9'-0"	Pv
CM	6.3570	1463.89	14.80	120	0.056625	1'-0"	Pf 0.057
47	35'-2½"			112.333			Pe 0.009
48	35'-2"			112.400		1'-0"	Pv
CM	6.3570	1769.19	17.88	120	0.080389	13'-9½"	Pf 2.522
48	35'-2"	305.30		112.400	Flow (q) from Route 8	17'-7"	Pe 0.037
49	35'-1"			114.959	E(17'-7")	31'-4½"	Pv
FR	8.2490	1769.19	10.62	120	0.022603	28'-11"	Pf 1.609
49	35'-1"			114.959		42'-3½"	Pe 12.529
4894	6'-2½"			129.098	2E(21'-1½"), f(-0.000), BOR 3	71'-2½"	Pv
FR	8.2490	1769.19	10.62	120	0.022603	139'-8"	Pf 16.948
4894	6'-2½"			129.098		411'-1"	Pe 3.068
90	-0'-10½"			149.114	4BV(14'-1"), 2PO(41'-1½"), 2T(41'-1½"), 4E(21'-1½"), 2sCV(52'-10"), PRV(-4.500)	550'-9"	Pv
DY	6.0650	1769.19	19.65	120	0.101077	0'-0"	Pf 0.000
90	-0'-10½"			149.114			Pe -0.000
91	-0'-10½"			149.114		0'-0"	Pv
Pump		Velocity					
91		1769.19		149.114	Rating: 130.000 @ 1500.00		
5003		Q=1769.19	10.62	25.416	Fire Pump Churn Pressure: 147.000		
FR	8.2490	1769.19	10.62	120	0.022603	7'-8½"	Pf 1.209
5003	-0'-8"			25.416		45'-9½"	Pe -0.578
8	0'-8"			26.047	GV(4'-8½"), T(41'-1½")	53'-6"	Pv
UG	8.3900	1769.19	10.27	140	0.015648	67'-2"	Pf 2.458
8	0'-8"			26.047		89'-11"	Pe 2.023
9	-4'-0"			30.528	E(30'-6½"), T(59'-4½")	157'-1"	Pv
CM	7.9800	749.85	4.81	150	0.003592	2123'-0½"	Pf 13.108
9	-4'-0"			30.528		134'-3½"	Pe
10	-4'-0"			43.637	6EE(13'-7"), BFP(-5.000), T(52'-10")	2257'-4½"	Pv
		0.00			Hose Allowance At Source		
10		1919.19					
Route 2							
CM	2.7050	4.11	0.23	120	0.000069	10'-0"	Pf 0.001
501	38'-9½"	121.15	16.8	52.000	Sprinkler		Pe 0.000
503	38'-9½"			52.001		10'-0"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SW 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	2.7050	125.25	6.99	120	0.038451	8'-9"	Pf 0.336
503	38'-9½"	121.15	16.8	52.001	Sprinkler		Pe 0.000
504	38'-9½"			52.337		8'-9"	Pv
CM	2.7050	246.79	13.78	120	0.134838	146'-7"	Pf 24.815
504	38'-9½"	121.54	16.8	52.337	Sprinkler,	37'-5"	Pe 0.939
51	36'-8"			78.092	2PO(18'-8½")	184'-0½"	Pv
CM	4.3100	581.21	12.78	120	0.068041	10'-0"	Pf 0.680
51	36'-8"	334.42		78.092	Flow (q) from Route 6		Pe 0.090
52	36'-5½"			78.862		10'-0"	Pv
CM	4.3100	829.37	18.24	120	0.131350	10'-0"	Pf 1.313
52	36'-5½"	248.15		78.862	Flow (q) from Route 4		Pe 0.090
53	36'-3"			80.266		10'-0"	Pv
CM	4.3100	714.56	15.71	120	0.099706	10'-0"	Pf 0.997
53	36'-3"			80.266			Pe 0.090
54	36'-0½"			81.353		10'-0"	Pv
CM	4.3100	596.99	13.13	120	0.071498	10'-0"	Pf 0.715
54	36'-0½"			81.353			Pe 0.090
55	35'-10"			82.158		10'-0"	Pv
CM	4.3100	474.36	10.43	120	0.046725	10'-0"	Pf 0.467
55	35'-10"			82.158			Pe 0.090
126	35'-7½"			82.716		10'-0"	Pv
RN	2.7050	129.88	7.25	120	0.041120	473'-1½"	Pf 22.534
126	35'-7½"			82.716	PO(18'-8½")	74'-10½"	Pe -0.000
45	35'-7½"			105.249	3PO(18'-8½")	548'-0"	Pv
Route 3							
CM	2.7050	117.47	6.56	120	0.034148	8'-9"	Pf 0.299
505	38'-7"	121.74	16.8	52.513	Sprinkler		Pe -0.000
506	38'-7"			52.812		8'-9"	Pv
CM	2.7050	239.56	13.37	120	0.127617	299'-0"	Pf 42.938
506	38'-7"	122.09	16.8	52.812	Sprinkler,	37'-5"	Pe 0.939
41	36'-5½"			96.688	2PO(18'-8½")	336'-5½"	Pv
Route 4							
CM	2.7050	4.27	0.24	120	0.000074	10'-0"	Pf 0.001
505	38'-7"	121.74	16.8	52.513	Sprinkler		Pe 0.000
507	38'-7"			52.514		10'-0"	Pv
CM	2.7050	126.02	7.04	120	0.038886	8'-9"	Pf 0.340
507	38'-7"	121.74	16.8	52.514	Sprinkler		Pe 0.000
508	38'-7"			52.854		8'-9"	Pv
CM	2.7050	248.15	13.85	120	0.136217	146'-7"	Pf 25.069
508	38'-7"	122.14	16.8	52.854	Sprinkler,	37'-5"	Pe 0.939
52	36'-5½"			78.862	2PO(18'-8½")	184'-0½"	Pv
Route 5							
CM	3.3340	13.61	0.50	120	0.000229	10'-0"	Pf 0.002
509	39'-0"	173.88	22.4	60.254	Sprinkler		Pe -0.000
510	39'-0"			60.256		10'-0"	Pv
CM	3.3340	187.49	6.89	120	0.029296	8'-9"	Pf 0.256
510	39'-0"	173.88	22.4	60.256	Sprinkler		Pe -0.000
511	39'-0"			60.512		8'-9"	Pv
CM	3.3340	361.73	13.29	120	0.098817	299'-0"	Pf 33.993
511	39'-0"	174.25	22.4	60.512	Sprinkler,	44'-11½"	Pe 0.939
83	36'-10½"			95.444	2PO(22'-6")	344'-0"	Pv
CM	4.2600	361.73	8.14	120	0.029954	10'-0"	Pf 0.299
83	36'-10½"			95.444			Pe 0.090
40	36'-8"			95.834		10'-0"	Pv
Route 6							
CM	3.3340	160.27	5.89	120	0.021917	8'-9"	Pf 0.192
509	39'-0"	173.88	22.4	60.254	Sprinkler		Pe 0.000
512	39'-0"			60.445		8'-9"	Pv
CM	3.3340	334.42	12.29	120	0.085459	146'-7"	Pf 16.372
512	39'-0"	174.15	22.4	60.445	Sprinkler,	44'-11½"	Pe 0.939
85	36'-10"			77.757	2PO(22'-6")	191'-7"	Pv
CM	4.3100	334.42	7.35	120	0.024473	10'-0"	Pf 0.245
85	36'-10"			77.757			Pe 0.090
51	36'-8"			78.092		10'-0"	Pv
Route 7							
FR	6.2800	150.00	1.55	140	0.000668	4'-0"	Pf 0.017
87	0'-0"	150.00		28.968	Hydrant,	22'-1"	Pe 1.739
88	-4'-0"			30.725	E(22'-1")	26'-1"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SW System 3)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
UG	8.3900	150.00	0.87	140	0.000163	22'-5"	Pf 0.013
88	-4'-0"			30.725		59'-4½"	Pe
89	-4'-0"			30.739	T(59'-4½")	81'-9½"	Pv
CM	7.9800	1169.34	7.50	150	0.008172	885'-0½"	Pf 12.898
89	-4'-0"	1019.34		30.739	Flow (q) from Route 15	81'-6"	Pe
10	-4'-0"			43.637	4EE(13'-7"), BFP(-5.000), S, E(27'-2)	966'-6½"	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	38'-4"	Pf 2.062
4850	3'-0"	50.00		104.610	Hose(42'-3½")	69'-6½"	Pe -14.893
4696	37'-4"			91.778	2E(6'-10"), PO(13'-7½")	107'-11"	Pv
CM	3.3340	255.30	9.38	120	0.051864	62'-0"	Pf 3.216
4696	37'-4"	205.30		91.778	Flow (q) from Route 14	62'-0"	Pe -0.000
4707	37'-4"			94.994		62'-0"	Pv
CM	3.3340	305.30	11.22	120	0.072204	183'-1"	Pf 16.466
4707	37'-4"	50.00		94.994	Flow (q) from Route 9	44'-11½"	Pe 0.940
48	35'-2"			112.400	2PO(22'-6")	228'-0½"	Pv
Route 9							
CM	2.2030	50.00	4.21	120	0.019110	38'-4"	Pf 2.062
4853	3'-0"	50.00		107.825	Hose(42'-3½")	69'-6½"	Pe -14.893
4707	37'-4"			94.994	2E(6'-10"), PO(13'-7½")	107'-11"	Pv
Route 10							
RN	2.7050	114.81	6.41	120	0.032730	473'-1½"	Pf 17.936
53	36'-3"			80.266	PO(18'-8½")	74'-10½"	Pe -0.000
42	36'-3"			98.201	3PO(18'-8½")	548'-0"	Pv
Route 11							
RN	2.7050	117.57	6.56	120	0.034201	473'-1½"	Pf 18.742
54	36'-0½"			81.353	PO(18'-8½")	74'-10½"	Pe -0.000
43	36'-0½"			100.095	3PO(18'-8½")	548'-0"	Pv
Route 12							
CM	4.3100	344.48	7.58	120	0.025852	10'-1"	Pf 0.261
126	35'-7½"	129.88		82.716	Flow (q) from Route 2	10'-1"	Pe 0.091
124	35'-4½"			83.067		10'-1"	Pv
RN	2.7050	139.18	7.77	120	0.046730	473'-1½"	Pf 25.608
124	35'-4½"			83.067	PO(18'-8½")	74'-10½"	Pe -0.000
46	35'-4½"			108.675	3PO(18'-8½")	548'-0"	Pv
Route 13							
RN	2.7050	122.63	6.85	120	0.036976	473'-1½"	Pf 20.262
55	35'-10"			82.158	PO(18'-8½")	74'-10½"	Pe -0.000
44	35'-10"			102.420	3PO(18'-8½")	548'-0"	Pv
Route 14							
CM	4.3100	205.30	4.51	120	0.009924	10'-0"	Pf 0.099
124	35'-4½"	139.18		83.067	Flow (q) from Route 12	10'-0"	Pe 0.090
125	35'-2"			83.257		10'-0"	Pv
RN	3.3340	205.30	7.54	120	0.034653	228'-0½"	Pf 9.461
125	35'-2"			83.257	PO(22'-6")	44'-11½"	Pe -0.940
4696	37'-4"			91.778	PO(22'-6")	273'-0½"	Pv
Route 15							
CM	7.9800	1019.34	6.54	150	0.006339	33'-2"	Pf 0.210
9	-4'-0"	749.85		30.528	Flow (q) from Route 1	33'-2"	Pe
89	-4'-0"			30.739		33'-2"	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

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
BalV	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 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



Hydraulic Summary

Job Number: NC-1403
Report Description: ESFR (NE System 4)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

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 50.000	Area of Application NA									
Additional Hose Supplies	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²								
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 215</td> <td>50.00</td> </tr> <tr> <td>Hose At Node 218</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>150.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 215	50.00	Hose At Node 218	50.00	Hydrant At Node 87	150.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)										
Hose At Node 215	50.00										
Hose At Node 218	50.00										
Hydrant At Node 87	150.00										
Total Hose Streams 250.00	<div style="text-align: center;"> <p>11-17-23</p> </div>										
System Flow Demand 1723.23				Total Water Required (Including Hose Allowance) 1723.23							
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 30.83 between nodes 1490 and 6											
Maximum Velocity Under Ground 9.13 between nodes 9 and 8											
Volume capacity of Wet Pipes 21156.00 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)
10	Water Supply		82.000	50.000	1900.00	55.289	1723.23	48.971	6.318
91	Pump		147.000	130.000	1500.00	167.692	1573.23	161.375	6.318

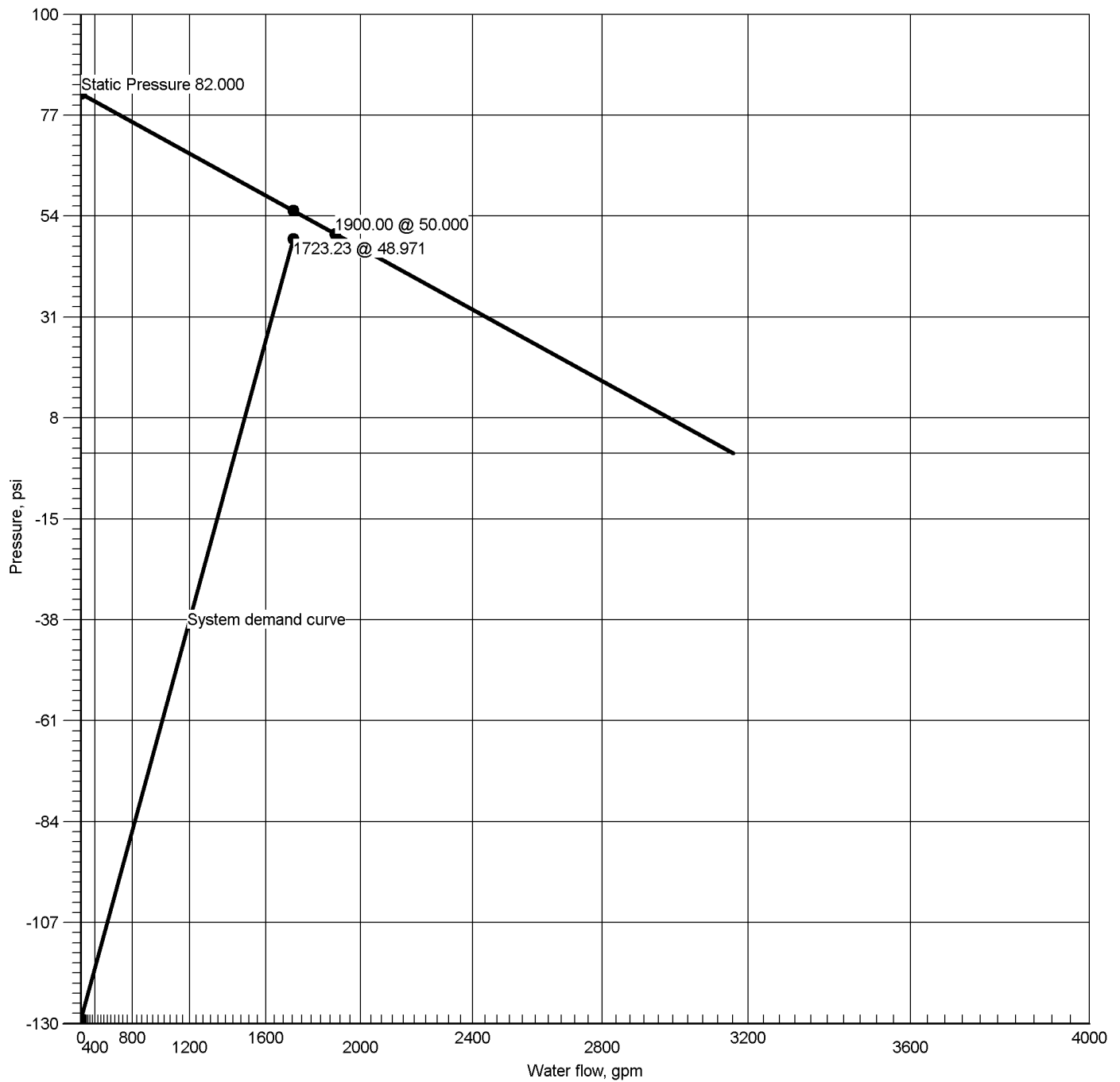
Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension
Address 1 130 w 9th Ave. Suite 100	FAX	
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com	
Address 3	Web-Site	



Water Supply at Node 10



Hydraulic Graph

Water Supply at Node 10

Static Pressure
82.000

Residual Pressure
50.000 @ 1900.00

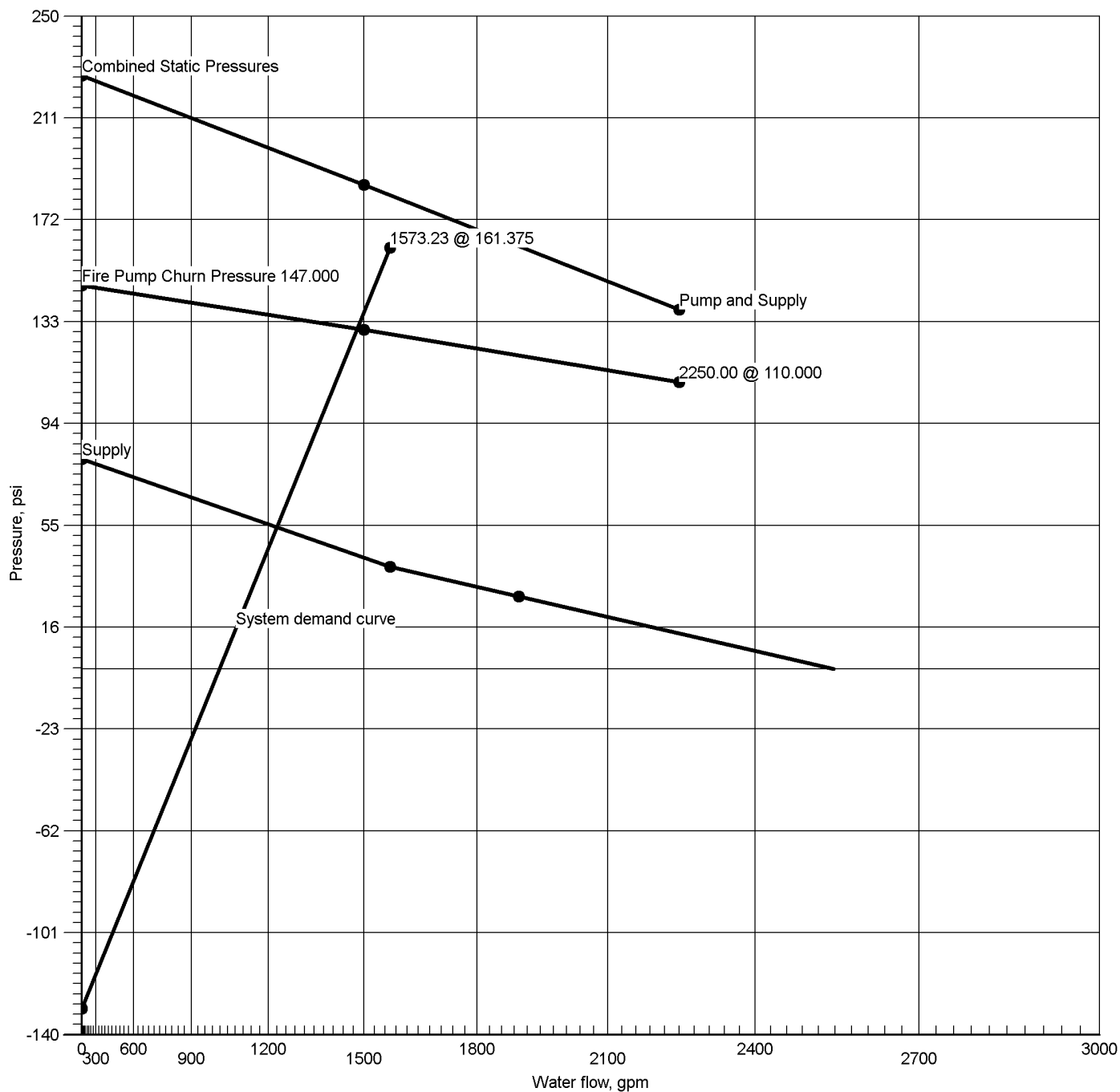
Available Pressure at System Demand
55.289 @ 1723.23

Required Pressure at System Demand
48.971 @ 1723.23

Required Pressure at System Demand (Including Hose Allowance at Source)
48.971 @ 1723.23



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static: Pressure	Fire Pump Churn Pressure	
227.555	147.000	
Residual: Pressure		
128.440 @ 1573.23		
Available Pressure at System Demand		
167.692 @ 1573.23		
Required Pressure at System Demand		
161.375 @ 1573.23		



Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	150.00	150.00	0	35.728			
Sprinkler	101	123.02	121.15	16.8	53.620			
Sprinkler	102	123.42	121.15	16.8	53.967			
Sprinkler	103	123.02	121.15	16.8	53.621			
Sprinkler	104	123.48	121.15	16.8	54.019			
Sprinkler	105	123.42	121.15	16.8	53.969			
Sprinkler	106	123.81	121.15	16.8	54.315			
Sprinkler	107	123.42	121.15	16.8	53.969			
Sprinkler	111	121.24	121.15	16.8	52.081			
Sprinkler	112	122.11	121.15	16.8	52.829			
Hose	215	50.00	50.00	0	82.195			
Hose	218	50.00	50.00	0	69.951			
Sprinkler	5489	121.27	121.15	16.8	52.108			
⇒ Sprinkler	5490	121.15	121.15	16.8	52.000			

⇒ Most Demanding Sprinkler Data



Node Analysis

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
10	-4'-0	S, E(27'-2)	48.971	1723.23
87	0'-0	Hyd	35.728	150.00
101	37'-6½	Spr(-53.620)	53.620	123.02
102	37'-6½	Spr(-53.967)	53.967	123.42
103	37'-6½	Spr(-53.621)	53.621	123.02
104	37'-6½	Spr(-54.019)	54.019	123.48
105	37'-9	Spr(-53.969)	53.969	123.42
106	37'-9	Spr(-54.315)	54.315	123.81
107	37'-9	Spr(-53.969)	53.969	123.42
111	37'-4	Spr(-52.081)	52.081	121.24
112	37'-4	Spr(-52.829)	52.829	122.11
215	3'-0	Hose(42'-3½)	82.195	50.00
218	3'-0	Hose(42'-3½)	69.951	50.00
5489	37'-4	Spr(-52.108)	52.108	121.27
5490	37'-4	Spr(-52.000)	52.000	121.15
5691	37'-9	Spr(-54.372)	54.372	123.88
1	35'-5	PO(18'-8½)	104.634	
2	35'-7½	PO(18'-8½)	105.111	
3	35'-10	PO(18'-8½)	106.161	
4	36'-0½	PO(18'-8½)	107.666	
5	36'-3	PO(18'-8½)	109.704	
6	36'-5½	PO(18'-8½)	112.361	
7	36'-8	PO(18'-8½)	114.530	
8	0'-8		33.330	
9	-4'-0	T(59'-4½)	37.331	
11	35'-4½	PO(18'-8½)	73.937	
12	35'-7	PO(18'-8½)	74.467	
13	35'-9½	PO(18'-8½)	75.620	
14	37'-4½		100.543	
15	35'-2½	PO(22'-6)	104.544	
16	37'-4		68.331	
17	35'-2	PO(22'-6)	73.825	
88	-4'-0	E(22'-1)	37.485	
89	-4'-0	T(59'-4½)	37.498	
90	-0'-10½		161.375	
91	-0'-10½	P2(-128.350)	161.375	
109	36'-2½	PO(18'-8½)	76.790	
110	36'-5	PO(18'-8½)	76.948	
114	36'-0	PO(18'-8½)	76.371	
365	37'-4½	PO(13'-7½)	69.365	
382	37'-4	PO(13'-7½)	57.121	
1490	36'-7		114.354	
1492	36'-7½	PO(18'-8½)	76.929	
4787	35'-2		129.289	
4917	6'-2½	PO(12'-3½), BOR 4	143.716	
5003	-0'-8	P1	32.935	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (NE System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
Route 1							
CM	2.7050	62.98	3.52	120	0.010778	10'-0"	Pf 0.108
5490	37'-4"	121.15	16.8	52.000	Sprinkler		Pe -0.000
5489	37'-4"			52.108		10'-0"	Pv
CM	2.7050	184.25	10.29	120	0.078526	63'-10"	Pf 5.013
5489	37'-4"	121.27	16.8	52.108	Sprinkler		Pe -0.000
382	37'-4"			57.121		63'-10"	Pv
CM	2.7050	234.25	13.08	120	0.122438	100'-0"	Pf 12.244
382	37'-4"	50.00		57.121	Flow (q) from Route 8		Pe -0.000
365	37'-4½"			69.365		100'-0"	Pv
CM	2.7050	284.25	15.87	120	0.175127	178'-0½"	Pf 31.178
365	37'-4½"	50.00		69.365	Flow (q) from Route 9		Pe -0.000
14	37'-4½"			100.543		178'-0½"	Pv
CM	3.3340	284.25	10.45	120	0.063265	3'-5½"	Pf 3.063
14	37'-4½"			100.543		44'-11½"	Pe 0.938
15	35'-2½"			104.544	2PO(22'-6")	48'-5"	Pv
CM	4.3100	284.25	6.25	120	0.018118	10'-0"	Pf 0.181
15	35'-2½"			104.544			Pe -0.092
1	35'-5"			104.634		10'-0"	Pv
CM	4.3100	526.15	11.57	120	0.056597	10'-0"	Pf 0.566
1	35'-5"	241.89		104.634	Flow (q) from Route 3		Pe -0.089
2	35'-7½"			105.111		10'-0"	Pv
CM	4.3100	768.37	16.90	120	0.114040	10'-0"	Pf 1.140
2	35'-7½"	242.23		105.111	Flow (q) from Route 5		Pe -0.090
3	35'-10"			106.161		10'-0"	Pv
CM	4.3100	921.48	20.26	120	0.159604	10'-0"	Pf 1.596
3	35'-10"	153.10		106.161	Flow (q) from Route 12		Pe -0.090
4	36'-0½"			107.666		10'-0"	Pv
CM	4.3100	1076.61	23.68	120	0.212842	10'-0"	Pf 2.128
4	36'-0½"	155.13		107.666	Flow (q) from Route 2		Pe -0.090
5	36'-3"			109.704		10'-0"	Pv
CM	4.3100	1236.03	27.18	120	0.274793	10'-0"	Pf 2.747
5	36'-3"	159.42		109.704	Flow (q) from Route 11		Pe -0.090
6	36'-5½"			112.361		10'-0"	Pv
CM	4.3100	1401.89	30.83	120	0.346872	5'-11"	Pf 2.055
6	36'-5½"	165.85		112.361	Flow (q) from Route 10		Pe -0.062
1490	36'-7"			114.354		5'-11"	Pv
CM	6.3570	1401.89	14.17	120	0.052268	4'-1"	Pf 0.213
1490	36'-7"			114.354			Pe -0.037
7	36'-8"			114.530		4'-1"	Pv
CM	6.3570	1573.23	15.90	120	0.064697	182'-9½"	Pf 14.104
7	36'-8"	171.34		114.530	Flow (q) from Route 13	35'-2½"	Pe 0.656
4787	35'-2"			129.289	2E(17'-7")	218'-0"	Pv
FR	8.2490	1573.23	9.44	120	0.018191	39'-7½"	Pf 1.874
4787	35'-2"			129.289		63'-5"	Pe 12.553
4917	6'-2½"			143.716	3E(21'-1½"), f(-0.000), BOR 4	103'-0½"	Pv
FR	8.2490	1573.23	9.44	120	0.018191	143'-8"	Pf 14.591
4917	6'-2½"			143.716		411'-1"	Pe 3.068
90	-0'-10½"			161.375	4BV(14'-1), 2PO(41'-1½), 2T(41'-1½), 4E(21'-1½), 2sCV(52'-10), PRV(-4.500)	554'-9"	Pv
DY	6.0650	1573.23	17.47	120	0.081345	0'-0"	Pf 0.000
90	-0'-10½"			161.375			Pe -0.000
91	-0'-10½"			161.375		0'-0"	Pv
Pump		Velocity					
91		1573.23		161.375	Rating: 130.000 @ 1500.00		
5003		Q=1573.23	9.44	32.935	Fire Pump Churn Pressure: 147.000		
FR	8.2490	1573.23	9.44	120	0.018191	7'-8½"	Pf 0.973
5003	-0'-8"			32.935		45'-9½"	Pe -0.578
8	0'-8"			33.330	GV(4'-8½"), T(41'-1½")	53'-6"	Pv
UG	8.3900	1573.23	9.13	140	0.012594	67'-2"	Pf 1.978
8	0'-8"			33.330		89'-11"	Pe 2.023
9	-4'-0"			37.331	E(30'-6½"), T(59'-4½")	157'-1"	Pv
CM	7.9800	673.11	4.32	150	0.002942	2123'-0½"	Pf 11.640
9	-4'-0"			37.331		134'-3½"	Pe
10	-4'-0"			48.971	6EE(13'-7"), BFP(-5.000), T(52'-10)	2257'-4½"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (NE 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	
		0.00				Hose Allowance At Source		
10		1723.23						
Route 2								
CM	2.7050	58.17	3.25	120		0.009303	8'-9"	Pf 0.081
5490	37'-4"	121.15	16.8	52.000		Sprinkler		Pe 0.000
111	37'-4"			52.081			8'-9"	Pv
CM	2.7050	179.41	10.02	120		0.074748	10'-0"	Pf 0.747
111	37'-4"	121.24	16.8	52.081		Sprinkler		Pe 0.000
112	37'-4"			52.829			10'-0"	Pv
CM	2.7050	301.52	16.83	120		0.195308	79'-4½"	Pf 15.503
112	37'-4"	122.11	16.8	52.829		Sprinkler		Pe 0.000
16	37'-4"			68.331			79'-4½"	Pv
CM	3.3340	301.52	11.08	120		0.070556	19'-7"	Pf 4.554
16	37'-4"			68.331			44'-11½"	Pe 0.940
17	35'-2"			73.825		2PO(22'-6")	64'-6½"	Pv
CM	4.3100	301.52	6.63	120		0.020206	10'-0"	Pf 0.202
17	35'-2"			73.825				Pe -0.090
11	35'-4½"			73.937			10'-0"	Pv
CM	4.3100	552.55	12.15	120		0.061965	10'-0"	Pf 0.620
11	35'-4½"	251.04		73.937		Flow (q) from Route 4		Pe -0.090
12	35'-7"			74.467			10'-0"	Pv
CM	4.3100	804.86	17.70	120		0.124259	10'-0"	Pf 1.243
12	35'-7"	252.30		74.467		Flow (q) from Route 6		Pe -0.090
13	35'-9½"			75.620			10'-0"	Pv
CM	4.3100	651.75	14.33	120		0.084102	10'-0"	Pf 0.842
13	35'-9½"			75.620				Pe -0.090
114	36'-0"			76.371			10'-0"	Pv
RN	2.7050	155.13	8.66	120		0.057123	473'-0"	Pf 31.296
114	36'-0"			76.371		PO(18'-8½")	74'-10½"	Pe -0.001
4	36'-0½"			107.666		3PO(18'-8½")	547'-10½"	Pv
Route 3								
CM	2.7050	118.48	6.61	120		0.034691	10'-0"	Pf 0.347
101	37'-6½"	123.02	16.8	53.620		Sprinkler		Pe -0.000
102	37'-6½"			53.967			10'-0"	Pv
CM	2.7050	241.89	13.50	120		0.129928	345'-3½"	Pf 49.729
102	37'-6½"	123.42	16.8	53.967		Sprinkler,	37'-5"	Pe 0.937
1	35'-5"			104.634		2PO(18'-8½")	382'-9"	Pv
Route 4								
CM	2.7050	4.54	0.25	120		0.000083	8'-9"	Pf 0.001
101	37'-6½"	123.02	16.8	53.620		Sprinkler		Pe 0.000
103	37'-6½"			53.621			8'-9"	Pv
CM	2.7050	127.56	7.12	120		0.039774	10'-0"	Pf 0.398
103	37'-6½"	123.02	16.8	53.621		Sprinkler		Pe 0.000
104	37'-6½"			54.019			10'-0"	Pv
CM	2.7050	251.04	14.02	120		0.139162	98'-11½"	Pf 18.978
104	37'-6½"	123.48	16.8	54.019		Sprinkler,	37'-5"	Pe 0.940
11	35'-4½"			73.937		2PO(18'-8½")	136'-4½"	Pv
Route 5								
CM	2.7050	118.41	6.61	120		0.034657	10'-0"	Pf 0.347
105	37'-9"	123.42	16.8	53.969		Sprinkler		Pe -0.000
106	37'-9"			54.315			10'-0"	Pv
CM	2.7050	242.23	13.52	120		0.130261	345'-4"	Pf 49.857
106	37'-9"	123.81	16.8	54.315		Sprinkler,	37'-5"	Pe 0.939
2	35'-7½"			105.111		2PO(18'-8½")	382'-9"	Pv
Route 6								
CM	2.7050	5.00	0.28	120		0.000099	8'-9"	Pf 0.001
105	37'-9"	123.42	16.8	53.969		Sprinkler		Pe 0.000
107	37'-9"			53.969			8'-9"	Pv
CM	2.7050	128.42	7.17	120		0.040271	10'-0"	Pf 0.403
107	37'-9"	123.42	16.8	53.969		Sprinkler		Pe 0.000
5691	37'-9"			54.372			10'-0"	Pv
CM	2.7050	252.30	14.09	120		0.140460	98'-11½"	Pf 19.155
5691	37'-9"	123.88	16.8	54.372		Sprinkler,	37'-5"	Pe 0.940
12	35'-7"			74.467		2PO(18'-8½")	136'-4½"	Pv
Route 7								



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (NE System 4)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
FR	6.2800	150.00	1.55	140	0.000668	4'-0"	Pf 0.017
87	0'-0"	150.00		35.728	Hydrant,	22'-1"	Pe 1.739
88	-4'-0"			37.485	E(22'-1)	26'-1"	Pv
UG	8.3900	150.00	0.87	140	0.000163	22'-5"	Pf 0.013
88	-4'-0"			37.485		59'-4½"	Pe
89	-4'-0"			37.498	T(59'-4½)	81'-9½"	Pv
CM	7.9800	1050.12	6.74	150	0.006697	885'-0½"	Pf 11.473
89	-4'-0"	900.12		37.498	Flow (q) from Route 14	81'-6"	Pe
10	-4'-0"			48.971	4EE(13'-7), BFP(-5.000), S, E(27'-2)	966'-6½"	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	38'-5"	Pf 2.064
218	3'-0"	50.00		69.951	Hose(42'-3½)	69'-6½"	Pe -14.893
382	37'-4"			57.121	2E(6'-10), PO(13'-7½)	108'-0"	Pv
Route 9							
CM	2.2030	50.00	4.21	120	0.019110	38'-5"	Pf 2.064
215	3'-0"	50.00		82.195	Hose(42'-3½)	69'-6½"	Pe -14.893
365	37'-4½"			69.365	2E(6'-10), PO(13'-7½)	108'-0"	Pv
Route 10							
CM	4.3100	337.20	7.42	120	0.024850	10'-0"	Pf 0.249
109	36'-2½"			76.790		10'-0"	Pe -0.090
110	36'-5"			76.948			Pv
RN	2.7050	165.85	9.26	120	0.064639	473'-0"	Pf 35.414
110	36'-5"			76.948	PO(18'-8½)	74'-10½"	Pe -0.001
6	36'-5½"			112.361	3PO(18'-8½)	547'-10½"	Pv
Route 11							
CM	4.3100	496.62	10.92	120	0.050862	10'-0"	Pf 0.509
114	36'-0"	155.13		76.371	Flow (q) from Route 2	10'-0"	Pe -0.090
109	36'-2½"			76.790			Pv
RN	2.7050	159.42	8.90	120	0.060079	473'-0"	Pf 32.916
109	36'-2½"			76.790	PO(18'-8½)	74'-10½"	Pe -0.001
5	36'-3"			109.704	3PO(18'-8½)	547'-10½"	Pv
Route 12							
RN	2.7050	153.10	8.55	120	0.055746	473'-0"	Pf 30.542
13	35'-9½"			75.620	PO(18'-8½)	74'-10½"	Pe -0.001
3	35'-10"			106.161	3PO(18'-8½)	547'-10½"	Pv
Route 13							
CM	4.3100	171.34	3.77	120	0.007102	10'-0"	Pf 0.071
110	36'-5"	165.85		76.948	Flow (q) from Route 10	10'-0"	Pe -0.090
1492	36'-7½"			76.929			Pv
RN	2.7050	171.34	9.57	120	0.068651	473'-0"	Pf 37.611
1492	36'-7½"			76.929	PO(18'-8½)	74'-10½"	Pe -0.010
7	36'-8"			114.530	3PO(18'-8½)	547'-10"	Pv
Route 14							
CM	7.9800	900.12	5.77	150	0.005036	33'-2"	Pf 0.167
9	-4'-0"	673.11		37.331	Flow (q) from Route 1	33'-2"	Pe
89	-4'-0"			37.498			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

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
BalV	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 Summary

Job Number: NC-1403
Report Description: ESFR (E System 5)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

System		Remote Area(s)							
Most Demanding Sprinkler Data 22.4 K-Factor 141.67 at 40.000	Occupancy ESFR	Job Suffix							
Hose Allowance At Source 0.00	Pressure 50.000	Area of Application NA							
Additional Hose Supplies	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²						
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 2764</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>200.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 2764	50.00	Hydrant At Node 87	200.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)								
Hose At Node 2764	50.00								
Hydrant At Node 87	200.00								
<p>11-17-23</p>									
Total Hose Streams 250.00									
System Flow Demand 1954.65	Total Water Required (Including Hose Allowance) 1954.65								
Maximum Pressure Unbalance In Loops 0.000									
Maximum Velocity Above Ground 39.50 between nodes 3326 and 31									
Maximum Velocity Under Ground 10.18 between nodes 9 and 8									
Volume capacity of Wet Pipes 21197.62 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)
10	Water Supply		82.000	50.000	1900.00	48.277	1954.65	39.674	8.603
91	Pump		147.000	130.000	1500.00	153.909	1754.65	145.306	8.603

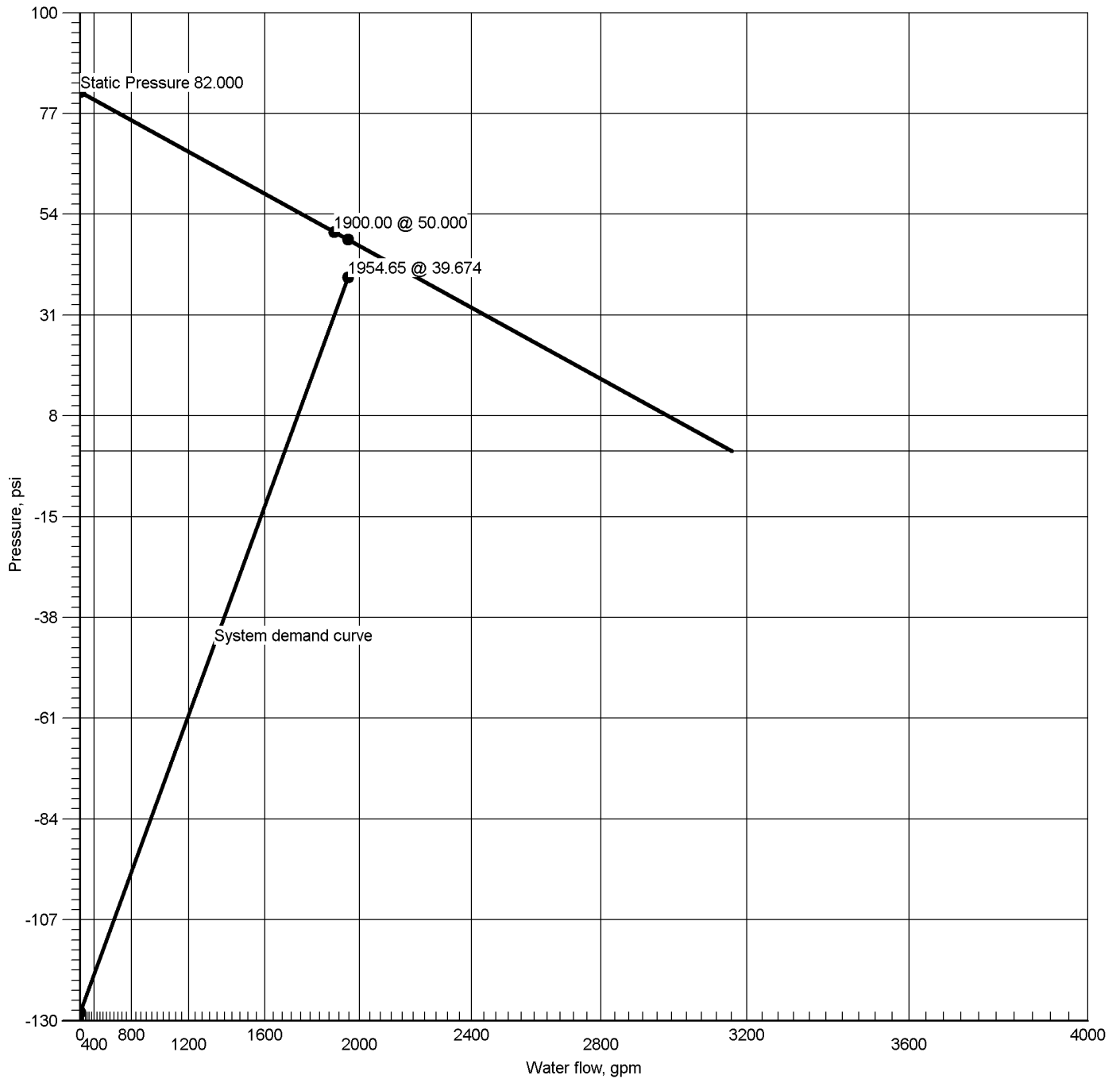
Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension
Address 1 130 w 9th Ave. Suite 100	FAX	
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com	
Address 3	Web-Site	



Water Supply at Node 10



Hydraulic Graph
Water Supply at Node 10

Static: Pressure
82.000

Residual: Pressure
50.000 @ 1900.00

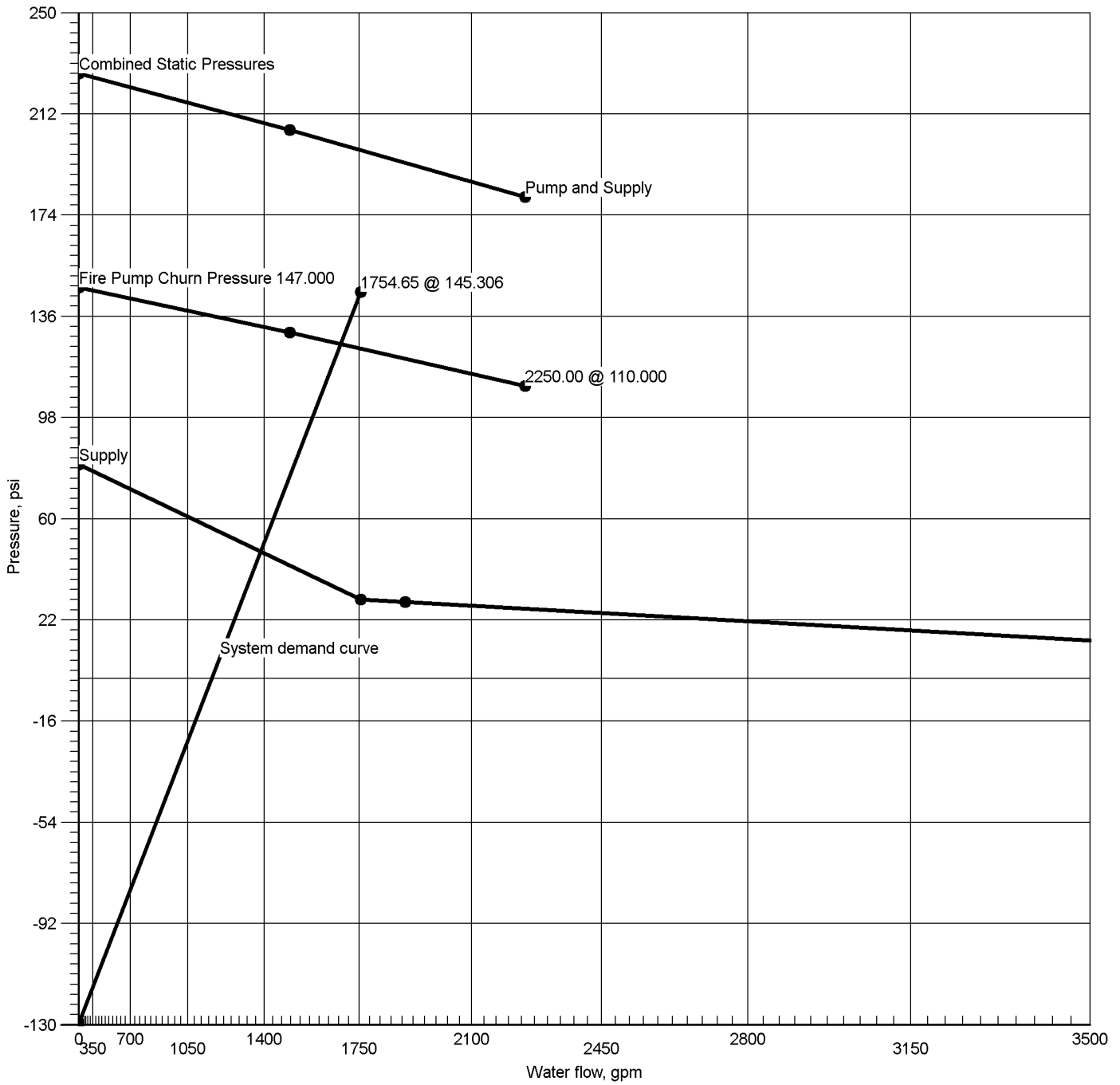
Available Pressure at System Demand
48.277 @ 1954.65

Required Pressure at System Demand
39.674 @ 1954.65

Required Pressure at System Demand (Including Hose Allowance at Source)
39.674 @ 1954.65



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static Pressure	Fire Pump Churn Pressure	
227.555	147.000	
Residual Pressure		
124.066 @ 1754.65		
Available Pressure at System Demand		
153.909 @ 1754.65		
Required Pressure at System Demand		
145.306 @ 1754.65		



Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	200.00	200.00	0	24.705			
⇒ Sprinkler	301	141.67	141.67	22.4	40.000			
Sprinkler	302	141.90	141.67	22.4	40.132			
Sprinkler	303	141.67	141.67	22.4	40.001			
Sprinkler	304	141.98	141.67	22.4	40.176			
Sprinkler	305	141.74	141.67	22.4	40.037			
Sprinkler	306	141.97	141.67	22.4	40.172			
Sprinkler	307	141.74	141.67	22.4	40.038			
Sprinkler	308	142.04	141.67	22.4	40.209			
Sprinkler	309	142.35	141.67	22.4	40.383			
Sprinkler	310	142.59	141.67	22.4	40.523			
Sprinkler	311	142.35	141.67	22.4	40.384			
Sprinkler	312	142.64	141.67	22.4	40.552			

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: NC-1403

Report Description: ESFR (E System 5)

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
10	-4'-0	S, E(27'-2)	39.674	1954.65
87	0'-0	Hyd	24.705	200.00
301	39'-2½	Spr(-40.000)	40.000	141.67
302	39'-2½	Spr(-40.132)	40.132	141.90
303	39'-2½	Spr(-40.001)	40.001	141.67
304	39'-2½	Spr(-40.176)	40.176	141.98
305	39'-5½	Spr(-40.037)	40.037	141.74
306	39'-5½	Spr(-40.172)	40.172	141.97
307	39'-5½	Spr(-40.038)	40.038	141.74
308	39'-5½	Spr(-40.209)	40.209	142.04
309	39'-8	Spr(-40.383)	40.383	142.35
310	39'-8	Spr(-40.523)	40.523	142.59
311	39'-8	Spr(-40.384)	40.384	142.35
312	39'-8	Spr(-40.552)	40.552	142.64
2764	3'-0	Hose(42'-3½)	67.289	50.00
8	0'-8		21.853	
9	-4'-0	T(59'-4½)	26.297	
24	36'-10½	PO(22'-6)	63.559	
25	36'-10½	PO(22'-6)	63.937	
26	36'-11	PO(22'-6)	64.896	
27	36'-11½	PO(22'-6)	66.680	
28	36'-11½	PO(22'-6)	69.078	
29	37'-0	PO(22'-6)	72.222	
30	37'-0	PO(22'-6)	76.309	
31	37'-0½	E(13'-11)	84.589	
33	36'-10½	PO(22'-6)	51.598	
34	36'-10½	PO(22'-6)	51.633	
35	36'-11	PO(22'-6)	52.011	
36	36'-11½	PO(22'-6)	53.017	
37	36'-11½	PO(22'-6)	53.626	
38	37'-0	PO(22'-6)	53.913	
39	37'-0½	PO(22'-6)	54.014	
88	-4'-0	E(22'-1)	26.474	
89	-4'-0	T(59'-4½)	26.497	
90	-0'-10½		145.306	
91	-0'-10½	P2(-123.975)	145.306	
119	39'-5½	PO(22'-6)	53.799	
121	36'-10	PO(22'-6)	51.671	
1860	36'-10	PO(22'-6)	63.510	
2940	39'-5½	PO(13'-7½)	53.775	
3326	36'-9½		101.126	
4929	34'-5½		112.466	
5003	-0'-8	P1	21.241	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (E System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
Route 1							
CM	3.3340	131.02	4.82	120	0.015097	8'-9"	Pf 0.132
301	39'-2½"	141.67	22.4	40.000	Sprinkler		Pe -0.000
302	39'-2½"			40.132		8'-9"	Pv
CM	3.3340	272.93	10.03	120	0.058681	336'-9"	Pf 22.401
302	39'-2½"	141.90	22.4	40.132	Sprinkler,	44'-11½"	Pe 1.026
24	36'-10½"			63.559	2PO(22'-6)	381'-9"	Pv
CM	4.3100	429.66	9.45	120	0.038907	10'-0"	Pf 0.389
24	36'-10½"	156.73		63.559	Flow (q) from Route 9		Pe -0.011
25	36'-10½"			63.937		10'-0"	Pv
CM	4.3100	704.21	15.49	120	0.097051	10'-0"	Pf 0.971
25	36'-10½"	274.55		63.937	Flow (q) from Route 3		Pe -0.011
26	36'-11"			64.896		10'-0"	Pv
CM	4.3100	982.11	21.60	120	0.179575	10'-0"	Pf 1.796
26	36'-11"	277.90		64.896	Flow (q) from Route 5		Pe -0.011
27	36'-11½"			66.680		10'-0"	Pv
CM	4.3100	1151.20	25.32	120	0.240922	10'-0"	Pf 2.409
27	36'-11½"	169.09		66.680	Flow (q) from Route 10		Pe -0.011
28	36'-11½"			69.078		10'-0"	Pv
CM	4.3100	1331.99	29.29	120	0.315555	10'-0"	Pf 3.156
28	36'-11½"	180.79		69.078	Flow (q) from Route 11		Pe -0.011
29	37'-0"			72.222		10'-0"	Pv
CM	4.3100	1534.03	33.73	120	0.409770	10'-0"	Pf 4.098
29	37'-0"	202.04		72.222	Flow (q) from Route 8		Pe -0.011
30	37'-0"			76.309		10'-0"	Pv
CM	4.3100	1754.65	38.59	120	0.525412	1'-10"	Pf 8.282
30	37'-0"	220.62		76.309	Flow (q) from Route 2	13'-11"	Pe -0.002
31	37'-0½"			84.589	E(13'-11)	15'-9"	Pv
CM	4.2600	1754.65	39.50	120	0.556134	16'-4½"	Pf 16.438
31	37'-0½"			84.589		13'-2"	Pe 0.099
3326	36'-9½"			101.126	E(13'-2)	29'-6½"	Pv
CM	6.3570	1754.65	17.74	120	0.079171	95'-2½"	Pf 10.326
3326	36'-9½"			101.126		35'-2½"	Pe 1.014
4929	34'-5½"			112.466	2E(17'-7)	130'-5"	Pv
FR	8.2490	1754.65	10.53	120	0.022260	173'-11"	Pf 17.522
4929	34'-5½"			112.466		411'-1"	Pe 15.318
90	-0'-10½"			145.306	f(-0.000), 4BV(14'-1), 2PO(41'-1 ½), 2T(41'-1½), 4E(21'-1½), 2sC V(52'-10), PRV(-4.500)	585'-0"	Pv
DY	6.0650	1754.65	19.49	120	0.099545	0'-0"	Pf 0.000
90	-0'-10½"			145.306			Pe -0.000
91	-0'-10½"			145.306		0'-0"	Pv
Pump		Velocity					
91		1754.65		145.306	Rating: 130.000 @ 1500.00		
5003		Q=1754.65	10.53	21.241	Fire Pump Churn Pressure: 147.0 00		
FR	8.2490	1754.65	10.53	120	0.022260	7'-8½"	Pf 1.191
5003	-0'-8"			21.241		45'-9½"	Pe -0.578
8	0'-8"			21.853	GV(4'-8½"), T(41'-1½")	53'-6"	Pv
UG	8.3900	1754.65	10.18	140	0.015411	67'-2"	Pf 2.421
8	0'-8"			21.853		89'-11"	Pe 2.023
9	-4'-0"			26.297	E(30'-6½"), T(59'-4½")	157'-1"	Pv
CM	7.9800	763.17	4.90	150	0.003711	2123'-0½"	Pf 13.377
9	-4'-0"			26.297		134'-3½"	Pe
10	-4'-0"			39.674	6EE(13'-7), BFP(-5.000), T(52'-1 0)	2257'-4½"	Pv
		0.00			Hose Allowance At Source		
10		1954.65					
Route 2							
CM	3.3340	10.65	0.39	120	0.000145	10'-0"	Pf 0.001
301	39'-2½"	141.67	22.4	40.000	Sprinkler		Pe 0.000
303	39'-2½"			40.001		10'-0"	Pv
CM	3.3340	152.32	5.60	120	0.019948	8'-9"	Pf 0.175
303	39'-2½"	141.67	22.4	40.001	Sprinkler		Pe 0.000
304	39'-2½"			40.176		8'-9"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (E System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
CM	3.3340	294.30	10.82	120		0.067464	
304	39'-2½	141.98	22.4	40.176		Sprinkler,	109'-1½ Pf 10.397
33	36'-10½			51.598		2PO(22'-6)	44'-11½ Pe 1.025
							154'-1½ Pv
CM	4.3100	137.57	3.03	120		0.004732	
33	36'-10½			51.598			10'-0 Pf 0.047
34	36'-10½			51.633			10'-0 Pe -0.012
							10'-0 Pv
CM	4.3100	430.50	9.47	120		0.039049	
34	36'-10½	292.93		51.633		Flow (q) from Route 4	10'-0 Pf 0.390
35	36'-11			52.011			10'-0 Pe -0.012
							10'-0 Pv
CM	4.3100	722.53	15.89	120		0.101774	
35	36'-11	292.03		52.011		Flow (q) from Route 6	10'-0 Pf 1.018
36	36'-11½			53.017			10'-0 Pe -0.012
							10'-0 Pv
CM	4.3100	553.45	12.17	120		0.062150	
36	36'-11½			53.017			10'-0 Pf 0.621
37	36'-11½			53.626			10'-0 Pe -0.012
							10'-0 Pv
CM	4.3100	372.66	8.19	120		0.029900	
37	36'-11½			53.626			10'-0 Pf 0.299
38	37'-0			53.913			10'-0 Pe -0.012
							10'-0 Pv
CM	4.3100	220.62	4.85	120		0.011337	
38	37'-0			53.913			10'-0 Pf 0.113
39	37'-0½			54.014			10'-0 Pe -0.012
							10'-0 Pv
RN	3.3340	220.62	8.11	120		0.039587	
39	37'-0½			54.014		PO(22'-6)	473'-1 Pf 22.288
30	37'-0			76.309		3PO(22'-6)	89'-11½ Pe 0.007
							563'-0½ Pv
Route 3							
CM	3.3340	132.58	4.87	120		0.015431	
305	39'-5½	141.74	22.4	40.037		Sprinkler	8'-9 Pf 0.135
306	39'-5½			40.172			8'-9 Pe 0.000
							8'-9 Pv
CM	3.3340	274.55	10.09	120		0.059330	
306	39'-5½	141.97	22.4	40.172		Sprinkler,	336'-11½ Pf 22.659
25	36'-10½			63.937		2PO(22'-6)	44'-11½ Pe 1.106
							381'-11 Pv
Route 4							
CM	3.3340	9.16	0.34	120		0.000110	
305	39'-5½	141.74	22.4	40.037		Sprinkler	10'-0 Pf 0.001
307	39'-5½			40.038			10'-0 Pe -0.000
							10'-0 Pv
CM	3.3340	150.89	5.55	120		0.019604	
307	39'-5½	141.74	22.4	40.038		Sprinkler	8'-9 Pf 0.172
308	39'-5½			40.209			8'-9 Pe -0.000
							8'-9 Pv
CM	3.3340	292.93	10.77	120		0.066885	
308	39'-5½	142.04	22.4	40.209		Sprinkler,	109'-4 Pf 10.320
34	36'-10½			51.633		2PO(22'-6)	44'-11½ Pe 1.104
							154'-3½ Pv
Route 5							
CM	3.3340	135.31	4.97	120		0.016024	
309	39'-8	142.35	22.4	40.383		Sprinkler	8'-9 Pf 0.140
310	39'-8			40.523			8'-9 Pe 0.000
							8'-9 Pv
CM	3.3340	277.90	10.21	120		0.060675	
310	39'-8	142.59	22.4	40.523		Sprinkler,	337'-1½ Pf 23.184
26	36'-11			64.896		2PO(22'-6)	44'-11½ Pe 1.188
							382'-1½ Pv
Route 6							
CM	3.3340	7.04	0.26	120		0.000068	
309	39'-8	142.35	22.4	40.383		Sprinkler	10'-0 Pf 0.001
311	39'-8			40.384			10'-0 Pe -0.000
							10'-0 Pv
CM	3.3340	149.39	5.49	120		0.019244	
311	39'-8	142.35	22.4	40.384		Sprinkler	8'-9 Pf 0.168
312	39'-8			40.552			8'-9 Pe -0.000
							8'-9 Pv
CM	3.3340	292.03	10.73	120		0.066505	
312	39'-8	142.64	22.4	40.552		Sprinkler,	109'-6 Pf 10.274
35	36'-11			52.011		2PO(22'-6)	44'-11½ Pe 1.185
							154'-6 Pv
Route 7							
FR	6.2800	200.00	2.07	140		0.001137	
87	0'-0	200.00		24.705		Hydrant,	4'-0 Pf 0.030
88	-4'-0			26.474		E(22'-1)	22'-1 Pe 1.739
							26'-1 Pv
UG	8.3900	200.00	1.16	140		0.000277	
88	-4'-0			26.474			22'-5 Pf 0.023
89	-4'-0			26.497		T(59'-4½)	59'-4½ Pe
							81'-9½ Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (E System 5)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
CM	7.9800	1191.48	7.64	150	0.008460	885'-0½	Pf 13.177
89	-4'-0	991.48		26.497	Flow (q) from Route 13	81'-6	Pe
10	-4'-0			39.674	4EE(13'-7), BFP(-5.000), S, E(27'-2)	966'-6½	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	43'-2	Pf 2.285
2764	3'-0	50.00		67.289	Hose(42'-3½)	76'-4½	Pe -15.798
2940	39'-5½			53.775	3E(6'-10), PO(13'-7½)	119'-6½	Pv
CM	3.3340	50.00	1.84	120	0.002540	9'-7½	Pf 0.024
2940	39'-5½			53.775			Pe 0.000
119	39'-5½			53.799		9'-7½	Pv
CM	3.3340	202.04	7.42	120	0.033640	471'-1½	Pf 17.362
119	39'-5½	152.04		53.799	Flow (q) from Route 14	44'-11½	Pe 1.062
29	37'-0			72.222	2PO(22'-6)	516'-1	Pv
Route 9							
CM	4.3100	156.73	3.45	120	0.006022	10'-0	Pf 0.060
1860	36'-10	156.73		63.510	Flow (q) from Route 12		Pe -0.011
24	36'-10½			63.559		10'-0	Pv
Route 10							
RN	3.3340	169.09	6.21	120	0.024200	474'-6	Pf 13.660
36	36'-11½			53.017	PO(22'-6)	89'-11½	Pe 0.004
27	36'-11½			66.680	3PO(22'-6)	564'-5½	Pv
Route 11							
RN	3.3340	180.79	6.64	120	0.027390	474'-0½	Pf 15.448
37	36'-11½			53.626	PO(22'-6)	89'-11½	Pe 0.005
28	36'-11½			69.078	3PO(22'-6)	564'-0	Pv
Route 12							
CM	4.3100	156.73	3.45	120	0.006022	10'-0	Pf 0.060
33	36'-10½	137.57		51.598	Flow (q) from Route 2		Pe 0.012
121	36'-10			51.671		10'-0	Pv
RN	3.3340	156.73	5.76	120	0.021030	473'-0½	Pf 11.840
121	36'-10			51.671	PO(22'-6)	89'-11½	Pe 0.000
1860	36'-10			63.510	3PO(22'-6)	563'-0	Pv
Route 13							
CM	7.9800	991.48	6.36	150	0.006022	33'-2	Pf 0.200
9	-4'-0	763.17		26.297	Flow (q) from Route 1		Pe
89	-4'-0			26.497		33'-2	Pv
Route 14							
RN	3.3340	152.04	5.59	120	0.019880	2'-5	Pf 0.943
38	37'-0			53.913	PO(22'-6)	44'-11½	Pe -1.056
119	39'-5½			53.799	PO(22'-6)	47'-5	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

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

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
BalV	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 Summary

Job Number: NC-1403
Report Description: ESFR (SE System 6)

Job	
Job Number NC-1403	Designer DB
Job Name: Town Center 22	State Certification/License Number
Address 1 NE Town Center Blvd. Lee's Summit MO 64064	AHJ Lee's Summit
Address 2	Job Site/Building
Address 3	Drawing Name Town Center 22 draw

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 50.000	Area of Application NA									
Additional Hose Supplies	Number Of Sprinklers Calculated 12	Number Of Nozzles Calculated 0	Coverage Per Sprinkler 100.00 ft ²								
<table border="1"> <thead> <tr> <th>Node</th> <th>Flow(gpm)</th> </tr> </thead> <tbody> <tr> <td>Hose At Node 4868</td> <td>50.00</td> </tr> <tr> <td>Hose At Node 4871</td> <td>50.00</td> </tr> <tr> <td>Hydrant At Node 87</td> <td>150.00</td> </tr> </tbody> </table>	Node	Flow(gpm)	Hose At Node 4868	50.00	Hose At Node 4871	50.00	Hydrant At Node 87	150.00	AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area		
Node	Flow(gpm)										
Hose At Node 4868	50.00										
Hose At Node 4871	50.00										
Hydrant At Node 87	150.00										
Total Hose Streams 250.00	<p style="text-align: center;">11-17-23</p>										
System Flow Demand 1918.63				Total Water Required (Including Hose Allowance) 1918.63							
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 39.81 between nodes 100 and 4641											
Maximum Velocity Under Ground 10.26 between nodes 9 and 8											
Volume capacity of Wet Pipes 21188.08 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)
10	Water Supply		82.000	50.000	1900.00	49.417	1918.63	43.613	5.804
91	Pump		147.000	130.000	1500.00	154.915	1768.63	149.111	5.804

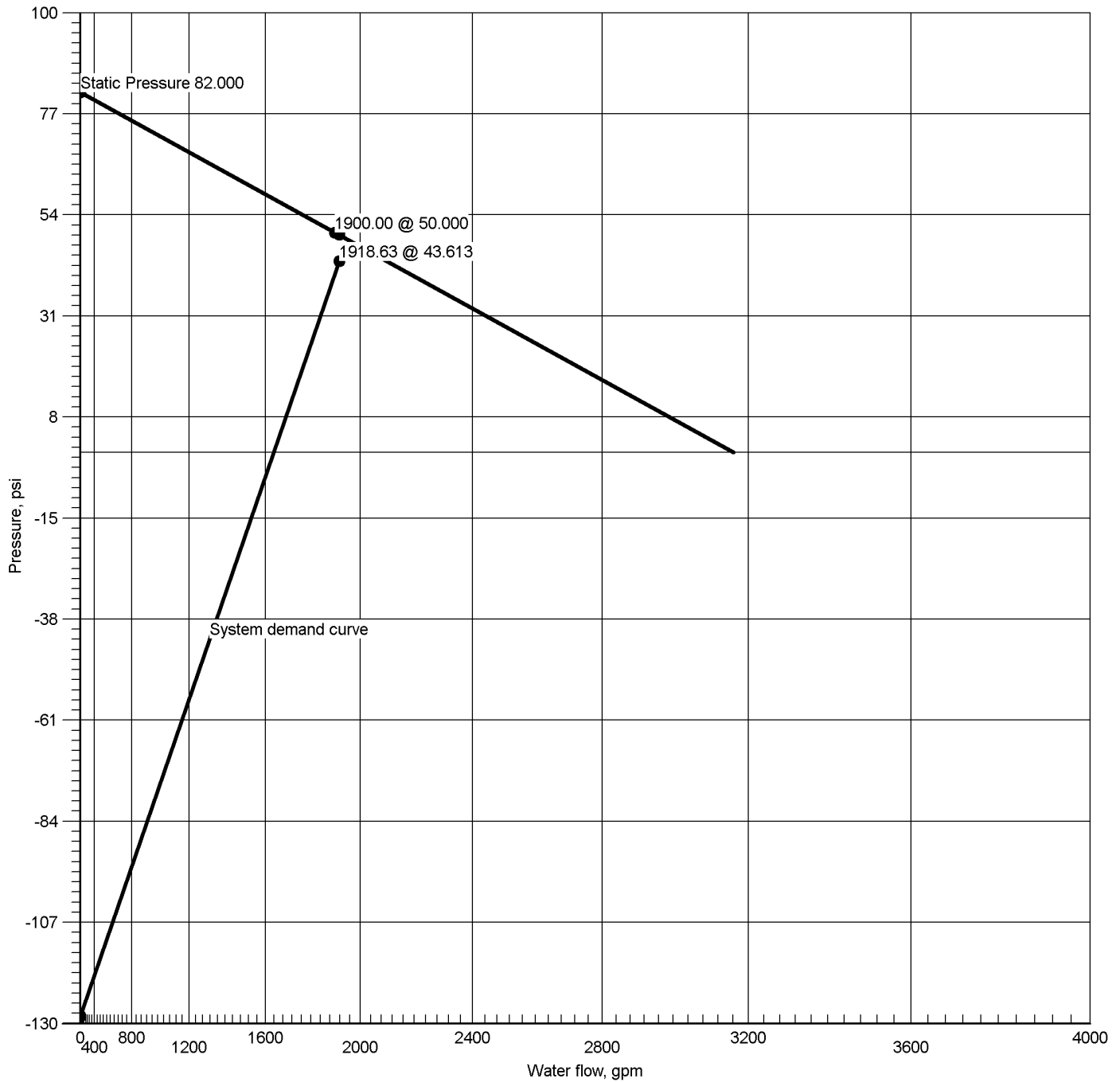
Pumps: Static = Churn (Pressure @ Zero Flow)

Contractor

Contractor Number 1	Contact Name Derek Bisoglio	Contact Title Design
Name of Contractor: Alliance Fire Protection	Phone 816-679-8021	Extension
Address 1 130 w 9th Ave. Suite 100	FAX	
Address 2 North Kansas City, MO 64116	E-mail dbisoglio@afpsprink.com	
Address 3	Web-Site	



Water Supply at Node 10



Hydraulic Graph
Water Supply at Node 10

Static: Pressure
82.000

Residual: Pressure
50.000 @ 1900.00

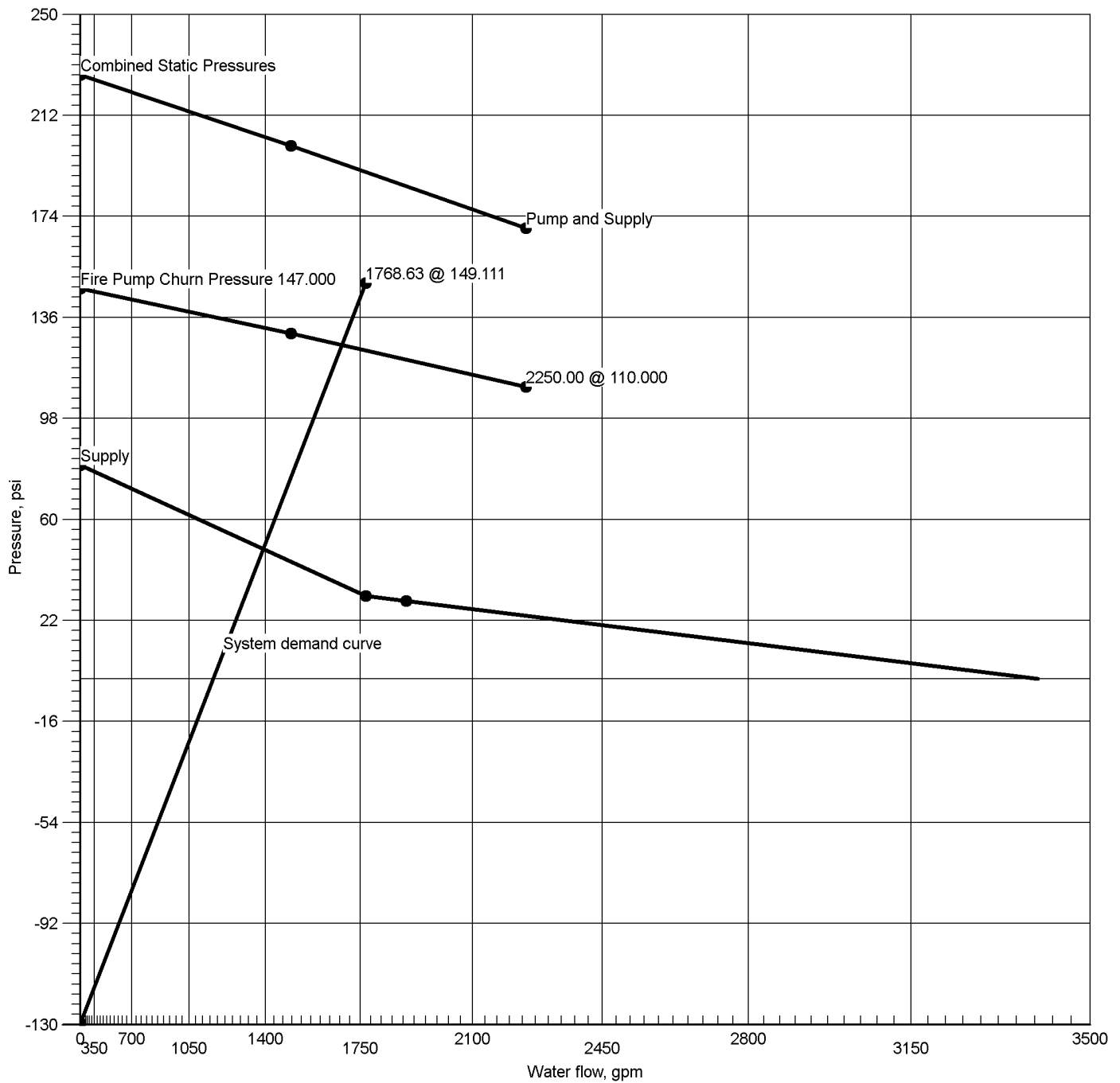
Available Pressure at System Demand
49.417 @ 1918.63

Required Pressure at System Demand
43.613 @ 1918.63

Required Pressure at System Demand (Including Hose Allowance at Source)
43.613 @ 1918.63



Pump at Node 91



Hydraulic Graph	Static + Churn Pressure	Fire Pump Rating
Pump at Node 91	227.555	130.000 @ 1500.00
Static: Pressure	Fire Pump Churn Pressure	
227.555	147.000	
Residual: Pressure		
123.712 @ 1768.63		
Available Pressure at System Demand		
154.915 @ 1768.63		
Required Pressure at System Demand		
149.111 @ 1768.63		



Summary Of Outflowing Devices

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)			
Hydrant	87	150.00	150.00	0	28.949			
⇒ Sprinkler	601	121.15	121.15	16.8	52.000			
Sprinkler	602	121.52	121.15	16.8	52.324			
Sprinkler	603	121.15	121.15	16.8	52.002			
Sprinkler	604	121.61	121.15	16.8	52.402			
Sprinkler	605	121.75	121.15	16.8	52.518			
Sprinkler	606	122.13	121.15	16.8	52.844			
Sprinkler	607	121.75	121.15	16.8	52.519			
Sprinkler	608	122.22	121.15	16.8	52.925			
Sprinkler	609	173.65	141.67	22.4	60.100			
Sprinkler	610	173.66	141.67	22.4	60.101			
Sprinkler	611	174.07	141.67	22.4	60.386			
Sprinkler	612	173.98	141.67	22.4	60.325			
Hose	4868	50.00	50.00	0	104.967			
Hose	4871	50.00	50.00	0	100.372			

⇒ Most Demanding Sprinkler Data



Node Analysis

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
10	-4'-0	S, E(27'-2)	43.613	1918.63
87	0'-0	Hyd	28.949	150.00
601	38'-10	Spr(-52.000)	52.000	121.15
602	38'-10	Spr(-52.324)	52.324	121.52
603	38'-10	Spr(-52.002)	52.002	121.15
604	38'-10	Spr(-52.402)	52.402	121.61
605	38'-7½	Spr(-52.518)	52.518	121.75
606	38'-7½	Spr(-52.844)	52.844	122.13
607	38'-7½	Spr(-52.519)	52.519	121.75
608	38'-7½	Spr(-52.925)	52.925	122.22
609	39'-0½	Spr(-60.100)	60.100	173.65
610	39'-0½	Spr(-60.101)	60.101	173.66
611	39'-0½	Spr(-60.386)	60.386	174.07
612	39'-0½	Spr(-60.325)	60.325	173.98
4868	3'-0	Hose(42'-3½)	104.967	50.00
4871	3'-0	Hose(42'-3½)	100.372	50.00
8	0'-8		26.030	
9	-4'-0	T(59'-4½)	30.510	
20	36'-8	PO(18'-8½)	77.292	
21	36'-5½	PO(18'-8½)	78.073	
22	36'-3	PO(18'-8½)	79.500	
23	36'-0½	PO(18'-8½)	80.600	
82	36'-10½	PO(22'-6)	76.954	
88	-4'-0	E(22'-1)	30.706	
89	-4'-0	T(59'-4½)	30.720	
90	-0'-10½		149.111	
91	-0'-10½	P2(-123.621)	149.111	
92	36'-8	PO(18'-8½)	96.044	
93	36'-5½	PO(18'-8½)	96.885	
94	36'-3	PO(18'-8½)	98.371	
95	36'-0½	PO(18'-8½)	100.246	
96	35'-10	PO(18'-8½)	102.563	
97	35'-7½	PO(18'-8½)	105.387	
100	35'-2		113.809	
108	35'-7½	PO(18'-8½)	81.964	
122	36'-10½	PO(22'-6)	95.659	
4043	35'-10	PO(18'-8½)	81.409	
4403	35'-4½	PO(18'-8½)	108.837	
4404	35'-4½	PO(18'-8½)	82.311	
4641	35'-2	PO(22'-6)	112.936	
4642	35'-2	PO(22'-6)	82.495	
4784	37'-4½	PO(13'-7½)	92.135	
4801	37'-4½	PO(13'-7½)	87.541	
4902	6'-2½	PO(12'-3½), BOR 6	129.058	
5003	-0'-8	P1	25.400	



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SE System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
Route 1							
CM	2.7050	114.25	6.38	120	0.032436	10'-0"	Pf 0.324
601	38'-10"	121.15	16.8	52.000	Sprinkler	10'-0"	Pe 0.000
602	38'-10"			52.324			Pv
CM	2.7050	235.77	13.16	120	0.123912	307'-10"	Pf 42.781
602	38'-10"	121.52	16.8	52.324	Sprinkler,	37'-5"	Pe 0.939
92	36'-8"			96.044	2PO(18'-8½")	345'-3"	Pv
CM	4.2600	594.54	13.38	120	0.075103	10'-0"	Pf 0.751
92	36'-8"	358.76		96.044	Flow (q) from Route 5	10'-0"	Pe 0.090
93	36'-5½"			96.885			Pv
CM	4.2600	831.26	18.71	120	0.139620	10'-0"	Pf 1.396
93	36'-5½"	236.73		96.885	Flow (q) from Route 3	10'-0"	Pe 0.090
94	36'-3"			98.371		10'-0"	Pv
CM	4.2600	949.28	21.37	120	0.178489	10'-0"	Pf 1.785
94	36'-3"	118.02		98.371	Flow (q) from Route 2	10'-0"	Pe 0.090
95	36'-0½"			100.246			Pv
CM	4.2600	1069.90	24.08	120	0.222697	10'-0"	Pf 2.226
95	36'-0½"	120.62		100.246	Flow (q) from Route 10	10'-0"	Pe 0.090
96	35'-10"			102.563		10'-0"	Pv
CM	4.2600	1195.43	26.91	120	0.273433	10'-0"	Pf 2.734
96	35'-10"	125.53		102.563	Flow (q) from Route 11	10'-0"	Pe 0.090
97	35'-7½"			105.387		10'-0"	Pv
CM	4.2600	1328.08	29.89	120	0.332193	10'-1½"	Pf 3.359
97	35'-7½"	132.64		105.387	Flow (q) from Route 14	10'-1½"	Pe 0.091
4403	35'-4½"			108.837			Pv
CM	4.2600	1469.94	33.09	120	0.400807	10'-0"	Pf 4.009
4403	35'-4½"	141.87		108.837	Flow (q) from Route 13	10'-0"	Pe 0.090
4641	35'-2"			112.936			Pv
CM	4.2600	1768.63	39.81	120	0.564362	1'-6½"	Pf 0.859
4641	35'-2"	298.69		112.936	Flow (q) from Route 8	1'-6½"	Pe 0.014
100	35'-2"			113.809			Pv
CM	8.2490	1768.63	10.62	120	0.022590	55'-11"	Pf 2.696
100	35'-2"			113.809		63'-5"	Pe 12.553
4902	6'-2½"			129.058	3E(21'-1½"), f(-0.000), BOR 6	119'-4"	Pv
FR	8.2490	1768.63	10.62	120	0.022590	141'-8"	Pf 16.986
4902	6'-2½"			129.058		411'-1"	Pe 3.068
90	-0'-10½"			149.111	4BV(14'-1), 2PO(41'-1½"), 2T(41'-1½"), 4E(21'-1½"), 2sCV(52'-10), PRV(-4.500)	552'-9"	Pv
DY	6.0650	1768.63	19.64	120	0.101017	0'-0"	Pf 0.000
90	-0'-10½"			149.111		0'-0"	Pe -0.000
91	-0'-10½"			149.111			Pv
Pump							
91		1768.63	Velocity	149.111	Rating: 130.000 @ 1500.00		
5003		Q=1768.63	10.62	25.400	Fire Pump Churn Pressure: 147.000		
FR	8.2490	1768.63	10.62	120	0.022590	7'-8½"	Pf 1.209
5003	-0'-8"			25.400		45'-9½"	Pe -0.578
8	0'-8"			26.030	GV(4'-8½"), T(41'-1½")	53'-6"	Pv
UG	8.3900	1768.63	10.26	140	0.015639	67'-2"	Pf 2.457
8	0'-8"			26.030		89'-11"	Pe 2.023
9	-4'-0"			30.510	E(30'-6½"), T(59'-4½")	157'-1"	Pv
CM	7.9800	749.64	4.81	150	0.003590	2123'-0½"	Pf 13.104
9	-4'-0"			30.510		134'-3½"	Pe
10	-4'-0"			43.613	6EE(13'-7), BFP(-5.000), T(52'-10)	2257'-4½"	Pv
		0.00			Hose Allowance At Source		
10		1918.63					
Route 2							
CM	2.7050	6.90	0.39	120	0.000180	8'-9"	Pf 0.002
601	38'-10"	121.15	16.8	52.000	Sprinkler	8'-9"	Pe -0.000
603	38'-10"			52.002			Pv
CM	2.7050	128.05	7.15	120	0.040052	10'-0"	Pf 0.401
603	38'-10"	121.15	16.8	52.002	Sprinkler	10'-0"	Pe -0.000
604	38'-10"			52.402			Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SE System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
CM	2.7050	249.66	13.94	120	0.137750	136'-5"	Pf 23.951
604	38'-10"	121.61	16.8	52.402	Sprinkler,	37'-5"	Pe 0.939
20	36'-8"			77.292	2PO(18'-8½")	173'-10½"	Pv
CM	4.3100	586.25	12.89	120	0.069136	10'-0"	Pf 0.691
20	36'-8"	336.59		77.292	Flow (q) from Route 6	10'-0"	Pe 0.090
21	36'-5½"			78.073			Pv
CM	4.3100	837.37	18.41	120	0.133704	10'-0"	Pf 1.337
21	36'-5½"	251.11		78.073	Flow (q) from Route 4	10'-0"	Pe 0.090
22	36'-3"			79.500			Pv
RN	2.7050	118.02	6.59	120	0.034444	473'-0"	Pf 18.871
22	36'-3"			79.500	PO(18'-8½")	74'-10½"	Pe 0.000
94	36'-3"			98.371	3PO(18'-8½")	547'-10½"	Pv
Route 3							
CM	2.7050	114.60	6.40	120	0.032622	10'-0"	Pf 0.326
605	38'-7½"	121.75	16.8	52.518	Sprinkler	10'-0"	Pe 0.000
606	38'-7½"			52.844			Pv
CM	2.7050	236.73	13.22	120	0.124843	307'-10"	Pf 43.102
606	38'-7½"	122.13	16.8	52.844	Sprinkler,	37'-5"	Pe 0.939
93	36'-5½"			96.885	2PO(18'-8½")	345'-3"	Pv
Route 4							
CM	2.7050	7.14	0.40	120	0.000192	8'-9"	Pf 0.002
605	38'-7½"	121.75	16.8	52.518	Sprinkler	8'-9"	Pe -0.000
607	38'-7½"			52.519			Pv
CM	2.7050	128.89	7.20	120	0.040545	10'-0"	Pf 0.405
607	38'-7½"	121.75	16.8	52.519	Sprinkler	10'-0"	Pe -0.000
608	38'-7½"			52.925			Pv
CM	2.7050	251.11	14.02	120	0.139238	136'-5"	Pf 24.210
608	38'-7½"	122.22	16.8	52.925	Sprinkler,	37'-5"	Pe 0.939
21	36'-5½"			78.073	2PO(18'-8½")	173'-10½"	Pv
Route 5							
CM	3.3340	11.04	0.41	120	0.000155	8'-9"	Pf 0.001
609	39'-0½"	173.65	22.4	60.100	Sprinkler	8'-9"	Pe 0.000
610	39'-0½"			60.101			Pv
CM	3.3340	184.69	6.79	120	0.028494	10'-0"	Pf 0.285
610	39'-0½"	173.66	22.4	60.101	Sprinkler	10'-0"	Pe 0.000
611	39'-0½"			60.386			Pv
CM	3.3340	358.76	13.18	120	0.097320	307'-10"	Pf 34.334
611	39'-0½"	174.07	22.4	60.386	Sprinkler,	44'-11½"	Pe 0.939
122	36'-10½"			95.659	2PO(22'-6")	352'-9½"	Pv
CM	4.2600	358.76	8.08	120	0.029500	10'-0"	Pf 0.295
122	36'-10½"			95.659			Pe 0.090
92	36'-8"			96.044			Pv
Route 6							
CM	3.3340	162.62	5.98	120	0.022514	10'-0"	Pf 0.225
609	39'-0½"	173.65	22.4	60.100	Sprinkler	10'-0"	Pe -0.000
612	39'-0½"			60.325			Pv
CM	3.3340	336.59	12.37	120	0.086488	136'-5"	Pf 15.690
612	39'-0½"	173.98	22.4	60.325	Sprinkler,	44'-11½"	Pe 0.939
82	36'-10½"			76.954	2PO(22'-6")	181'-5"	Pv
CM	4.3100	336.59	7.40	120	0.024768	10'-0"	Pf 0.248
82	36'-10½"			76.954			Pe 0.090
20	36'-8"			77.292			Pv
Route 7							
FR	6.2800	150.00	1.55	140	0.000668	4'-0"	Pf 0.017
87	0'-0"	150.00		28.949	Hydrant,	22'-1"	Pe 1.739
88	-4'-0"			30.706	E(22'-1)	26'-1"	Pv
UG	8.3900	150.00	0.87	140	0.000163	22'-5"	Pf 0.013
88	-4'-0"			30.706		59'-4½"	Pe
89	-4'-0"			30.720	T(59'-4½")	81'-9½"	Pv
CM	7.9800	1169.00	7.50	150	0.008167	885'-0½"	Pf 12.894
89	-4'-0"	1019.00		30.720	Flow (q) from Route 15	81'-6"	Pe
10	-4'-0"			43.613	4EE(13'-7"), BFP(-5.000), S, E(27'-2)	966'-6½"	Pv
Route 8							
CM	2.2030	50.00	4.21	120	0.019110	38'-4"	Pf 2.062
4871	3'-0"	50.00		100.372	Hose(42'-3½")	69'-6½"	Pe -14.893
4801	37'-4½"			87.541	2E(6'-10"), PO(13'-7½")	107'-11"	Pv



Hydraulic Analysis

Job Number: NC-1403
Report Description: ESFR (SE System 6)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Fittings	Eq. Length	Summary
Upstream				Pn		Total Length	
CM	3.3340	248.69	9.14	120	0.049405	93'-0"	Pf 4.595
4801	37'-4½"	198.69		87.541	Flow (q) from Route 12		Pe 0.000
4784	37'-4½"			92.135		93'-0"	Pv
CM	3.3340	298.69	10.98	120	0.069337	241'-5½"	Pf 19.861
4784	37'-4½"	50.00		92.135	Flow (q) from Route 9	44'-11½"	Pe 0.940
4641	35'-2"			112.936	2PO(22'-6")	286'-5½"	Pv
Route 9							
CM	2.2030	50.00	4.21	120	0.019110	38'-4"	Pf 2.062
4868	3'-0"	50.00		104.967	Hose(42'-3½")	69'-6½"	Pe -14.893
4784	37'-4½"			92.135	2E(6'-10"), PO(13'-7½")	107'-11"	Pv
Route 10							
RN	2.7050	120.62	6.73	120	0.035859	473'-0"	Pf 19.646
23	36'-0½"	719.35		80.600	PO(18'-8½"), Flow (q) from Route	74'-10½"	Pe 0.000
95	36'-0½"			100.246	16	547'-10½"	Pv
					3PO(18'-8½")		
Route 11							
CM	4.3100	598.73	13.17	120	0.071883	10'-0"	Pf 0.719
23	36'-0½"	719.35		80.600	Flow (q) from Route 16		Pe 0.090
4043	35'-10"			81.409		10'-0"	Pv
RN	2.7050	125.53	7.01	120	0.038611	473'-0"	Pf 21.154
4043	35'-10"			81.409	PO(18'-8½")	74'-10½"	Pe 0.000
96	35'-10"			102.563	3PO(18'-8½")	547'-10½"	Pv
Route 12							
CM	4.3100	340.56	7.49	120	0.025310	10'-1½"	Pf 0.256
108	35'-7½"			81.964			Pe 0.091
4404	35'-4½"			82.311		10'-1½"	Pv
CM	4.3100	198.69	4.37	120	0.009340	10'-0"	Pf 0.093
4404	35'-4½"			82.311			Pe 0.090
4642	35'-2"			82.495		10'-0"	Pv
RN	3.3340	198.69	7.30	120	0.032616	138'-6½"	Pf 5.985
4642	35'-2"			82.495	PO(22'-6")	44'-11½"	Pe -0.940
4801	37'-4½"			87.541	PO(22'-6")	183'-6"	Pv
Route 13							
RN	2.7050	141.87	7.92	120	0.048416	473'-0"	Pf 26.526
4404	35'-4½"			82.311	PO(18'-8½")	74'-10½"	Pe 0.000
4403	35'-4½"			108.837	3PO(18'-8½")	547'-10½"	Pv
Route 14							
CM	4.3100	473.20	10.41	120	0.046513	10'-0"	Pf 0.465
4043	35'-10"	125.53		81.409	Flow (q) from Route 11		Pe 0.090
108	35'-7½"			81.964		10'-0"	Pv
RN	2.7050	132.64	7.41	120	0.042752	473'-0"	Pf 23.423
108	35'-7½"			81.964	PO(18'-8½")	74'-10½"	Pe 0.000
97	35'-7½"			105.387	3PO(18'-8½")	547'-10½"	Pv
Route 15							
CM	7.9800	1019.00	6.54	150	0.006335	33'-2"	Pf 0.210
9	-4'-0"	749.64		30.510	Flow (q) from Route 1		Pe
89	-4'-0"			30.720		33'-2"	Pv
Route 16							
CM	4.3100	719.35	15.82	120	0.100945	10'-0"	Pf 1.009
22	36'-3"	118.02		79.500	Flow (q) from Route 2		Pe 0.090
23	36'-0½"			80.600		10'-0"	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

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
BalV	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