

CALCULATION SUMMARY

Project Name : Johnsonville Elementary

Project Location: 18495 NC-27

Drawing No. : PM9192

City: Cameron, NC 28326

Design Areas

Design Area Name	Calc. Mode (Model)	Occupancy	Area of Application	Total Water	Pressure @ Source	Min. Density	Min. Pressure	Min. Flow	Calculated Heads	Hose Streams	Margin To Source
			(ft ²)	(gpm)	(psi)	(gpm/ft ²)	(psi)	(gpm)	#	(gpm)	(psi)
2	Demand (HW)	OH1	1000	424	Required 35.5	0.15	7.2	15	10	250	39.2

HYDRAULIC CALCULATIONS for

Job Information

Project Name : Johnsonville Elementary

Contract No. : PM9192

City: Cameron, NC 28326

Project Location: 18495 NC-27

Date: 10/29/2021

Contractor Information

Name of Contractor: VSC Fire & Security, Inc.

Address: 263 Hein Drive

City: Garner, NC 27529

Phone Number: 919-645-5880

E-mail: @vsconfire.com

Name of Designer: MB

Authority Having Jurisdiction:

Design

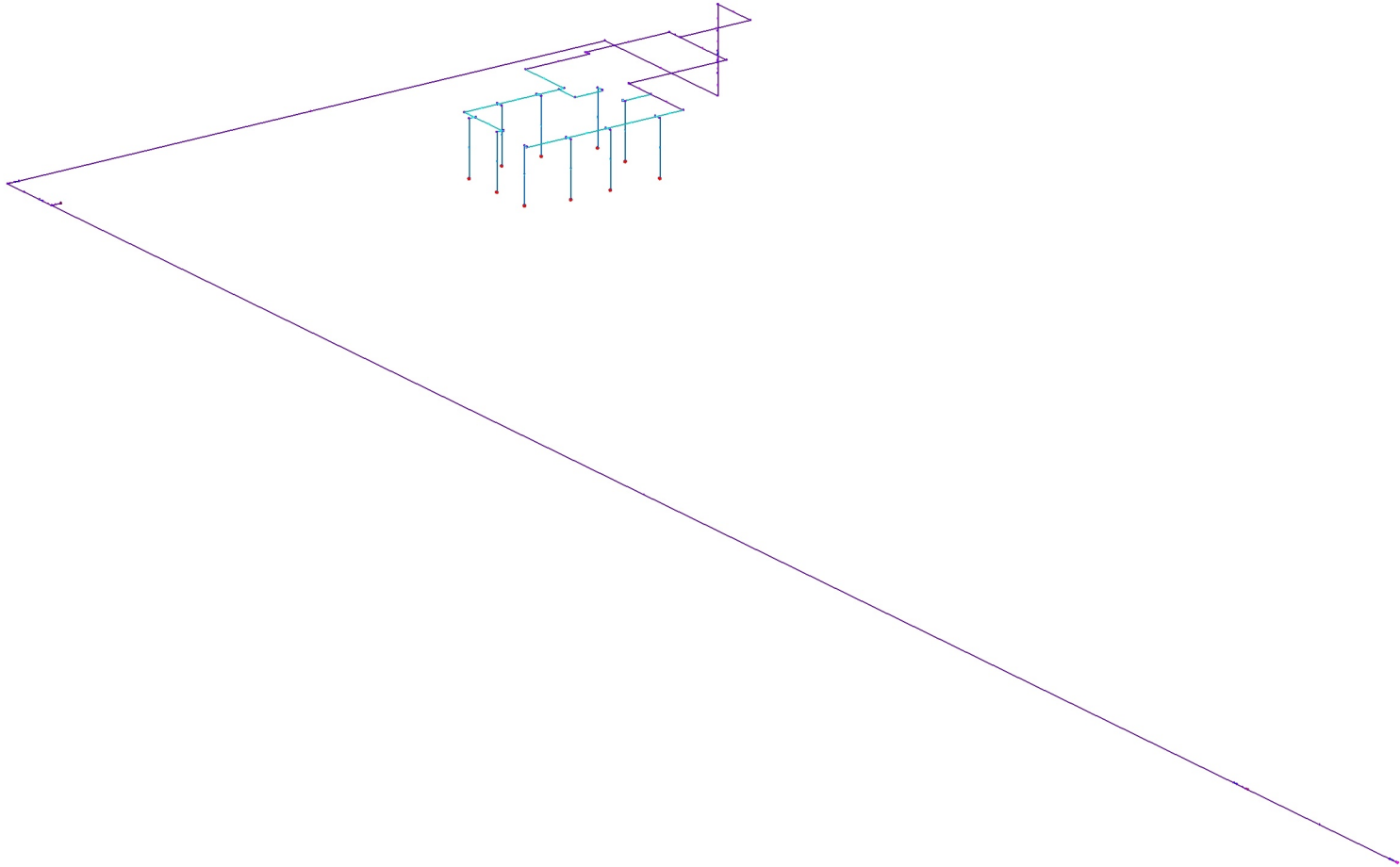
Remote Area Name	2
Remote Area Location	KITCHEN
Occupancy Classification	OH1
Density (gpm/ft ²)	0.15
Area of Application (ft ²)	1000
Coverage per Sprinkler (ft ²)	100
Number of Calculated Sprinklers	10
In-Rack Demand (gpm)	0
Special Heads	
Hose Streams (gpm)	250
Total Water Required (incl. Hose Streams) (gpm)	424
Required Pressure at Source (psi)	35.5
Type of System	Wet
Volume - Entire System (gal)	1508.1 gal

Water Supply Information

Date	10/15/2021
Location	Hwy 24 & Hwy 27 In front of Self Storage
Source	TEST

Notes

Diagram for Design Area : 2 (Optimized Hvdraulic Simplified)



Hydraulic Analysis for : 2

Calculation Info

Calculation Mode	Demand
Hydraulic Model	Hazen-Williams
Fluid Name	Water @ 60F (15.6C)
Fluid Weight, (lb/ft ³)	N/A for Hazen-Williams calculation.
Fluid Dynamic Viscosity, (lb-s/ft ²)	N/A for Hazen-Williams calculation.

Water Supply Parameters

Supply 1 : TEST

Flow (gpm)	Pressure (psi)
0	77
840	69

Supply Analysis

Node at Source	Static Pressure (psi)	Residual Pressure (psi)	Flow (gpm)	Available Pressure (psi)	Total Demand (gpm)	Required Pressure (psi)
TEST	77	69	840	74.7	424	35.5

Hoses

Inside Hose Flow / Standpipe Demand (gpm)	250
Outside Hose Flow (gpm)	0
Additional Outside Hose Flow (gpm)	
Other (custom defined) Hose Flow (gpm)	0
Total Hose Flow (gpm)	250

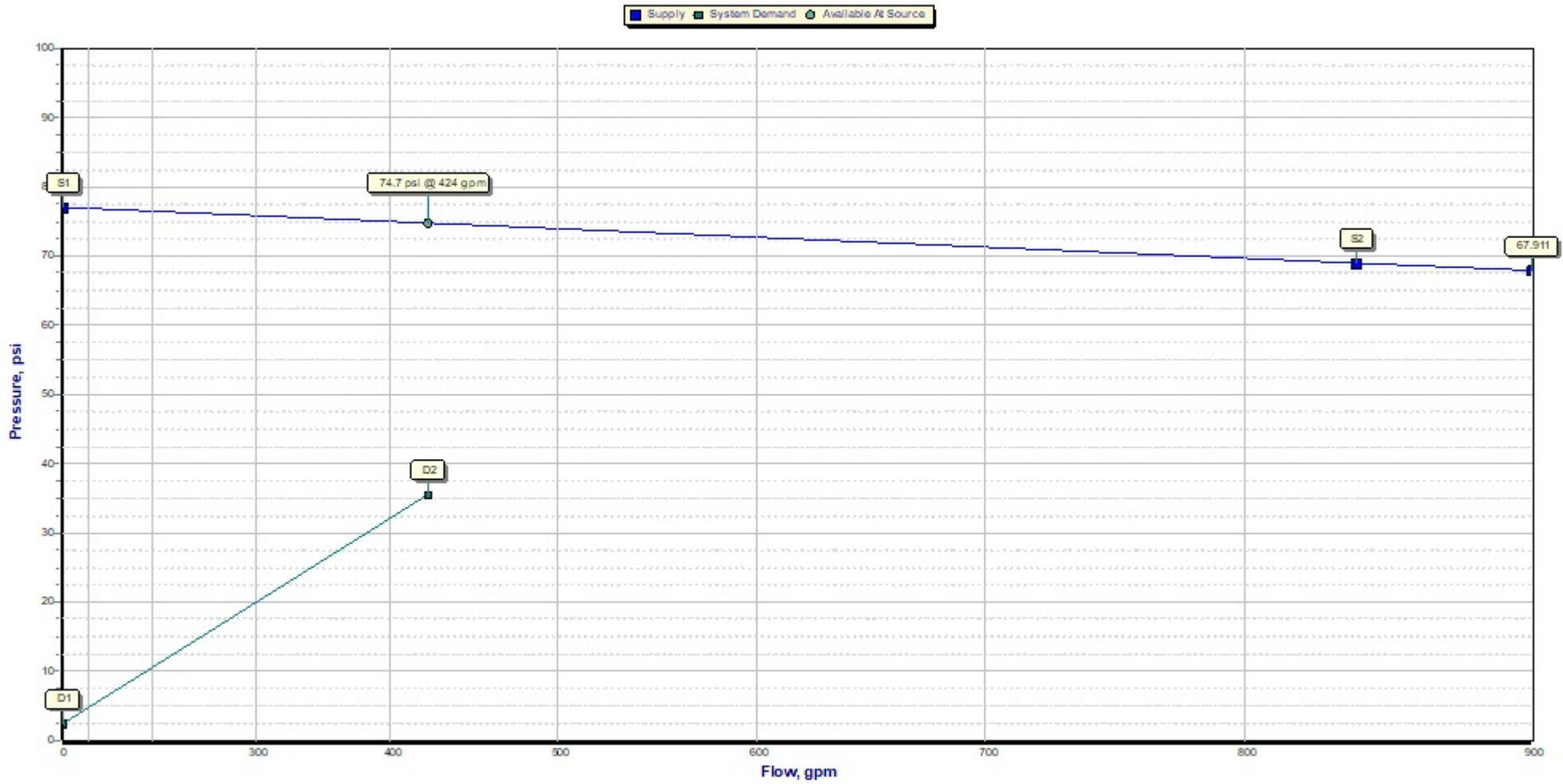
Sprinklers

Ovehead Sprinkler Flow (gpm)	174
InRack Sprinkler Flow (gpm)	0
Other (custom defined) Sprinkler Flow (gpm)	0
Total Sprinkler Flow (gpm)	174

Other

Required Margin of Safety (psi)	0
TEST - Pressure (psi)	35.5
TEST - Flow (gpm)	424
Demand w/o System Pump(s)	N/A

Hydraulic Analysis for : 2



Hydraulic Analysis for : 2

Graph Labels

Label	Description	Values	
		Flow (gpm)	Pressure (psi)
S1	Supply point #1 - Static	0	77
S2	Supply point #2 - Residual	840	69
D1	Elevation Pressure	0	2.5
D2	System Demand	424	35.5

Curve Intersections & Safety Margins

Curve Name	Intersection		Safety Margin	
	Pressure (psi)	Flow (gpm)	Pressure (psi)	@ Flow (gpm)
Supply	72.2	635.1	39.2	424

Open Heads

Head Ref.	Head Type	Coverage	K-Factor	Required			Calculated		
				Density	Flow	Pressure	Density	Flow	Pressure
		(ft ²)	(gpm/psi ^{1/2})	(gpm/ft ²)	(gpm)	(psi)	(gpm/ft ²)	(gpm)	(psi)
K100	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.157	15.7	7.8
K101	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.16	16	8.1
K102	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.178	17.8	10.1
K103	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.191	19.1	11.7
K104	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.199	19.9	12.6
K105	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.15	15	7.2
K106	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.153	15.3	7.5
K107	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.18	18	10.3
K108	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.189	18.9	11.4
K109	Overhead Sprinkler	100	5.6	0.15	15	7.2	0.183	18.3	10.7

Node Data

Node# Elev	Type Hgroup	K-Fact. Open/Closed	Discharge Overdischarge	Coverage Density	Tot. Pres. Elev. Pres.	Req. Pres. Req. Discharge
ft		gpm/psi½	gpm gpm	ft² gpm/ft²	psi psi	psi gpm
K 105 0	Overhead Sprinkler HEAD	5.6 Open	15 0	100 0.15	7.2 -2.5	7.2 15
K 106 0	Overhead Sprinkler HEAD	5.6 Open	15.3 0.3	100 0.153	7.5 -2.5	7.2 15
K 100 0	Overhead Sprinkler HEAD	5.6 Open	15.7 0.7	100 0.157	7.8 -2.5	7.2 15
K 101 0	Overhead Sprinkler HEAD	5.6 Open	16 1	100 0.16	8.1 -2.5	7.2 15
K 102 0	Overhead Sprinkler HEAD	5.6 Open	17.8 2.8	100 0.178	10.1 -2.5	7.2 15
K 107 0	Overhead Sprinkler HEAD	5.6 Open	18 3	100 0.18	10.3 -2.5	7.2 15
K 109 0	Overhead Sprinkler HEAD	5.6 Open	18.3 3.3	100 0.183	10.7 -2.5	7.2 15
K 108 0	Overhead Sprinkler HEAD	5.6 Open	18.9 3.9	100 0.189	11.4 -2.5	7.2 15
K 103 0	Overhead Sprinkler HEAD	5.6 Open	19.1 4.1	100 0.191	11.7 -2.5	7.2 15
K 104 0	Overhead Sprinkler HEAD	5.6 Open	19.9 4.9	100 0.199	12.6 -2.5	7.2 15
O41 10.5	Node NODE				4.6 -7	
139 10.5	Node NODE				5.4 -7	
138 10.5	Node NODE				7.8 -7	
O39 10.5	Node NODE				8 -7	
O38 10.5	Node NODE				9.4 -7	
137 10.5	Node NODE				9.6 -7	
O37 10.5	Node NODE				10.1 -7	
O19 10.5	Node NODE				11.6 -7	
O21 10.5	Node NODE				11.7 -7	
O33 10.5	Node NODE				11.8 -7	
O25 10.5	Node NODE				13.2 -7	
O91 5.76	Node NODE				18.6 -4.9	
O93-O 2.29	Node NODE				20.1 -3.4	
O93-I 1.49	Node NODE				20.6 -3.1	
O94-O 0.6	Node NODE				21 -2.7	

Node Data

Node# Elev	Type Hgroup	K-Fact. Open/Closed	Discharge Overdischarge	Coverage Density	Tot. Pres. Elev. Pres.	Req. Pres. Req. Discharge
ft		gpm/psi ^{1/2}	gpm gpm	ft ² gpm/ft ²	psi psi	psi gpm
094-I 0.21	Node NODE				21.2 -2.5	
095 -1.67	Node NODE				22 -1.7	
H100 -5.67	Inside Hose HOSE		250		23.9 0	250
098-O -5.67	Node NODE				23.9 0	
098-I -5.67	Node NODE				23.9 0	
099 -5.67	Node NODE				24 0	
100-O -5.67	Node NODE				24 0	
100-I -5.67	Node NODE				24 0	
101 -5.67	Node NODE				24 0	
102-O -5.67	Node NODE				24.3 0	
102-I -5.67	Node NODE				24.4 0	
104-O -5.67	Node NODE				24.4 0	
104-I -5.67	Node NODE				35.4 0	
106-O -5.67	Node NODE				35.5 0	
106-I -5.67	Node NODE				35.5 0	
TEST -5.67	Supply SUPPLY		-424		35.5 0	

PIPE INFORMATION

Node 1 Node 2	Elev 1 Elev 2	K-Factor 1 K-Factor 2	Flow added (q) Total flow (Q)	Nominal ID Actual ID	Fittings quantity x (name) = length	L F T	C Factor Pf per ft	total (Pt) elev (Pe) frict (Pf)	NOTES
	(ft)	(gpm/psi ^{1/2})	(gpm)	(in)	(ft)	(ft)	(psi)	(psi)	

Path No: 1

K105 041	0 10.5	5.6	15 15	1 1.049	3x(vsc.90)= 6	20.19 6 26.19	120 0.0761	7.2 -4.5 2	
041 039	10.5 10.5		15.3 30.3	1 1.049	1x(vsc.90)= 2	9.98 2 11.98	120 0.2803	4.6 0 3.4	
039 038	10.5 10.5		18 48.3	1.25 1.38		8 0 8	120 0.1744	8 0 1.4	
038 037	10.5 10.5		18.9 67.2	1.5 1.61		4.5 0 4.5	120 0.152	9.4 0 0.7	
037 033	10.5 10.5		18.3 85.5	2 2.067	1x(vsc.Tee-Br)= 8.5 1x(vsc.90)= 3.5	12.32 12 24.32	120 0.0703	10.1 0 1.7	
033 025	10.5 10.5		0 85.5	2.5 2.635	1x(vsc.Tee-Br)= 14.83 3x(vsc.90)= 17.71	33.94 32.54 66.48	120 0.0216	11.8 0 1.4	
025 091	10.5 5.76		88.5 174	2.5 2.635	1x(coupling)= 1.37 2x(vsc.90)= 11.81	28.55 13.18 41.73	120 0.0803	13.2 2.1 3.4	
091 093-O	5.76 2.29		0 174	6 6.357	1x(coupling)= 1.26	3.47 1.26 4.73	120 0.0011	18.6 1.5 0	
093-O 093-I	2.29 1.49		0 174	6 0		0.8 0 0.8	0 0.207	20.1 0.3 0.2	Vic717 Check ***
093-I 094-O	1.49 0.6		0 174	6 6.357	1x(coupling)= 1.26	0.89 1.26 2.15	120 0.0011	20.6 0.4 0	
094-O 094-I	0.6 0.21		0 174	6 0		0.39 0 0.39	0 0.0952	21 0.2 0.0	Vic705W Btfly ***
094-I 095	0.21 -1.67		0 174	6 6.357	1x(coupling)= 1.26	1.88 1.26 3.14	120 0.0011	21.2 0.8 0	
095 098-O	-1.67 -5.67		0 174	6 6.4	1x(coupling)= 1.73 2x(UG.90)= 38.02	155.28 39.75 195.02	140 0.0008	22 1.7 0.2	
098-O 098-I	-5.67 -5.67		0 174	6 0		0.88 0 0.88	0 0.0138	23.9 0 0.0	OS&Y Valve ***
098-I 099	-5.67 -5.67		0 174	6 6.4	1x(UG.Tee-Br)= 51.84	1.45 51.84 53.29	140 0.0008	23.9 0 0.0	
099 100-O	-5.67 -5.67		0 174	8 8.55	1x(coupling)= 3.72	9.26 3.72 12.98	140 0.0002	24 0 0	

PIPE INFORMATION

Node 1 Node 2	Elev 1 Elev 2	K-Factor 1 K-Factor 2	Flow added (q) Total flow (Q)	Nominal ID Actual ID	Fittings quantity x (name) = length	L F T	C Factor Pf per ft	total (Pt) elev (Pe) frict (Pf)	NOTES
	(ft)	(gpm/psi ^{1/2})	(gpm)	(in)	(ft)	(ft)	(psi)	(psi)	

Path No: 1

100-0	-5.67		0	8		0.96	0	24	OS&Y Valve
100-1	-5.67		174	0		0	0.0068	0	***
						0.96		0	
100-1	-5.67		0	8		2.6	140	24	
101	-5.67		174	8.55		0	0.0002	0	
						2.6		0	
101	-5.67		250	8	1x(coupling)= 3.72	341.83	140	24	
102-0	-5.67		424	8.55		3.72	0.001	0	
						345.55		0.4	
102-0	-5.67		0	8		0.96	0	24.3	OS&Y Valve
102-1	-5.67		424	0		0	0.0167	0	***
						0.96		0.0	
102-1	-5.67		0	8	1x(coupling)= 3.72	2.57	140	24.4	
104-0	-5.67		424	8.55		3.72	0.001	0	
						6.29		0	
104-0	-5.67		0	8		0.5	0	24.4	Watts909 RPZ
104-1	-5.67		424	0		0	22.1451	0	***
						0.5		11.1	
104-1	-5.67		0	8	1x(coupling)= 3.72	41.06	140	35.4	
106-0	-5.67		424	8.55		3.72	0.001	0	
						44.78		0.0	
106-0	-5.67		0	8		0.96	0	35.5	OS&Y Valve
106-1	-5.67		424	0		0	0.0167	0	***
						0.96		0.0	
106-1	-5.67		0	8		1.32	140	35.5	
TEST	-5.67		424	8.55		0	0.001	0	
						1.32		0	
TEST								35.5	

Path No: 2

K106	0	5.6	15.3	1	1x(vsc.Tee-Br)= 5	12.19	120	7.5	
O41	10.5		15.3	1.049	2x(vsc.90)= 4	9	0.0792	-4.5	
						21.19		1.7	
O41								4.6	

PIPE INFORMATION

Node 1 Node 2	Elev 1 Elev 2	K-Factor 1 K-Factor 2	Flow added (q) Total flow (Q)	Nominal ID Actual ID	Fittings quantity x (name) = length	L F T	C Factor Pf per ft	total (Pt) elev (Pe) frict (Pf)	NOTES
	(ft)	(gpm/psi ^{1/2})	(gpm)	(in)	(ft)	(ft)	(psi)	(psi)	

Path No: 3

K100 139	0 10.5	5.6	15.7 15.7	1 1.049	3x(vsc.90)= 6	19.5 6 25.5	120 0.0826	7.8 -4.5 2.1	
139 138	10.5 10.5		16 31.6	1 1.049		8 0 8	120 0.3032	5.4 0 2.4	
138 137	10.5 10.5		17.8 49.5	1.25 1.38		10 0 10	120 0.1825	7.8 0 1.8	
137 019	10.5 10.5		19.1 68.6	1.5 1.61	1x(vsc.Tee-Br)= 6.35	5.69 6.35 12.04	120 0.1578	9.6 0 1.9	
019 021	10.5 10.5		0 68.6	2.5 2.635		9.33 0 9.33	120 0.0143	11.6 0 0.1	
021 025	10.5 10.5		19.9 88.5	2.5 2.635	1x(vsc.Tee-Br)= 14.83 2x(vsc.90)= 11.81	39.81 26.63 66.44	120 0.023	11.7 0 1.5	
025								13.2	

Path No: 4

K101 139	0 10.5	5.6	16 16	1 1.049	1x(vsc.Tee-Br)= 5 2x(vsc.90)= 4	12.17 9 21.17	120 0.0855	8.1 -4.5 1.8	
139								5.4	

Path No: 5

K102 138	0 10.5	5.6	17.8 17.8	1 1.049	1x(vsc.Tee-Br)= 5 2x(vsc.90)= 4	12.17 9 21.17	120 0.1049	10.1 -4.5 2.2	
138								7.8	

Path No: 6

K107 039	0 10.5	5.6	18 18	1 1.049	1x(vsc.Tee-Br)= 5 2x(vsc.90)= 4	12.17 9 21.17	120 0.1062	10.3 -4.5 2.2	
039								8	

Path No: 7

K109 037	0 10.5	5.6	18.3 18.3	1 1.049	1x(vsc.Tee-Br)= 5 4x(vsc.90)= 8	22.33 13 35.33	120 0.1103	10.7 -4.5 3.9	
037								10.1	

PIPE INFORMATION

Node 1 Node 2	Elev 1 Elev 2	K-Factor 1 K-Factor 2	Flow added (q) Total flow (Q)	Nominal ID Actual ID	Fittings quantity x (name) = length	L F T	C Factor Pf per ft	total (Pt) elev (Pe) frict (Pf)	NOTES
	(ft)	(gpm/psi ^½)	(gpm)	(in)	(ft)	(ft)	(psi)	(psi)	

Path No: 8

K108	0	5.6	18.9	1	1x(vsc.Tee-Br)= 5	12.17	120	11.4	
O38	10.5		18.9	1.049	2x(vsc.90)= 4	9	0.1172	-4.5	
						21.17		2.5	
O38								9.4	

Path No: 9

K103	0	5.6	19.1	1	1x(vsc.Tee-Br)= 5	12.17	120	11.7	
137	10.5		19.1	1.049	2x(vsc.90)= 4	9	0.1194	-4.5	
						21.17		2.5	
137								9.6	

Path No: 10

K104	0	5.6	19.9	1	1x(vsc.Tee-Br)= 5	17.19	120	12.6	
O21	10.5		19.9	1.049	3x(vsc.90)= 6	11	0.1283	-4.5	
						28.19		3.6	
O21								11.7	

Path No: 11

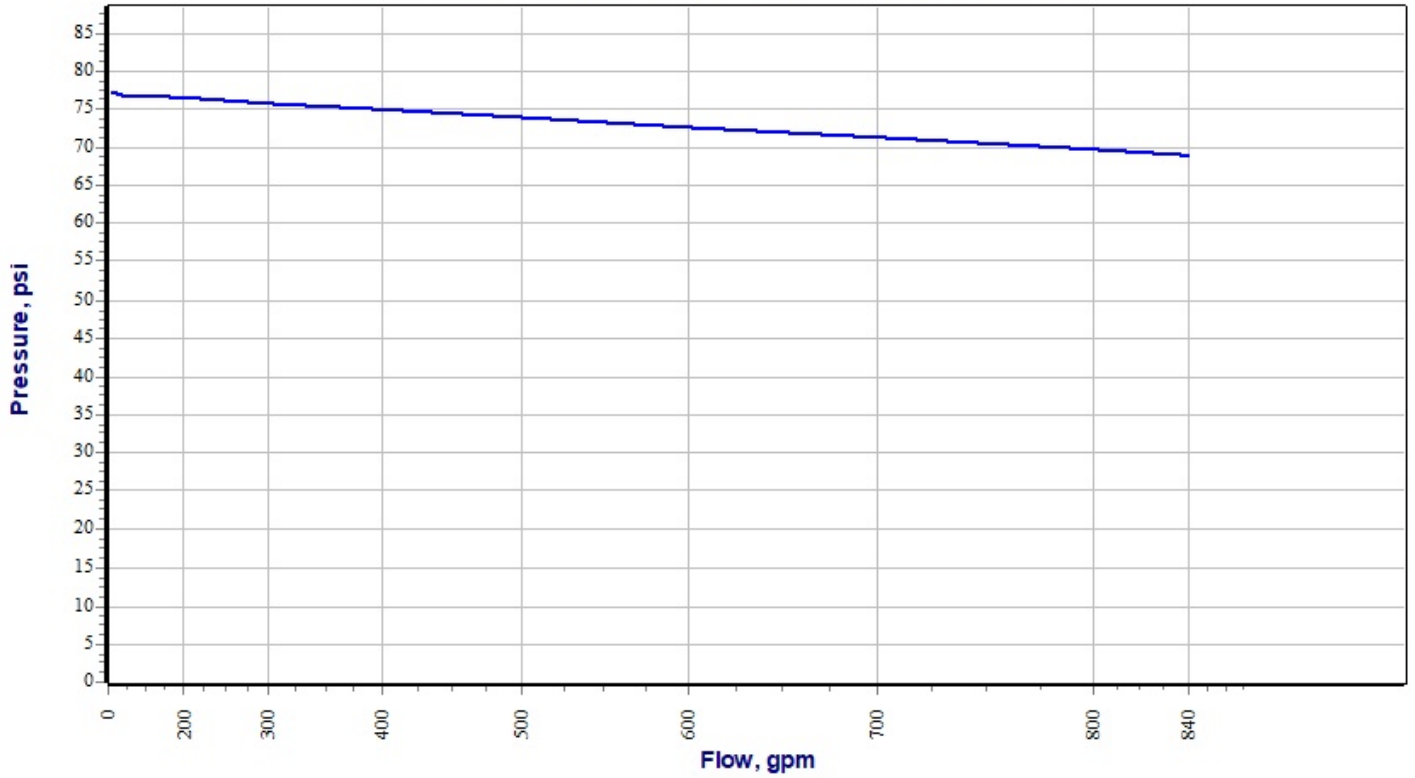
H100	-5.67		250	6	1x(UG.Tee-Br)= 51.84	1.84	140	23.9	
101	-5.67		250	6.4		51.84	0.0016	0	
						53.68		0.1	
101								24	

* Pressures are balanced to a high degree of accuracy. Values may vary by 0.1 psi due to display rounding.

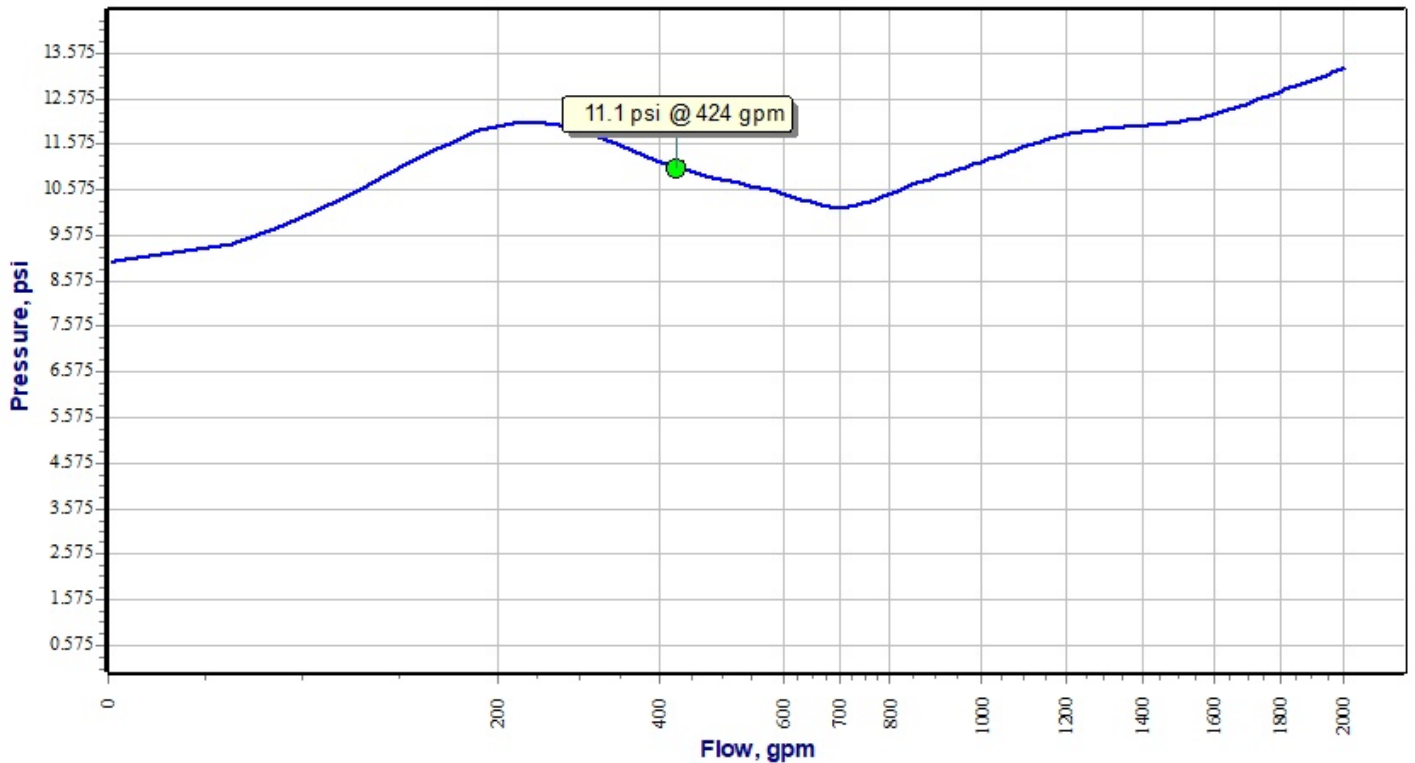
* Maximum Velocity of 11.75 ft/s occurs in the following pipe(s): (138-139)

*** Device pressure loss (gain in the case of pumps) is calculated from the device's curve. If the device curve is printed with this report, it will appear below. The length of the device as shown in the table above comes from the CAD drawing. The friction loss per unit of length is calculated based upon the length and the curve-based loss/gain value. Internal ID and C Factor values are irrelevant as the device is not represented as an addition to any pipe, but is an individual item whose loss/gain is based solely on the curve data.

Pressure vs. Flow Function
Design Area: 2; Supply Ref.: TEST; Supply Name:TEST

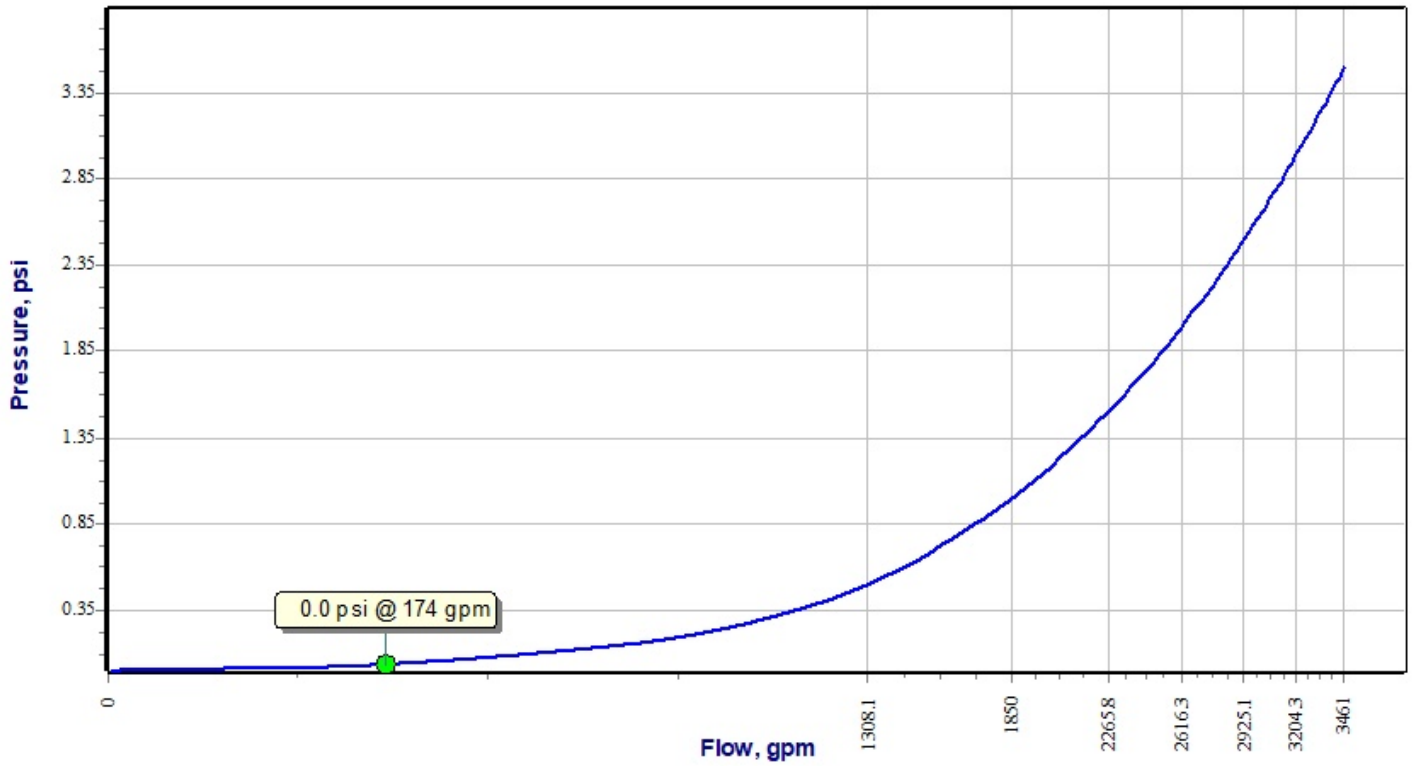


Pressure Loss Function
Design Area: 2; BFP Ref.: 406 (Watts909 RPZ, Size = 8); Inlet Node: 104-I; Outlet Node: 104-O



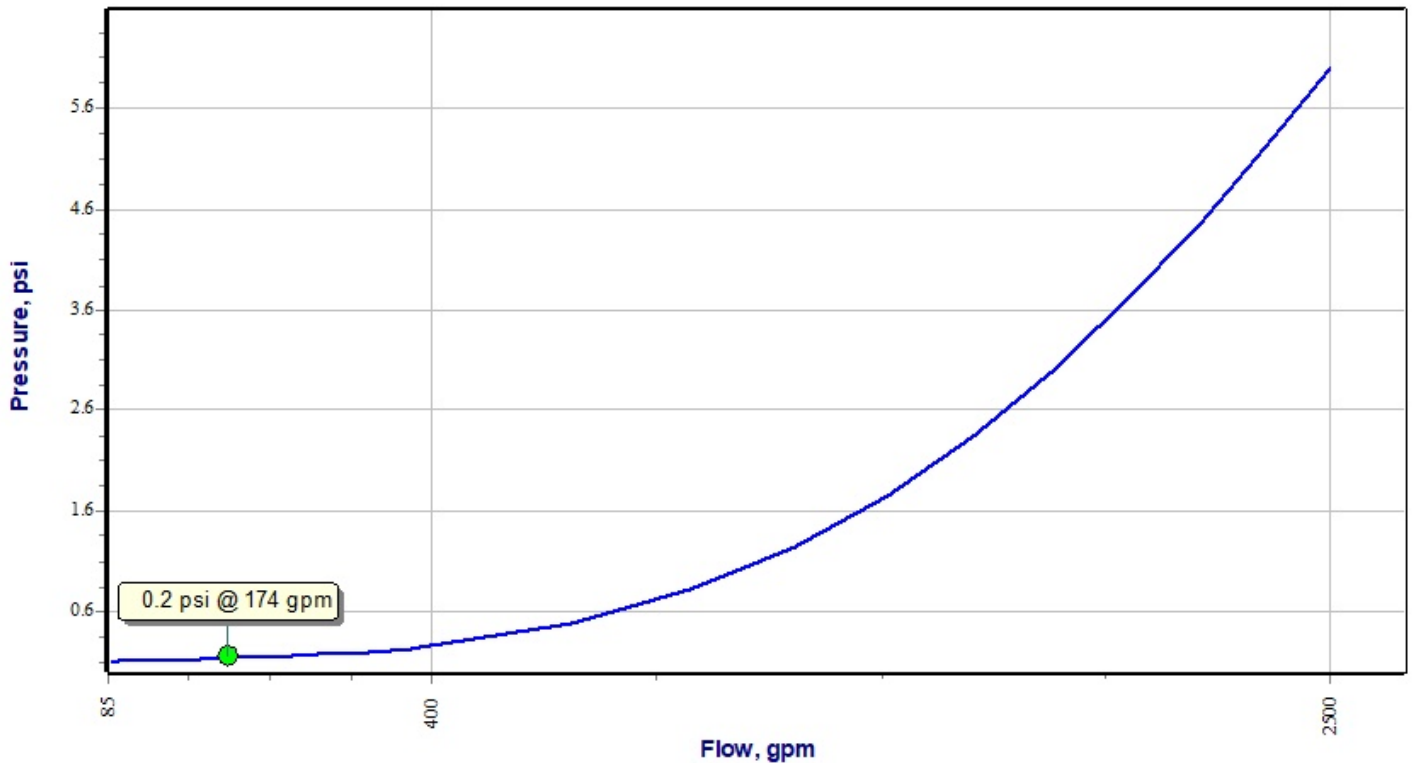
Pressure Loss Function

Design Area: 2; Valve Ref.: 401 (Vic705W Btfly, Size = 6); Inlet Node: 094-I; Outlet Node: 094-O



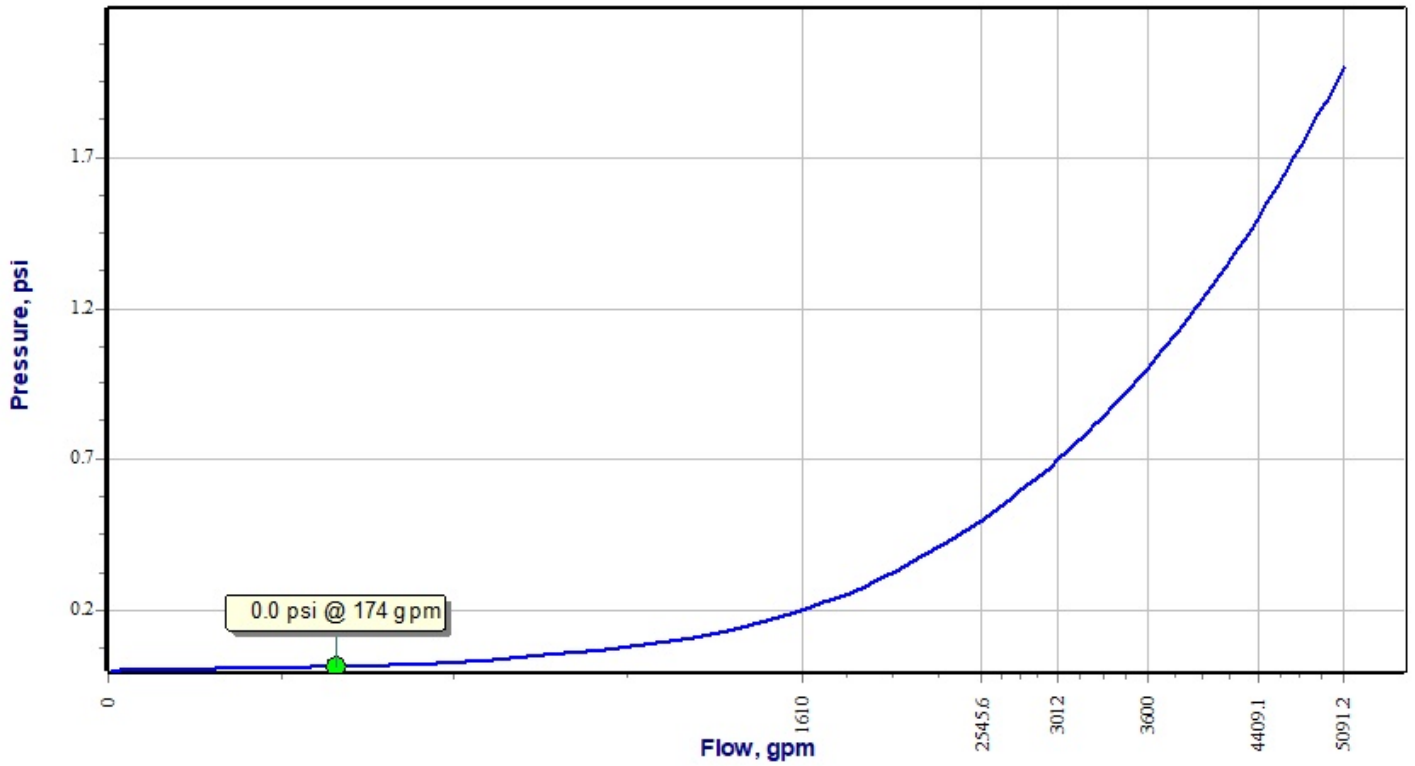
Pressure Loss Function

Design Area: 2; Valve Ref.: 402 (Vic717 Check, Size = 6); Inlet Node: 093-I; Outlet Node: 093-O



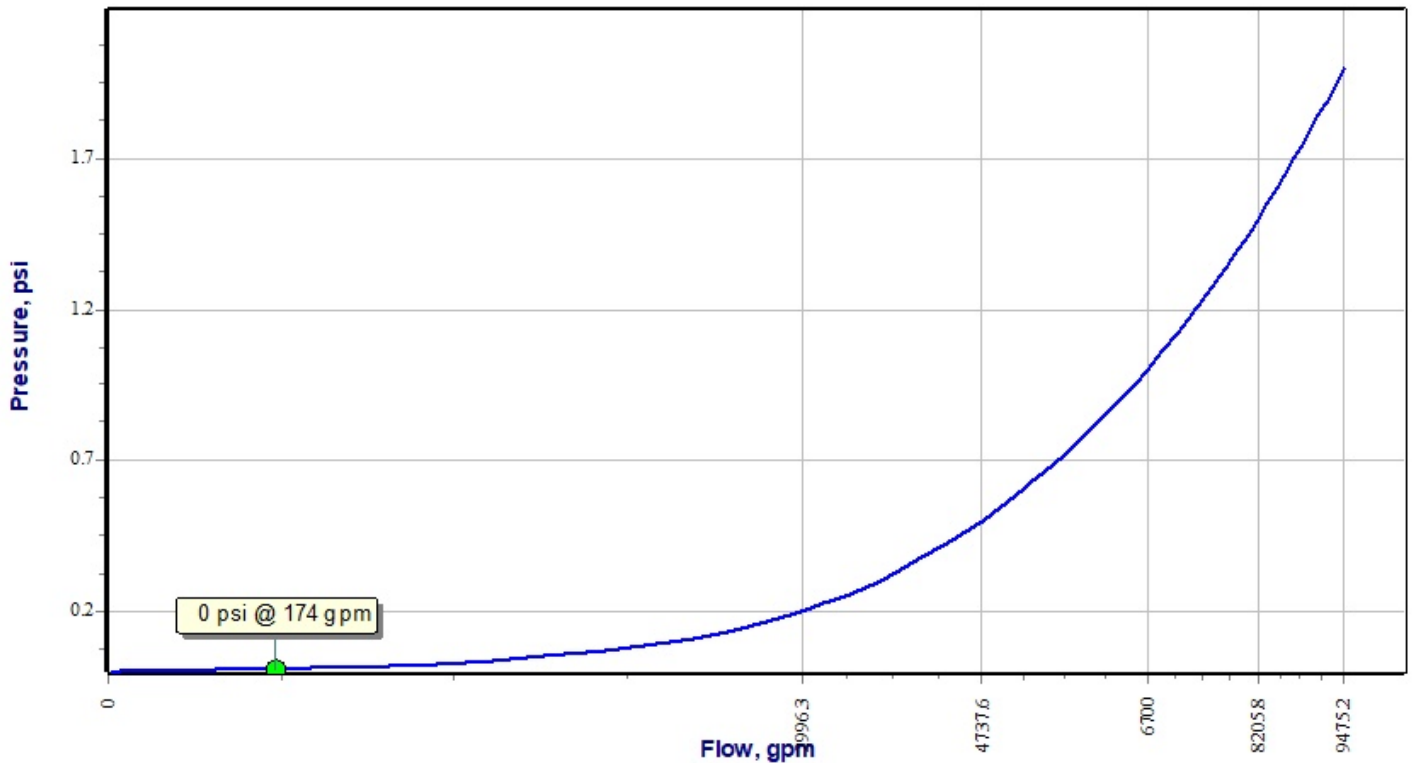
Pressure Loss Function

Design Area: 2; Valve Ref.: 403 (OS&Y Valve, Size = 6); Inlet Node: 098-I; Outlet Node: 098-O

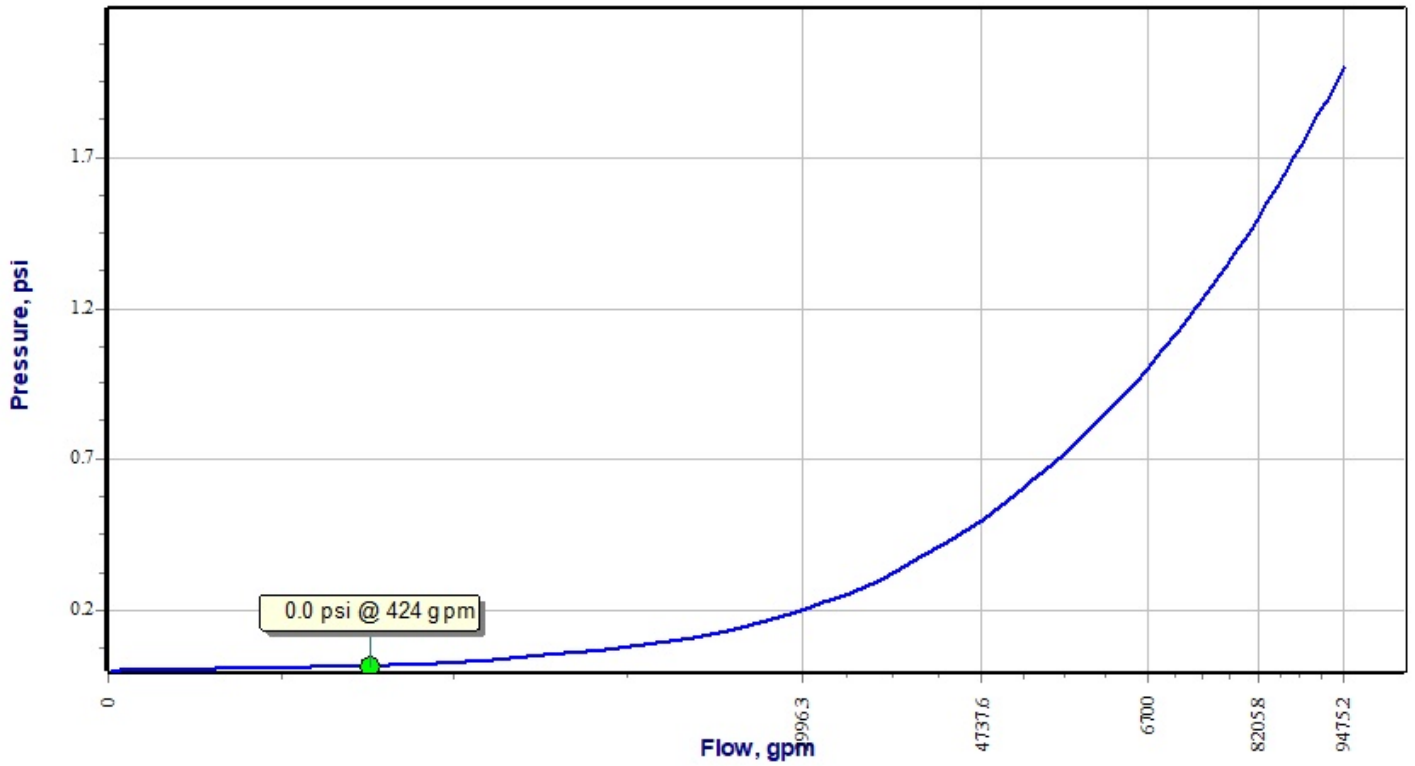


Pressure Loss Function

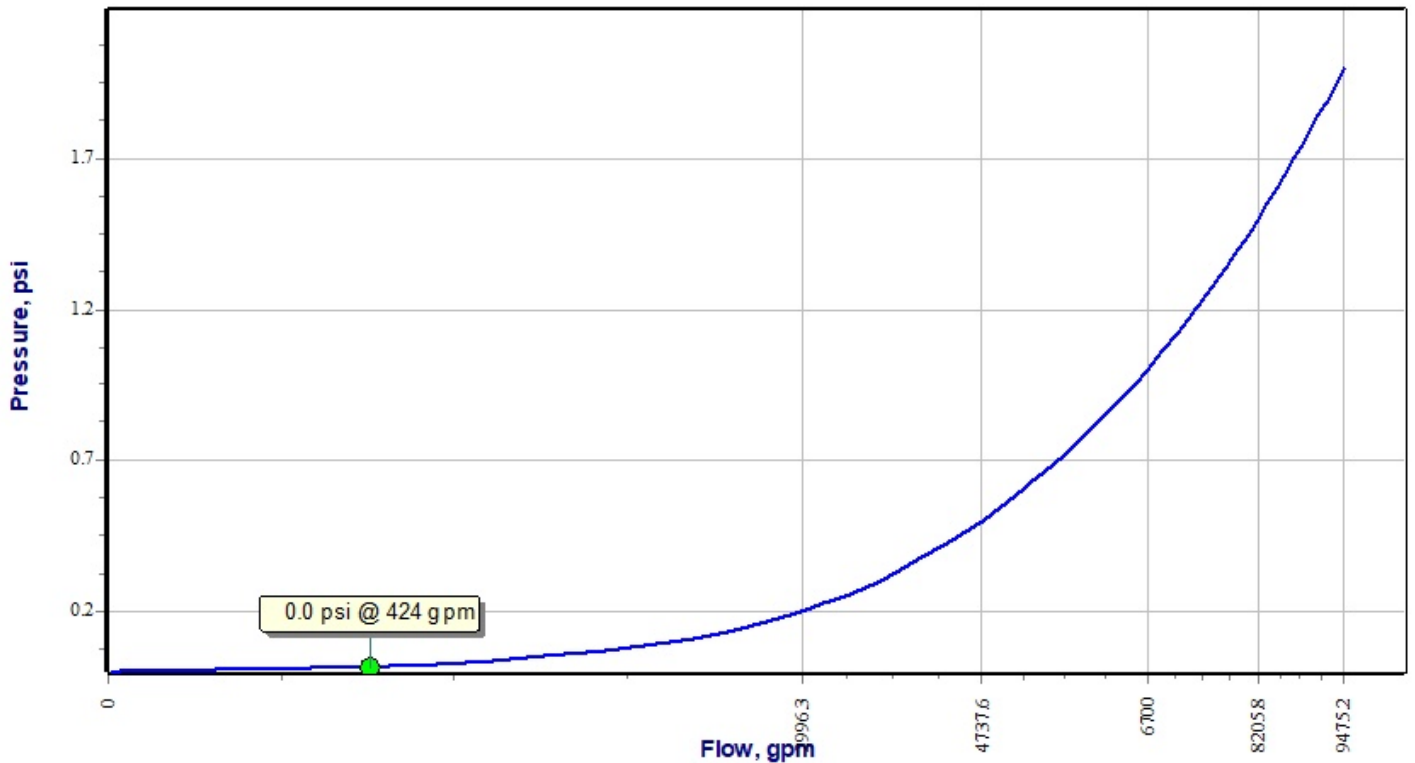
Design Area: 2; Valve Ref.: 404 (OS&Y Valve, Size = 8); Inlet Node: 100-I; Outlet Node: 100-O



Pressure Loss Function
Design Area: 2; Valve Ref.: 405 (OS&Y Valve, Size = 8); Inlet Node: 102-I; Outlet Node: 102-O



Pressure Loss Function
Design Area: 2; Valve Ref.: 407 (OS&Y Valve, Size = 8); Inlet Node: 106-I; Outlet Node: 106-O





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 FAX: (910) 637-0096
 License #P-1095

FIRE FLOW TEST RESULTS:

Test Number 1
 Test Date & Time 12/1/2020 - 10:30
 Client _____
 Location Johnsonville Elementary School
 Performed by J Maples, Logan willams
Sam Tracy

Static Pressure	<u>77</u>	psi	Location: <u>Hwy 24 & Hwy 27 Infront of Self Storage</u>
Residual Pressure	<u>69</u>	psi	Location: _____
Nozzle inside Diameter	_____	inches	(measure nozzle used)
Pitot Tube Pressure	<u>24</u>	psi	Location: <u>Infront of School (hydrant #18,495)</u>
Discharge rate (measured)	<u>840</u>	gpm	Flow Measuring Device: <u>PollardWater Pitot Gauge</u>
Required Residual Pressure	<u>30</u>	psi	(varies - 20psi minimum)

Formula: $Q_R = Q_F \times \left(\frac{H_R}{H_F}\right)^{0.54}$

- Q(R) = Rated Capacity (in gpm) at 20 psi residual
- Q(F) = Total test flow (gpm) from at pitot pressure
- H(R) = Static Pressure - 20psi
- H(F) = Static Pressure - Residual Pressure

Q(R) =

<u>840</u>	<u>47</u>	<u>8</u>
Q(F)	H(R)	H(F)

Available Fire Flow Q(R) =	2,185	gpm at 30 psi residual
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Performed By: Jackson Maples _____ 12/1/2020
 Date

Certified By: _____
 Date

Notes: Residual hydrant #19,590 (hydrant #'s taken from Harnett County GIS)