



Emerald Fire

Fire Sprinkler Specialists

11505 Burnham Dr, Gig Harbor, Washington 98332

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STEP BY STEP ELC – FP HYDRAULIC CALCULATIONS

JOB NO. 225002

FIRE PROTECTION HYDRAULIC CALCULATIONS

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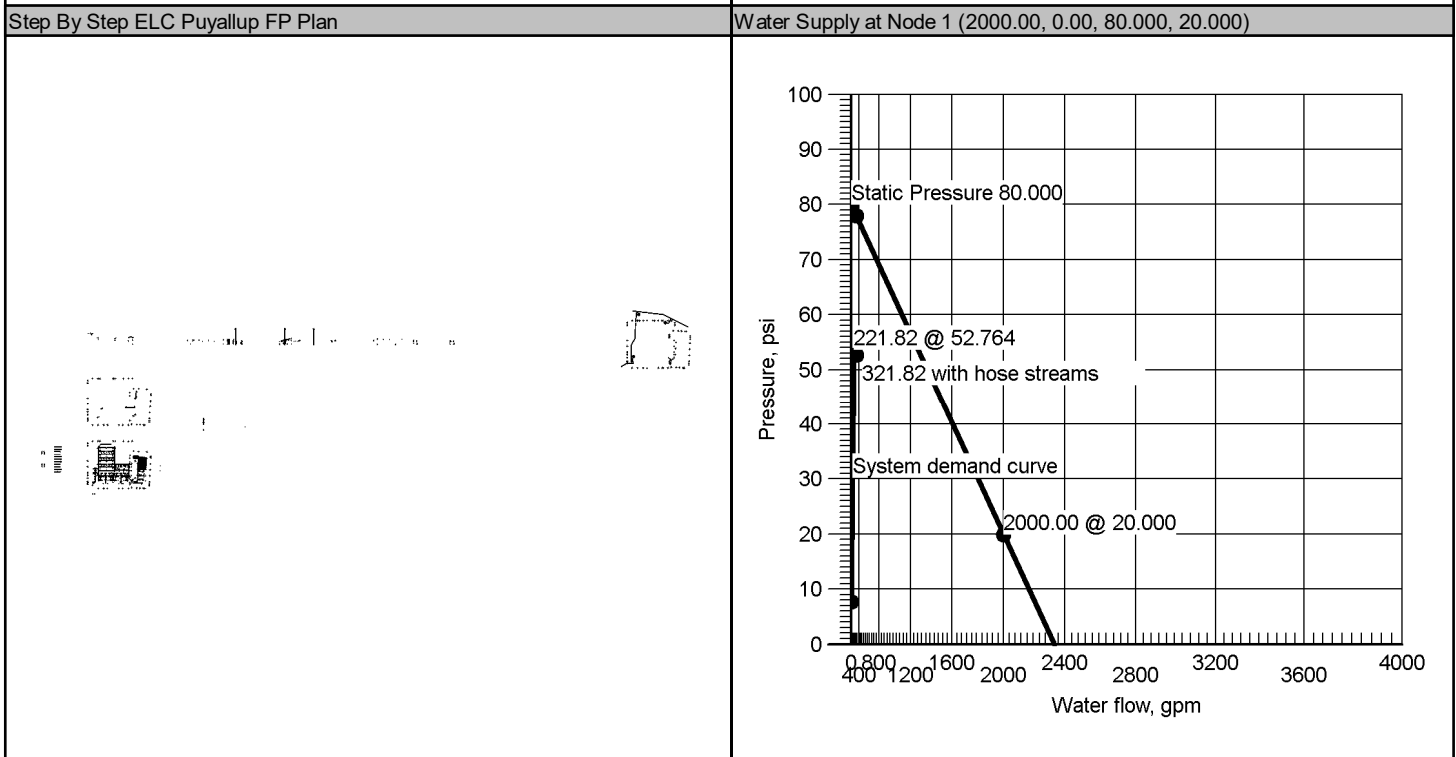
Hydraulic Overview

Job Number: 225002
Report Description: Light Hazard (1)

Job		
Job Number 225002	Design Engineer MICHAEL HALLENGREN	
Job Name: Step by Step ELC	Phone 360-710-6988	FAX N/A
Address 1 3303 8th Ave SE,	State Certification/License Number EMERAFL980MR	
Address 2 Puyallup, WA 98372	AHJ Pierce County	
Address 3	Job Site/Building Step by Step ELC	

System	
Density 0.10gpm/ft ²	Area of Application 1500ft ² (Actual 1083ft ²)
Most Demanding Sprinkler Data 5.6 K-Factor 22.50 at 16.143	Hose Streams 100.00
Coverage Per Sprinkler 225ft ²	Number Of Sprinklers Calculated 9
System Pressure Demand 52.764	System Flow Demand 221.82
Total Demand 321.82 @ 52.764	Pressure Result +25.193 (32.3%)

Supplies						Check Point Gauges			
Node	Name	Flow(gpm)	Hose Flow(gpm)	Static(psi)	Residual(psi)	Identifier	Pressure(psi)	K-Factor(K)	Flow(gpm)
1	Water Supply	2000.00	100.00	80.000	20.000	B.O.R.	52.341	30.66	221.82





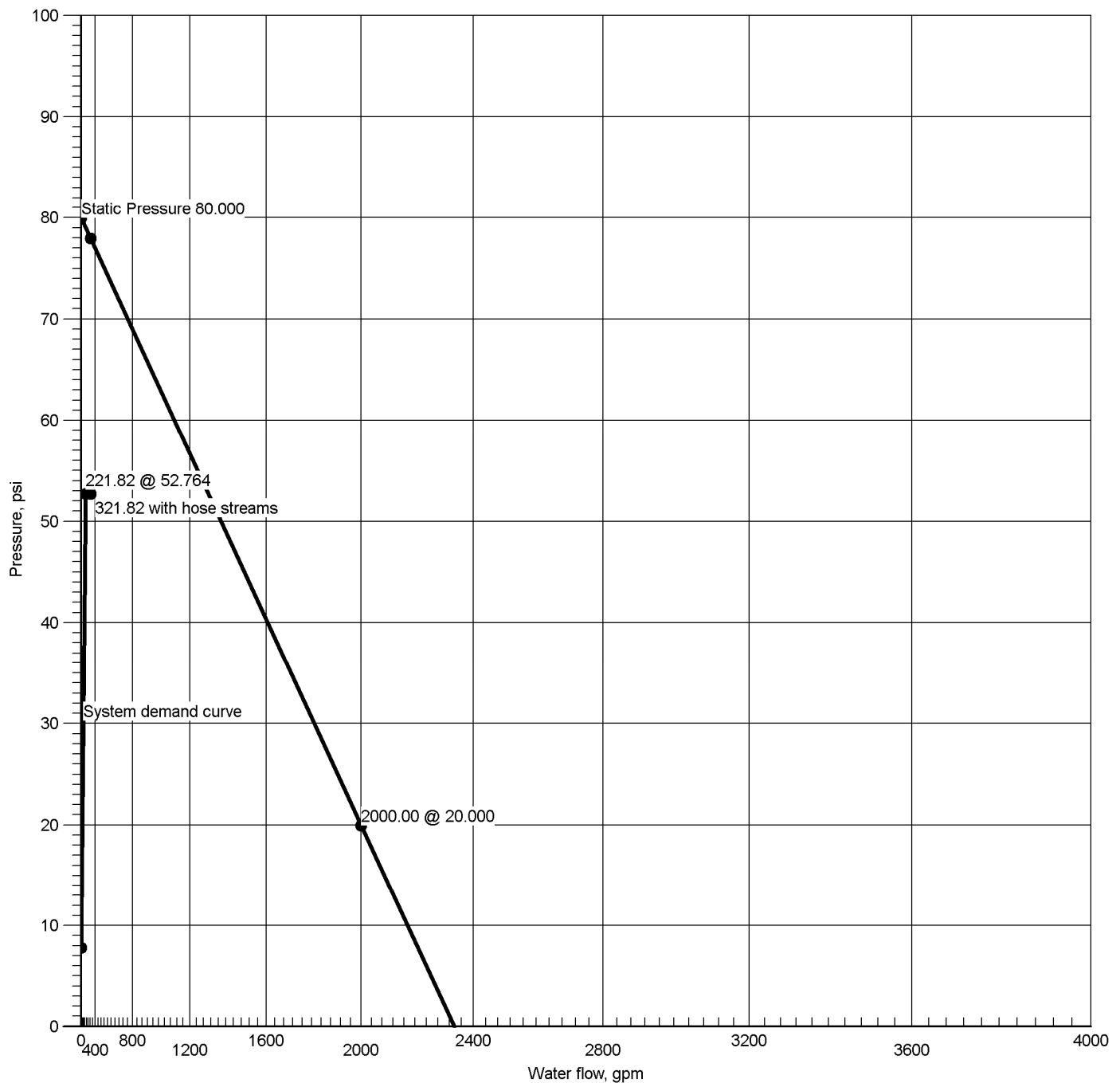
Job Number: 225002

Report Description: Light Hazard (1)

Job											
Job Number 225002					Design Engineer MICHAEL HALLENGREN						
Job Name: Step by Step ELC					State Certification/License Number EMERAFL980MR						
Address 1 3303 8th Ave SE,					AHJ Pierce County						
Address 2 Puyallup, WA 98372					Job Site/Building Step by Step ELC						
Address 3					Drawing Name Step By Step ELC Puyallup FP Plan						
System					Remote Area(s)						
Most Demanding Sprinkler Data 5.6 K-Factor 22.50 at 16.143					Occupancy Light Hazard			Job Suffix			
Hose Allowance At Source 100.00					Density 0.10gpm/ft²			Area of Application 1500ft² (Actual 1083ft²)			
Additional Hose Supplies NodeFlow(gpm)					Number Of Sprinklers Calculated 9		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 225ft²		
					AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area Left: 52.764						
Total Hose Streams 100.00											
System Flow Demand 221.82			Total Water Required (Including Hose Allowance) 321.82								
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 18.12 between nodes 213 and 219											
Maximum Velocity Under Ground 5.09 between nodes 17 and 19											
Volume capacity of Wet Pipes 1427.94gal			Volume capacity of Dry Pipes								
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply	100.00	80.000	20.000		2000.00	77.957		321.82	52.764	25.193
Contractor											
Contractor Number EMERAFL980MR		Contact Name Michael Hallengren					Contact Title				
Name of Contractor: Emerald Fire, LLC		Phone 253-377-6988					Extension				
Address 1 11021 Cramer Rd. KPN		FAX									
Address 2 Gig Harbor, WA 98329		E-mail Michaelh@emeraldfirellc.com									
Address 3		Web-Site									



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure

80.000

Residual: Pressure

20.000 @ 2000.00

Available Pressure at Time of Test

77.957 @ 321.82

System Demand

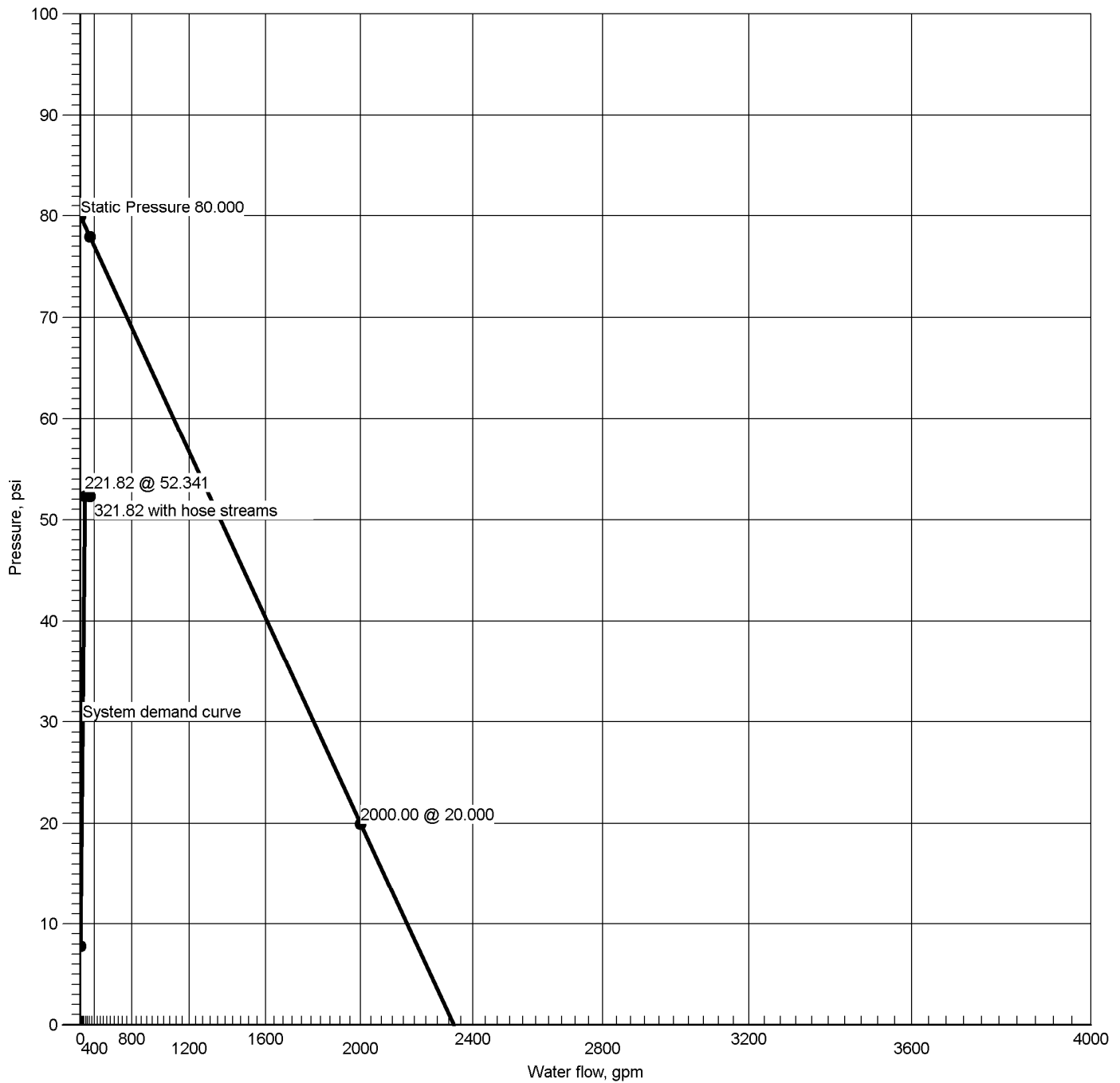
52.764 @ 221.82

System Demand (Including Hose Allowance at Source)

52.764 @ 321.82



B.O.R.



Hydraulic Graph

B.O.R.

Static: Pressure

N/A

Residual: Pressure

N/A

Available Pressure at Time of Test

N/A

System Demand

52.341 @ 221.82

System Demand (Including Hose Allowance at Source)

52.341 @ N/A



Summary Of Outflowing Devices

Job Number: 225002
Report Description: Light Hazard (1)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Sprinkler	838	25.24	22.50	5.6	20.313		
Sprinkler	849	25.47	22.50	5.6	20.687		
Sprinkler	850	26.14	22.50	5.6	21.781		
⇒ Sprinkler	860	22.50	22.50	5.6	16.143		
Sprinkler	864	23.26	22.50	5.6	17.258		
Sprinkler	865	23.86	22.50	5.6	18.153		
Sprinkler	866	22.62	22.50	5.6	16.322		
Sprinkler	889	26.05	22.50	5.6	21.632		
Sprinkler	899	26.68	22.50	5.6	22.704		

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: 225002
Report Description: Light Hazard (1)

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
1	-3'-0	S	52.764	221.82
838	11'-7½	Spr(-20.313), T(5'-0)	20.313	25.24
849	14'-0½	Spr(-20.687)	20.687	25.47
850	10'-1½	Spr(-21.781)	21.781	26.14
860	15'-0½	Spr(-16.143)	16.143	22.50
864	12'-10½	Spr(-17.258)	17.258	23.26
865	9'-11½	Spr(-18.153)	18.153	23.86
866	15'-0½	Spr(-16.322)	16.322	22.62
889	14'-0½	Spr(-21.632)	21.632	26.05
899	10'-1½	Spr(-22.704)	22.704	26.68
3	-3'-0	T(47'-3½)	52.695	
17	0'-6		43.743	
19	0'-6		43.181	
20	-3'-0	B.O.R.	52.341	
150	15'-1	PO(5'-0)	22.673	
178	15'-1	PO(7'-5)	22.687	
213	15'-1	PO(7'-5)	22.901	
219	15'-0½	PO(5'-0)	17.303	
302	15'-1	PO(7'-5)	23.732	
658	10'-7	fE(9'-4)	38.683	
765	0'-9		50.720	



Hydraulic Analysis

Job Number: 225002
Report Description: Light Hazard (1)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	1.0490	22.50	8.35	120		0.161813	2'-2	Pf 1.160
860	15'-0½	22.50	5.6	16.143		Sprinkler,	5'-0	Pe
219	15'-0½			17.303		PO(5'-0)	7'-2	Pv
BL	1.4420	92.25	18.12	120		0.467373	2'-1½	Pf 5.623
219	15'-0½	22.62 + 47.12		17.303		Flow (q) from Route 2 and 3	9'-11	Pe -0.025
213	15'-1			22.901		LtE(2'-5½), PO(7'-5)	12'-0½	Pv
CM	2.6350	169.09	9.95	120		0.076118	10'-11	Pf 0.832
213	15'-1	76.85		22.901		Flow (q) from Route 5		Pe
302	15'-1			23.732			10'-11	Pv
CM	2.6350	221.82	13.05	120		0.125766	66'-7	Pf 12.998
302	15'-1	52.73		23.732		Flow (q) from Route 7	36'-9½	Pe 1.953
658	10'-7			38.683		2LtE(5'-6), T(16'-5½), fE(9'-4)	103'-4	Pv
FR	4.2600	221.82	4.99	120		0.012121	10'-1	Pf 0.122
658	10'-7			38.683				Pe 4.375
19	0'-6			43.181			10'-1	Pv
UG	4.2200	221.82	5.09	140		0.009542	25'-2½	Pf 0.560
19	0'-6			43.181			33'-5½	Pe 0.002
17	0'-6			43.743		2E(16'-8½)	58'-8	Pv
FR	4.2600	221.82	4.99	120		0.012121	164'-11	Pf 7.078
17	0'-6			43.743			153'-8½	Pe -0.101
765	0'-9			50.720		6fE(8'-11½), 3fT(21'-1), C(26'-4), 2f(-0.000), GV(2'-7½), BFP(-3.7 76), St(-0.561), LtE(7'-11)	318'-8	Pv
UG	6.2800	221.82	2.30	140		0.001377	3'-6	Pf 0.005
765	0'-9			50.720				Pe 1.617
20	-3'-0			52.341		B.O.R.	3'-6	Pv
UG	6.2800	221.82	2.30	140		0.001377	165'-11½	Pf 0.354
20	-3'-0			52.341			91'-5	Pe
3	-3'-0			52.695		E(22'-1), 2EE(11'-0½), T(47'-3½)	257'-4	Pv
UG	8.3900	221.82	1.29	140		0.000336	128'-10	Pf 0.068
3	-3'-0			52.695			74'-8	Pe
1	-3'-0			52.764		EE(15'-3), T(59'-4½), S	203'-6	Pv
		100.00				Hose Allowance At Source		
1		321.82						
Route 2								
BL	1.0490	22.62	8.40	120		0.163471	1'-0	Pf 0.981
866	15'-0½	22.62	5.6	16.322		Sprinkler,	5'-0	Pe
219	15'-0½			17.303		PO(5'-0)	6'-0	Pv
Route 3								
BL	1.4420	47.12	9.26	120		0.134892	7'-3½	Pf 0.983
864	12'-10½	23.86	5.6	17.258		Sprinkler, Flow (q) from Route 4		Pe -0.939
219	15'-0½			17.303			7'-3½	Pv
Route 4								
BL	1.4420	23.86	4.69	120		0.038297	9'-10½	Pf 0.379
865	9'-11½	23.86	5.6	18.153		Sprinkler		Pe -1.273
864	12'-10½			17.258			9'-10½	Pv
Route 5								
AO	1.0490	25.24	9.37	120		0.200133	12'-3½	Pf 3.863
838	11'-7½	25.24	5.6	20.313		Sprinkler,	7'-0	Pe -1.503
150	15'-1			22.673		E(2'-0), PO(5'-0)	19'-3½	Pv
CM	2.6350	25.24	1.48	120		0.002256	6'-1½	Pf 0.014
150	15'-1			22.673				Pe
178	15'-1			22.687			6'-1½	Pv
CM	2.6350	76.85	4.52	120		0.017695	12'-1	Pf 0.214
178	15'-1	51.61		22.687		Flow (q) from Route 6		Pe
213	15'-1			22.901			12'-1	Pv
Route 6								
BL	1.4420	51.61	10.14	120		0.159583	5'-6½	Pf 2.465
849	14'-0½	26.14	5.6	20.687		Sprinkler,, Flow (q) from Route 8	9'-11	Pe -0.465
178	15'-1			22.687		LtE(2'-5½), PO(7'-5)	15'-5½	Pv
Route 7								
BL	1.4420	52.73	10.36	120		0.166068	5'-6½	Pf 2.565
889	14'-0½	26.68	5.6	21.632		Sprinkler,, Flow (q) from Route 9	9'-11	Pe -0.465
302	15'-1			23.732		LtE(2'-5½), PO(7'-5)	15'-5½	Pv
Route 8								



Hydraulic Analysis

Job Number: 225002
Report Description: Light Hazard (1)

Pipe Type	Diameter	Flow	Velocity	HWC	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt	Pn	Eq. Length	Summary
Upstream						Total Length	
BL	1.4420	26.14	5.13	120		0.045328	13'-1½" Pf 0.594
850	10'-1½"	26.14	5.6	21.781		Sprinkler	Pe -1.689
849	14'-0½"			20.687			13'-1½" Pv

Route 9

BL	1.4420	26.68	5.24	120		0.047101	13'-1½" Pf 0.618
899	10'-1½"	26.68	5.6	22.704		Sprinkler	Pe -1.689
889	14'-0½"			21.632			13'-1½" Pv

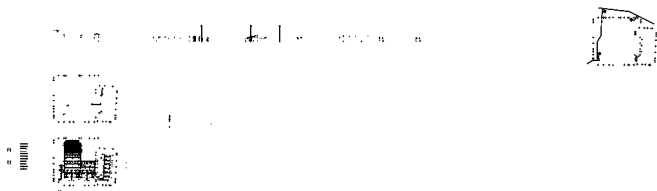
Equivalent Pipe Lengths of Valves and Fittings (C=120 only)	C Value Multiplier				
$\left(\frac{\text{Actual Inside Diameter}}{\text{Schedule 40 Steel Pipe Inside Diameter}} \right)^{4.87} = \text{Factor}$	Value Of C	100	130	140	150
	Multiplying Factor	0.713	1.16	1.33	1.51

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



Hydraulic Overview

Job Number: 225002
Report Description: Light Hazard (2)

Job									
Job Number 225002					Design Engineer MICHAEL HALLENGREN				
Job Name: Step by Step ELC					Phone 360-710-6988			FAX N/A	
Address 1 3303 8th Ave SE,					State Certification/License Number EMERAFL980MR				
Address 2 Puyallup, WA 98372					AHJ Pierce County				
Address 3					Job Site/Building Step by Step ELC				
System									
Density 0.10gpm/ft ²					Area of Application 1500ft ² (Actual 2018ft ²)				
Most Demanding Sprinkler Data 5.6 K-Factor 26.00 at 21.556					Hose Streams 100.00				
Coverage Per Sprinkler 137ft ²					Number Of Sprinklers Calculated 22			Number Of Sprinklers Calculated 0	
System Pressure Demand 58.702					System Flow Demand 500.43				
Total Demand 600.43 @ 58.702					Pressure Result +14.820 (20.2%)				
Supplies					Check Point Gauges				
<u>Node</u>	<u>Name</u>	<u>Flow(gpm)</u>	<u>Hose Flow(gpm)</u>	<u>Static(psi)</u>	<u>Residual(psi)</u>	<u>Identifier</u>	<u>Pressure(psi)</u>	<u>K-Factor(K)</u>	<u>Flow(gpm)</u>
1	Water Supply	2000.00	100.00	80.000	20.000	B.O.R.	56.798	66.4	500.43
									
Step By Step ELC Puyallup FP Plan						Water Supply at Node 1 (2000.00, 0.00, 80.000, 20.000)			
									



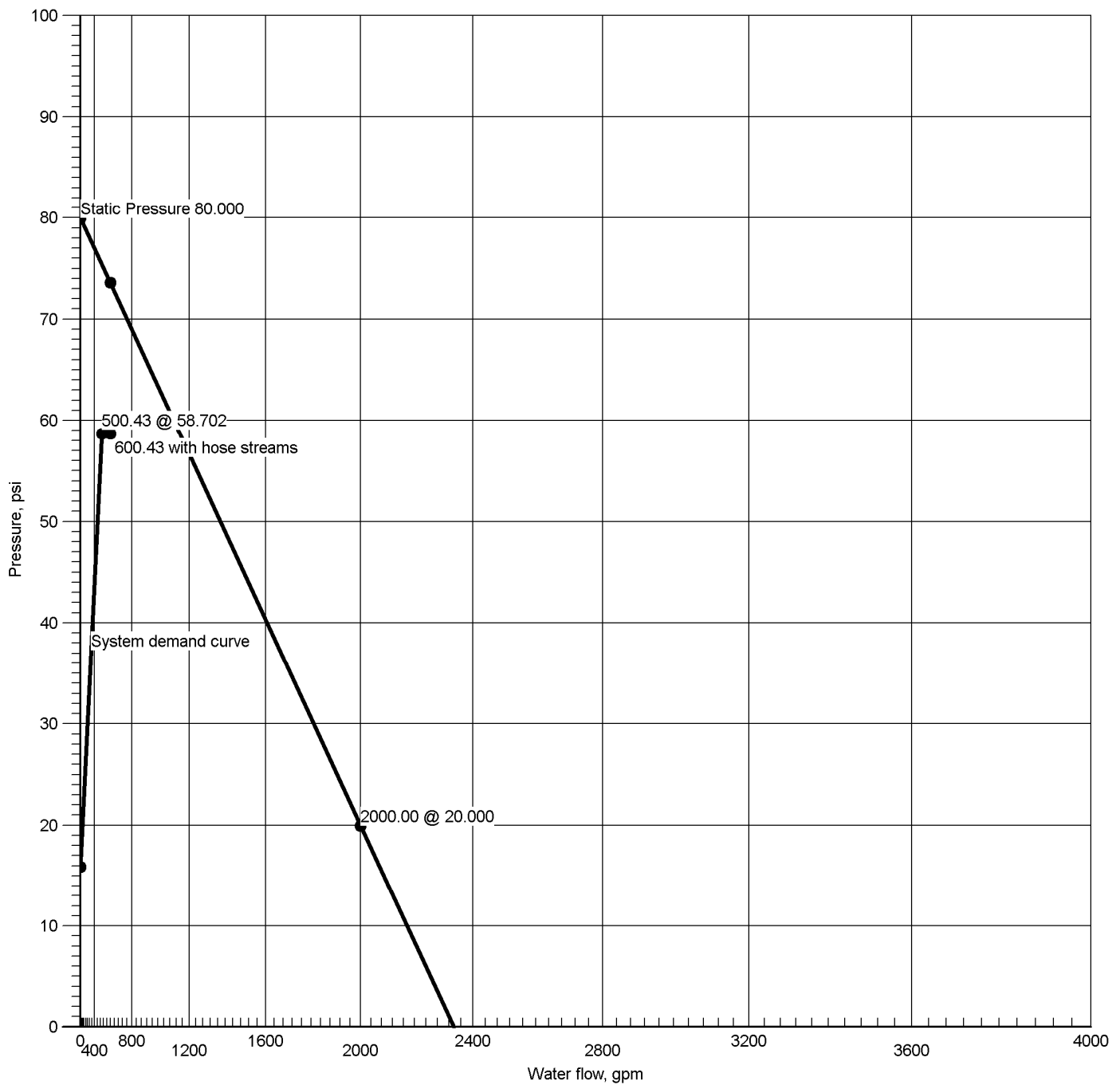
Hydraulic Summary

Job Number: 225002
Report Description: Light Hazard (2)

Job											
Job Number 225002				Design Engineer MICHAEL HALLENGREN							
Job Name: Step by Step ELC				State Certification/License Number EMERAFL980MR							
Address 1 3303 8th Ave SE,				AHJ Pierce County							
Address 2 Puyallup, WA 98372				Job Site/Building Step by Step ELC							
Address 3				Drawing Name Step By Step ELC Puyallup FP Plan							
System				Remote Area(s)							
Most Demanding Sprinkler Data 5.6 K-Factor 26.00 at 21.556				Occupancy Light Hazard			Job Suffix				
Hose Allowance At Source 100.00				Density 0.10gpm/ft ²			Area of Application 1500ft ² (Actual 2018ft ²)				
Additional Hose Supplies <u>Node</u> <u>Flow(gpm)</u>				Number Of Sprinklers Calculated 22		Number Of Nozzles Calculated 0		Coverage Per Sprinkler 137ft ²			
				AutoPeak Results: Pressure For Remote Area(s) Adjacent To Most Remote Area							
				Left: 58.702			Right: 58.702				
Total Hose Streams 100.00											
System Flow Demand 500.43		Total Water Required (Including Hose Allowance) 600.43									
Maximum Pressure Unbalance In Loops 0.000											
Maximum Velocity Above Ground 13.50 between nodes 133 and 923											
Maximum Velocity Under Ground 5.18 between nodes 3 and 20											
Volume capacity of Wet Pipes 1427.94gal		Volume capacity of Dry Pipes									
Supplies											
Node	Name	Hose Flow (gpm)	Static (psi)	Residual (psi)	@	Flow (gpm)	Available (psi)	@	Total Demand (gpm)	Required (psi)	Safety Margin (psi)
1	Water Supply	100.00	80.000	20.000		2000.00	73.523		600.43	58.702	14.820
Contractor											
Contractor Number EMERAFL980MR		Contact Name Michael Hallengren					Contact Title				
Name of Contractor: Emerald Fire, LLC		Phone 253-377-6988					Extension				
Address 1 11021 Cramer Rd. KPN		FAX									
Address 2 Gig Harbor, WA 98329		E-mail Michaelh@emeraldfirellc.com									
Address 3		Web-Site									



Water Supply at Node 1



Hydraulic Graph

Water Supply at Node 1

Static: Pressure

80.000

Residual: Pressure

20.000 @ 2000.00

Available Pressure at Time of Test

73.523 @ 600.43

System Demand

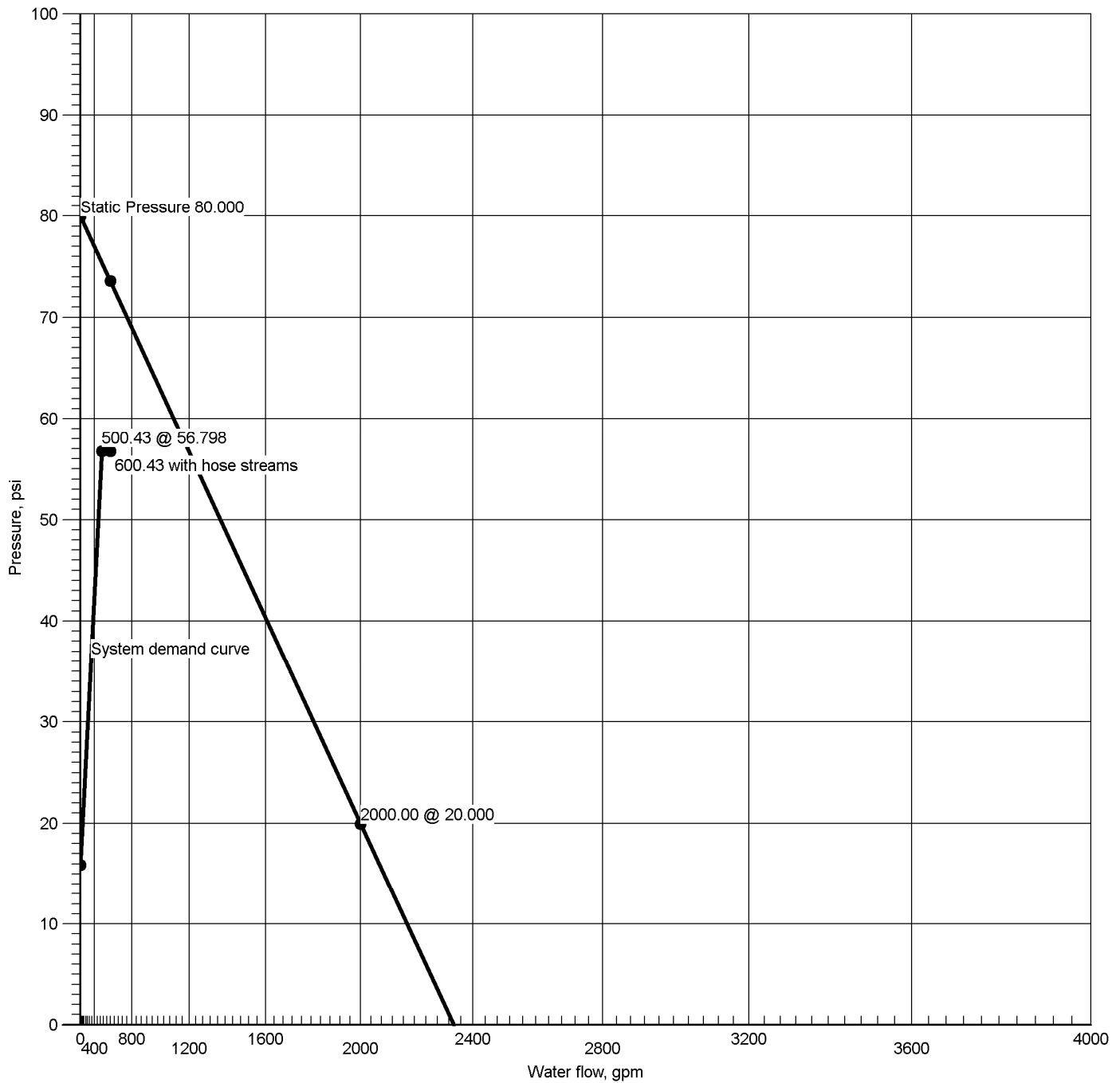
58.702 @ 500.43

System Demand (including Hose Allowance at Source)

58.702 @ 600.43



B.O.R.



Hydraulic Graph

B.O.R.

Static: Pressure

N/A

Residual: Pressure

N/A

Available Pressure at Time of Test

N/A

System Demand

56.798 @ 500.43

System Demand (Including Hose Allowance at Source)

56.798 @ N/A



Summary Of Outflowing Devices

Job Number: 225002
Report Description: Light Hazard (2)

Device		Actual Flow (gpm)	Minimum Flow (gpm)	K-Factor (K)	Pressure (psi)		
Sprinkler	915	26.83	26.00	5.6	22.955		
Sprinkler	916	26.18	26.00	5.6	21.860		
⇒ Sprinkler	917	26.00	26.00	5.6	21.556		
Sprinkler	918	23.66	13.70	5.6	17.851		
Sprinkler	919	21.59	13.70	5.6	14.867		
Sprinkler	920	20.46	13.70	5.6	13.353		
Sprinkler	921	21.50	13.70	5.6	14.734		
Sprinkler	922	22.59	13.70	5.6	16.272		
Sprinkler	923	24.65	13.70	5.6	19.369		
Sprinkler	932	23.96	13.70	5.6	18.309		
Sprinkler	933	22.01	13.70	5.6	15.445		
Sprinkler	934	17.81	13.70	5.6	10.114		
Sprinkler	935	18.73	13.70	5.6	11.185		
Sprinkler	936	22.90	13.70	5.6	16.729		
Sprinkler	937	24.85	13.70	5.6	19.689		
Sprinkler	938	25.57	13.70	5.6	20.854		
Sprinkler	944	24.15	13.70	5.6	18.597		
Sprinkler	945	22.20	13.70	5.6	15.713		
Sprinkler	946	18.01	13.70	5.6	10.338		
Sprinkler	947	18.83	13.70	5.6	11.306		
Sprinkler	948	23.00	13.70	5.6	16.874		

⇒ Most Demanding Sprinkler Data



Node Analysis

Job Number: 225002
Report Description: Light Hazard (2)

Node	Elevation(Foot)	Fittings	Pressure(psi)	Discharge(gpm)
1	-3'-0	S	58.702	500.43
915	9'-6	Spr(-22.955)	22.955	26.83
916	9'-6	Spr(-21.860)	21.860	26.18
917	9'-6	Spr(-21.556)	21.556	26.00
918	22'-5	Spr(-17.851)	17.851	23.66
919	26'-5	Spr(-14.867)	14.867	21.59
920	29'-4½	Spr(-13.353)	13.353	20.46
921	29'-4½	Spr(-14.734)	14.734	21.50
922	26'-5	Spr(-16.272)	16.272	22.59
923	22'-5	Spr(-19.369)	19.369	24.65
932	22'-5	Spr(-18.309)	18.309	23.96
933	26'-5	Spr(-15.445)	15.445	22.01
934	33'-8½	Spr(-10.114)	10.114	17.81
935	33'-8½	Spr(-11.185)	11.185	18.73
936	26'-5	Spr(-16.729)	16.729	22.90
937	22'-5	Spr(-19.689)	19.689	24.85
938	20'-5	Spr(-20.854)	20.854	25.57
944	22'-5	Spr(-18.597)	18.597	24.15
945	26'-5	Spr(-15.713)	15.713	22.20
946	33'-8½	Spr(-10.338)	10.338	18.01
947	33'-8½	Spr(-11.306)	11.306	18.83
948	26'-5	Spr(-16.874)	16.874	23.00
949	22'-5	Spr(-19.845)	19.845	24.95
3	-3'-0	T(47'-3½)	58.394	
20	-3'-0	B.O.R.	56.798	
113	9'-6	PO(9'-11)	25.590	
122	19'-8	PO(7'-5)	23.041	
123	19'-8		23.037	
133	19'-8	PO(7'-5)	24.904	
148	19'-8	PO(7'-5)	23.283	
152	26'-7½	Z	15.358	
157	26'-7½	Z	16.640	
160	19'-8	PO(7'-5)	24.965	
177	19'-8	PO(5'-0)	25.036	
202	19'-8	PO(7'-5)	23.635	
205	26'-7½	Z	15.626	
210	26'-7½	Z	16.786	
214	19'-8	PO(7'-5)	25.155	
582	15'-8½	fT(21'-6)	32.994	
583	15'-8½	fT(21'-6)	32.336	
765	0'-9		55.160	



Hydraulic Analysis

Job Number: 225002
Report Description: Light Hazard (2)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 1								
BL	1.6820	26.00	3.75	120		0.021212	14'-4	Pf 0.304
917	9'-6	26.00	5.6	21.556		Sprinkler		Pe
916	9'-6			21.860			14'-4	Pv
BL	1.6820	52.18	7.53	120		0.076967	14'-2½	Pf 1.094
916	9'-6	26.18	5.6	21.860		Sprinkler		Pe
915	9'-6			22.955			14'-2½	Pv
BL	1.6820	79.01	11.41	120		0.165814	6'-0	Pf 2.636
915	9'-6	26.83	5.6	22.955		Sprinkler,	9'-11	Pe
113	9'-6			25.590		PO(9'-11)	15'-11	Pv
BL	2.1570	79.01	6.94	120		0.049379	24'-7	Pf 1.851
113	9'-6			25.590			12'-11	Pe -4.404
123	19'-8			23.037		3fE(4'-3½)	37'-6	Pv
CM	3.2600	79.01	3.04	120		0.006607	0'-6	Pf 0.003
123	19'-8			23.037				Pe
122	19'-8			23.041			0'-6	Pv
CM	3.2600	144.73	5.56	120		0.020245	12'-0	Pf 0.243
122	19'-8	65.72		23.041		Flow (q) from Route 6		Pe
148	19'-8			23.283			12'-0	Pv
CM	3.2600	208.51	8.01	120		0.039780	8'-10	Pf 0.351
148	19'-8	63.78		23.283		Flow (q) from Route 2		Pe
202	19'-8			23.635			8'-10	Pv
CM	3.2600	272.86	10.49	120		0.065430	68'-4	Pf 7.637
202	19'-8	64.35		23.635		Flow (q) from Route 3	48'-4½	Pe 1.722
582	15'-8½			32.994		4fE(6'-8½), fT(21'-6)	116'-8½	Pv
FR	4.2600	500.43	11.26	120		0.054602	50'-1	Pf 15.675
582	15'-8½	227.57		32.994		Flow (q) from Route 4	88'-5½	Pe 6.491
765	0'-9			55.160		4fE(8'-11½), 2fT(21'-1), 2f(-0.00 0), GV(2'-7½), BFP(-8.512), St(- 0.401), LtE(7'-11)	138'-6½	Pv
UG	6.2800	500.43	5.18	140		0.006202	3'-6	Pf 0.022
765	0'-9			55.160				Pe 1.617
20	-3'-0			56.798		B.O.R.	3'-6	Pv
UG	6.2800	500.43	5.18	140		0.006202	165'-11½	Pf 1.596
20	-3'-0			56.798			91'-5	Pe
3	-3'-0			58.394		E(22'-1), 2EE(11'-0½), T(47'-3½)	257'-4	Pv
UG	8.3900	500.43	2.90	140		0.001513	128'-10	Pf 0.308
3	-3'-0			58.394			74'-8	Pe
1	-3'-0			58.702		EE(15'-3), T(59'-4½), S	203'-6	Pv
		100.00				Hose Allowance At Source		
1		600.43						
Route 2								
AO	1.0490	17.81	6.61	120		0.104999	12'-7½	Pf 2.165
934	33'-8½	17.81	5.6	10.114		Sprinkler,	8'-0	Pe 3.080
152	26'-7½			15.358		4E(2'-0), Z	20'-7½	Pv
BL	1.4420	17.81	3.50	120		0.022295	0'-6	Pf 0.011
152	26'-7½			15.358				Pe 0.076
933	26'-5			15.445			0'-6	Pv
BL	1.4420	39.82	7.82	120		0.098773	11'-5	Pf 1.128
933	26'-5	22.01	5.6	15.445		Sprinkler		Pe 1.735
932	22'-5			18.309			11'-5	Pv
BL	1.4420	63.78	12.53	120		0.236132	6'-1	Pf 3.778
932	22'-5	23.96	5.6	18.309		Sprinkler,	9'-11	Pe 1.197
148	19'-8			23.283		LtE(2'-5½), PO(7'-5)	16'-0	Pv
Route 3								
AO	1.0490	18.01	6.68	120		0.107144	12'-7½	Pf 2.209
946	33'-8½	18.01	5.6	10.338		Sprinkler,	8'-0	Pe 3.080
205	26'-7½			15.626		4E(2'-0), Z	20'-7½	Pv
BL	1.4420	18.01	3.54	120		0.022750	0'-6	Pf 0.011
205	26'-7½			15.626				Pe 0.076
945	26'-5			15.713			0'-6	Pv
BL	1.4420	40.20	7.90	120		0.100551	11'-5	Pf 1.148
945	26'-5	22.20	5.6	15.713		Sprinkler		Pe 1.735
944	22'-5			18.597			11'-5	Pv
BL	1.4420	64.35	12.64	120		0.240076	6'-1	Pf 3.841
944	22'-5	24.15	5.6	18.597		Sprinkler,	9'-11	Pe 1.197
202	19'-8			23.635		LtE(2'-5½), PO(7'-5)	16'-0	Pv



Hydraulic Analysis

Job Number: 225002
Report Description: Light Hazard (2)

Pipe Type	Diameter	Flow	Velocity	HWC	Pn	Friction Loss	Length	Pressure
Downstream	Elevation	Discharge	K-Factor	Pt		Fittings	Eq. Length	Summary
Upstream							Total Length	
Route 4								
AO	1.0490	18.73	6.95	120		0.115243	12'-7½"	Pf 2.376
935	33'-8½"	18.73	5.6	11.185		Sprinkler,	8'-0"	Pe 3.080
157	26'-7½"			16.640		4E(2'-0), Z	20'-7½"	Pv
BL	1.4420	18.73	3.68	120		0.024470	0'-6"	Pf 0.012
157	26'-7½"			16.640			0'-6"	Pe 0.076
936	26'-5"			16.729				Pv
BL	1.4420	41.63	8.18	120		0.107264	11'-5"	Pf 1.225
936	26'-5"	22.90	5.6	16.729		Sprinkler	11'-5"	Pe 1.735
937	22'-5"			19.689				Pv
BL	1.4420	66.48	13.06	120		0.254969	6'-1"	Pf 4.079
937	22'-5"	24.85	5.6	19.689		Sprinkler,	9'-11"	Pe 1.197
160	19'-8"			24.965		LtE(2'-5½), PO(7'-5)	16'-0"	Pv
CM	3.2600	135.21	5.20	120		0.017851	4'-0"	Pf 0.071
160	19'-8"	68.73		24.965		Flow (q) from Route 7	4'-0"	Pe
177	19'-8"			25.036				Pv
CM	3.2600	160.79	6.18	120		0.024594	4'-10"	Pf 0.119
177	19'-8"	25.57		25.036		Flow (q) from Route 8	4'-10"	Pe
214	19'-8"			25.155				Pv
CM	3.2600	227.57	8.75	120		0.046766	68'-4"	Pf 5.459
214	19'-8"	66.78		25.155		Flow (q) from Route 5	48'-4½"	Pe 1.722
583	15'-8½"			32.336		4fE(6'-8½), fT(21'-6)	116'-8½"	Pv
CM	4.2600	227.57	5.12	120		0.012708	51'-9½"	Pf 0.658
583	15'-8½"			32.336			51'-9½"	Pe 0.000
582	15'-8½"			32.994				Pv
Route 5								
AO	1.0490	18.83	6.99	120		0.116399	12'-7½"	Pf 2.400
947	33'-8½"	18.83	5.6	11.306		Sprinkler,	8'-0"	Pe 3.080
210	26'-7½"			16.786		4E(2'-0), Z	20'-7½"	Pv
BL	1.4420	18.83	3.70	120		0.024715	0'-6"	Pf 0.012
210	26'-7½"			16.786			0'-6"	Pe 0.076
948	26'-5"			16.874				Pv
BL	1.4420	41.83	8.22	120		0.108222	11'-5"	Pf 1.236
948	26'-5"	23.00	5.6	16.874		Sprinkler	11'-5"	Pe 1.735
949	22'-5"			19.845				Pv
BL	1.4420	66.78	13.12	120		0.257095	6'-1"	Pf 4.113
949	22'-5"	24.95	5.6	19.845		Sprinkler,	9'-11"	Pe 1.197
214	19'-8"			25.155		LtE(2'-5½), PO(7'-5)	16'-0"	Pv
Route 6								
BL	1.4420	20.46	4.02	120		0.028827	8'-4½"	Pf 0.242
920	29'-4½"	20.46	5.6	13.353		Sprinkler	8'-4½"	Pe 1.273
919	26'-5"			14.867				Pv
BL	1.4420	42.06	8.26	120		0.109288	11'-5"	Pf 1.248
919	26'-5"	21.59	5.6	14.867		Sprinkler	11'-5"	Pe 1.735
918	22'-5"			17.851				Pv
BL	1.4420	65.72	12.91	120		0.249566	6'-1"	Pf 3.993
918	22'-5"	23.66	5.6	17.851		Sprinkler,	9'-11"	Pe 1.197
122	19'-8"			23.041		LtE(2'-5½), PO(7'-5)	16'-0"	Pv
Route 7								
BL	1.4420	21.50	4.22	120		0.031575	8'-4½"	Pf 0.265
921	29'-4½"	21.50	5.6	14.734		Sprinkler	8'-4½"	Pe 1.273
922	26'-5"			16.272				Pv
BL	1.4420	44.08	8.66	120		0.119242	11'-5"	Pf 1.362
922	26'-5"	22.59	5.6	16.272		Sprinkler	11'-5"	Pe 1.735
923	22'-5"			19.369				Pv
BL	1.4420	68.73	13.50	120		0.271155	6'-1"	Pf 4.338
923	22'-5"	24.65	5.6	19.369		Sprinkler,	9'-11"	Pe 1.197
133	19'-8"			24.904		LtE(2'-5½), PO(7'-5)	16'-0"	Pv
CM	3.2600	68.73	2.64	120		0.005105	12'-0"	Pf 0.061
133	19'-8"			24.904				Pe
160	19'-8"			24.965				Pv
Route 8								
AO	1.0490	25.57	9.49	120		0.205060	7'-9½"	Pf 3.856
938	20'-5"	25.57	5.6	20.854		Sprinkler,	11'-0"	Pe 0.326
177	19'-8"			25.036		3E(2'-0), PO(5'-0)	18'-9½"	Pv



Hydraulic Analysis

Job Number: 225002
Report Description: Light Hazard (2)

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

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

C Value Multiplier

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

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

Pipe Type Legend

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

Units Legend

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

Fittings Legend

ALV Alarm Valve
AngV Angle Valve
b Bushing
BaV Ball Valve
BFP Backflow Preventer
BV Butterfly Valve
C Cross Flow Turn 90°
cplg Coupling
Cr Cross Run
CV Check Valve
DeV Deluge Valve
DPV Dry Pipe Valve
E 90° Elbow
EE 45° Elbow
Ee1 11¼° Elbow
Ee2 22½° Elbow
f Flow Device
fd Flex Drop
FDC Fire Department Connection
fE 90° FireLock(TM) Elbow
fEE 45° FireLock(TM) Elbow
flg Flange
FN Floating Node
fT FireLock(TM) Tee
g Gauge
GloV Globe Valve
GV Gate Valve
Ho Hose
Hose Hose
HV Hose Valve
Hyd Hydrant
LtE Long Turn Elbow
mecT Mechanical Tee
Noz Nozzle
P1 Pump In
P2 Pump Out
PIV Post Indicating Valve
PO Pipe Outlet
PRV Pressure 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