

**FINAL UTILITY REPORT  
FOR  
SADDLEHORN RANCH  
FILING 1**

Prepared for:

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September 18, 2019

Job Number 25142.02

ENGINEER'S STATEMENT:

The attached utility plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said utility report has been prepared according to the criteria established by Colorado Springs Utilities Criteria and said report is in conformity with the master plans for water distribution and wastewater collection for the affected area. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

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Mike Bramlett, Colorado P.E. # 32314  
For and On Behalf of JR Engineering, LLC

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Date

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## **GENERAL LOCATION AND DESCRIPTION**

This report presents the utility system analysis for the water distribution for the proposed Filing 1 of Saddlehorn Ranch development. The Saddlehorn Ranch development was previously modeled in the Saddlehorn Ranch Master Utility Report by JR Engineering, dated July 2019. Proposed lot counts and known densities are used in calculations presented in this report for planning areas that were previously based on approved planning densities. This report has been prepared to demonstrate compliance with the Master Utility Report for Saddlehorn Ranch.

### ***Project Location and Description***

This report presents the utility system analysis for the water system for Filing 1 of Saddlehorn Ranch. Filing 1 is comprised of approximately 174 developed acres in the southwest corner of Saddlehorn ranch, located in portions of Section 3 and Section 10 of Township 13 South, Range 65 West of the 6<sup>th</sup> P.M., El Paso County, Colorado. This report accounts for a total of 51 SFE. The site is bounded on the west by Curtis Road, on the east by future filings for Saddlehorn Ranch, on the south by undeveloped land and low density houses, and on the north by future filings of Saddlehorn Ranch. See Appendix A for the Site Vicinity Map.

Easements or tracts necessary for utilities will be provided at time of final platting in accordance with the El Paso County standards regarding location and size of easements and tracts.

The purpose of this study is to analyze the water demands of the proposed development. The water system was analyzed for 3 scenarios at 2 different pressures for a total of 6 scenarios. The results of this study have been compared to Colorado Springs Utilities Hydraulic Analysis Report Modeling Criteria to demonstrate design compliance. See Appendix B for relevant exhibits.

All proposed on-site lots will use septic systems in lieu of a sanitary sewer, therefore no analysis of a sanitary network was done for this development.

## **WATER SYSTEM ANALYSIS**

### ***Existing Water System***

There is no existing water system on-site in Filing 1 of Saddlehorn Ranch.

### ***Proposed Water System***

A total of 51 SFE's are estimated for the proposed water system collection for Filing 1 of the Saddlehorn development. The proposed water distribution system for the Saddlehorn Ranch development will be fed by an onsite water treatment plant in the southwest corner of the site to be designed by others. The proposed water system will include a series of 12 and 8-inch water mains and will be looped to allow for all areas to be serviced with a critical pipe out of service. The total required storage volume at full build out is 81,991 gallons. The site's elevation ranges approximately 70 feet from 6,695 to 6,765 feet. The WaterCAD model map as well as junction demands and storage volumes have been provided within Appendix B. The proposed water system is being designed as its own metro district which future filings and potentially adjacent developments will be a part of.

### ***Hydraulic Design***

Design criteria used to analyze the hydraulics of the site was established using the "Colorado Springs Utilities Waterline Extension and Service Standards." The following is a summary of the criteria.

<u>Hydraulic Condition</u>	<u>Pressure (psi)</u>
Minimum dynamic pressures (based on 20% tank stage):	
Max Daily Demand + fire flow	20
Peak Hour Demand	60
 <u>Maximum Velocities and Head losses</u>	 <u>Unit</u>
Maximum velocity with Max Day Demands	5 fps
Maximum velocity with Max Day + Fire Flow Demands	20 fps
Maximum head loss through 8", 12", 16" (transmission):	3.0ft/1000ft
Hazen Williams 'C' factor: 120 ( 8" PVC), 123 (12" PVC)	

Required Fire Flow = 1,500 gpm

### ***Domestic Demand Design***

Water System demands were established using the “Colorado Springs Utilities Waterline Extension and Service Standards.” Design criteria for the analysis are summarized in Table 1 below.

Table 1: Water System Design Criteria

<b>Type of Use</b>	<b>Average Daily Flow (gpd/DU)</b>	<b>Peaking Factor (Max Day/Avg. Day)</b>
Residential: Single Family	595	2.65

### ***Design Scenarios***

The water distribution system utilized Bentley’s WaterCAD V.8 to model and analyze the system. Three scenarios were completed; one for Average Daily Flow, one for Max Day flow, and one for Max Day flow plus fire flow. The scenarios were analyzed at two different pressures, 85psi and 105psi, which are the proposed upper and lower bounds of operating pressure for the proposed water treatment plant to be designed by others. To determine the operating pressures, a minimum ground elevation of 6768.50 was assumed for the water treatment plant and a conversion factor of 2.3ft/psi was applied. The tank HGL for the model was 6964.0 and 7010.0 for the 85psi and 105psi scenarios, respectively. The WaterCAD model map showing the analysis area is included within Appendix B. Since the development is outside of any existing pressure zone, none was used to determine required pressure in the tank, while the peaking factor (2.65) was assumed to be the highest out of the available pressure zones. Specific site demands for scenarios of average day, max day, and fire flows are found in Appendix B and a summary of the results are found in the tables below.

**Table 1: Filing 15 Total Demand Summary Table**

<b>Saddlehorn Filing 1 Water Demand</b>				
<b>Dwelling Units</b>	<b>Unit Demand (gpd/DU)</b>	<b>Avg. Day Demand (gpd)</b>	<b>Peaking Factor</b>	<b>Max Day Demand (gpd)</b>
51	595	30,345	2.65	80,414

### 85 PSI

#### *Average Day*

Average demands were assigned to the system consistent with those presented in Appendix B. The minimum pressure within the system for the average day scenario was calculated to be at junction J-3 at 87.2 psi. This exceeds the minimum of 60 psi. The maximum pressure within the system occurred at junction J-45 at 116.6 psi, and is below the maximum pressure of 180 psi. The maximum velocity in this scenario of 0.06 fps occurred in pipe P-264. The maximum allowable velocity within a pipe as designated by the CSU standards is 5 fps. There was no absolute headloss found in this scenario.

#### *Max Day*

Max day demands were assigned to the system consistent with those presented in Appendix B. The minimum pressure within the system for the max day scenario was calculated to be at junction J-3 at 87.2 psi. This exceeds the minimum of 60 psi. The maximum pressure within the system occurred at junction J-45 at 116.5 psi, and is below the maximum pressure of 180 psi. The maximum velocity in this scenario of 0.16 fps occurred in pipe P-264. The maximum allowable velocity within a pipe as designated by the CSU standards is 5 fps. There was no absolute headloss found in this scenario.

#### *Max Day + Fire Flow*

The fire flow used was governed by the IFC s Table B105.1 “minimum required fire-flow and flow duration for buildings”. The required storage for fire flow represents 1,500 gpm for a two-hour period of time or 180,000 gallons. Max day demands were assigned to the system consistent with those presented in Appendix B. Additionally, a fire flow of 1,500 gpm was iteratively applied to individual proposed hydrant locations in order to determine the worst case condition. Under all

scenarios, all points in the system exceeded the required 20 psi residual pressure. The max day plus the fire flow scenario that produced the lowest residual pressure in the system occurred when the fire flow of 1,500 gpm was applied to J-1 resulting in a residual pressure of 79.0 psi at J-1. The maximum velocity in this scenario of 9.59 fps occurred in pipe P-277. The maximum allowable velocity within a pipe as designated by the CSU standards is 20 fps. Fire flow test results demonstrate that the proposed system is capable of providing the required flows under modeled conditions. Refer to Appendix B for both the fire flow test and pressure test results.

### 105 PSI

#### *Average Day*

Average demands were assigned to the system consistent with those presented in Appendix B. The minimum pressure within the system for the max day scenario was calculated to be at junction J-3 at 107.1 psi. This exceeds the minimum of 60 psi. The maximum pressure within the system occurred at junction J-45 at 136.5 psi, and is below the maximum pressure of 180 psi. The maximum velocity in this scenario of 0.06 fps occurred in pipe P-264. The maximum allowable velocity within a pipe as designated by the CSU standards is 5 fps. There was no absolute headloss found in this scenario.

#### *Max Day*

Max day demands were assigned to the system consistent with those presented in Appendix B. The minimum pressure within the system for the max day scenario was calculated to be at junction J-3 at 107.1 psi. This exceeds the minimum of 60 psi. The maximum pressure within the system occurred at junction J-45 at 136.4 psi, and is below the maximum pressure of 180 psi. The maximum velocity in this scenario of 0.16 fps occurred in pipe P-264. The maximum allowable velocity within a pipe as designated by the CSU standards is 5 fps. There was no absolute headloss found in this scenario.

#### *Max Day + Fire Flow*



The fire flow used was governed by the IFC s Table B105.1 “minimum required fire-flow and flow duration for buildings”. The required storage for fire flow represents 1,500 gpm for a two-hour period of time or 180,000 gallons. Max day demands were assigned to the system consistent with those presented in Appendix B. Additionally, a fire flow of 1,500 gpm was iteratively applied to individual proposed hydrant locations in order to determine the worst case condition. Under all scenarios, all points in the system exceeded the required 20 psi residual pressure. The max day plus the fire flow scenario that produced the lowest residual pressure in the system occurred when the fire flow of 1,500 gpm was applied to J-1 resulting in a residual pressure of 98.9 psi at J-1. The maximum velocity in this scenario of 9.59 fps occurred in pipe P-277. The maximum allowable velocity within a pipe as designated by the CSU standards is 20 fps. Fire flow test results demonstrate that the proposed system is capable of providing the required flows under modeled conditions. Refer to Appendix B for both the fire flow test and pressure test results.

#### *Potential SIA Items and Permitting*

There are no off-site improvements necessary to complete this project.

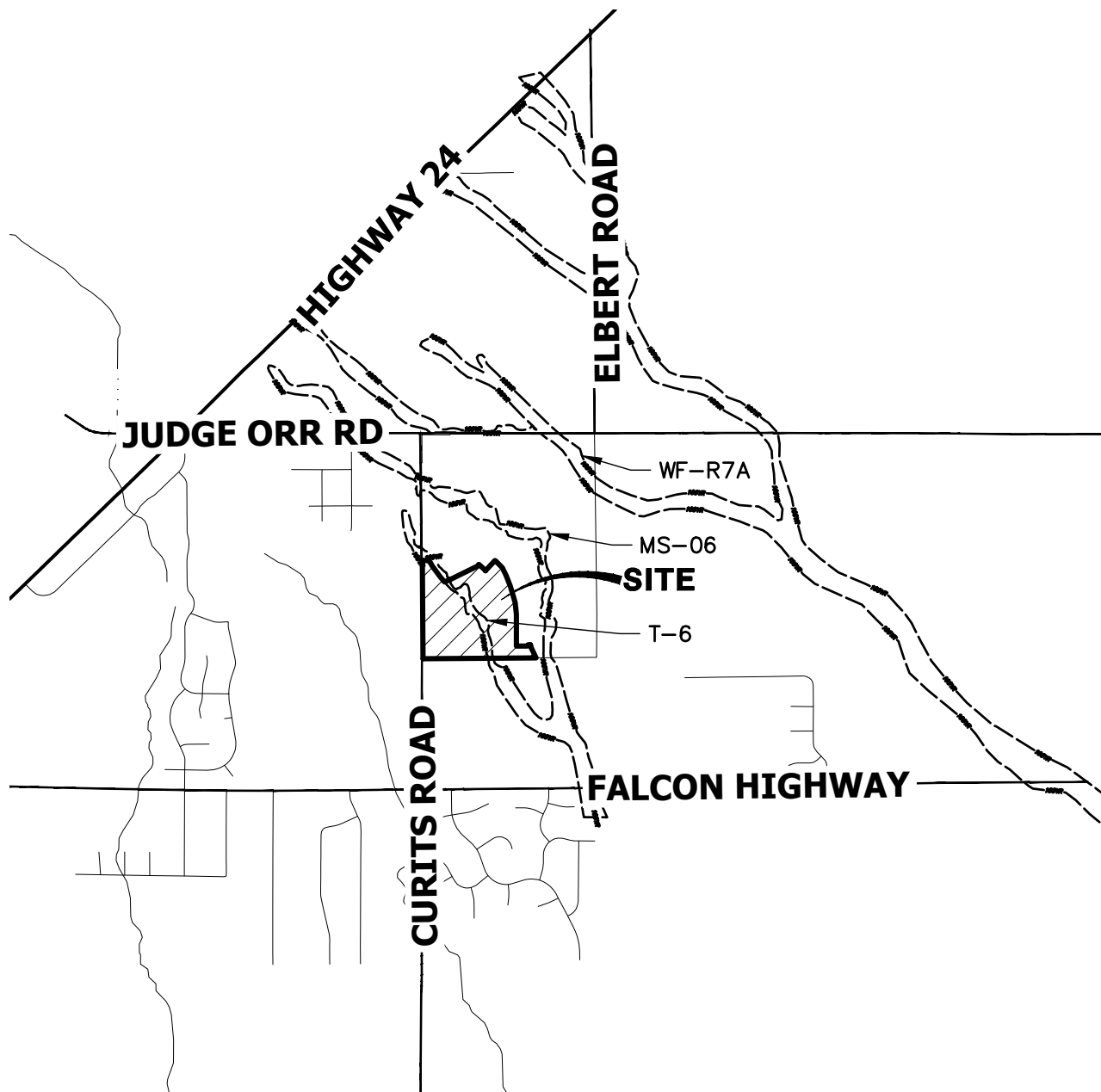
### **CONCLUSION**

The proposed water system that will service Filing 1 of the Saddlehorn Ranch site has been demonstrated to be in compliance with the standards set forth by Colorado Springs Utilities and the Master Utility Report by JR Engineering, dated April 2019. The Utilities Department and Saddlehorn Metro District is not responsible or liable for assumptions made by the Developer regarding utility information associated with the proposed development.

## REFERENCES

1.     Water Line Extension and Service Standards. Colorado Springs Utilities. 2018.
2.     Hydraulic Analysis Report Modeling Criteria. Colorado Springs Utilities. 2012.

**APPENDIX A**  
**VICINITY MAP**



5000 2500 0 5000 10000



ORIGINAL SCALE: 1" = 5000'



VICINITY MAP  
SADDLEHORN RANCH FILING 1  
25142.02  
2/21/19  
SHEET 1 OF 1



**J-R ENGINEERING**

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**APPENDIX B**  
**WATER SYSTEM DATA**

# SADDLEHORN RANCH FILING 1

## WATER SYSTEM MAP



COLORADO SPRINGS UTILITIES HYDRAULIC MODELING CRITERIA		
Max Day (85 PSI)	Ultimate Buildout	Filing 1 Standalone
Minimum System Pressure (PSI)	81.6	87.2
Maximum System Pressure (PSI)	129.9	116.5
Maximum System Velocity (FT/S)	0.7	0.16
Maximum System Headloss (FT)	0.110	0.000
Max Day + Fire Flow (85 PSI)		
Minimum System Pressure (PSI)	43.5	79.0
Number of Junctions Less than 20 psi	0	0
Maximum System Pressure (PSI)	119.6	113.3
Maximum System Velocity (FT/S)	9.62	9.59
Maximum System Headloss (FT)	22.1	10.35

**LEGEND**

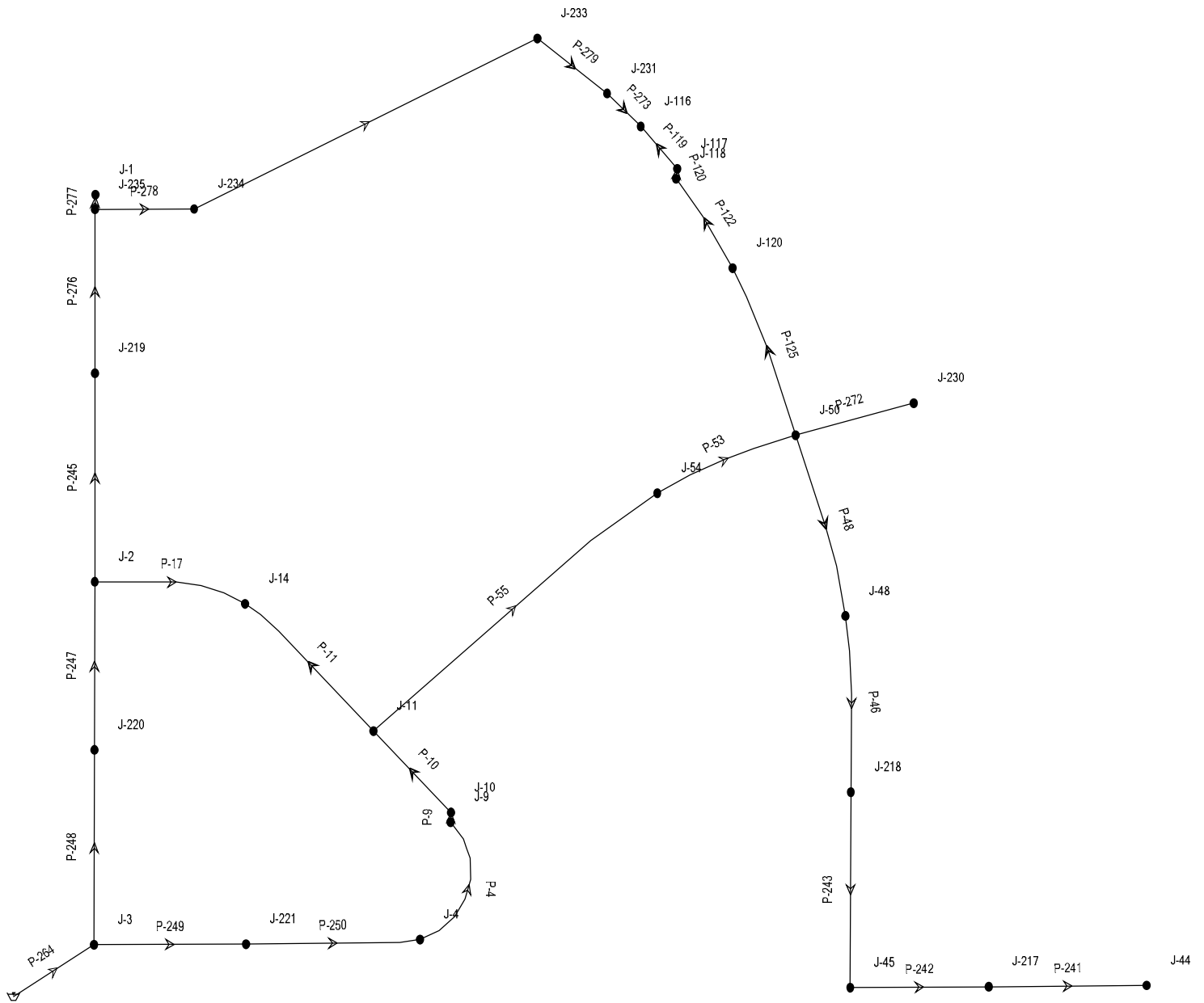
- P-1 12-IN PVC WATERLINE
- P-1 8-IN PVC WATERLINE
- J-1 WATERCAD JUNCTION
- PROPERTY LINE
- RIGHT-OF-WAY LINE

200 100 0 200  
ORIGINAL SCALE: 1" = 200'

WATER SYSTEM MAP  
SADDLEHORN RANCH  
JOB NO. 25142.02  
09/18/2019  
SHEET 1 OF 1

X:\Temp Project Files\2510000\_01\2514202 Drawings\Utility Report\WaterCAD System Map.dwg, Layout: 9/18/2019 2:47:32 PM, VaagRD

## 105 PSI



# AVERAGE DAY

## 85 PSI

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	1.24	6,964.0	116.6
J-44	6,696.3	<None>	0.41	6,964.0	115.8
J-217	6,698.9	<None>	0.41	6,964.0	114.7
J-218	6,700.9	<None>	1.65	6,964.0	113.8
J-48	6,706.3	<None>	0.83	6,964.0	111.5
J-230	6,706.8	<None>	0.00	6,964.0	111.3
J-50	6,710.8	<None>	1.65	6,964.0	109.5
J-4	6,713.7	<None>	0.83	6,964.0	108.3
J-54	6,716.4	<None>	1.24	6,964.0	107.1
J-120	6,719.2	<None>	1.24	6,964.0	105.9
J-9	6,721.6	<None>	0.00	6,964.0	104.9
J-10	6,721.6	<None>	0.83	6,964.0	104.9
J-116	6,726.8	<None>	2.07	6,964.0	102.6
J-117	6,727.0	<None>	0.00	6,964.0	102.5
J-118	6,727.0	<None>	0.00	6,964.0	102.5
J-11	6,727.2	<None>	0.83	6,964.0	102.5
J-231	6,731.6	<None>	0.00	6,964.0	100.5
J-233	6,732.4	<None>	0.00	6,964.0	100.2
J-221	6,736.5	<None>	1.24	6,964.0	98.4
J-14	6,737.8	<None>	1.24	6,964.0	97.9
J-234	6,738.5	<None>	0.00	6,964.0	97.6
J-235	6,750.3	<None>	0.00	6,964.0	92.5
J-219	6,751.8	<None>	0.83	6,964.0	91.8
J-1	6,752.4	<None>	0.83	6,964.0	91.5
J-2	6,758.7	<None>	1.24	6,964.0	88.8
J-220	6,761.4	<None>	0.83	6,964.0	87.7
J-3	6,762.4	<None>	1.65	6,964.0	87.2



# AVERAGE DAY

## 85 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-248	522	8.0	True	120.0	5.76	0.04	0.00
P-55	993	12.0	True	123.0	9.11	0.03	0.00
P-264	257	12.0	True	123.0	21.06	0.06	0.00
P-48	504	8.0	True	120.0	4.54	0.03	0.00
P-10	301	12.0	True	123.0	10.76	0.03	0.00
P-276	439	8.0	True	120.0	2.45	0.02	0.00
P-250	467	12.0	True	123.0	12.41	0.04	0.00
P-249	407	12.0	True	123.0	13.65	0.04	0.00
P-247	451	8.0	True	120.0	4.94	0.03	0.00
P-46	473	8.0	True	120.0	3.72	0.02	0.00
P-4	390	12.0	True	123.0	11.58	0.03	0.00
P-9	26	12.0	True	123.0	11.58	0.03	0.00
P-11	486	8.0	True	120.0	0.82	0.01	0.00
P-17	413	8.0	True	120.0	0.42	0.00	0.00
P-53	403	12.0	True	123.0	7.87	0.02	0.00
P-119	150	8.0	True	120.0	0.44	0.00	0.00
P-120	27	8.0	True	120.0	0.44	0.00	0.00
P-122	284	8.0	True	120.0	0.44	0.00	0.00
P-125	479	8.0	True	120.0	1.68	0.01	0.00
P-241	423	8.0	True	120.0	0.41	0.00	0.00
P-242	371	8.0	True	120.0	0.83	0.01	0.00
P-243	524	8.0	True	120.0	2.07	0.01	0.00
P-245	559	8.0	True	120.0	3.28	0.02	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00
P-273	126	8.0	True	120.0	1.63	0.01	0.00
P-275	1,027	8.0	True	120.0	1.63	0.01	0.00
P-277	40	8.0	True	120.0	0.83	0.01	0.00
P-278	265	8.0	True	120.0	1.63	0.01	0.00
P-279	238	8.0	True	120.0	1.63	0.01	0.00

# MAX DAY

85 PSI

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	3.28	6,964.0	116.5
J-44	6,696.3	<None>	1.09	6,964.0	115.8
J-217	6,698.9	<None>	1.09	6,964.0	114.7
J-218	6,700.9	<None>	4.38	6,964.0	113.8
J-48	6,706.3	<None>	2.19	6,964.0	111.5
J-230	6,706.8	<None>	0.00	6,964.0	111.3
J-50	6,710.8	<None>	4.38	6,964.0	109.5
J-4	6,713.7	<None>	2.19	6,964.0	108.3
J-54	6,716.4	<None>	3.28	6,964.0	107.1
J-120	6,719.2	<None>	3.28	6,964.0	105.9
J-9	6,721.6	<None>	0.00	6,964.0	104.9
J-10	6,721.6	<None>	2.19	6,964.0	104.9
J-116	6,726.8	<None>	5.47	6,964.0	102.6
J-117	6,727.0	<None>	0.00	6,964.0	102.5
J-118	6,727.0	<None>	0.00	6,964.0	102.5
J-11	6,727.2	<None>	2.19	6,964.0	102.4
J-231	6,731.6	<None>	0.00	6,964.0	100.5
J-233	6,732.4	<None>	0.00	6,964.0	100.2
J-221	6,736.5	<None>	3.28	6,964.0	98.4
J-14	6,737.8	<None>	3.28	6,964.0	97.9
J-234	6,738.5	<None>	0.00	6,964.0	97.6
J-235	6,750.3	<None>	0.00	6,964.0	92.5
J-219	6,751.8	<None>	2.19	6,964.0	91.8
J-1	6,752.4	<None>	2.19	6,964.0	91.5
J-2	6,758.7	<None>	3.28	6,964.0	88.8
J-220	6,761.4	<None>	2.19	6,964.0	87.7
J-3	6,762.4	<None>	4.38	6,964.0	87.2

# MAX DAY

## 85 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-248	522	8.0	True	120.0	15.27	0.10	0.00
P-264	257	12.0	True	123.0	55.82	0.16	0.00
P-55	993	12.0	True	123.0	24.15	0.07	0.00
P-247	451	8.0	True	120.0	13.08	0.08	0.00
P-48	504	8.0	True	120.0	12.04	0.08	0.00
P-250	467	12.0	True	123.0	32.89	0.09	0.00
P-249	407	12.0	True	123.0	36.17	0.10	0.00
P-245	559	8.0	True	120.0	8.68	0.06	0.00
P-46	473	8.0	True	120.0	9.85	0.06	0.00
P-4	390	12.0	True	123.0	30.70	0.09	0.00
P-10	301	12.0	True	123.0	28.51	0.08	0.00
P-275	1,027	8.0	True	120.0	4.31	0.03	0.00
P-276	439	8.0	True	120.0	6.50	0.04	0.00
P-53	403	12.0	True	123.0	20.87	0.06	0.00
P-243	524	8.0	True	120.0	5.47	0.03	0.00
P-273	126	8.0	True	120.0	4.31	0.03	0.00
P-9	26	12.0	True	123.0	30.70	0.09	0.00
P-125	479	8.0	True	120.0	4.45	0.03	0.00
P-11	486	8.0	True	120.0	2.17	0.01	0.00
P-17	413	8.0	True	120.0	1.11	0.01	0.00
P-119	150	8.0	True	120.0	1.17	0.01	0.00
P-120	27	8.0	True	120.0	1.17	0.01	0.00
P-122	284	8.0	True	120.0	1.17	0.01	0.00
P-241	423	8.0	True	120.0	1.09	0.01	0.00
P-242	371	8.0	True	120.0	2.19	0.01	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00
P-277	40	8.0	True	120.0	2.19	0.01	0.00
P-278	265	8.0	True	120.0	4.31	0.03	0.00
P-279	238	8.0	True	120.0	4.31	0.03	0.00

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	3.28	6,956.5	113.3
J-44	6,696.3	<None>	1.09	6,956.5	112.6
J-217	6,698.9	<None>	1.09	6,956.5	111.5
J-218	6,700.9	<None>	4.38	6,956.5	110.6
J-48	6,706.3	<None>	2.19	6,956.5	108.3
J-230	6,706.8	<None>	0.00	6,956.6	108.1
J-4	6,713.7	<None>	2.19	6,960.0	106.6
J-50	6,710.8	<None>	4.38	6,956.6	106.3
J-54	6,716.4	<None>	3.28	6,957.0	104.1
J-9	6,721.6	<None>	0.00	6,959.0	102.7
J-10	6,721.6	<None>	2.19	6,958.9	102.7
J-120	6,719.2	<None>	3.28	6,952.8	101.1
J-11	6,727.2	<None>	2.19	6,958.1	99.9
J-221	6,736.5	<None>	3.28	6,961.3	97.2
J-118	6,727.0	<None>	0.00	6,950.6	96.7
J-117	6,727.0	<None>	0.00	6,950.4	96.7
J-116	6,726.8	<None>	5.47	6,949.2	96.2
J-14	6,737.8	<None>	3.28	6,956.5	94.6
J-231	6,731.6	<None>	0.00	6,948.3	93.8
J-233	6,732.4	<None>	0.00	6,946.5	92.6
J-234	6,738.5	<None>	0.00	6,938.7	86.6
J-3	6,762.4	<None>	4.38	6,962.4	86.5
J-220	6,761.4	<None>	2.19	6,958.5	85.3
J-2	6,758.7	<None>	3.28	6,955.1	85.0
J-219	6,751.8	<None>	2.19	6,944.8	83.5
J-235	6,750.3	<None>	0.00	6,936.7	80.6
J-1	6,752.4	<None>	1,502.19	6,934.9	79.0

# MAX DAY + FIRE

85 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-245	559	8.0	True	120.0	929.77	5.93	10.35
P-276	439	8.0	True	120.0	927.58	5.92	8.09
P-275	1,027	8.0	True	120.0	574.61	3.67	7.80
P-248	522	8.0	True	120.0	570.15	3.64	3.91
P-125	479	8.0	True	120.0	583.36	3.72	3.74
P-247	451	8.0	True	120.0	567.96	3.63	3.35
P-122	284	8.0	True	120.0	580.08	3.70	2.19
P-278	265	8.0	True	120.0	574.61	3.67	2.02
P-279	238	8.0	True	120.0	574.61	3.67	1.81
P-277	40	8.0	True	120.0	1,502.19	9.59	1.79
P-264	257	12.0	True	123.0	1,555.82	4.41	1.63
P-11	486	8.0	True	120.0	368.38	2.35	1.62
P-17	413	8.0	True	120.0	365.09	2.33	1.36
P-250	467	12.0	True	123.0	978.01	2.77	1.26
P-119	150	8.0	True	120.0	580.08	3.70	1.16
P-249	407	12.0	True	123.0	981.29	2.78	1.10
P-55	993	12.0	True	123.0	603.07	1.71	1.09
P-4	390	12.0	True	123.0	975.82	2.77	1.05
P-273	126	8.0	True	120.0	574.61	3.67	0.96
P-10	301	12.0	True	123.0	973.63	2.76	0.81
P-53	403	12.0	True	123.0	599.78	1.70	0.44
P-120	27	8.0	True	120.0	580.08	3.70	0.21
P-9	26	12.0	True	123.0	975.82	2.77	0.07
P-48	504	8.0	True	120.0	12.04	0.08	0.00
P-46	473	8.0	True	120.0	9.85	0.06	0.00
P-243	524	8.0	True	120.0	5.47	0.03	0.00
P-241	423	8.0	True	120.0	1.09	0.01	0.00
P-242	371	8.0	True	120.0	2.19	0.01	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00

# AVERAGE DAY

## 105 PSI

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	1.24	7,010.0	136.5
J-44	6,696.3	<None>	0.41	7,010.0	135.7
J-217	6,698.9	<None>	0.41	7,010.0	134.6
J-218	6,700.9	<None>	1.65	7,010.0	133.7
J-48	6,706.3	<None>	0.83	7,010.0	131.4
J-230	6,706.8	<None>	0.00	7,010.0	131.2
J-50	6,710.8	<None>	1.65	7,010.0	129.4
J-4	6,713.7	<None>	0.83	7,010.0	128.2
J-54	6,716.4	<None>	1.24	7,010.0	127.0
J-120	6,719.2	<None>	1.24	7,010.0	125.8
J-9	6,721.6	<None>	0.00	7,010.0	124.8
J-10	6,721.6	<None>	0.83	7,010.0	124.8
J-116	6,726.8	<None>	2.07	7,010.0	122.5
J-117	6,727.0	<None>	0.00	7,010.0	122.4
J-118	6,727.0	<None>	0.00	7,010.0	122.4
J-11	6,727.2	<None>	0.83	7,010.0	122.4
J-231	6,731.6	<None>	0.00	7,010.0	120.4
J-233	6,732.4	<None>	0.00	7,010.0	120.1
J-221	6,736.5	<None>	1.24	7,010.0	118.3
J-14	6,737.8	<None>	1.24	7,010.0	117.8
J-234	6,738.5	<None>	0.00	7,010.0	117.5
J-235	6,750.3	<None>	0.00	7,010.0	112.4
J-219	6,751.8	<None>	0.83	7,010.0	111.7
J-1	6,752.4	<None>	0.83	7,010.0	111.5
J-2	6,758.7	<None>	1.24	7,010.0	108.7
J-220	6,761.4	<None>	0.83	7,010.0	107.6
J-3	6,762.4	<None>	1.65	7,010.0	107.1

# AVERAGE DAY

## 105 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-248	522	8.0	True	120.0	5.76	0.04	0.00
P-55	993	12.0	True	123.0	9.11	0.03	0.00
P-264	257	12.0	True	123.0	21.06	0.06	0.00
P-48	504	8.0	True	120.0	4.54	0.03	0.00
P-10	301	12.0	True	123.0	10.76	0.03	0.00
P-276	439	8.0	True	120.0	2.45	0.02	0.00
P-250	467	12.0	True	123.0	12.41	0.04	0.00
P-249	407	12.0	True	123.0	13.65	0.04	0.00
P-247	451	8.0	True	120.0	4.94	0.03	0.00
P-46	473	8.0	True	120.0	3.72	0.02	0.00
P-4	390	12.0	True	123.0	11.58	0.03	0.00
P-9	26	12.0	True	123.0	11.58	0.03	0.00
P-11	486	8.0	True	120.0	0.82	0.01	0.00
P-17	413	8.0	True	120.0	0.42	0.00	0.00
P-53	403	12.0	True	123.0	7.87	0.02	0.00
P-119	150	8.0	True	120.0	0.44	0.00	0.00
P-120	27	8.0	True	120.0	0.44	0.00	0.00
P-122	284	8.0	True	120.0	0.44	0.00	0.00
P-125	479	8.0	True	120.0	1.68	0.01	0.00
P-241	423	8.0	True	120.0	0.41	0.00	0.00
P-242	371	8.0	True	120.0	0.83	0.01	0.00
P-243	524	8.0	True	120.0	2.07	0.01	0.00
P-245	559	8.0	True	120.0	3.28	0.02	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00
P-273	126	8.0	True	120.0	1.63	0.01	0.00
P-275	1,027	8.0	True	120.0	1.63	0.01	0.00
P-277	40	8.0	True	120.0	0.83	0.01	0.00
P-278	265	8.0	True	120.0	1.63	0.01	0.00
P-279	238	8.0	True	120.0	1.63	0.01	0.00

# MAX DAY

## 105 PSI

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	3.28	7,010.0	136.4
J-44	6,696.3	<None>	1.09	7,010.0	135.7
J-217	6,698.9	<None>	1.09	7,010.0	134.6
J-218	6,700.9	<None>	4.38	7,010.0	133.7
J-48	6,706.3	<None>	2.19	7,010.0	131.4
J-230	6,706.8	<None>	0.00	7,010.0	131.2
J-50	6,710.8	<None>	4.38	7,010.0	129.4
J-4	6,713.7	<None>	2.19	7,010.0	128.2
J-54	6,716.4	<None>	3.28	7,010.0	127.0
J-120	6,719.2	<None>	3.28	7,010.0	125.8
J-9	6,721.6	<None>	0.00	7,010.0	124.8
J-10	6,721.6	<None>	2.19	7,010.0	124.8
J-116	6,726.8	<None>	5.47	7,010.0	122.5
J-117	6,727.0	<None>	0.00	7,010.0	122.4
J-118	6,727.0	<None>	0.00	7,010.0	122.4
J-11	6,727.2	<None>	2.19	7,010.0	122.3
J-231	6,731.6	<None>	0.00	7,010.0	120.4
J-233	6,732.4	<None>	0.00	7,010.0	120.1
J-221	6,736.5	<None>	3.28	7,010.0	118.3
J-14	6,737.8	<None>	3.28	7,010.0	117.8
J-234	6,738.5	<None>	0.00	7,010.0	117.5
J-235	6,750.3	<None>	0.00	7,010.0	112.4
J-219	6,751.8	<None>	2.19	7,010.0	111.7
J-1	6,752.4	<None>	2.19	7,010.0	111.4
J-2	6,758.7	<None>	3.28	7,010.0	108.7
J-220	6,761.4	<None>	2.19	7,010.0	107.6
J-3	6,762.4	<None>	4.38	7,010.0	107.1



# MAX DAY

105 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-248	522	8.0	True	120.0	15.27	0.10	0.00
P-264	257	12.0	True	123.0	55.82	0.16	0.00
P-55	993	12.0	True	123.0	24.15	0.07	0.00
P-247	451	8.0	True	120.0	13.08	0.08	0.00
P-48	504	8.0	True	120.0	12.04	0.08	0.00
P-250	467	12.0	True	123.0	32.89	0.09	0.00
P-249	407	12.0	True	123.0	36.17	0.10	0.00
P-245	559	8.0	True	120.0	8.68	0.06	0.00
P-46	473	8.0	True	120.0	9.85	0.06	0.00
P-4	390	12.0	True	123.0	30.70	0.09	0.00
P-10	301	12.0	True	123.0	28.51	0.08	0.00
P-275	1,027	8.0	True	120.0	4.31	0.03	0.00
P-276	439	8.0	True	120.0	6.50	0.04	0.00
P-53	403	12.0	True	123.0	20.87	0.06	0.00
P-243	524	8.0	True	120.0	5.47	0.03	0.00
P-273	126	8.0	True	120.0	4.31	0.03	0.00
P-9	26	12.0	True	123.0	30.70	0.09	0.00
P-125	479	8.0	True	120.0	4.45	0.03	0.00
P-11	486	8.0	True	120.0	2.17	0.01	0.00
P-17	413	8.0	True	120.0	1.11	0.01	0.00
P-119	150	8.0	True	120.0	1.17	0.01	0.00
P-120	27	8.0	True	120.0	1.17	0.01	0.00
P-122	284	8.0	True	120.0	1.17	0.01	0.00
P-241	423	8.0	True	120.0	1.09	0.01	0.00
P-242	371	8.0	True	120.0	2.19	0.01	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00
P-277	40	8.0	True	120.0	2.19	0.01	0.00
P-278	265	8.0	True	120.0	4.31	0.03	0.00
P-279	238	8.0	True	120.0	4.31	0.03	0.00

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-45	6,694.6	<None>	3.28	7,002.5	133.2
J-44	6,696.3	<None>	1.09	7,002.5	132.5
J-217	6,698.9	<None>	1.09	7,002.5	131.4
J-218	6,700.9	<None>	4.38	7,002.5	130.5
J-48	6,706.3	<None>	2.19	7,002.5	128.2
J-230	6,706.8	<None>	0.00	7,002.6	128.0
J-4	6,713.7	<None>	2.19	7,006.0	126.5
J-50	6,710.8	<None>	4.38	7,002.6	126.2
J-54	6,716.4	<None>	3.28	7,003.0	124.0
J-9	6,721.6	<None>	0.00	7,005.0	122.6
J-10	6,721.6	<None>	2.19	7,004.9	122.6
J-120	6,719.2	<None>	3.28	6,998.8	121.0
J-11	6,727.2	<None>	2.19	7,004.1	119.8
J-221	6,736.5	<None>	3.28	7,007.3	117.1
J-118	6,727.0	<None>	0.00	6,996.6	116.6
J-117	6,727.0	<None>	0.00	6,996.4	116.6
J-116	6,726.8	<None>	5.47	6,995.2	116.1
J-14	6,737.8	<None>	3.28	7,002.5	114.5
J-231	6,731.6	<None>	0.00	6,994.3	113.7
J-233	6,732.4	<None>	0.00	6,992.5	112.5
J-234	6,738.5	<None>	0.00	6,984.7	106.5
J-3	6,762.4	<None>	4.38	7,008.4	106.4
J-220	6,761.4	<None>	2.19	7,004.5	105.2
J-2	6,758.7	<None>	3.28	7,001.1	104.9
J-219	6,751.8	<None>	2.19	6,990.8	103.4
J-235	6,750.3	<None>	0.00	6,982.7	100.5
J-1	6,752.4	<None>	1,502.19	6,980.9	98.9

# MAX DAY + FIRE

105 PSI

Label	Length (ft)	Diameter (in)	Is Open?	Hazen-Williams C	Flow (Absolute) (gpm)	Velocity (Maximum) (ft/s)	Headloss (ft)
P-245	559	8.0	True	120.0	929.77	5.93	10.35
P-276	439	8.0	True	120.0	927.58	5.92	8.09
P-275	1,027	8.0	True	120.0	574.61	3.67	7.80
P-248	522	8.0	True	120.0	570.15	3.64	3.91
P-125	479	8.0	True	120.0	583.36	3.72	3.74
P-247	451	8.0	True	120.0	567.96	3.63	3.35
P-122	284	8.0	True	120.0	580.08	3.70	2.19
P-278	265	8.0	True	120.0	574.61	3.67	2.02
P-279	238	8.0	True	120.0	574.61	3.67	1.81
P-277	40	8.0	True	120.0	1,502.19	9.59	1.79
P-264	257	12.0	True	123.0	1,555.82	4.41	1.63
P-11	486	8.0	True	120.0	368.38	2.35	1.62
P-17	413	8.0	True	120.0	365.09	2.33	1.36
P-250	467	12.0	True	123.0	978.01	2.77	1.26
P-119	150	8.0	True	120.0	580.08	3.70	1.16
P-249	407	12.0	True	123.0	981.29	2.78	1.10
P-55	993	12.0	True	123.0	603.07	1.71	1.09
P-4	390	12.0	True	123.0	975.82	2.77	1.05
P-273	126	8.0	True	120.0	574.61	3.67	0.96
P-10	301	12.0	True	123.0	973.63	2.76	0.81
P-53	403	12.0	True	123.0	599.78	1.70	0.44
P-120	27	8.0	True	120.0	580.08	3.70	0.21
P-9	26	12.0	True	123.0	975.82	2.77	0.07
P-48	504	8.0	True	120.0	12.04	0.08	0.00
P-46	473	8.0	True	120.0	9.85	0.06	0.00
P-243	524	8.0	True	120.0	5.47	0.03	0.00
P-241	423	8.0	True	120.0	1.09	0.01	0.00
P-242	371	8.0	True	120.0	2.19	0.01	0.00
P-272	328	12.0	True	123.0	0.00	0.00	0.00

**Saddlehorn Ranch Filing 1**  
**Water System Demands**

<b>Junction</b>	<b># Units Served</b>	<b>Average Day (GPD)</b>	<b>Average Day (GPM)</b>	<b>Max Day (GPD)</b>	<b>Max Day (GPM)</b>
1	2	1,190	0.83	3,154	2.19
2	3	1,785	1.24	4,730	3.28
3	4	2,380	1.65	6,307	4.38
4	2	1,190	0.83	3,154	2.19
9	0	0	0.00	0	0.00
10	2	1,190	0.83	3,154	2.19
11	2	1,190	0.83	3,154	2.19
14	3	1,785	1.24	4,730	3.28
44	1	595	0.41	1,577	1.09
45	3	1,785	1.24	4,730	3.28
48	2	1,190	0.83	3,154	2.19
50	4	2,380	1.65	6,307	4.38
54	3	1,785	1.24	4,730	3.28
116	5	2,975	2.07	7,884	5.47
117	0	0	0.00	0	0.00
118	0	0	0.00	0	0.00
120	3	1,785	1.24	4,730	3.28
217	1	595	0.41	1,577	1.09
218	4	2,380	1.65	6,307	4.38
219	2	1,190	0.83	3,154	2.19
220	2	1,190	0.83	3,154	2.19
221	3	1,785	1.24	4,730	3.28
230	0	0	0.00	0	0.00
231	0	0	0.00	0	0.00
<b>Total</b>	51	30,345	21.07	80,414	55.84

**APPENDIX C**  
**REFERENCE MATERIAL**

# Hydraulic Analysis Report Modeling Criteria

## Junction Inputs

### Water Demands

Land use categories with typical densities and water demands are summarized in Tables 1 through 4.

Specific land use information with estimated dwelling units per acre should be use when available. If the number of dwelling units per acre is not known, the demand rate for different land uses should be calculated on a per acre basis.

Based on a mix of 60% Residential, 30% Commercial and 10% Parks, the water demand for raw land without specific land use, should be 1800/Gal/Day/Acre.

Table 1 - Residential Demand			
Classification	DU/Acre	Avg Gal/Day/Unit	Avg Gal/Day/Acre
Multi Family	6+	290	1800
Medium Residential	6+	290	1800
Low Residential	2 to 5	475	1700
Very Low Residential	<2	700	750

Note: Dwelling Units per acre are based on use of 60% of an acre being buildable.

**Table 2 - Commercial Demand**

Classification	Avg Gal/Day/Acre
Retail	1500
Restaurant	3900
Office	1900
Lodging	2500
Convenience Grocery Stores	6500
Car Wash	9000
Storage/Warehouse	1700
Fitness Club	2500
Office/Industrial Average	1800
Raw Land w/out Specific Land Use	1800

**Table 3 - School Demand**

School Type	Average Acres	Average Gal/Day/Acre
Elementary School	10	2000
Middle School	15	2000
High School	40	2000

Note – School usage will vary depending upon installation of sports fields. The above use numbers are based on sports fields being installed. However, each school will vary and a more accurate water demand can be determined when the number and type of sports fields are determined for the individual site.

**Table 4 - Parks/Recreational Demand**

Use Type	Average Gal/Day/Acre
Golf Course	2200
Neighborhood Park	2200
Community Park	2200
Trail	100
Open Space	100

Input average day demands to model junctions. Input demands in the model should be expressed in million gallons per day, mgd. Model output demands can be expressed as mgd, and/or gpm. Demands should be entered only at junctions on pipes 16" or smaller, and only where demands are expected. Demands are not added at junctions on pipes greater than 16" as these pipes are typically transmission lines. Do not add demands on hydrant nodes, unless it is at the end of a street or cul de sac.

To model max day demands, use the maximum day to average day (MD/AD) peaking factors as shown in Table 5, or as determined by Water Planning & Design and as specified on HGL Response Form. Peaking factors are pressure zone specific.

**Table 5 - Peaking Factors**

Pressure Zone	MD/AD
BRGT	2.65
TMPL	2.65
NFLD	2.50
HILN	2.20
LOLN	2.00

Note: From 2009 Finished Water Master Plan Update

## Junction Elevation

Use proposed ground surface elevation

For elevations at hydrants, add 2 feet to the hydrant flange elevation

## Pipe Inputs

### Diameter

For DIP and PVC, use nominal diameters, for HDPE DR 9, use inside diameters.

HDPE DR 9 Nominal diameter, (inches)	Inside Diameter, ID, (inches)
6	5.274
8	6.917
12	10.090
16	13.302
20	16.528
24	19.722

### Roughness

Nominal Pipe Diameter (inches)	Hazen- Williams Roughness Coefficients (C)
6	118
8	120
12	123
16	124
24	126
36, 42	128
54	130

### Minor Losses

Enter minor losses on hydrant laterals only. Use 4.1 on hydrant laterals.

### Pressure Requirements

- Maintain a minimum pressure of 60 psi under maximum day demands.
- Maintain a minimum pressure of 20 psi under maximum day demands plus fire flow.
- Pressure should not exceed 180 psi. To avoid pressures greater than 180 psi, PRV's may be required. When pressure exceeds 170 psi, DIP is required. Contact Water Planning and Design if pressures exceed 170 psi.

### Head Loss and Velocity Requirements

- Size pipelines for the worst-case scenario of maximum day demand conditions plus fire flow.
- Maintain headloss less than or equal to 3 ft/1000 ft for 8", 12" and 16" pipelines, for maximum day conditions without fire flow.
- Desired velocities are <5 ft/sec for maximum day conditions.
- Desired maximum velocities of 20 ft/sec under maximum day conditions plus fire flow, or other emergency conditions.



## **Fire Flow Modeling Criteria**

Fire flow calculations will be required at all critical hydrants under full-build out conditions and partial build out conditions. Critical hydrants are typically those with the largest required fire flow, and/or the highest flange elevation, in each building area and/or phase. Modeled fire flows should be reduced by 10% then rounded down to whole hundred. For example, a modeled fire flow of 2,663 gpm reduced by 10% is 2,396.7 gpm, which rounded down to whole hundred is 2,300 gpm.