Water Study

Water Basis of Design Report

Happy Valley 18

FINAL Basis of Design Report

☑ **APPROVED**

☐ **APPROVED AS NOTED**

☐ **REVISE AND RESUBMIT**

CITY OF SCOTTSDALE

SCOTTSDALE WATER

9379 E San Salvador Dr.
Scottsdale, AZ 85258

Disclaimer: If approved; the approval is granted under the condition that the final construction documents submitted for city review will match the information herein. Any subsequent changes in the water or sewer design that materially impact design criteria or standards will require re-analysis, re-submittal, and approval of a revised basis of design report prior to the plan review submission.; this approval is not a guarantee of construction document acceptance.
For questions or clarifications contact the Water Resources Planning and Engineering Department at 480-312-5685.

BY scan **DATE** 2/21/2020

02/21/2020

Prepared for:

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Prepared by:

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Registered Professional Engineer (Civil)
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THOMA
Date Signed: 01-21-2020
ARIZONA, U.S.A.

Kimley»Horn

291104098
January 2020
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13-ZN-2019
1/28/2020

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1.0 INTRODUCTION

Happy Valley 18, the “project”, is a proposed 21-lot single family residential subdivision located on approximately 29 acres at the southwest corner of Happy Valley Road and Alma School Road in Scottsdale, Arizona. The project lies within a portion of the northeast quarter of Section 8, Township 4 north, Range 5 east of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. Refer to **Exhibit 1** for a Vicinity Map.

The purpose of this report is to calculate the project’s water demands, determine the available system capacity and proposed hydraulics of the planned water system while meeting the requirements of the City of Scottsdale and the 2015 International Fire Code (IFC). As a result of this analysis, it will be determined if the potable water infrastructure is capable of satisfying the projected fire flow and domestic water demands for the project.

2.0 EXISTING WATER DISTRIBUTION SYSTEM

There is an existing 8” water main in Happy Valley Road along the north boundary of the project. This existing water main transitions to a 12” main near the intersection of Alma School Road. There is also an existing 6” waterline in Alma School Road approximately 452’ south of the site. There is an existing stub provided in Alma School Road before the line jogs northeast into the North Greenman Road alignment.

3.0 PROPOSED WATER DISTRIBUTION SYSTEM

There is an existing 8” water line that runs from Happy Valley Road south through the site. In order to serve the project, the existing 8” water line will be cut at the northern leg of Tract A and tied into the proposed 8” waterline system with an 8” tee. The remainder of the existing 8” waterline will be abandoned. This proposed 8” water main will extend throughout the site and follow the roadway alignment to provide a domestic water service connection for each lot and fire hydrants spaced no more than 600’ apart. Refer to **Exhibit 2** for a water system layout.

The second connection for the site is provided approximately 452’ south of the site in the Alma School Road alignment. There is an existing 6” water line, with stub, that the proposed 8” waterline will tie into.

For more detail on the proposed connections see **Section 4.3**.

4.0 BASIS OF DESIGN

4.1 DOMESTIC WATER DEMAND

Per Figure 6-1.2 of the *City of Scottsdale Design Standards & Policies Manual,* the average day demand (ADD) for residential land use (<2 du/acre) is 0.69 gallons per minute per unit (gpm/du). Maximum Day Demand (MDD) is calculated as 2.0 times the ADD and Peak Hour Demand (PHD) is calculated as 3.5 times the ADD. Refer to **Table 1** below for a summary of domestic water demands.

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Table 1 Domestic Water Demands

Land Use	ADD (gpm/du)	Dwelling units (du)	ADD (gpm)	MDD (gpm)	PHD (gpm)
Residential (<2 du/acre)	0.69	21	14.5	29	50.8

4.2 FIRE FLOW DEMAND

Per Table B105.1(1) of the *2015 IFC*, the required fire flow for single family residential dwellings is 1,000 gpm for a 1-hour duration.

4.3 DESIGN PARAMETERS

The following design criteria will be utilized for this project:

Table 2 Design Parameters

Design Criteria	ADD	PHD	MDD + Fire Flow
Minimum Pressure (psi)	50	50	30
Maximum Pressure (psi)	100	100	100
Maximum Velocity (ft/sec)	5	5	10

The Happy Valley 18 project will connect in two places to the existing City of Scottsdale water system, one to the existing waterline stubbing south from Happy Valley Road and the second through East Desert Vista Drive, south of the Site. The first connection will require a tee to be cut into the existing 8" waterline with isolation valves per the DSPM. The 8" waterline off Happy Valley Road has sufficient valves located to isolate the waterline during construction. Refer to **Exhibit 2** for a water system layout.

For the second connection, the proposed 8" line is aligned in Tract A until the southern leg of Tract A where the 8" line turns south in the proposed water and sewer easement. From there, the proposed 8" water line tees in East Desert Vista Drive where it remains an 8" line. To the west the line terminates in the existing cul-de-sac in a proposed fire hydrant. To the east, the proposed 8" water line continues until it turns south in the Alma School Road alignment. The 8" water line continues approximately 452' south to the existing 6" water line stub where a proposed connection is made. A reducer is proposed to connect the proposed 8" waterline to the existing 6" waterline. A majority of the water line will be located within the private street tract, Tract A, with a blanket water and sewer facilities easement located over it. The portion of the water line outside the private street tract will be within a 30-foot water and sewer facilities easement. The waterline in Alma School Road has existing isolation valves north of the connection in North Greenman Road and south of the connection in Alma School Road (see QS 46-53). Refer to **Exhibit 2** for a water system layout.

All waterlines will be 8" DIP Class 350, with 3 foot of minimum cover. The ends of the proposed cul-de-sacs will have fire hydrants to allow for flushing the waterlines. The dip sections under the proposed

storm drains will be realigned per MAG STD DTL 404. All waterlines will be located within water/sewer facility easements.

4.4 HYDRAULIC MODEL

A water model, using Bentley's WaterCAD V8i program, was used to analyze the proposed water system. To determine the existing and static and residual water pressures in the area, a fire hydrant flow test was completed using the adjacent fire hydrants near the project. The results from this test produced three different data points for static, residual, and maximum water pressures with associated flow rates. This data was then input into the water model and simulated as a reservoir and pump. Refer to **Appendix E** for Fire Hydrant Flow Test results.

The following scenarios were modeled to evaluate the existing and proposed water infrastructure to demonstrate compliance with the design parameters identified in this report:

- Average Day Demand
- Peak Hour Demand
- Maximum Day Demand + Fire Flow Demand

Refer to **Exhibit 3** for the WaterCAD network.

4.5 HYDRAULIC MODEL RESULTS

The results for Average Day Demand and Peak Hour Demand can be seen in **Appendix B** and **Appendix C**, respectively. All junctions maintained a minimum pressure of 72 psi or greater and all pipes maintained a velocity of 0.32 ft/sec or less.

The results for Maximum Day Demand + Fire Flow Demand can be seen in **Appendix D**. All proposed fire hydrants meet the minimum required fire flow of 1,000 gpm at a minimum pressure of 30 psi with a maximum velocity of 10 ft/sec.

5.0 CONCLUSION

Based on the results presented in this report, the existing water infrastructure has the capability to support the proposed development while conforming to the City of Scottsdale's design criteria. An 8" water main is proposed onsite which will connect to an existing 8" water main in Happy Valley Road.

APPENDIX A: Exhibits

Exhibit 1 – Vicinity Map

Exhibit 2 – Water System Layout

Exhibit 3 – WaterCAD Network

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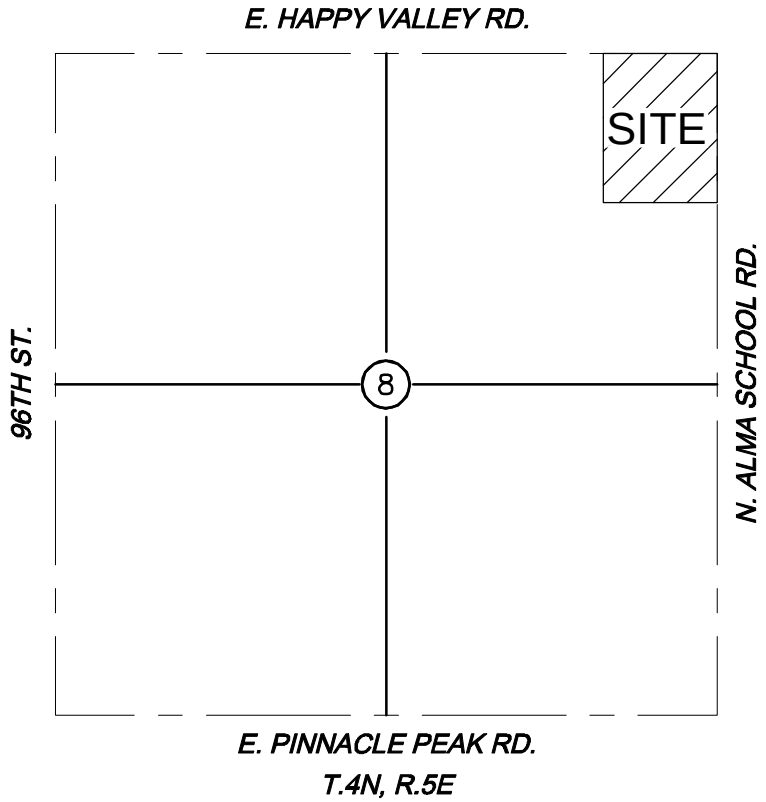

PROJECT NO. 291104098 DRAWING NAME 1 OF 1		HAPPY VALLEY 18 EXHIBIT 1 VICINITY MAP	SCALE (H): NTS SCALE (V): NTS DESIGNED BY: MML DRAWN BY: MML CHECKED BY: MML DATE: 5/30/2019	Kimley»Horn © 2019 KIMLEY-HORN AND ASSOCIATES, INC. 7740 North 16th Street, Suite 300 Phoenix, Arizona 85020 (602) 944-5500	

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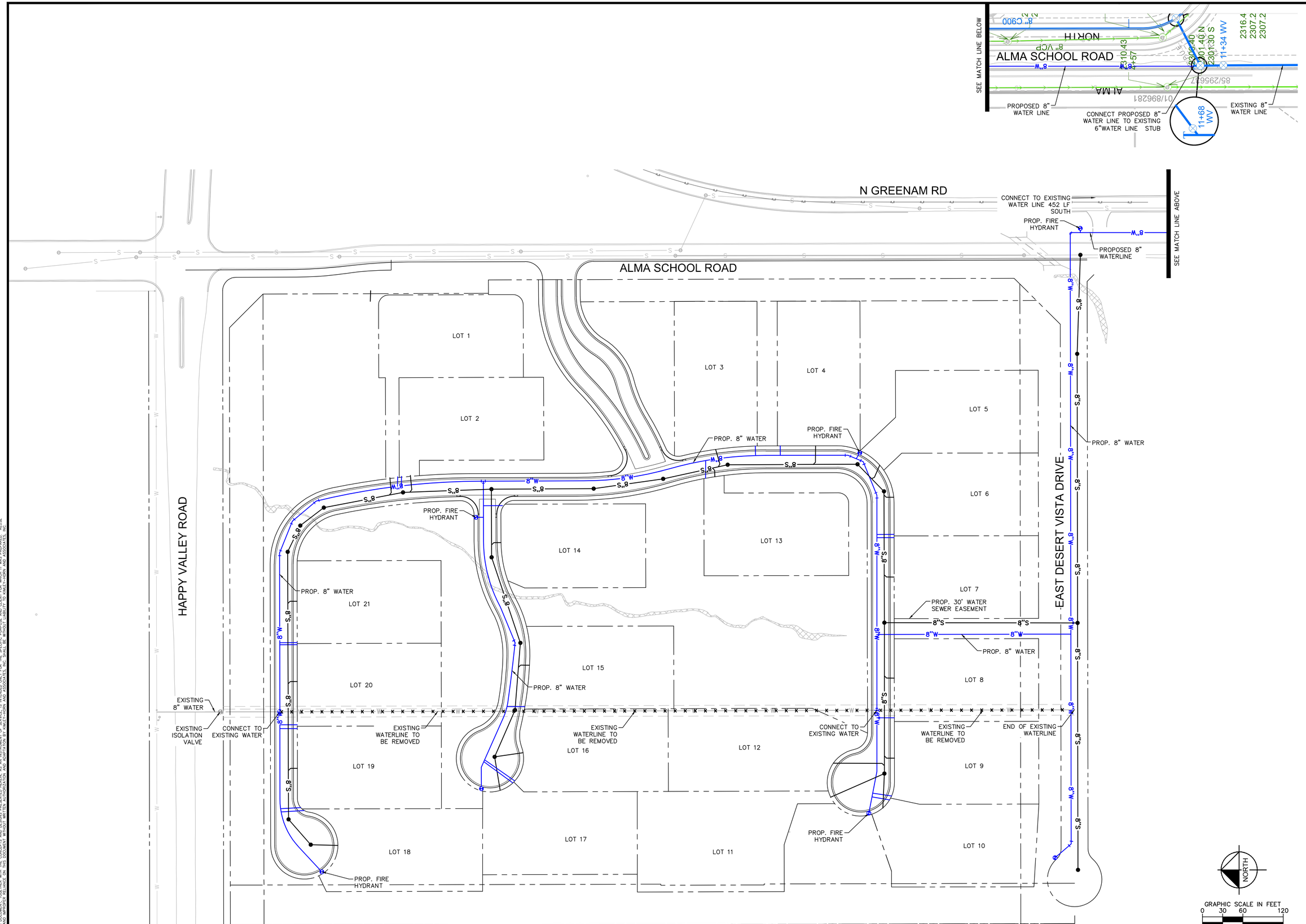

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn

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7740 North 16th Street, Suite 300
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SCALE (H): 1"=60'
SCALE (V): NONE
DESIGNED BY: JRT
DRAWN BY: JRTL
CHECKED BY: CLB
DATE: 01/20/2020

HAPPY VALLEY 18
SCOTTSDALE, ARIZONA
EXHIBIT 2
WATER SYSTEM LAYOUT

PROJECT NO.

DRAWING NAME

OF

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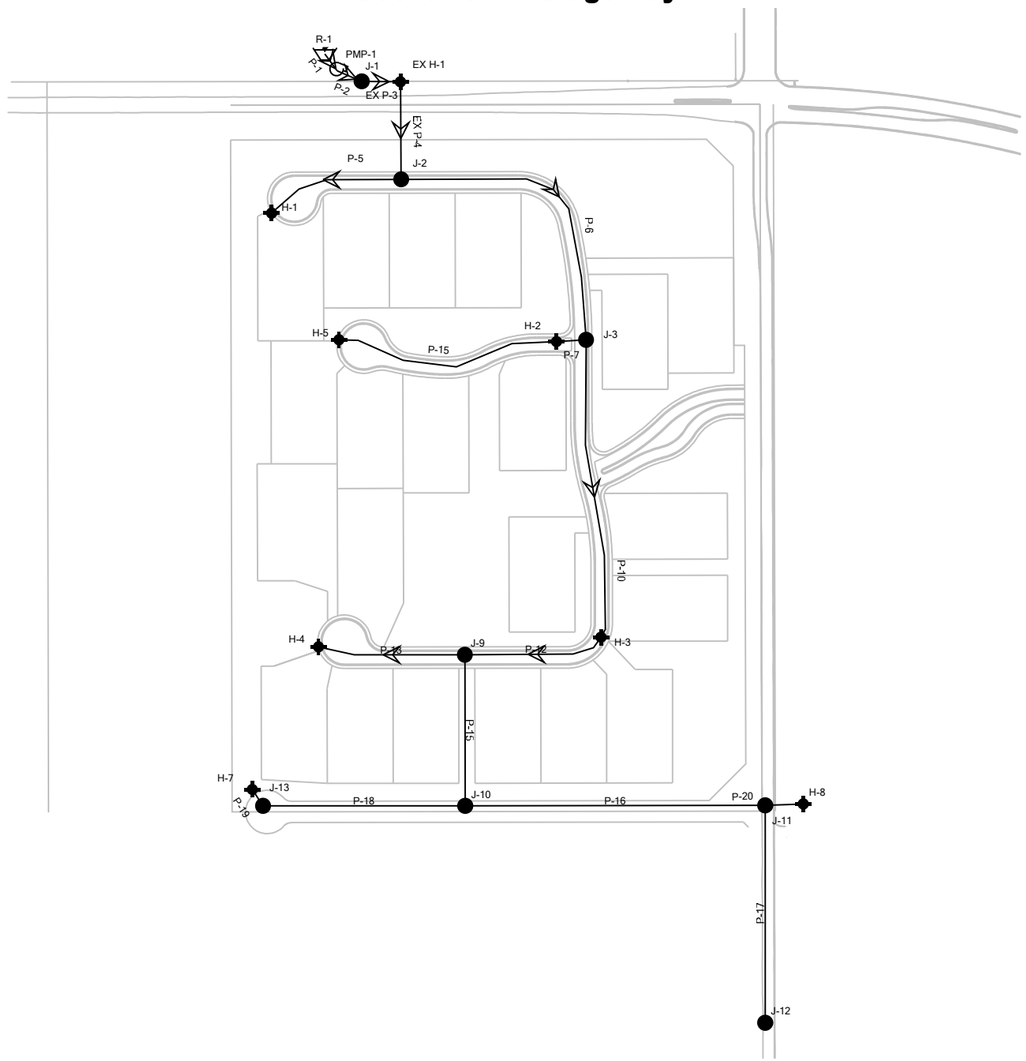
Scenario: Average Day



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APPENDIX B: Average Day Demand Results

Pipe Table

Junction Table

Hydrant Table

Reservoir Table

Pump Table

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Pipe Table - Time: 0.00 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	39	R-1	PMP-1	48.0	Ductile Iron	130.0	15	0.00	0.000
P-2	50	PMP-1	J-1	48.0	Ductile Iron	130.0	15	0.00	0.000
EX P-3	72	J-1	EX H-1	8.0	Ductile Iron	130.0	15	0.09	0.000
EX P-4	182	EX H-1	J-2	8.0	Ductile Iron	130.0	15	0.09	0.000
P-5	262	J-2	H-1	8.0	Ductile Iron	130.0	1	0.01	0.000
P-6	581	J-2	J-3	8.0	Ductile Iron	130.0	12	0.07	0.000
P-7	55	J-3	H-2	8.0	Ductile Iron	130.0	0	0.00	0.000
P-10	560	J-3	H-3	8.0	Ductile Iron	130.0	8	0.05	0.000
P-15	424	H-2	H-5	8.0	Ductile Iron	130.0	0	0.00	0.000
P-12	266	H-3	J-9	8.0	Ductile Iron	130.0	6	0.04	0.000
P-13	275	J-9	H-4	8.0	Ductile Iron	130.0	6	0.04	0.000
P-15	282	J-9	J-10	6.0	Ductile Iron	130.0	0	0.00	0.000
P-16	560	J-10	J-11	6.0	Ductile Iron	130.0	0	0.00	0.000
P-17	406	J-11	J-12	6.0	Ductile Iron	130.0	0	0.00	0.000
P-18	378	J-10	J-13	6.0	Ductile Iron	130.0	0	0.00	0.000
P-19	37	J-13	H-7	6.0	Ductile Iron	130.0	0	0.00	0.000
P-20	71	H-8	J-11	6.0	Ductile Iron	130.0	0	0.00	0.000

Junction Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
33	J-1	2,365.00	0	2,532.08	72
37	J-2	2,365.85	1	2,532.08	72
41	J-3	2,352.35	4	2,532.07	78
70	J-9	2,335.76	0	2,532.07	85
73	J-10	2,316.00	0	2,532.07	93
75	J-11	2,325.00	0	2,532.07	90
77	J-12	2,312.00	0	2,532.07	95
79	J-13	2,313.00	0	2,532.07	95

Hydrant Table - Time: 0.00 hours

ID	Label	Length (Hydrant Lateral) (ft)	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
35	EX H-1	20	2,365.51	0	2,532.08	72
39	H-1	20	2,366.54	1	2,532.08	72
43	H-2	20	2,347.39	0	2,532.07	80
47	H-3	20	2,342.69	2	2,532.07	82
53	H-4	20	2,328.61	6	2,532.07	88
60	H-5	20	2,352.89	0	2,532.07	78
81	H-7	20	2,314.00	0	2,532.07	94
83	H-8	20	2,324.00	0	2,532.07	90

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Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
30	R-1	2,366.00	<None>	15	2,366.00

Pump Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
31	PMP-1	2,366.00	Flow Test	On	2,366.00	2,532.08	15	166.08

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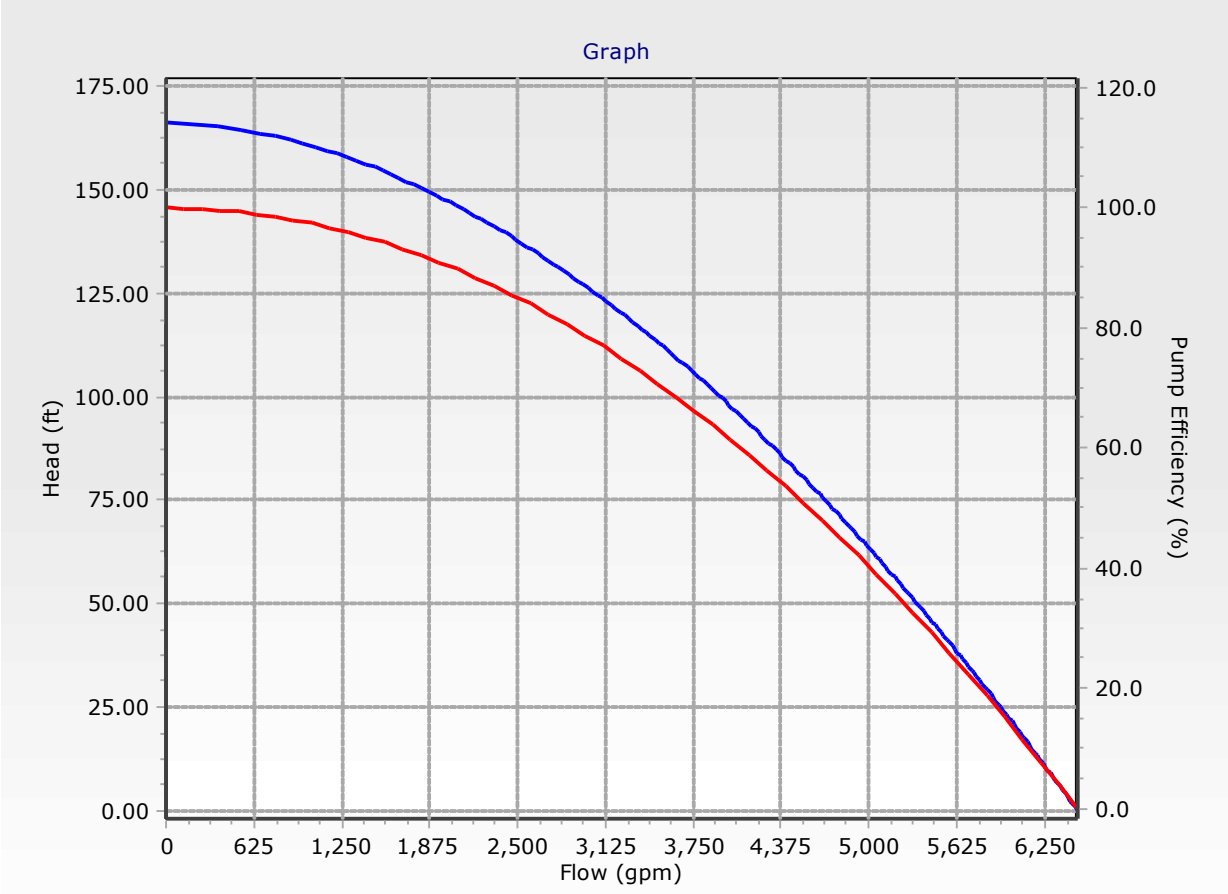
Pump Definition Detailed Report: Flow Test

Element Details			
ID	62	Notes	
Label	Flow Test		

Pump Definition Type			
Pump Definition Type	Standard (3 Point)	Design Head	152.24 ft
Shutoff Flow	0 gpm	Maximum Operating Flow	5,441 gpm
Shutoff Head	166.08 ft	Maximum Operating Head	46.13 ft
Design Flow	1,695 gpm		

Pump Efficiency Type			
Pump Efficiency Type	Best Efficiency Point	Motor Efficiency	100.0 %
BEP Efficiency	100.0 %	Is Variable Speed Drive?	False
BEP Flow	0 gpm		

Transient (Physical)			
Inertia (Pump and Motor)	0.000 lb·ft²	Specific Speed	SI=25, US=1280
Speed (Full)	0 rpm	Reverse Spin Allowed?	True



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APPENDIX C: Peak Hour Demand Results

Pipe Table

Junction Table

Hydrant Table

Reservoir Table

Pump Table

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Pipe Table - Time: 0.00 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	39	R-1	PMP-1	48.0	Ductile Iron	130.0	51	0.01	0.000
P-2	50	PMP-1	J-1	48.0	Ductile Iron	130.0	51	0.01	0.000
EX P-3	72	J-1	EX H-1	8.0	Ductile Iron	130.0	51	0.32	0.000
EX P-4	182	EX H-1	J-2	8.0	Ductile Iron	130.0	51	0.32	0.000
P-5	262	J-2	H-1	8.0	Ductile Iron	130.0	5	0.03	0.000
P-6	581	J-2	J-3	8.0	Ductile Iron	130.0	41	0.26	0.000
P-7	55	J-3	H-2	8.0	Ductile Iron	130.0	0	0.00	0.000
P-10	560	J-3	H-3	8.0	Ductile Iron	130.0	27	0.17	0.000
P-15	424	H-2	H-5	8.0	Ductile Iron	130.0	0	0.00	0.000
P-12	266	H-3	J-9	8.0	Ductile Iron	130.0	19	0.12	0.000
P-13	275	J-9	H-4	8.0	Ductile Iron	130.0	19	0.12	0.000
P-15	282	J-9	J-10	6.0	Ductile Iron	130.0	0	0.00	0.000
P-16	560	J-10	J-11	6.0	Ductile Iron	130.0	0	0.00	0.000
P-17	406	J-11	J-12	6.0	Ductile Iron	130.0	0	0.00	0.000
P-18	378	J-10	J-13	6.0	Ductile Iron	130.0	0	0.00	0.000
P-19	37	J-13	H-7	6.0	Ductile Iron	130.0	0	0.00	0.000
P-20	71	H-8	J-11	6.0	Ductile Iron	130.0	0	0.00	0.000

Junction Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
33	J-1	2,365.00	0	2,532.06	72
37	J-2	2,365.85	5	2,532.04	72
41	J-3	2,352.35	14	2,532.01	78
70	J-9	2,335.76	0	2,532.00	85
73	J-10	2,316.00	0	2,532.00	93
75	J-11	2,325.00	0	2,532.00	90
77	J-12	2,312.00	0	2,532.00	95
79	J-13	2,313.00	0	2,532.00	95

Hydrant Table - Time: 0.00 hours

ID	Label	Length (Hydrant Lateral) (ft)	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
35	EX H-1	20	2,365.51	0	2,532.05	72
39	H-1	20	2,366.54	5	2,532.04	72
43	H-2	20	2,347.39	0	2,532.01	80
47	H-3	20	2,342.69	7	2,532.00	82
53	H-4	20	2,328.61	19	2,531.99	88
60	H-5	20	2,352.89	0	2,532.01	77
81	H-7	20	2,314.00	0	2,532.00	94
83	H-8	20	2,324.00	0	2,532.00	90

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Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
30	R-1	2,366.00	<None>	51	2,366.00

Pump Table - Time: 0.00 hours

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)	Flow (Total) (gpm)	Pump Head (ft)
31	PMP-1	2,366.00	Flow Test	On	2,366.00	2,532.06	51	166.06

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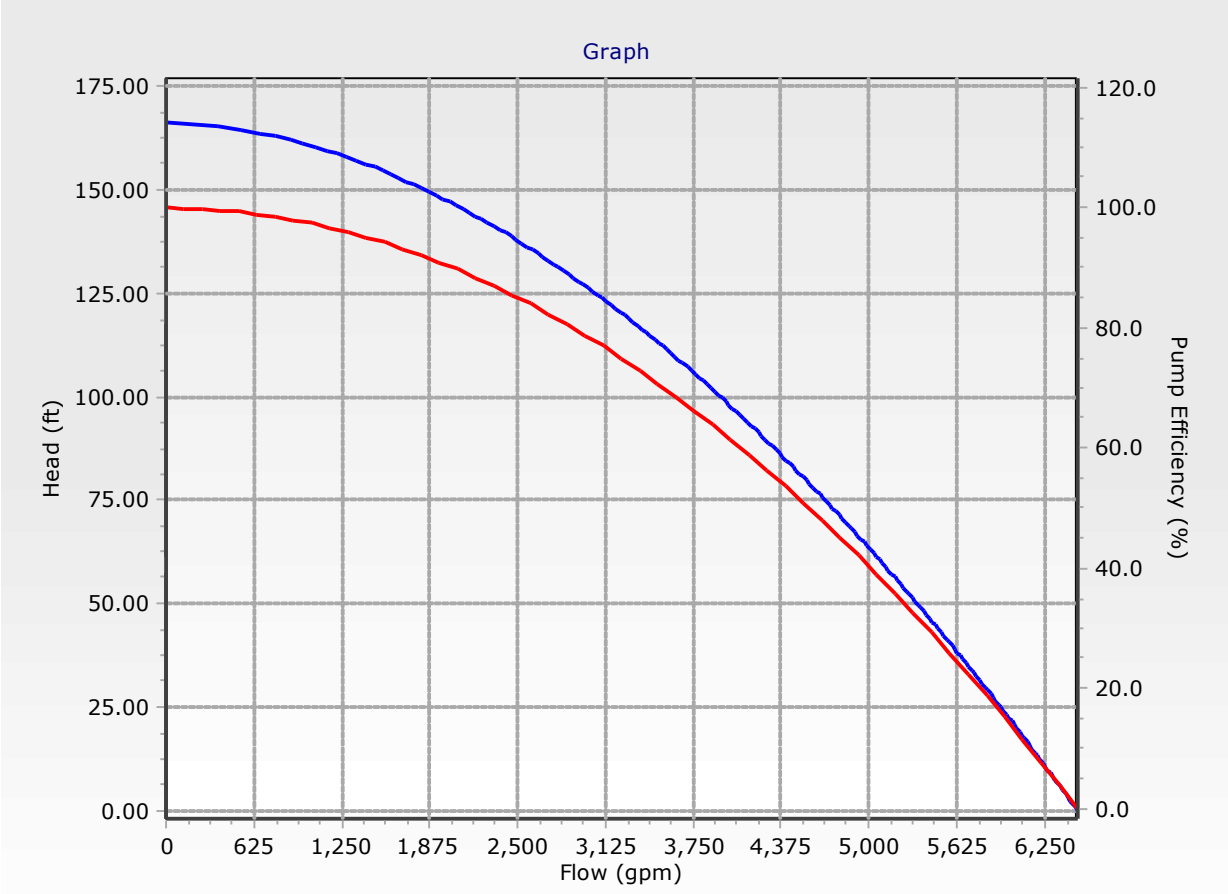
Pump Definition Detailed Report: Flow Test

Element Details			
ID	62	Notes	
Label	Flow Test		

Pump Definition Type			
Pump Definition Type	Standard (3 Point)	Design Head	152.24 ft
Shutoff Flow	0 gpm	Maximum Operating Flow	5,441 gpm
Shutoff Head	166.08 ft	Maximum Operating Head	46.13 ft
Design Flow	1,695 gpm		

Pump Efficiency Type			
Pump Efficiency Type	Best Efficiency Point	Motor Efficiency	100.0 %
BEP Efficiency	100.0 %	Is Variable Speed Drive?	False
BEP Flow	0 gpm		

Transient (Physical)			
Inertia (Pump and Motor)	0.000 lb·ft²	Specific Speed	SI=25, US=1280
Speed (Full)	0 rpm	Reverse Spin Allowed?	True



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APPENDIX D: Maximum Day Demand + Fire Flow Results

Fire Flow Table

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Fire Flow Node FlexTable: Fire Flow Report

Label	Elevation (ft)	Fire Flow (Needed) (gpm)	Pressure (Residual Lower Limit) (psi)	Pressure Head (ft)	Pressure (psi)
EX H-1	2,365.51	1,000	0	166.57	72
H-1	2,366.54	1,000	0	165.54	72
H-2	2,347.39	1,000	0	184.68	80
H-3	2,342.69	1,000	0	189.38	82
H-4	2,328.61	1,000	0	203.46	88
H-5	2,352.89	1,000	0	179.18	78
H-7	2,314.00	1,000	0	218.07	94
H-8	2,324.00	1,000	0	208.07	90
J-1	2,365.00	1,000	0	167.08	72
J-2	2,365.85	1,000	0	166.23	72
J-3	2,352.35	1,000	0	179.72	78
J-9	2,335.76	1,000	0	196.31	85
J-10	2,316.00	1,000	0	216.07	93
J-11	2,325.00	1,000	0	207.07	90
J-12	2,312.00	1,000	0	220.07	95
J-13	2,313.00	1,000	0	219.07	95

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Alternative Summary Report
Alternative: Base Fire Flow

Base Fire Flow

Fire Flow (Needed)	1,000 gpm	Fire Flow Auxiliary Results Type	None
Fire Flow (Upper Limit)	3,500 gpm	Velocity (Upper Limit)	10.00 ft/s
Pressure (Residual Lower Limit)	0 psi	Pressure (System Lower Limit)	30 psi
Pressure (Zone Lower Limit)	0 psi	Pipe Velocity Greater Than	0.00 ft/s
Use Minimum System Pressure Constraint?	True	Node Pressure Less Than	0 psi
Use Velocity Constraint?	True	Pipe Set	All Pipes
Use Pipe Velocity Greater Than?	False	Fire Flow Nodes	All Fire Flow Nodes
Use Node Pressure Less Than?	False	Fire Flow Auxiliary Results Type	None
Apply Fire Flows By	Adding to Baseline Demand	Auxiliary Output Selection Set	<No Elements>

13: Base Fire Flow, Junction and Hydrant Alternative Report

*	ID	Label	Specify Local Fire Flow Constraints?	Fire Flow (Needed) (gpm)	Fire Flow (Upper Limit) (gpm)
True	35	EX H-1	False	1,000	3,500
True	39	H-1	False	1,000	3,500
True	43	H-2	False	1,000	3,500
True	47	H-3	False	1,000	3,500
True	53	H-4	False	1,000	3,500
True	60	H-5	False	1,000	3,500
True	81	H-7	False	1,000	3,500
True	83	H-8	False	1,000	3,500
True	33	J-1	False	1,000	3,500
True	37	J-2	False	1,000	3,500
True	41	J-3	False	1,000	3,500
True	70	J-9	False	1,000	3,500
True	73	J-10	False	1,000	3,500
True	75	J-11	False	1,000	3,500
True	77	J-12	False	1,000	3,500
True	79	J-13	False	1,000	3,500

Pressure (Residual Lower Limit) (psi)	Pressure (Zone Lower Limit) (psi)	Pressure (System Lower Limit) (psi)	Velocity (Upper Limit) (ft/s)
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00

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Alternative Summary Report
Alternative: Base Fire Flow
13: Base Fire Flow, Junction and Hydrant Alternative Report

Pressure (Residual Lower Limit) (psi)	Pressure (Zone Lower Limit) (psi)	Pressure (System Lower Limit) (psi)	Velocity (Upper Limit) (ft/s)
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00
0	0	30	10.00

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APPENDIX E: Fire Hydrant Flow Test Results

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1/28/2020

Flow Test Summary

Project Name:	EJFT 19101
Project Address:	24770 N Alma School Rd, Scottsdale, AZ 85255
Date of Flow Test:	2019-05-08
Time of Flow Test:	7:36 AM
Data Reliable Until:	2019-11-08
Conducted By:	Cesar Reyna & Austin Gourley (EJ Flow Tests) 602.999.7637
Witnessed By:	Sonny Schreiner (City of Scottsdale) 602.819.7718
City Forces Contacted:	City of Scottsdale (602.819.7718)
Permit Number:	C58208

Note Scottsdale requires a max static pressure of 72 psi for safety factor

Raw Flow Test Data

Static Pressure:	116.0 PSI
Residual Pressure:	110.0 PSI
Flowing GPM:	1,695
GPM @ 20 PSI:	7,576

Data with a 44 PSI Safety Factor

Static Pressure:	72.0 PSI
Residual Pressure:	66.0 PSI
Flowing GPM:	1,695
GPM @ 20 PSI:	5,441

Hydrant F_1

Pitot Pressure (1):	25	PSI
Coefficient of Discharge (1):	0.9	
Hydrant Orifice Diameter (1):	2.5	inches
Pitot Pressure (2):	26	PSI
Coefficient of Discharge (2):	0.9	
Hydrant Orifice Diameter (2):	2.5	inches

Project Site

Static-Residual Hydrant

Flow Hydrant

Main Size
8 inches

Distance Between F_1 and R
2619 ft (measured linearly)

Static-Residual Elevation
2375 ft (above sea level)

Flow Hydrant (F_1) Elevation
2316 ft (above sea level)

Elevation & distance values are approximate

EJ Flow Tests, LLC
21505 North 78th Ave. | Suite 130 | Peoria, Arizona 85382 | (602) 999-7637 | www.ejengineering.com
John L. Echeverri | NICET Level IV 078493 SME | C-16 FP Contractor ROC 271705 AZ | NFPA CFPS 1915
www.flowtestsummary.com

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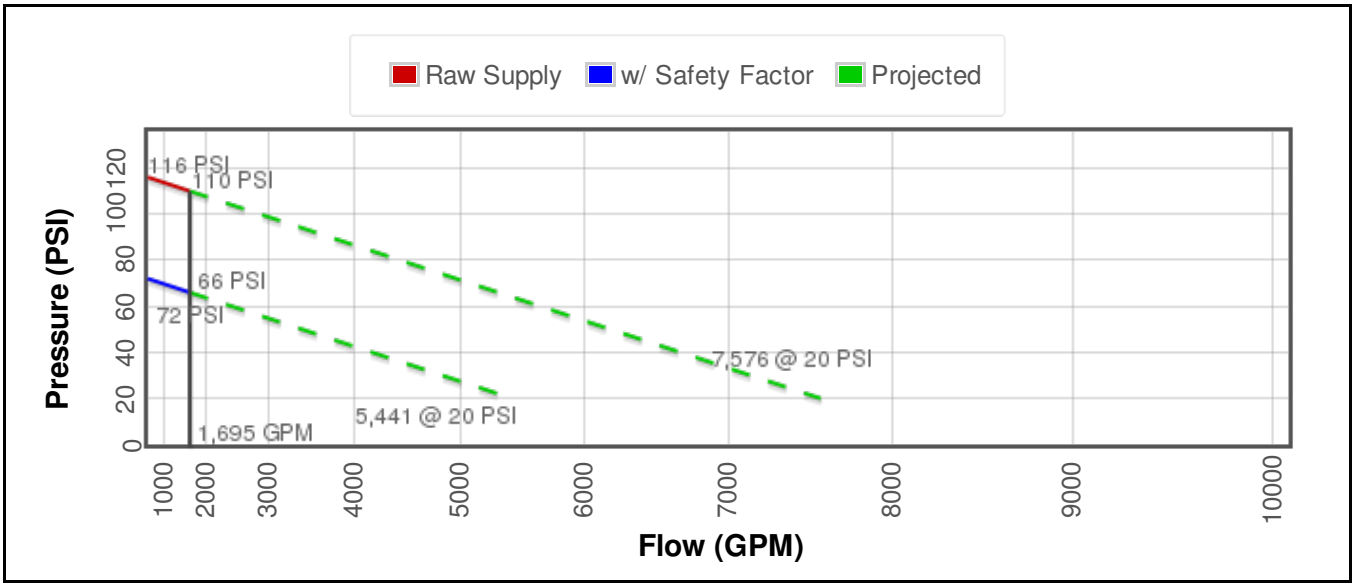
Flow Test Summary

Static-Residual Hydrant

Flow Hydrant (only hydrant F1 shown for clarity)

Approximate Project Site

Water Supply Curve $N^{1.85}$ Graph



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